



COMPREHENSIVE WASTEWATER MANAGEMENT PLAN DRAFT RECOMMENDED PLAN

Town of Bourne, MA

December 13, 2024



— An Apex Company —

TABLE OF CONTENTS

LIST OF TABLES	III
LIST OF FIGURES	V
LIST OF APPENDICES	VI
SECTION 1 EXECUTIVE SUMMARY	1
SECTION 1.1 TRADITIONAL WASTEWATER AND NITROGEN MANAGEMENT TECHNOLOGIES	1
SECTION 1.2 NON-TRADITIONAL WASTEWATER AND NITROGEN MANAGEMENT TECHNOLOGIES ..	3
SECTION 1.3 IMPLEMENTATION SCHEDULE AND COST	4
SECTION 2 NEEDS ASSESSMENT (PHASE 1) SUMMARY	7
SECTION 3 ALTERNATIVES ANALYSIS (PHASE 2) SUMMARY	8
SECTION 4 RECOMMENDED PLAN (PHASE 3)	9
SECTION 4.1 PRELIMINARY DESIGN CRITERIA	9
Section 4.1.1 Traditional (Conventional) Technologies	9
Section 4.1.2 Non-Traditional Technologies	21
Section 4.1.3 Summary by Watershed	23
SECTION 5 IMPACTS	25
SECTION 5.1 ENVIRONMENTAL IMPACTS	25
Section 5.1.1 Surface and Groundwater Quality	25
Section 5.1.2 Water Supply	26
Section 5.1.3 Air Quality	26
Section 5.1.4 Noise Levels	26
Section 5.1.5 Wetlands, Floodplains, and Waterways	27
Section 5.1.6 Endangered Species	28
Section 5.1.7 Historical and Archaeological Sites	29
Section 5.1.8 Agricultural Land	30
Section 5.1.9 Environmentally Sensitive Areas	30
SECTION 5.2 TRANSPORTATION IMPACTS	31
Section 5.2.1 Vehicular Traffic	31
Section 5.2.2 Pedestrian and Bicycle Transportation	31

SECTION 5.3 INSTITUTIONAL IMPACTS.....	31
<i>Section 5.3.1 Health Department.....</i>	<i>31</i>
<i>Section 5.3.2 Department of Public Works, Sewer Division.....</i>	<i>33</i>
<i>Section 5.3.3 Stormwater Management Team.....</i>	<i>33</i>
<i>Section 5.3.4 Responsible Management Entity</i>	<i>34</i>
SECTION 6 COST ESTIMATE	38
SECTION 6.1 TRADITIONAL SOLUTIONS	38
<i>Section 6.1.1 General Use I/A Onsite Systems</i>	<i>38</i>
<i>Section 6.1.2 Core Sewer Areas.....</i>	<i>42</i>
<i>Section 6.1.3 Traditional Cost Summary</i>	<i>45</i>
SECTION 6.2 NON-TRADITIONAL SOLUTIONS	46
<i>Section 6.2.1 Pilot EIA Program.....</i>	<i>46</i>
<i>Section 6.2.2 Stormwater BMP.....</i>	<i>47</i>
<i>Section 6.2.3 Non-Traditional Cost Summary.....</i>	<i>50</i>
SECTION 6.3 PLAN COST SUMMARY	50
SECTION 7 IMPLEMENTATION PLAN	52
SECTION 7.1 SCHEDULE	52
SECTION 7.2 FUNDING SOURCES	52
<i>Section 7.2.1 Federal</i>	<i>52</i>
<i>Section 7.2.2 State</i>	<i>53</i>
SECTION 7.3 208 PLAN CONSISTENCY FOR ADAPTIVE MANAGEMENT	56
<i>Section 7.3.1 Data Monitoring</i>	<i>56</i>
<i>Section 7.3.2 Quality Management Plan.....</i>	<i>56</i>
<i>Section 7.3.3 Reporting.....</i>	<i>57</i>
SECTION 7.4 WATERSHED PERMIT APPLICATION.....	58
<i>Section 7.4.1 General Considerations</i>	<i>58</i>
<i>Section 7.4.2 Megansett-Squeteague Harbor.....</i>	<i>59</i>
<i>Section 7.4.3 Phinney's Harbor</i>	<i>59</i>
SECTION 8 PUBLIC PARTICIPATION	61
SECTION 8.1 PHASES 1 AND 2 SUMMARY	61
SECTION 8.2 PHASE 3 (THIS PLAN)	61

LIST OF TABLES

Table ES-1: Title 5 Default GUIA Implementation Timeline	2
Table ES-2: Proposed Traditional Nitrogen Removal Summary	3
Table ES-3: Non-Traditional Nitrogen Removal Summary	4
Table ES-4: Non-Traditional Estimated Annual Cost	4
Table ES-5: Draft Recommended Plan Cost Summary	6
Table 1: Summary of Bourne Watersheds	7
Table 2: Summary of 2022 Alternatives and Total Estimated Nitrogen Removal.....	8
Table 3: GUIA Onsite System Estimated Nitrogen Removal Summary	9
Table 4: Typical Residential Title 5 Design Capacity	10
Table 5: General Use I/A Onsite System Design Capacity	10
Table 6: General Use I/A Onsite System Treatment Processes.....	10
Table 7: Title 5 Default GUIA Implementation Timeline.....	12
Table 8: Watershed Permit Example GUIA Implementation Timeline	13
Table 9: Sewer Alternatives Summary.....	17
Table 10: Megansett-Squeteague WWTF Parcel Alternatives - Soil Type.....	19
Table 11: Flows of Existing Facility and Proposed Sewer Alternative.....	20
Table 12: Buzzards Bay WWTF Flow Gap	21
Table 13: Pilot Enhanced I/A Onsite System Summary	22
Table 14: Summary of Recommended Plan Nitrogen Removals.....	24
Table 15: Threatened or Endangered Species in Bourne	28
Table 16: Title 5 (Default) vs. Watershed Permit (Opt-In).....	32
Table 17: Bourne Sewer Department Budget	33
Table 18: EPA Management Models	35
Table 19: GUIA Budgetary Capital Costs	38
Table 20: GUIA Opinion of Probable Construction Cost (OPCC) – New Installation.....	39
Table 21: General Use I/A Estimated Annual Energy Costs	40
Table 22: GUIA Operation, Monitoring, and Maintenance Cost Estimate	40
Table 23: GUIA Total Costs by Watershed.....	41
Table 24: TMDL Watershed Core Sewer Area Capital Cost Calculations	42
Table 25: Low Pressure Sewer System Costs, March 2024 OPCC.....	43
Table 26: Buzzards Bay WWTF Capital Cost Estimate	43
Table 27: Pocasset Harbor and Pocasset River Capital Costs	44
Table 28: Buzzards Bay WWTF Existing Operation and Maintenance Costs.....	44
Table 29: Proposed Sewer Alternative Estimated New O&M Costs	45
Table 30: Traditional Solution Cost Summary	46
Table 31: EIA Opinion of Probable Construction Cost (OPCC) – New Installation	46
Table 32: EIA Operation, Monitoring, and Maintenance Cost Estimate.....	47
Table 33: Buttermilk Bay EIA Pilot Total Cost	47
Table 34: Typical Stormwater Costs.....	48
Table 35: Bourne Capital Planned Spending - Stormwater	48
Table 36: Annual O&M Cost for Stormwater, per Curb Mile	49

Table 37: Stormwater Removal Costs per Kg Nitrogen	50
Table 38: Non-Traditional Solution Cost Summary	50
Table 39: Draft Recommended Plan Cost Summary	51
Table 40: Stakeholder Data Monitoring Sources	56
Table 41: Updated Stakeholder Meeting Schedule	61
Table 42: Phase 3 Public Participation Meeting Schedule	62

LIST OF FIGURES

Figure 1: Megansett-Squeteague Harbor Sewer Alternative	14
Figure 2: Phinney's Harbor Sewer Alternative	15
Figure 3: Buttermilk Bay Core Sewer Area - Alternative 1	16
Figure 4: Buttermilk Bay Core Sewer Area – Alternative 2.....	17
Figure 5: Potential WWTF Sites Megansett-Squeteague Sewer Alternative	18
Figure 6: Massachusetts Historical Commission Historic Districts and Site Map with Phinney's Harbor Core Sewer Area.....	29
Figure 7: Town of Bourne Stormwater Management Team.....	34
Figure 8: Massachusetts CWT State Revolving Fund (SRF) Loan Process	54

LIST OF APPENDICES

APPENDIX A: Full Page Watershed Recommended Plan Figures

APPENDIX B: General Use I/A Vendor Information

APPENDIX C: Low Pressure Core Sewer Area Vendor Information

APPENDIX D: Implementation Schedule

APPENDIX E: Implementation Cost Estimate

Terms and Acronyms

208 Plan	The Section 208 Area Wide Water Quality Management Plan, developed under Section 208 of the Clean Water Act in 1978 and updated in 2015, is a framework to restore embayment water quality on Cape Cod. See also CCC.
303(d) List	Massachusetts' list of impaired and threatened waters per Clean Water Act Section 303(d).
ACEC	Areas of Critical Environmental Concern
BBC	Buzzards Bay Coalition
BGS	Below Ground Surface
BMP	Best Management Practice can describe a stormwater treatment system or standard of care
BOD5	5-Day Biochemical Oxygen Demand measures the organic strength of wastewater
BOH	Board of Health
CCC	Cape Cod Commission is a regional land use planning, economic development, and regulatory agency created in 1990 to serve the citizens and 15 towns of Barnstable County, Massachusetts.
CEC	Contaminants of Emerging Concern
CFR	Code of Federal Regulation
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
CWMP	Comprehensive Wastewater Management Plan; See Town Website "Frequently Asked Questions" Fact Sheet
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
DPW	Department of Public Works
DO	Dissolved Oxygen
DRI	Development of Regional Impact
EIA	Enhanced Innovative/Alternative
EIR	Environmental Impact Report
ENF	Environmental Notification Form
EOEEA	Executive Office of Energy and Environmental Affairs
EP	Environmental Partners, <i>LLC</i>
FEIR	Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FIRM	Federal Insurance Rate Map
GIS	Geographic Information System
GUIA	General Use Approved Innovative and Alternative (Onsite Wastewater Systems)
GWDP	Groundwater Discharge Permit
GPD or (gpd)	Gallons per Day
I/A	Innovative and Alternative Onsite System
I/I	Inflow and Infiltration, or uncontrolled flow sources into a sewer system. Typically, from breaches in manholes, pipe joints, service connections or illegal connections.
IMA	Inter-municipal Agreement
IUP	Intended Use Plan

Terms and Acronyms

JBCC	Joint Base Cape Cod
LCP	Local Comprehensive Plan, completed in 2019 by Town of Bourne
LiDAR	Light Detection and Ranging; used for gathering terrain and elevation data, typically by drone or aircraft use.
MASSGIS	Massachusetts Office of Geographic Information Systems
MASSTC	Massachusetts Alternative Septic System Test Center
MCL	Maximum Contaminant Level
MEP	Massachusetts Estuaries Project
MEPA	Massachusetts Environmental Policy Act is a public review of potential environmental impacts of projects.
MESA	Massachusetts Endangered Species Act
mg/L	Milligrams per Liter
MMA	Massachusetts Maritime Academy
NEIWPCC	The New England Interstate Water Pollution Control Commission is a regional commission that helps the states of the Northeast preserve and advance water quality.
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NHESP	National Heritage and Endangered Species Program
NOAA	National Oceanic and Atmospheric Administration, a federal department of the U.S. Department of Commerce
NPC	Notice of Project Change
NRCS	National Resources Conservation Service: a federal agency which provides soil data and regional agricultural support
NPS	Non-point source describes water runoff which collects from multiple sources (ground, street, roof) as opposed to a point source or single outlet (effluent pipe or groundwater discharge wick)
PPM	Parts Per Million; see also “mg/L”
PPY	Pounds per year; lbs./year
PRB	Permeable Reactive Barrier
PWSD2	Public Water Supply District #2
RME	Responsible Management Entity
RSF	Recirculating Sand Filter
SAS	Soil Absorption System also known as a leach field
SBR	Sequencing Batch Reactor: a technology used for wastewater treatment
SCADA	Supervisory Control and Data Acquisition; A process control and monitoring system for Water and Wastewater Treatment Facilities
SMAST	School of Marine Science and Technology, University of Massachusetts Dartmouth
SNEP	Southeast New England Program: A partnership of government and non-government organizations all collaborating to innovatively improve water quality and habitats within New England’s coastal watersheds.
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflow
STEG	Septic Tank Effluent Gravity

Terms and Acronyms

STEP	Septic Tank Effluent Pump
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TR-16	Technical Report No. 16—Guides for the Design of Wastewater Treatment Works by NEIWPCC; Used as guide by engineers and operators for design criteria
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey; A federal agency responsible for soil, groundwater, stream, and environmental data collection.
UV	Ultraviolet; A method for disinfection of wastewater effluent prior to discharge.
WAC	Wastewater Access Chamber
WPA	Wetlands Protection Act
WQS	Water Quality Standard
WWTF or WWTP	Wastewater Treatment Facility or Wastewater Treatment Plant.

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SECTION 1 EXECUTIVE SUMMARY

In 2021, the Town of Bourne initiated the development of a Comprehensive Wastewater Management Plan (CWMP). This plan has four distinct phases:

1. **Needs Assessment:** During this phase, Bourne assessed the requirements and identified the key needs related to wastewater management.
2. **Identification of Alternatives:** In Phase 2, Bourne evaluated various alternatives for inclusion in the Recommended Plan. These alternatives included both traditional wastewater approaches and a non-traditional option.
3. **Draft Recommended Plan:** The current report focuses on Phase 3, which presents the Draft Recommended Plan. This plan outlines the proposed strategies and actions for wastewater management.
4. **Compliance Review with MEPA and CCC 208 Plan:** As part of the process, the plan will undergo a compliance review following submission of the Recommended Plan to ensure alignment with the Massachusetts Environmental Policy Act (MEPA) and the Cape Cod Commission (CCC) 208 Plan.

During Phase 3, MassDEP updated 310 CMR 15.00, the Title 5 Onsite Wastewater Treatment regulations. Additionally, the existing definition of Nitrogen Sensitive Areas was expanded to include Natural Resource designated areas or TMDL watersheds with existing nitrogen impairments. This regulatory change created a pivotal moment for Bourne as they considered the implementation of their recommended plan:

- **Default Title 5 Individual Time Constraints:** This option adheres to the standard Title 5 regulations, allowing a five-year timeline (until July 2030) for individual homeowners within the NSA – Natural Resource watersheds, to replace their existing non-nitrogen reducing onsite systems with Best Available Nitrogen Reducing Technology and for any new construction to comply immediately.
- **Town-based Watershed Permit:** Alternatively, Bourne could elect to apply for a Watershed Permit, which provides a townwide time constraint of twenty years, along with specific operation and reporting requirements.

The Draft Recommended Plan thoroughly examines the implementation of the proposed strategies, considering both perspectives. As of November 2024, the Select Board has not filed a Notice of Intent to pursue a Watershed Permit for either of its Natural Resource – Nitrogen Sensitive Area designated coastal embayments: Megansett-Squeteague Harbor and Phinney's Harbor. Therefore Title 5 timelines remain in effect for existing Title 5 (non-nitrogen reducing onsite systems) and applies for any new construction under the Town of Bourne's current Board of Health bylaws.

SECTION 1.1 TRADITIONAL WASTEWATER AND NITROGEN MANAGEMENT TECHNOLOGIES

As determined during the Alternatives Analysis, traditional wastewater and nitrogen management strategies include General Use Approved Innovative and Alternative (GUIA) Onsite Wastewater

Systems, Decentralized Wastewater Treatment Facilities (WWTFs), Centralized WWTFs, and Regional WWTFs. The Town decided to choose widespread GUIA and one Core Sewer Area (for Phinney's Harbor) as the first round of implementation for the Nitrogen Sensitive Areas (TMDL Watersheds). As part of adaptive management planning, a second Core Sewer Area (proposed for Buttermilk Bay) and additional widespread GUIA implementation is proposed for Pocasset Harbor and Pocasset River watersheds.

The Draft Recommended plan employees General Use I/A systems as the standard for implementation. As MassDEP approves new technologies and classifies them as Best Available Nitrogen Reducing Technology, they will be incorporated into the program. As of February 2024, the MassDEP General Use Approved I/A systems list contains five approved manufacturers with multiple additional systems under Pilot or Provisional permit.

Under the current Title 5 requirements, there are no additional implications for the Buttermilk Bay, Pocasset Harbor, or Pocasset River watersheds, as they are not designated as Natural Resource Nitrogen Sensitive Areas as of April 2024. Therefore, the number of systems can be implemented steadily over the entire 20-year CWMP Planning period, with a prioritization of those systems with the shortest nitrogen travel time in groundwater (i.e., closest to the coastal water body) and moving outwards in the watershed (i.e., the longest nitrogen travel time in groundwater). **Appendix A** provides full page figures of the recommended plan by watershed.

Table ES-1 summarized the proposed Implementation Timeline required if Bourne chooses to default to the new Title 5 regulations. The table is organized by priority watershed (by number of systems, over five-year increments).

Table ES-1: Title 5 Default GUIA Implementation Timeline

Watershed	Years 1 – 5	Years 6 - 10	Years 11 – 15	Years 16 - 20
Megansett-Squeteague Harbor	285	0	0	0
Phinney's Harbor	1,133	0	0	0
Buttermilk Bay	0	125	125	125
Pocasset Harbor	0	483	483	483
Pocasset River	0	217	217	217
Subtotal # Installations	1,418	825	825	825

If the Town pursues a Watershed Permit for Megansett-Squeteague and Phinney's Harbors the implementation could be phased such that installation is paced out over the permit period (about 71 systems per year) as opposed to the Title 5 five-year requirement (over 283 systems per year). The objective would be to distribute the implementation of individual GUIA onsite systems evenly across the watersheds, ensuring a balanced implementation townwide. Table ES-2 summarizes the traditional nitrogen removal summary, excluding the Core Sewer Area as identified for Phinney's Harbor. As part of adaptive management, the Core Sewer Area alternative proposed in Buttermilk Bay will be revisited based on development and flow capacity within the existing Town-owned Buzzards Bay WWTF collection and treatment system. Therefore, a combination of GUIA and a non-

traditional alternative Pilot using Enhanced Innovative/Alternative (EIA) onsite systems is assumed for Buttermilk Bay until the Town revisits regional opportunities for centralized wastewater treatment and discharge.

Table ES-2: Proposed Traditional Nitrogen Removal Summary

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Estimated Traditional Nitrogen Removal³ (kg N/yr.)	Amount left to remove⁴ (kg N/yr.)
Megansett-Squeteague Harbor ¹ .	564	570	0
Phinney's Harbor ¹ .	1,706	1,744	0
Buttermilk Bay ² .	1,402	1,740	0
Pocasset Harbor ² .	3,120	2,910	210
Pocasset River ² .	1,289	1,290	0
Total	8,072	8,254	210

1. Based on Total Maximum Daily Limit (TMDL) for Total Nitrogen.

2. Based on estimated 25% removal of total controllable nitrogen load.

3. Phinney's Harbor removal based on proposed Core Sewer Area and all others assume widespread GUIA use (except for Buttermilk Bay, which assumes GUIA and an EIA pilot area).

4. Townwide, the minimum total nitrogen removal is met, however, individual watershed goals may still require additional reduction. Under this scenario, the Pocasset Harbor watershed still requires 210 kg N per year to be removed in addition to the Traditional removal.

SECTION 1.2 NON-TRADITIONAL WASTEWATER AND NITROGEN MANAGEMENT TECHNOLOGIES

At the conclusion of the Phase 2 Alternatives Analysis, only Stormwater Best Management Practices was selected as the non-traditional technology for Bourne to utilize as part of the Recommended Plan. After revisiting the Core Sewer Area in Buttermilk Bay, a second technology (Enhanced I/A onsite systems) was selected as a pilot program to implement in the mostly residential neighborhood where Core Sewer Area 1 had been identified. See the Buttermilk Bay revised figures in **Appendix A**.

Stormwater Best Management Practices (BMPs) were utilized as a townwide solution and updated to reflect the MassDEP maximum of no more than 20% of the required nitrogen removal loading per year. Adding the EIA Pilot for Buttermilk Bay, the Town can meet its overall nitrogen removal goals using traditional and non-traditional wastewater management technologies. See Table ES-3 below for a summary of the remaining nitrogen removal met by the non-traditional nitrogen removal technologies.

Table ES-3: Non-Traditional Nitrogen Removal Summary

Embayment	Nitrogen Removal Remaining (Kg-N/yr.)	Estimated Non-Traditional Nitrogen Removal (kg N/yr.)	Goal Met?
Megansett-Squeteague Harbor	63	113	Yes
Phinneys Harbor	0	341	Yes
Buttermilk Bay*	814	1,084	Yes, with EIA Pilot or Core Sewer Area
Pocasset Harbor	558	624	Yes
Pocasset River	141	258	Yes
Total	1,576	1,616	Yes

SECTION 1.3 IMPLEMENTATION SCHEDULE AND COST

Section 6 of this report improvised an analysis of the capital, operation and maintenance, and total annual costs each alternative. It covers both the overall Townwide implementation and individual (homeowner) estimated costs. Table ES-4 below shows the non-traditional solution cost summary for the Stormwater BMPs and Table ES-5 summarizes the traditional solution cost summaries for each watershed. All costs in this report are at a conceptual level, Class 5 cost estimates, which means that they could fluctuate between -50% and +100%. The non-traditional cost estimate is in today's dollars and does not include inflation.

Table ES-4: Non-Traditional Estimated Annual Cost

Watershed	Bourne Load Removal Goal	Stormwater Removal Maximum (20% of Controllable load)	Estimated Annual Cost ³ .
Megansett-Squeteague Harbor ¹ .	564	113	\$ 101,700
Phinneys Harbor ¹ .	1,706	341	\$ 306,900
Buttermilk Bay ² .	1,402	280	\$ 252,000
Pocasset Harbor ² .	3,120	624	\$ 561,600
Pocasset River ² .	1,289	258	\$ 232,200
Total	8,072	1,616	\$1,454,400

1. As required by TMDL.

2. Based on 20% removal of estimated total controllable load, subject to approval by MassDEP.

3. Opinion of annual cost is Class 5, conceptual cost (-50%/+100%) in March 2024 dollars (ENR 13532). This total does not include inflation.

As presented in Section 7, the implementation schedule follows a two-phased prioritization approach. The first phase focuses on prioritizing actions in its Natural Resource Nitrogen Sensitive Areas, while the second phase addresses nitrogen-impaired watersheds. The schedule included in **Appendix D** and cost estimate in **Appendix E** outline the approximate timeline of actions and associated costs with implementing the preferred alternative for wastewater treatment in each of the Town's five priority watersheds. The remaining watersheds, the Buzzards Bay Watershed, Cape Cod Canal Watershed, and Cape Cod Bay watersheds will be evaluated for any changes to their

nitrogen-impairment status during the Adaptive Management Planning updates scheduled every five years throughout the implementation plan. The goal of this Draft Recommended Plan is to gather feedback from stakeholders on addressing nitrogen pollution sources effectively while establishing sustainable goals.

Table ES-5: Draft Recommended Plan Cost Summary

Watershed	Design Basis					Opinion of Probable Costs ⁷			
	Alternative Type	Parcels (#)	Average Daily Flow (gpd)	WWTF Location	Collection System (mi) ⁴	Total Capital Cost (\$, 2024) No Inflation (+100%/-50%)	Total O&M Cost (\$/year) (+100%/-50%)	Asset Useful Lifetime (years) ⁵	Net Present Value (\$ Cost/year) ⁶
Megansett-Squeteague Harbor	GUIA	285	94,050	N/A	N/A	\$ 12,092,000	\$ 681,150	20	\$ 1,652,000
Megansett-Squeteague Harbor	Sewer	150	30,400	TBD, Satellite	4.8	\$ 13,853,000	\$ 961,200	20	\$ 2,073,000
Phinney's Harbor	GUIA	1,135	374,550	N/A	N/A	\$ 48,153,000	\$ 2,712,650	20	\$ 6,577,000
Phinney's Harbor	Sewer	436	86,100	Bourne Schools WWTF²	12.6	\$ 37,497,000	\$ 2,523,150	20	\$ 5,533,000
Buttermilk Bay	GUIA/EIA¹	375/330	232,650	N/A	N/A	\$ 33,410,000	\$ 2,486,850	17	\$ 5,451,000
Buttermilk Bay	Sewer 1	330	60,000	Buzzards Bay WWTF ³	8.0	\$ 24,171,000	\$ 1,602,000	20	\$ 3,542,000
Buttermilk Bay	Sewer 2	778	156,000	Buzzards Bay WWTF	12.5	\$ 41,421,000	\$ 2,503,125	20	\$ 5,827,000
Pocasset Harbor	GUIA	1,455	480,150	N/A	N/A	\$ 61,729,000	\$ 3,477,450	20	\$ 8,431,000
Pocasset Harbor	Sewer	710	125,250	TBD, Enhanced Satellite	23.7	\$ 69,341,000	\$ 4,739,250	20	\$ 10,304,000
Pocasset River	GUIA	645	212,850	N/A	N/A	\$ 27,365,000	\$ 1,541,550	20	\$ 3,738,000
Pocasset River	Sewer	300	52,920	TBD, Enhanced Satellite	10.0	\$ 29,299,000	\$ 2,002,500	20	\$ 4,354,000

1. Includes a combination of 375 GUIA and 330 EIA. Both must be used to meet TMDL loading.

2. Costs assume that evaluation, testing, and expansion of existing groundwater disposal field is allowable under Facility operating permit. Assumes that the additional flow will be able to be added to existing treatment facility footprint. Does not include capital upgrades to current facility, only expansion of existing facility to serve additional 87k gpd. Assumes flow expansion can be obtained within existing parcel (i.e., no land acquisition assumed).

3. Costs assume that evaluation, testing, and expansion of existing groundwater disposal field is allowable under Facility operating permit. Assumes that the additional flow will be able to be added to existing treatment facility footprint (i.e., no land acquisition costs included nor alternative locations for Buzzards Bay WWTF).

4. Pocasset Harbor and Pocasset River collection system based on density of 30 parcels per mile of sewer collection system.

5. Average lifespan of GUIA is 20 years and EIA is 15 years; Average of 17 years was used for this alternative.

6. Includes assumed 5% inflation in O&M costs over Lifecycle.

7. Opinion of annual cost is Class 5, conceptual cost (-50%/+100%) in March 2024 dollars (ENR 13532).

SECTION 2 NEEDS ASSESSMENT (PHASE 1)

SUMMARY

The first phase of the CWMP, completed in early 2022, outlined the Town's wastewater and nutrient management needs for the next twenty years. With a year-round population of 20,500 people, that increases to 40,000 during peak season, the Town of Bourne has unique seasonal wastewater management challenges. The Town consists of ten distinct villages, each with its own character and development needs. Bourne also balances significant landownership by Joint Base Cape Cod (JBCC).

The needs assessment revealed that Bourne possesses valuable environmental and water resources, including coastal embayments and direct discharge watersheds. The Town's wetlands, endangered species, groundwater, soils, and the MassDEP's Eelgrass study are of high importance. Over the past five years, there have been more than fifteen sampling failures under the Minimum Standards for Bathing Beaches (State Sanitary Code, Chapter VII). Table 1 shows each watershed's water quality and nitrogen pollution requirements. Priority areas for wastewater management based on Total Maximum Daily Load (TMDL) goals are identified and a systematic approach to addressing nitrogen loading issues is provided.

Table 1: Summary of Bourne Watersheds

Embayment	Nitrogen Impaired?	TMDL Requirement?	Bourne Total Removal Goal (Kg-N/yr.)
Phinney's Harbor	Yes	Yes	1,706
Megansett-Squeteague Harbor	Yes	Yes	564
Buttermilk Bay	Yes	No	1,402
Pocasset Harbor	Yes	No	3,120
Pocasset River	Yes	No	1,289
Buzzards Bay	No	No	TBD
Cape Cod Canal	No	No	TBD
Total			8,072

The Phase 1 report evaluated built systems, specifically the town's current planning demographics, including parcel density, land use, and zoning, as well as existing water and wastewater infrastructure. The Phase 1 report also summarizes the range of public engagement activities completed during the first phase, including workshops, meetings, and the distribution of information materials.

SECTION 3 ALTERNATIVES ANALYSIS (PHASE 2)

SUMMARY

The second phase of the Comprehensive Wastewater Management Plan assessed alternative wastewater treatment technologies and management approaches to improve water quality issues and infrastructure requirements identified during the Needs Assessment. The Needs Assessment completed in June 2022 determined that Bourne needs to remove approximately 8,100 kg of nitrogen annually to enhance water quality across priority watersheds.

For the alternatives analysis, Bourne prioritized five nitrogen-impaired watersheds. Two of these watersheds, Phinney's Harbor and Megansett-Squeteague Harbor, have been allocated a Total Maximum Daily Limit (TMDL). The remaining three watersheds - Buttermilk Bay, Pocasset Harbor, and Pocasset River - although not yet assigned a TMDL, are crucial for water quality improvement due to documented concerns, including eutrophication and nitrogen loading.

Through collaboration between the Board of Sewer Commissioners (BOSC) established a Wastewater Advisory Subcommittee (WAC), the teams developed evaluation criteria, evaluated over one hundred technologies, and rated top technologies on several factors such as design flexibility, environmental impacts, and public acceptance.

The resulting alternatives analysis returned several options for technologies to use across Bourne's nitrogen impaired watersheds. Table 2 summarizes the main alternatives and their estimated nitrogen removal rates.

Table 2: Summary of 2022 Alternatives and Total Estimated Nitrogen Removal

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Primary Alternative for Load Reduction	Estimated Nitrogen Removal Total (Kg-N/yr.)
Phinneys Harbor ¹ .	1,706	Core Sewer Area	1,744
Megansett-Squeteague Harbor ¹ .	564	GUIA	570
Buttermilk Bay ² .	1,402	GUIA plus EIA Pilot Area	1,925
Pocasset Harbor ² .	3,120	GUIA	3,292
Pocasset River ² .	1,289	GUIA	1,363
Buzzards Bay ³ .	TBD	-	-
Cape Cod Canal ³ .	TBD	-	-
Total	8,072		8,254
<i>Additional Removal</i>			<i>182</i>

1. Based on Total Maximum Daily Limit (TMDL) for Total Nitrogen.

2. Based on estimated 25% removal of total controllable nitrogen load.

3. MassDEP does not currently identify the Buzzards Bay and Cape Cod Canal watersheds as nitrogen impaired and therefore alternatives for these two watersheds will be considered as additions under future adaptive management reviews.

SECTION 4 RECOMMENDED PLAN (PHASE 3)

This CWMP Phase 3 – Draft Recommended Plan report outlines detailed design parameters, potential impacts, and mitigation measures, and develops costs and schedules for each of the alternatives selected through the Alternatives Analysis. In keeping with Bourne’s Local Comprehensive Plan vision to maximize opportunities for social and economic development while retaining an attractive, sustainable, and secure coastline and environment, this CWMP outlines the primary conventional alternatives to be used Townwide. This report develops the screened alternatives further, including their specific character in each watershed, the policy decision needed for their implementation, and their estimated costs.

SECTION 4.1 PRELIMINARY DESIGN CRITERIA

A conventional back up plan must be provided in each sub-watershed where the primary approach for the community is non-traditional technology for nitrogen reduction as the recommended plan. At minimum, the modeled reductions in the MEP TMDL report must be adhered to unless alternative percentage reductions for sub-watershed have been modeled using the MEP model.

The following sections outline the estimated nitrogen removal by technology and include the design criteria for each individual system. Given Bourne’s preference for a decentralized-focused approach to alternatives, the watershed wide implementation will be based on the specifications of the MassDEP General Use Approved I/A onsite systems.

Section 4.1.1 Traditional (Conventional) Technologies

According to MassDEP, conventional back up consists of any traditional wastewater management proven reduction strategy such as municipal sewerage, package treatment facilities, or General Use approved I/A systems. The table below outlines the Summary of Alternatives for Bourne, as determined in the 2022 Alternatives Analysis.

Table 3: GUIA Onsite System Estimated Nitrogen Removal Summary

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Number of GUIA Parcels	Estimated Nitrogen Removal GUIA (kg N/yr.)
Megansett-Squeteague Harbor	564	285	570
Phinneys Harbor	1,706	1,135	2,270
Buttermilk Bay	1,402	374 - 704	588 - 1,245
Pocasset Harbor	3,120	1,455	2,910
Pocasset River	1,289	645	1,290
Total	8,072	3,894 - 4,224	7,628 - 8,285

General Use I/A Onsite Systems

The General Use I/A onsite system alternative is based on the Title 5 sizing standards for typical residential household flows. Table 4 lists typical Title 5 system design parameters.

Table 4: Typical Residential Title 5 Design Capacity

Residential System	Title 5 Flow Estimate (gpd)	Typical System Size (gal)
2-Bedroom	220	1,000-1,500
3-Bedroom	330	1,000-2,000
4+ Bedroom	550	1,250-2,500+

The following manufacturers are on the MassDEP General Use I/A Onsite System List for Nitrogen Removal as of March 2022. The individual system capacities are listed below as well as the estimated nitrogen effluent, which is similar across the General Use I/A System category.

Table 5: General Use I/A Onsite System Design Capacity

Manufacturer/Model	MassDEP Approved Design Capacity (for individual system)	Nitrogen Effluent
Aquapoint: Bioclere	660-2,000 gpd	<19 mg/L
Bio-Microbics: FAST Treatment Systems	550-2,000 gpd	<19 mg/L
Septi-Tech: STAAR 0.5 Denite	660-2,000 gpd	<19 mg/L
Norweco: Singulair	660-2,000 gpd	<19 mg/L
Orenco: Advantex	660-2,000 gpd	<19 mg/L

The treatment processes for each system range from fixed-film bioreactor to aerobic and trickling filter components. The following matrix shows which processes are included in each General Use I/A baseline model:

Table 6: General Use I/A Onsite System Treatment Processes

Manufacturer/Model	Treatment Process			
	Fixed Film	Aerobic	Trickling Filter	Proprietary Media Filter
Aquapoint: Bioclere	X		X	
Bio-Microbics: FAST Treatment Systems		X		
Septi-Tech: STAAR 0.5 Denite		X	X	
Norweco: Singulair		X		X
Orenco: Advantex		X		X

- The Aquapoint Bioclere unit is a fixed film reactor consisting of a fiberglass tank containing a trickling filter section with inert plastic media, a clarifier and sump, a fan for aeration, and dosing and recirculating pumps.
- The Bio-Microbics FAST System is a Nitrogen Reducing Aerobic Treatment system, uses a Fixed Activated Sludge Treatment (FAST) to break down organic material and nutrients in wastewater. The MicroFAST module contains blocks of fixed media, and an airlift device placed inside a rectangular liner, which produces robust recirculation of oxygenated water throughout the submerged media.
- Septi-Tech STAAR 0.5 Denite system is a recirculating trickling filter with a pre-anoxic phase and a trickling filter media with recirculation happening within the trickling filter and recycled to an anoxic tank for enhanced nitrogen reduction.
- Norweco Singulair I/A system consists of enhanced three compartment tank with a pretreatment chamber, aerobic chamber, and settling/filtration chamber with a BioKinetic filter unit. The system removes nitrogen using timed aerobic and anaerobic periods in the second chamber.
- Orenco Advantex I/A onsite nitrogen reduction system has two compartments made of UV protected fiberglass reinforced basins that incorporate re-circulation blend tankage and discharge tankage into a single module, along with an aerobic textile filter media that treats wastewater.

The alternatives analysis concluded that a minimum of 3,900 systems would need to be installed to meet the Townwide nitrogen removal goals across all five of the nitrogen impaired watersheds. In the Bourne CWMP Alternatives Analysis Phase of the CWMP Bourne selected widespread use of the General Use I/A onsite systems,

Since the completion of the Alternatives Analysis there have been changes to Title 5 policies that impact the timeline for installing systems in the two Natural Resource Nitrogen Sensitive Areas (the two watersheds with Nitrogen TMDLs). Starting in July 2025, individual homeowners located in these TMDL watersheds are required to upgrade their onsite systems to be Best Available Nitrogen Reducing Technology (also known as nitrogen reducing system). Concurrently MassDEP has introduced a Watershed Permit Program, allowing communities to enter into long-term permits to extend the implementation requirements of the new Title 5 policies. As a result, a refinement of the alternative selected Phase 2 of the CWMP is necessary.

The following refinement presents the implementation of widespread use of the General Use I/A onsite systems for both the new Title 5 timeline and the new Watershed Permit timeline:

- Title 5 July 2023 revisions: Natural Resource NSA Compliance by July 2030. Individual homeowners in the Megansett-Squeteague Harbor and Phinney's Harbor watersheds will be responsible for upgrading their system to be Title 5 Best Available Nitrogen Reducing Technology
- Watershed Permit Program compliance by July 2045. The Town files a Notice of Intent to apply for a watershed permit, applies for and receives a Watershed Permit for each of its nitrogen TMDL watersheds, and extends the time for compliance to 2045 (approximately).

The removal requirement is 75% nitrogen source removal over the permit monitoring period.

The implementation of the recommended plan is a two phases plan and prioritizes actions in its Natural Resource Nitrogen Sensitive Areas first and addresses nitrogen-impaired watersheds in the second phase. To implement Title 5 GUIA Systems across the Natural Resource Nitrogen Sensitive Areas approximately 290 systems per year need to be replaced during the first five years across Megansett-Squeteague Harbor and Phinney's Harbor watersheds.

Under the current Title 5 requirements, there are no additional implications for the Buttermilk Bay, Pocasset Harbor, or Pocasset River watersheds (they have not been designated as Natural Resource Nitrogen Sensitive Areas as of April 2024). Therefore, the number of systems upgraded in these watersheds can be implemented gradually over the 20-year CWMP Planning period, with a prioritization of those systems with the shortest nitrogen travel time in groundwater (i.e., closest to coastal waterbody) and moving outwards in the watershed (i.e., the longest nitrogen travel time in groundwater). Full page figures showing the GUIA implementation areas and distance from water's edge are included in **Appendix A**. Below is an example summary of the Title 5 Implementation Table (by number of systems per 5-year period).

Table 7: Title 5 Default GUIA Implementation Timeline

Watershed	Years 1 – 5	Years 6 - 10	Years 11 – 15	Years 16 - 20
Megansett-Squeteague Harbor	285	0	0	0
Phinney's Harbor	1,133	0	0	0
Buttermilk Bay	0	125	125	125
Pocasset Harbor	0	483	483	483
Pocasset River	0	217	217	217
Subtotal # Installations	1,418	825	825	825

If the Town pursues a Watershed Permit for these two watersheds, then less than one hundred systems per year need to be installed for Megansett-Squeteague Harbor and Phinney's Harbors over the watershed permit period. The goal would be to spread implementation across the watersheds evenly, creating a more balanced implementation townwide. The following shows an example Watershed Permit Implementation Table (over 20 years).

Table 8: Watershed Permit Example GUIA Implementation Timeline

Watershed	Years 1 – 5	Years 6 - 10	Years 11 – 15	Years 16 - 20
Megansett-Squeteague Harbor	72	72	72	72
Phinney's Harbor	283	283	283	283
Buttermilk Bay	94	94	94	94
Pocasset Harbor	363	363	363	363
Pocasset River	163	163	163	163
Subtotal # Installations	975	975	975	975

The nitrogen reduction target for the Buttermilk Bay watershed cannot be achieved solely using GUIA. Therefore, the Buttermilk Bay decentralized onsite system alternative includes GUIA and an area of Enhanced Innovative/Alternative (EIA) onsite systems. This is a proposed pilot area and can be revisited as the plan is adapted over time. Additionally, Bourne has the opportunity to collaborate with neighboring communities, such as Wareham and Plymouth, to reduce nitrogen sources in the Buttermilk Bay Watershed.

Core Sewer Areas

As defined by MassDEP, Core Sewer Areas need to be sewerred due to the high septic loading produced from a dense area. Core sewer areas can be part of municipal package treatment plants or sewer extensions to larger municipal systems. Core Sewer Areas are not required for every watershed if suitable removal of nitrogen can be met using other conventional alternatives or sufficiently modeled non-traditional alternatives. The following alternatives for Megansett-Squeteague, Phinney's Harbor and Buttermilk Bay are examples of conventional alternatives for Core Sewer Areas.

Megansett-Squeteague Harbor

The Megansett-Squeteague Harbor Sewer Alternative includes sewerred 150 parcels to a new, satellite wastewater treatment facility with a total nitrogen removal of 615 kg N/year. This exceeds the goal of 564 kg N/year. The proposed location's address is 0 Megansett Road, which is currently vacant, and Town owned. More information about the parcel selection and location of the proposed facility is available further on in the text (Wastewater Treatment Facilities). The estimated average daily flow for this alternative is 30,440 gallons per day. The amount of pipe required to sewer this area is 4.8 miles. This was calculated by assuming the pipe length is 95% of the total length of roads between the parcels and the proposed facility. This assumes that the pipe would not need to be going the entire length of the roadway and can follow the shortest path. The figure below shows the proposed parcels to be sewerred and the proposed decentralized facility.

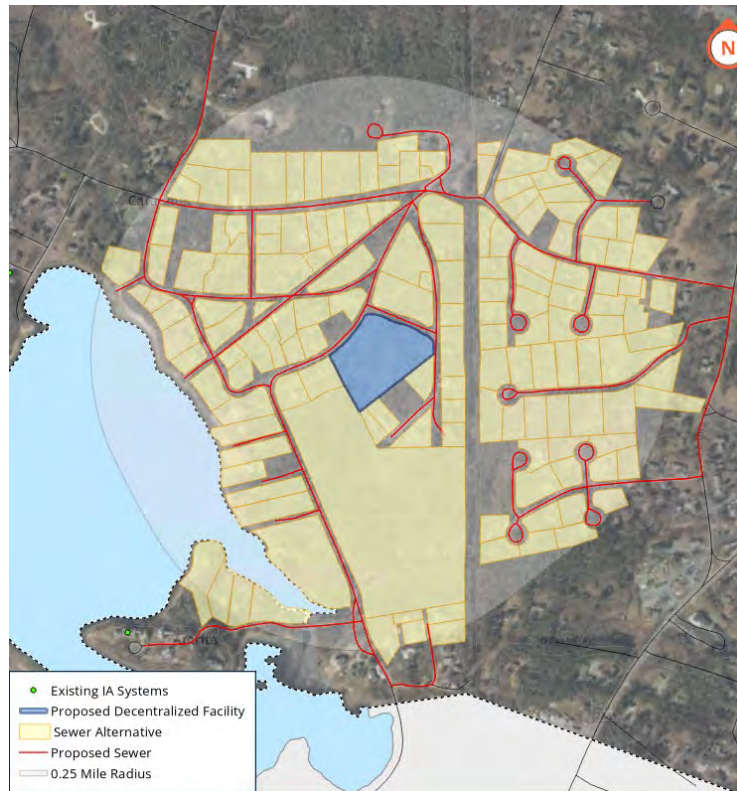


Figure 1: Megansett-Squeteague Harbor Sewer Alternative

Phinney's Harbor

The Phinney's Harbor Sewer Alternative includes sewerage 436 parcels to the existing Bourne Middle School WWTF with a total nitrogen removal of 1740 kg N/year. This exceeds the nitrogen removal goal of 1705 kg N/year. These parcels have an estimated flow of 86,100 gpd and were selected based on their proximity to Bourne Middle School (approximately 1.5 miles). The amount of pipe required to sewer this area is 12.6 miles and was calculated the same as the Megansett-Squeteague Harbor Sewer Alternative. This alternative excludes the existing I/A systems currently in place. The figure below shows the proposed sewerage parcels and their proximity to the Bourne Middle School WWTF.

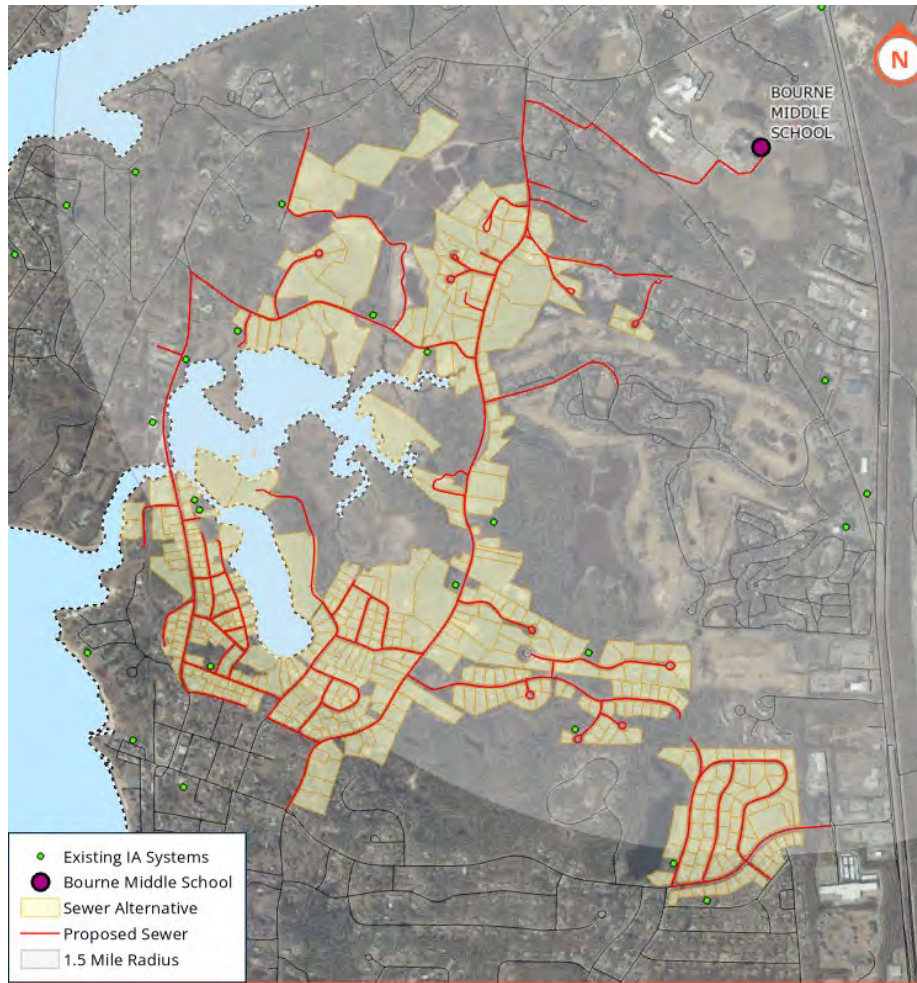


Figure 2: Phinney's Harbor Sewer Alternative

Buttermilk Bay - Sewer Alternative 1

The Core Sewer Area in Bourne identified during the Alternatives Analysis is in the Buttermilk Bay watershed. As shown in Figure 1 below, the area outlined in blue was selected as a Core Sewer Area alternative due to its proximity to the Bourne owned and operated Buzzards Bay WWTF and the overall nitrogen impairment in Buttermilk Bay. Approximately 330 residential parcels with an estimated 60,000 gallons per day (Peak Hourly Flow of 125,000 gpd) were selected along the southern portion of Buttermilk Bay, in densely developed neighborhoods. The estimated amount of sewer piping required is 6.2 miles. This was found using the same method as the Megansett-Squeteague Sewer Alternative.



Figure 3: Buttermilk Bay Core Sewer Area - Alternative 1

Buttermilk Bay - Sewer Alternative 2

The second alternative for Buttermilk Bay includes 778 parcels including Sewer Alternative 1. These parcels have an estimated flow of 156,000 gpd. The approximate length of sewer pipe is 12.5 miles. The figure below shows the entire Sewer Alternative 2. These sewer alternatives require additional flow capacity at the Buzzards Bay WWTF, both at the treatment plant and for its groundwater discharge permit. The estimated expansion of flow is dependent on buildout in the existing Buzzards Bay collection system, which can be reevaluated during the adaptive management process when Buttermilk Bay sewer alternatives are reviewed around Year 10 of the implementation plan. As of 2024, Buttermilk Bay does not have a Total Maximum Daily Limit (TMDL) for Nitrogen, which puts this watershed in Tier 2 of this CWMP implementation plan.



Figure 4: Buttermilk Bay Core Sewer Area – Alternative 2

Core Sewer Area Summary

Table 9 presents each of the Core Sewer Area conventional alternatives and their estimated nitrogen removal.

Table 9: Sewer Alternatives Summary

Sewer Alternative	Number of Parcels	Length of Pipe (miles)	Estimated Nitrogen Removal (kg N/year)	Nitrogen Removal Goal (kg N/year)
Megansett-Squeteague Harbor	150	4.8	615	564
Phinney's Harbor	436	12.6	1,740	1,705
Buttermilk Bay – Alternative 1	330	6.2	1,193	1,402
Buttermilk Bay – Alternative 2	778	12.5	2,740	1,402

Wastewater Treatment Facilities

New Satellite WWTF – Megansett-Squeteague

Facilities outside of Bourne, such as the New Silver Beach Wastewater System (owned and operated by the Town of Falmouth) and the Joint Base Cape Cod Wastewater System (owned by Converge and operated by Bay State Utility Services, Inc.), were not considered because they are more than 1 mile away from the watershed and outside the jurisdiction of the Town of Bourne. Therefore, the best option for siting a small satellite facility would be to use an existing vacant, developable parcel owned by the Town of Bourne. The figure below outlines potential locations and addresses of parcels that meet this criteria.

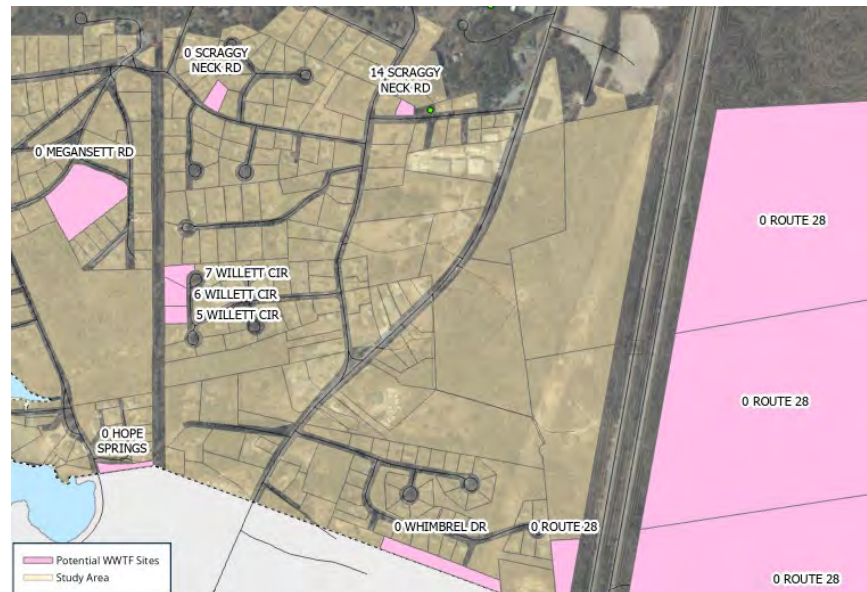


Figure 5: Potential WWTF Sites Megansett-Squeteague Sewer Alternative

A second set of criteria was used to further refine the potential parcels for WWTF siting. This refinement excluded all of the parcels located in Zone II Public Water Supply (PWS) wellhead protection areas (all Route 28 parcels, 0 Whimbrel Dr., 14 Scraggy Neck Road) as well as parcels too small to accommodate a satellite facility (0 Scraggy Neck Road Ext. and 0 Hope Springs Road). This process left two remaining parcels for assessment:

- 0 Megansett Road
- 5, 6, and 7 Willet Circle, treated as one parcel block.

The parcel soil types from the Natural Resource Conservation Service (a U.S. Department of Agriculture agency) Web Soil Survey¹ provided soil ratings according to wastewater disposal potential (i.e., well-drained and porous soils for rapid infiltration). The following table summarizes the Web Soil Survey indication of the Wastewater Rapid Infiltration potential for each identified parcel.

¹ Web Soil Survey. United States Department of Agriculture Natural Resources Conservation Science. Web. <https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

Table 10: Megansett-Squeteague WWTF Parcel Alternatives - Soil Type

Potential WWTF Parcel	Soil Type	Recommended for Wastewater Disposal
0 Megansett Road	46% 252D – Carver Coarse Sand, 15-35% Slope 54% 254B – Merrimac fine sandy loam	No; Very Limited Possibly, somewhat limited
5 – 7 Willet Circle	73% 252D – Carver Coarse Sand, 15-35% Slope 27% 600 – Sand and Gravel Pits	No; Very Limited Not Rated

The Willet Circle parcels have soil conditions listed as “very limited” or “not rated” for rapid infiltration of wastewater, which eliminated them from further consideration. The 0 Megansett Road parcel was listed as a majority (>50%) was listed as “somewhat limited,” which does not eliminate it from a potential wastewater infiltration use. Therefore, the 0 Megansett Road parcel is the best available location for a proposed satellite wastewater treatment facility for the Megansett-Squeteague watershed.

The core sewer area was identified based on proximity to 0 Megansett Road. Within a 0.25-mile radius of the proposed decentralized facility parcel, there are 150 developed parcels with residential uses that could be connected to the satellite facility.

Existing Bourne School Complex WWTF

The Bourne School Complex Wastewater Treatment Facility (Bourne Schools WWTF) currently treats wastewater for Peebles Elementary School, Bourne Middle School and Bourne High School, located at the campus on Waterhouse Road. The WWTF consists of primary treatment, flow equalization, rotating biological contactors (RBCs), secondary clarifier, a tertiary denitrification filter, clearwell dosing chamber (i.e., disinfection), and subsurface discharge system below the school playing fields. The WWTF also has odor control and an emergency generator. The WWTF typically treats 8,000 to 10,000 gpd, with a design capacity of 35,400 gpd, leaving an approximate availability of 25,000 gpd of flow.

The Phinney’s Harbor Core Sewer Alternative flow rate is approximately 86,000 gpd, which is well above the available capacity of the Bourne Schools WWTF. However, the gap of about 61,000 gpd can be addressed through the following:

- Addition of Flow Equalization Tanks (FET) to Bourne Schools WWTF
- Addition of Treatment Train to Bourne Schools WWTF
- Construction of a second facility at the Bourne Schools Campus, to be added to the existing Bourne Schools WWTF discharge permit
 - Modification of existing effluent subsurface discharge system to a higher capacity discharge type, such as vertical wicks and/or additional disposal fields.

Table 11: Flows of Existing Facility and Proposed Sewer Alternative

Parameter	Flow (gpd)
Design WWTF Flowrate	35,400
Typical Daily Usage	8,000-10,000
Available Flow	25,400-27,400
Proposed Sewered Area (Phinney's Harbor)	86,000
Additional Flow (upgrades required)	58,600-60,600

Existing Buzzards Bay WWTF

The Buzzards Bay Wastewater Treatment Facility (Buzzards Bay WWTF), located at 33 Armory Way in Bourne, has an approved design flowrate of 100,000 gpd. Wastewater from the existing collection system in Bourne connects via a diversion in the main gravity interceptor to a pumping station located at the Veteran's Memorial Community Center, across the street from the Bourne Main Street Pump Station.

The influent wastewater from the pump station settles in an equalization tank before screening for solids removal. The main treatment process includes three Membrane Bioreactors, for treatment and removal of organics and contaminants before disposal. The treated effluent is dispersed post-disinfection through a soil absorption system with a daily capacity not-to-exceed 335,000 gpd and loading rate of 3.0 gallons/day/square-foot, in compliance with the MassDEP's approved Groundwater Discharge Permit. Since coming online in August 2021, the Buzzards Bay WWTF operates at a daily flow rate between 20,000 gpd and 60,000 gpd with an average peak daily flow of 38,250 gpd.

Currently, the Bourne Board of Sewer Commissioners (BOSC) allocates available capacity to the Buzzards Bay WWTF through its application according to the Sewer Commission's allocation and reservation policies. As of December 2022, all remaining available capacity to the Buzzards Bay WWTF was allocated for Economic Development use. Therefore, the Core Sewer Area for Nitrogen Removal in Buttermilk Bay will require additional exploration for the expansion of (flow capacity, footprint, and discharge capacity) the existing Buzzards Bay WWTF or expansion of the Wareham Intermunicipal Agreement (IMA).

As the Wareham WWTF is currently undergoing improvements for nutrient removal and has limited existing capacity, it is recommended that the Buzzards Bay WWTF site be considered for expansion of treatment capacity and increase of groundwater discharge loading and/or expansion of the existing groundwater discharge area.

The Buttermilk Bay watershed is not considered a Natural Resource Nitrogen Sensitive Area as of April 2024. However, the Town has identified Buttermilk Bay as a high priority watershed for nitrogen removal. The Core Sewer Area was estimated to remove 1,160 kilograms of Nitrogen per year (kg N/year) by connecting 330 parcels via low pressure sewer to the Buzzards Bay WWTF. Therefore, as a core sewer area cannot be expanded at this time, a Pilot Project of Enhanced Innovative/Alternative onsite systems is proposed for the former Core Sewer Area, until regional options or expanded Buzzards Bay WWTF treatment and disposal can be considered.

If the Town decides to revisit this alternative and pursue Buzzards Bay WWTF treatment expansion or explore additional regional alternatives, then the following wastewater flow estimates are applicable to the Core Sewer Area (Alternative 1 from Alternatives Analysis) and Alternative 2 – expansion to the entire southern Buttermilk Bay coastline for nitrogen load management. See the full-page figures in **Appendix A**.

Table 12: Buzzards Bay WWTF Flow Gap

Sewer Alternative	Average Daily Flow² (gpd)	Maximum Monthly Flow³ (gpd)	Estimated Nitrogen Removal (kg N/yr.)
Buttermilk Bay Core Sewer Area – Alternative 1	60,000	125,000	1,160
Buttermilk Bay – Alternative 2 ¹	155,000	325,500	3,000

1. Alternative 2 Includes Alternative 1 plus remaining unsewered parcels along the southwestern end of Buttermilk Bay (along Cohasset Narrows).

2. Based on average water per capita use of 198 gallons per day.

3. Calculating using a 2.1 peaking factor of maximum month to average daily flows.

Section 4.1.2 Non-Traditional Technologies

Pilot and Provisional I/A Onsite Systems

Pilot and Provisional I/A Onsite Systems fall into the enhanced onsite wastewater treatment category, with the ability to treat to an effluent nitrogen concentration between 10 mg/L and 15 mg/L. While technology vendors state in their marketing materials that they can consistently treat below 10 mg/L, the threshold for the Best Available Nitrogen Reducing Technology remains at 10 mg/L, per MassDEP. As of April 2024, there are no General Use I/A approved technologies which meet the 10 mg/L nitrogen effluent efficiency. However, some Pilot and Provisional I/A onsite systems have demonstrated nitrogen removal performance below 15 mg/L in effluent concentrations.

As part of the Alternatives Analysis, Enhanced I/A Systems were considered within the top 10 alternative technologies chosen by Bourne for consideration as part of a recommended plan. The conventional General Use I/A technologies are able to meet the overall reduction for many of Bourne's embayments, however, due to lack of centralized wastewater treatment capacity at the Buzzards Bay WWTF, the Core Sewer Area as proposed in Buttermilk Bay is unable to move forward on the first iteration of the draft recommended plan. Therefore, the use of a Pilot Enhanced I/A Installation within the Buttermilk Bay watershed to remove the remaining nitrogen to meet the 25% reduction goal for a non-TMDL watershed is recommended at this time. See full page figure in **Appendix A** for the Pilot Enhanced I/A Onsite System location.

Table 13: Pilot Enhanced I/A Onsite System Summary

Watershed	# of Enhanced I/A Installations	Estimated Nitrogen Removal (kg N/yr.)
Buttermilk Bay	330	803

Stormwater Best Management Practices (BMP)

The Town of Bourne selected Stormwater Best Management Practices as their main non-traditional alternative to employ as part of their Comprehensive Wastewater Management Plan. Considering the Town is responsible for over 161 outfalls that discharge flow into twenty-six known receiving water segments, under their current Municipal Separate Storm Sewer System (MS4) program, the goal is to continue to improve upon the baseline actions already underway. The maximum allowable nitrogen credit for Stormwater Best Management Practices is 20% of the removal goal for each watershed.

To maximize the nitrogen removal credit and continue to maintain compliance with its existing MS4 permit, the Town will continue the following Best Management Practices:

- Sweep all streets and permittee-owned parking lots twice per year including once in the spring and in the fall.
- Annual inspections and maintenance of stormwater treatment structures
- Clean catch basins on an established schedule and report the number of catch basins cleaned and volume of material removed annually.

The Town of Bourne is also preparing a Queen Sewell Pond Watershed Assessment Plan (WAP), to reduce nitrogen and phosphorus runoff into the Queen Sewell Pond. In January 2024, the assessment team completed site soil evaluation and wetlands delineation for green stormwater infrastructure design. Next steps involve finalizing the WAP; designing and permitting green infrastructure to retrofit the public beach parking lot and the corresponding construction plans; community outreach including neighborhood meetings and a rain garden workshop in June 2024. ²

Bourne has multiple projects which are either underway or completed as part of the Cape Cod Water Resource Restoration Project (CCWRRP) funded by federal, state, and local governments, further maximizing the stormwater nitrogen removal credit. Below is the list of projects completed between 2021 and Present³:

- Fish Passage at Holway Axe Dam (Buttermilk Bay Basin)- Completed
- Stormwater Treatment Measures at Old Head of the Bay Road (Buttermilk Bay Basin)- Proposed
- Stormwater Treatment Measures at Monks Park (Buzzards Bay Basin)- In Progress

² Queen Sewell Watershed Action Plan. Town of Bourne. Web. <https://www.townofbourne.com/conservation/pages/queen-sewell-pond-watershed-action-plan>

³ Cape Cod Water Resource Restoration Project Story Map. Association to Preserve Cape Cod. Web. <https://apccatlas.maps.arcgis.com/apps/webappviewer/index.html?id=17b4940a7e9145bcb3a52e35133315e5>.

- Stormwater Treatment Measures at North Circuit and Circuit Avenue (Pocasset Harbor Basin)- Proposed
- Stormwater Treatment Measures at Saco Avenue (Pocasset Harbor Basin)- Proposed
- Fish Passage at Red Brook (Pocasset Harbor Basin)- In Progress

As of April 2024, MassDEP is in the process of updating the current Stormwater Regulations for Wetlands Protection Act (310 CMR 10.00) and Water Quality Certification (314 CMR 9.00) for Massachusetts.⁴ The draft regulations, published in January 2024, outline the following updated measures⁵:

- Updating outdated precipitation data to reflect increasing frequency and intensity of storm events. Peak runoff and discharge rates will be calculated using NOAA14 Plus and 100- year storm predictions.
- Aligning with EPA MS4's permit conditions including development rules, nutrient removal requirements and annual recharge value assumption changes.

The MassDEP goal in updating the regulation is to align the regulations with MS4 Permit compliance, to promote nature based Environmentally Sensitive Site Design (ESSD) and Low Impact Development (LID) through a revised, more user-friendly Stormwater Handbook, and to assist communities with TMDL compliance. The draft regulation public comment period was open through April 2024. In August 2024, MassDEP was reviewing the public comments received and expects that final regulations will be promulgated early 2025, for alignment with the Stormwater Best Management Practices Recommended Plan.

Section 4.1.3 Summary by Watershed

Based on the conventional, non-traditional, and policy-based alternatives summarized in each watershed, the overall town wide nitrogen removal alternatives are estimated to meet the town wide nitrogen removal goal of 8,100 kg N per year, with an additional 1,600 – 2,000 kg N per year removal. Only priority watersheds (Megansett-Squeteague Harbor, Phinney's Harbor, Buttermilk Bay, Pocasset Harbor, Pocasset River) are included in the total estimated nitrogen removal load calculations as Buzzards Bay and Cape Cod Canal load goals will be revisited when additional guidance on removal loading becomes available and as future iterations of Bourne's CWMP evolves. Table 14 summarizes the estimated alternative removal compared to the total removal goal.

⁴Stormwater Management Updates. MassDEP. Web. <https://www.mass.gov/info-details/massachusetts-stormwater-management-updates-advisory-committee>

⁵ "Proposed Stormwater Updates to the Massachusetts Wetlands and 401 Regulations." MassDEP. Presentation. Web. <https://www.mass.gov/doc/presentation-proposed-stormwater-updates-to-the-massachusetts-wetlands-and-401-regulations/download>

Table 14: Summary of Recommended Plan Nitrogen Removals

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Estimated Traditional Nitrogen Removal (kg N/yr.)²	Preferred Nitrogen Removal Alternative	Estimated Non-Traditional Nitrogen Removal (kg N/yr.)⁴	Total Estimated Removal
Megansett-Squeteague Harbor	564	504 - 631	GUIA	113	617 - 744
Phinneys Harbor	1,706	1,740 ³	Core Sewer	341	2,342 - 2,523
Buttermilk Bay ¹	1,402	588	GUIA with EIA	1,084	1,672
Pocasset Harbor	3,120	2,562	GUIA	624	3,186
Pocasset River	1,289	1,148	GUIA	258	1,406
Total	8,072	6,803 - 7,768		1,616	9,223 - 9,531

1. If Pilot EIA Program does not provide intended results, then General Use I/A Assumed for implementation, estimated to remove 517 kg N/year. The watershed removal totals 1,385 kg N/year, falling less than 20 kg N/year short of the 25% removal goal for the watershed.

2. Assumes number of individual homes with GUIA or individual homes sewer. For Buttermilk Bay only, this includes the GUIA alternative with an EIA study pilot area.

3. The Phinney's Harbor Core Sewer Area assumes removal of 1,740 kg N/year for 436 parcels discharging to the Bourne Public Schools WWTF. Depending on the path of groundwater flow from the BPS WWTF, the effluent concentration returning to the Phinney's Harbor watershed may be reduced thereby increasing the nitrogen removal estimate. For the purposes of this study, a conservative estimate of treated wastewater effluent nitrogen loading (to a treatment rate of 10 mg/L effluent concentration) is assumed for every parcel in the Phinney's Harbor Core Sewer Area, to be re-evaluated after hydrogeologic modeling is performed at the wastewater treatment plant.

4. The only non-traditional preferred alternative assumed at this time is the 20% maximum removal allowance for Stormwater Best Management practices, to be used Townwide.

SECTION 5 IMPACTS

SECTION 5.1 ENVIRONMENTAL IMPACTS

Section 5.1.1 Surface and Groundwater Quality

Historical toxic contamination persists in areas like New Bedford Harbor and the former Massachusetts Military Reservation on Cape Cod. However, ongoing contributions of toxic pollutants from households and lawns worsen the issue. During the mid-20th century, factories along the Acushnet River discharged polychlorinated biphenyls (PCBs) and heavy metals into the water, creating significant risks to aquatic life and human health due to their carcinogenic properties. Despite efforts to reduce pollution, PCBs still exist in the sediment of the harbor, particularly in the New Bedford upper harbor and Acushnet River where major factories operated. Similarly, in Bourne, past fuel and chemical spills, along with improper disposal practices at the Joint Base Cape Cod (formerly the Massachusetts Military Reservation), have contaminated groundwater flowing into Buzzards Bay with highly toxic substances.⁶

Based on ongoing water quality monitoring by Buzzards Bay, Association to Preserve Cape Cod, and other non-profit monitoring agencies, Bourne continues to document nitrogen pollution through overstimulation of growth of aquatic plants and algae. For the surface and groundwater in Bourne, multiple years of studies have indicated that nitrogen pollution is causing eutrophication in multiple local ponds (leading to temporary beach closures) and death of eel grass in the coastal estuaries, reducing dissolved oxygen in the water. For human health, increased nitrogen in the groundwater can negatively affect the shared Cape Cod Aquifer, where most public drinking water supplies sources are found in Cape Cod. Nitrogen in drinking water can restrict oxygen in the bloodstream and put vulnerable populations (infants) at risk.⁷

The installation of General Use I/A systems, in areas which comply with the Town of Bourne Board of Health regulations, can reduce nitrogen more than a traditional Title 5 septic system. Therefore, the widespread use of the nitrogen-reducing onsite system moving forward will reduce the amount of nitrogen entering the environment.

In Buttermilk Bay, where there is high density of residential homes, the Core Sewer Area will reduce the nitrogen loading into the Queen Sewell Pond and Buttermilk Bay surface water areas as well as reduce overall groundwater loading to the Cape Cod Aquifer. In June 2022, Bourne concluded its Needs Assessment, determining that the removal of approximately 8,100 kilograms of nitrogen per year (kg N/year) across their priority watersheds is necessary to meet their water quality objectives. MassDEP has identified on-site septic systems as the primary source of nitrogen contamination in

⁶"Toxic Pollution" Buzzards Bay Coalition. <https://www.savebuzzardsbay.org/current-issues/toxic-pollution/#:~:text=In%20Bourne%2C%20highly%20toxic%20chemicals,that%20flows%20to%20Buzzards%20Bay>. Accessed February 2024.

⁷"Nitrogen and Water." USGS. May 21, 2018. <https://www.usgs.gov/special-topics/water-science-school/science/nitrogen-and-water#:~:text=Excess%20nitrogen%20can%20cause%20overstimulation,block%20light%20to%20deeper%20waters> Accessed February 2024.

coastal communities. Decentralized systems can reduce nitrogen in multiple ways. These types of systems could include filtration and UV disinfection units, or a specialized denitrifying process, chemical process, disinfection unit and an operator to run the system.

Section 5.1.2 Water Supply

There are both Zone I and Zone II wellhead protection areas in the study area. The alternatives proposed can improve the groundwater quality within each watershed. Improvement in groundwater quality eventually leads to better surface water quality, as groundwater either moves from inland areas to coastal discharge areas, or toward ponds from tributary areas. The plan will reduce threats to groundwater quality associated with nitrogen within the Zones, improving the water supply to town citizens.⁸

Section 5.1.3 Air Quality

Microbes in newly installed septic systems require a pH between 6.8 and 7.6. When the pH drops below 6.8, the tank releases hydrogen sulfide, which has a smell like rotten eggs. In addition, if septic tanks are not closed and secured, there are many odorous fumes which can escape into households and create discomfort. However, with proper installation as well as maintenance, the system should not create any odor in the household.⁹

Construction vehicles can be a source of added air emissions and represent a direct short-term impact. During construction, heavy duty vehicles and equipment will generate emissions. In addition to these emissions, during excavation, there will be high dispersion of dust and soil into the air, creating particulate matter pollution in surrounding areas. This will negatively affect air quality in the town and can create unpleasant smells. To reduce these affects, the Contractor will perform dust control operations, in an approved manner, whenever a nuisance or hazard occurs or when directed by the Town or its representative, even though other work on the project may be suspended. Methods of controlling dust will meet all air pollutant standards set forth by federal and state regulatory agencies.

Section 5.1.4 Noise Levels

On average, construction equipment such as bulldozers, excavators, and backhoes create sounds between 85 and 105 decibels. To install a new system, excavation will be necessary on roads to reach the pipework, meaning that these areas will undergo higher levels of noise. Typically, an excavator could dig approximately 720 cubic yards of dirt per day, meaning that large sections of land are completed in a day, and noise would only be increased in a specific area for a brief period. In addition, the systems themselves should not provide any additional noise component. To avoid noise pollution, The Contractors tasked with the project will make every effort to reduce noise generated during operations. The equipment will have silencers or mufflers designed to

⁸ "Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast" USGS. November 23, 2016.

<https://pubs.usgs.gov/circ/2003/circ1262/> Accessed February 2024.

⁹ "How to Reduce Septic Tank Odor" Bailey Brothers. August 22, 2022 [https://baileyokc.com/blog/plumbing-faq/how-to-reduce-septic-tank-odor#:~:text=Inside%20the%20septic%20tank%2C%20microbes,like%20rotten%20eggs\)%20can%20develop.](https://baileyokc.com/blog/plumbing-faq/how-to-reduce-septic-tank-odor#:~:text=Inside%20the%20septic%20tank%2C%20microbes,like%20rotten%20eggs)%20can%20develop.)

Accessed February 2024.

operate at the lowest noise levels, ensuring compliance with state and federal regulations or regulations specified by the Town of Bourne.

In addition, hydraulic pumps, generators, gensets, noisy pipes, and exhaust fans are all components in the wastewater industry that create noise. However, these items are found at wastewater treatment facilities, which will strategically be placed as far away from residential areas as feasible. Some types of I/A systems use aeration to enhance the breakdown of organic matter. These systems may emit a low humming or bubbling sound due to air pumps or diffusers. Pumps and motors may also generate mechanical noises, such as humming or whirring. Typically, these units are underground, so the noise is muted due to their location. In terms of decibels, measurements were made 3.3 feet from the Aquapoint Bioclere I/A system, and five feet above the ground, at 90° intervals in four (4) directions. The average decibel level was 49.5, with a minimum of 45.5 and maximum of 52.8. The background level was 37.7 decibels. The maximum decibel of 52.8 is similar to the sound of a household refrigerator or a suburban area at night, meaning the system is barely noticeable in households once installed. ¹⁰

In Massachusetts there is a mandatory statewide building code that regulates both airborne noise (evaluated as Sound Transmission Class or STC) and structure-borne noise (evaluated as Impact Insulation Class or IIC) within the indoor spaces of residential structures. All new construction must abide by these ordinances to be compliant with current code.

Section 5.1.5 Wetlands, Floodplains, and Waterways

Wetland areas consist of open water, vegetated wetlands, and coastal landforms. Bourne has over 1,000 acres of Wetland Resource Areas, as defined by the Wetland Protection Act.

Most marshes, tidal flats, and freshwater wetlands in this ecosystem remain untouched and undeveloped, enabling them to serve their full potential as habitats, nurseries, and spawning grounds, and, in the case of barrier beaches, as a means of storm damage prevention. The plan aims to position its wastewater pumping stations at locations farthest from wetland resource areas feasible, ensuring that any potential system pollution does not encroach into these vital wetland habitats. ¹¹

Due to changes in climate, sea levels are rising, and weather patterns are changing. These are factors that contribute to severe flooding, especially in coastal areas such as Bourne. There are 242 properties in Bourne that have a greater than a 26% chance of severe flooding over the next 30 years. This represents 51% of all properties in Bourne. In addition to property damage, flooding can also cut off access to utilities, emergency services, transportation, and may impact overall economic well-being of an area. Sea level rise will magnify the frequency and severity of coastal storms in Bourne. Floodwater may inflow into septic tanks or inundate groundwater disposal fields, causing

¹⁰"Decibel Level Comparison Chart". Yale Environmental Health and Safety.

<https://ehs.yale.edu/sites/default/files/files/decibel-level-chart.pdf> Accessed February 2024.

¹¹"Bourne Back River and Headwater Wetlands ACEC". Mass.gov. April 1989. <https://www.mass.gov/info-details/bourne-back-river-and-headwater-wetlands-acec#:~:text=Most%20of%20the%20marshes%2C%20tidal,purposes%20of%20storm%20damage%20prevention> . Accessed February 2024.

solids to backup either in the soil absorption system or the septic tank. Ultimately, occurrences of negative public health events due to untreated wastewater will become more frequent as climate change progresses. The concern about long-term impacts of onsite systems near the coastline is a consideration for Bourne as they implement their recommended plan. Maintaining adaptive management strategies can help to invest in climate resilient wastewater solutions.

Section 5.1.6 Endangered Species

Currently in the Town of Bourne there are five species considered threatened or endangered. These include the Northern Red-bellied Cooter, the Red Knot, the Piping Plover, the Roseate Tern, as well as the Northern Long-eared Bat. All these species except for the Northern, Red-bellied Cooter and Northern Long-eared Bat live on coastal beaches, meaning that they will not be impacted during the construction process as construction will be taking place on roadways. Individual onsite systems will impact non-roadway systems. Previously developed parcels had a lower impact on species since it is a system update rather than new development. New development would require individual permitting and investigation. In the case of the Northern Red-bellied Cooter, which are found on Inland ponds and rivers, the new systems installed will improve groundwater quality which will eventually improve surface water quality, meaning that their habitats will improve in health. The systems will reduce the outflow of nitrogen into ponds and rivers, which will lead to a healthier and more prosperous ecosystem for these endangered species.¹² The table below shows the endangered or threatened species described above.

Table 15: Threatened or Endangered Species in Bourne

County	Species	General Status	General Location/Habitat	Town
Barnstable	Northern Red-bellied Cooter	Endangered	Inland Ponds and Rivers	Bourne (north of the Cape Cod Canal)
	Red Knot	Threatened	Coastal Beaches and Rocky Shores, sand, and mud flats	Coastal Towns
	Piping Plover	Threatened	Coastal Beaches	All towns
	Roseate Tern	Endangered	Coastal beaches and the Atlantic Ocean	All towns
	Northern Long-eared Bat	Threatened Final 4(d) Rule	Winter- mines and caves, Summer – wide variety of forested habitats	Statewide

For the Core Sewer Area, design will include local permitting through filing a Wetland Notice of Intent and performing a project detailed review of localized threatened or endangered species. Wetland scientists or ecologists will flag resource areas during the surveying and preliminary design phase to understand if project constraints exist or if mitigation is necessary.

¹²Table 2 Federally Listed Endangered and Threatened Species in Massachusetts. EPA. February 5, 2016. <https://www3.epa.gov/region1/npdes/hydrogp/2018gp/table-1-appendix-1-ma-esa.pdf> . Accessed February 2024.

For I/A Onsite systems, most systems will be installed on previously disturbed residential properties. If the new I/A system stays within the existing onsite system footprint, it is extremely unlikely that any habitat will be disturbed.

Section 5.1.7 Historical and Archaeological Sites

The Town of Bourne holds multiple historical structures such as the Civil War Memorial (Soldiers and Sailors), as well as archaeological sites such as Grove Field Ossuary and Old Bourne Cemetery. Bourne Town Hall, as well as Bourne Historical Society, are also located in the town. These sites hold significance to the town's history and culture. It is unlikely that any of these sites will be disturbed by Core Sewer Area construction or General Use I/A onsite system installation. As a part of standard design and permitting, Historical and Archaeological Sites of concern will be screened through the Massachusetts Historical Commission to determine if any affected area is within the project scope. The Core Sewer Area final design will be adjusted accordingly. However, the new sewer pipeline will be placed in roadways and rights-of-way (such as private roads, easements, or cross-country routes). The intent is to avoid interaction with any historical, archaeological, or potentially archaeological areas. Below is the approximate area of potential historical sites (blue areas) within the Phinney's Harbor Core Sewer Area (yellow areas with proposed sewer lines).

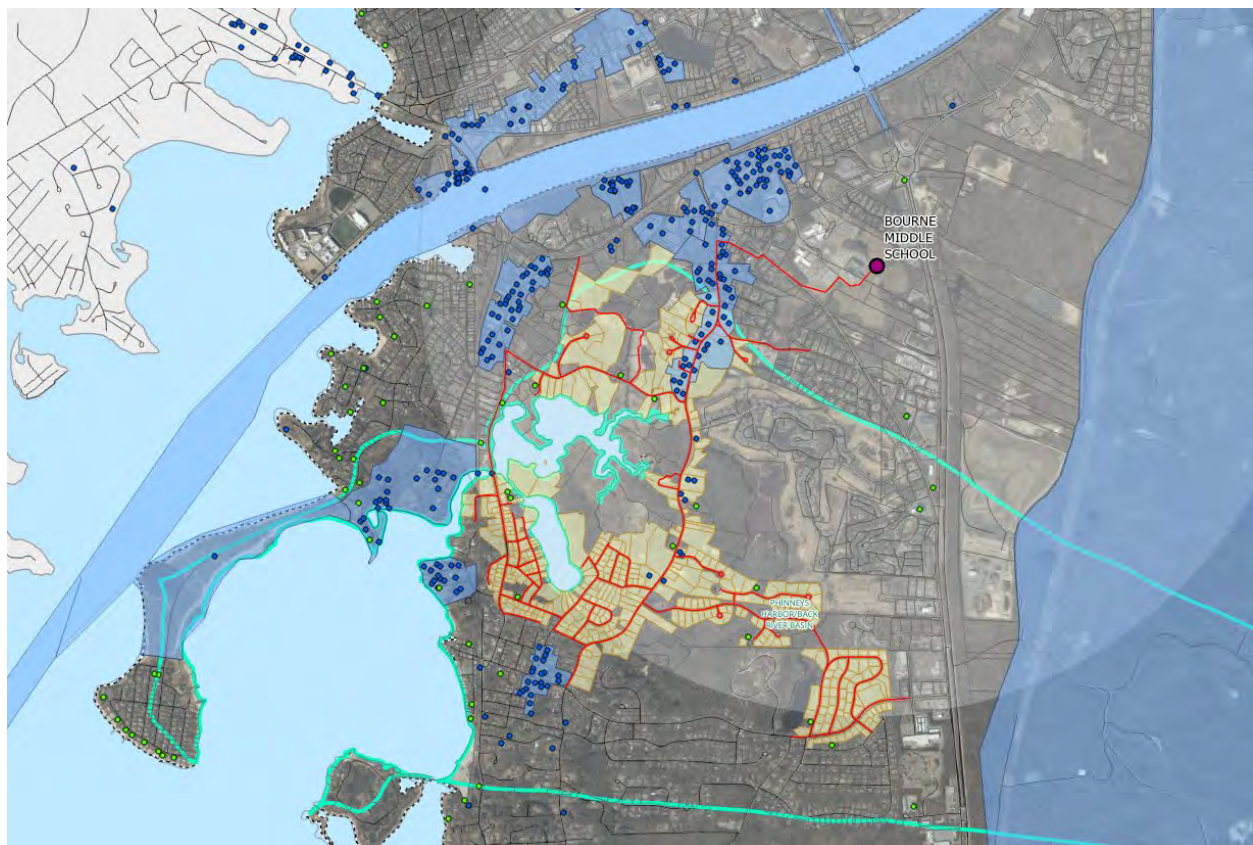


Figure 6: Massachusetts Historical Commission Historic Districts and Site Map with Phinney's Harbor Core Sewer Area

For the General Use I/A onsite systems, the installation will occur on previously disturbed residential properties. Therefore, precautions based on the home status (e.g., Historically Significant Properties) will be followed as part of any specialized permit required for installation.

Section 5.1.8 Agricultural Land

As referenced in the needs assessment, Agricultural purposes include cranberry bogs and other open farmland in the northern part of Bourne. The largest parcel use is the Joint Base Cape Cod (JBCC) tax exempt use, which represents the major southeast portion of Town. Bourne also has 54 miles of shoreline. However, most of the work proposed will be within existing disturbed areas (i.e., public roadways, private roadways, etc.) and will be reconstructed to match existing conditions, so that these areas will not be affected.

Section 5.1.9 Environmentally Sensitive Areas

The Town of Bourne is surrounded by the 7.8-mile Cape Cod Canal and the temperate waters of Buzzards Bay. Bourne is recognized as the entry point to Cape Cod because it offers convenient proximity to New Bedford, Providence, and Boston, facilitating access to these destinations and making it a popular tourist location.

There are few areas in the Town of Bourne which are considered Areas of critical Environmental Concern. Phinney's Harbor is considered an embayment system due to its shoreline. The Back River is located at the upper inland reaches of this embayment system. Designated as an Area of Critical Environmental Concern (ACEC) by the state, the Back River establishes a framework for local and regional stewardship. This embayment system facilitates a range of recreational activities, including boating, swimming, shell fishing, and fin fishing.¹³

Further south, the Pocasset River ACEC encompasses a small river and estuarine system located along the eastern coastline of Buzzards Bay. Originally selected for designation by various groups including the Town of Bourne Conservation Commission, Select Board, Finance Committee, and Planning Board, it received its Area of Environmental Concern (ACEC) status in 1980 due to its remarkable natural assets.

All the Wetlands in Bourne, especially the coastal saltwater marshes, are sensitive areas. The preservation of wetland resources and the enforcement of regulations are responsibilities shared by the Bourne Conservation Commission and the Department of Natural Resources. These agencies work together to enforce federal, state, and local laws and regulations aimed at the management, protection, and improvement of wetlands. Improperly managed systems can result in pollution runoff containing harmful substances. On-site sewer systems often involve excavation and alteration of land, which can change the natural hydrology of the area. This alteration may affect the water flow patterns in and around wetlands, potentially leading to changes in water levels, drainage patterns, and sediment deposition. To avoid these potential hazards, the Town will dedicate to

¹³ "Phinney's Harbor." Cape Cod Commission. October 2017. https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/Website_Resources/208/watershedreports/2017_Watershed_Report_UC_Phinneys_Harbor.pdf Accessed February 2024.

careful planning, management, and monitoring to minimize adverse impacts on surrounding wetlands and ensure the protection of these valuable ecosystems.¹⁴

SECTION 5.2 TRANSPORTATION IMPACTS

Section 5.2.1 Vehicular Traffic

Infrastructure projects have a notable short-term impact on traffic congestion due to construction activities near public and private roads. The Town plans to place its wastewater piping in public roadways, public rights-of-way, or private roadways (with necessary permissions and easements). Additionally, the Town aims to position its wastewater pumping stations near rights-of-way whenever feasible. A proactive approach will be taken to address construction-related traffic challenges.

The Town will consider completing construction during nightly working hours to avoid creating heavy traffic. The Town will also establish a well-developed public outreach approach for residents, businesses, and visitors to advise the public of anticipated traffic delays and/or detours due to construction. If detours are necessary, the next best route will be determined, and it will be clearly labeled.

Since Bourne is a tourist attraction during the summer, the tourist population during the summer will create higher traffic volumes. The Town would consider completing most construction at times when tourist visits are not as frequent.

Section 5.2.2 Pedestrian and Bicycle Transportation

As noted above, traffic will increase during installation of sewer systems due to construction blocking roadways and paths. Transportation management plans, including pedestrians and cyclists, are typically a standard Construction Design practice and will be most applicable to any roadway construction work in the Core Sewer Area.

Should construction activities impact bike lanes, alternative routes will be established and clearly indicated. In planning vehicle detours, considerations for bike accessibility will be incorporated. Furthermore, all construction zones will be marked with appropriate roadway signage to ensure clear labeling and to mitigate the risk of accidents, particularly for cyclists and pedestrians.

Decentralized I/A onsite alternative installation will take place in yards or private driveways and is not expected to disrupt any public pedestrian or cyclist transportation.

SECTION 5.3 INSTITUTIONAL IMPACTS

Section 5.3.1 Health Department

¹⁴ "Wetland Resources." Town of Bourne Local Comprehensive Plan. <https://townofbourneinc.wordpress.com/wetland-resources/>. Accessed February 2024.

The Health Department in the Town of Bourne currently comprises four full-time staff members. Their responsibilities include enforcing federal, state, and local public health laws, rules, and regulations. The team consists of a Health Agent, Assistant Health Agent, Health Inspector and Secretary.

The Health Department conducts inspections, issue permits and licenses, provide training and resources, maintain records and databases, and facilitate biweekly Board of Health meetings. The Health Department reports to the Board of Health which consists of five members who volunteer their time to address various public health issues.

By default, the Town of Bourne operates under Title 5 regulations for septic systems. This means that the homeowner is responsible for inspecting, maintaining, and upgrading their systems. The Health Department oversees compliance with these regulations. Alternatively, the town has the option to opt-in for a new Watershed Permit. The table below outlines the key differences between Title 5 and the Watershed Permit.

Table 16: Title 5 (Default) vs. Watershed Permit (Opt-In)

	Title 5	Watershed Permit
Who is responsible?	Individuals	Town
When are upgrades required?	New Build: July 2024 Existing Systems: July 2030	Per timeline of Watershed Management Plan (e.g., CWMP Implementation Timeline)
Is there an Application Process?	Local Permit	Yes
Are there annual requirements?	No, but Local Approving Authority keeps records/performs inspections	Yes
Are there additional costs to the Town?	No	Yes*
Are there fines for non-compliance?	Yes, if applicable under Title 5	Yes
Who is responsible for paying fines?	Homeowner	Town

*Town would likely need additional staff and monitoring technology, as the Town assumes responsibility for any permit non-compliance, which incurs costs outside the CWMP Recommended Plan implementation costs (difficult to predict at this time).

The Health Department can enhance its operations by integrating GIS mapping, increasing staff levels, and enhancing recordkeeping. Access to accurate and up-to-date GIS information would significantly improve the efficiency of the recordkeeping system, allowing relevant data to be stored locally for each system. Additional staff would facilitate the maintenance of both GIS data and the physical onsite systems. Our recommendation is to implement an enhanced electronic recordkeeping system for managing onsite systems. This system would involve digitally uploading

historical information currently available in hard copy and managing future data. Improved recordkeeping, whether electronic or not, will yield long-term benefits, especially in scenarios where ownership of the systems may change.

Section 5.3.2 Department of Public Works, Sewer Division

The Sewer Department operates as a subdivision in the Department of Public Works consisting of two full-time laborers with oversight and assistance from an office administrator, DPW Director, and Town Engineer. The Town of Bourne has a sewer division and sewer enterprise that maintains the existing sewer system. The Board of Sewer Commissioners consists of five board members and oversees rate setting, policy, and other related items to the sewer division.

The Buzzards Bay Wastewater Treatment Facility uses contracted services for its operation and maintenance. The two full-time laborers maintain and monitor five lift stations and the collection system which consists of gravity, low-pressure mains, and force mains. The office administrator maintains departmental records and permits. The DPW Director oversees the laborers and contract operations. The Engineering Staff assists with technical evaluations and operational issues.

The Sewer Department Budget for FY23 and FY24 are presented in Table 14. The FY24 budget was approved for an increase of approximately \$270,000 in large part due to an increase in debt service.

Table 17: Bourne Sewer Department Budget

Item	<i>FY23 Expended</i>	<i>FY24 Approved</i>
Personal Services	\$ 171,640.28	\$ 205,940.00
Purchase of Services	\$ 780,364.83	\$ 786,526.00
Supplies	\$ 9,152.70	\$ 20,700.00
Other Charges and Expenditures	\$ 224,128.88	\$ 329,681.00
Capital Outlay	\$ 132,672.84	\$ 95,000.00
Permanent Debt Service	\$ 11,400.00	\$ 164,118.00
Total	\$ 1,329,359.53	\$1,601,965.00

Section 5.3.3 Stormwater Management Team

We recommend Stormwater Best Management Practices (BMPs) across all watersheds. Stormwater BMPs encompass a range of strategies, including street sweeping, maintenance of stormwater utilities, education and public outreach programs, thoughtful land use planning, and effective industrial/commercial reduction and control measures. The Stormwater Management Plan for 2019 discusses a number of these BMPs. The Stormwater Management Program Team, displayed in the figure below, consists of department heads from DPW, Planning, Engineering Staff, Conservation,

and Board of Health¹⁵. This plan outlines numerous ways to manage stormwater and mitigate stormwater pollution that are listed below:

- Public outreach and education
- Control of construction site discharges
- Control of stormwater from development projects
- Good housekeeping program to minimize pollution from municipal operations or properties.

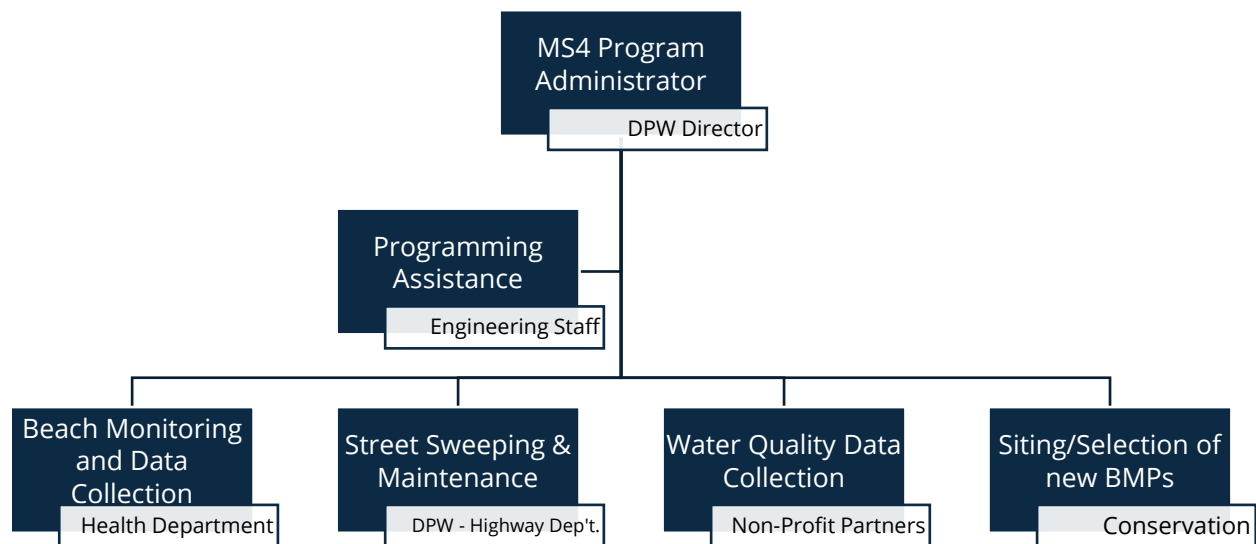


Figure 7: Town of Bourne Stormwater Management Team

Each BMP will require different resources or coordination. For example, street sweeping will require additional coordination with the highway department at the DPW which will not require additional staff but may require a change in the current street sweeping schedule.

Section 5.3.4 Responsible Management Entity

A Responsible Management Entity (RME) is an agency or other organization tasked with managing decentralized wastewater infrastructure (i.e., septic systems, private sewage systems, individual treatment systems, or onsite sewage systems). An RME is an emerging utility management strategy that can assist in the management of widespread General Use I/A Alternatives. The RME allows oversight of every aspect of the EIA (Enhanced Innovative/Alternative) System lifecycle to ensure that

¹⁵ "Stormwater Management Program (SWMP)." Town of Bourne. June 2019. https://www.townofbourne.com/sites/g/files/vyhlf7346/f/uploads/bourne_2019_stormwater_management_plan.pdf Accessed February 2024.

these systems are restoring the watersheds.¹⁶ The RME can be a third-party agency (e.g. Barnstable County Septic Utility Program Pilot) or can be Town-based, through an existing utility or through creation of a new utility.

A RME allows for management of these systems in a comprehensive manner. This way the community can learn from newer systems as they are developed and installed. It allows the town to comply with watershed plans and environmental goals in a more customized manner.

How does a RME work?

The EPA has various management models for decentralized systems. There are two that outline an RME, one being where the property owner owns the system and the other where the RME owns the system. The table below outlines the main differences between the two models.

Table 18: EPA Management Models¹⁷

	Name	Owner	RME Action	Best for
Model 4	RME Operation and Maintenance Model	Property Owner	Tracks compliance with inspections and other required maintenance	Clustered systems
Model 5	RME Ownership Model	RME	Owns, operates, and manages the decentralized systems comparable to the centralized system	Clustered systems serving multiple properties under different ownership

Model 4 requires more work from the property owner which has an impact on ease of operation for the RME since the RME is tracking compliance. Model 5 gives the RME more control but requires more work upfront to establish a system.

Case Studies

The following outlines three case studies across the United States where the town implemented an RME using management Models 4 or 5.

Blacksburg, VA¹⁸: This follows Model 5 with the DPW serving as the RME. In this case, there were about two hundred homes, each with their own septic system but connected to the same collection system that uses internet based remote monitoring. The responsibility of

¹⁶ "What is an RME?" Massachusetts Alternative Septic System Test Center. December 2022.

<https://www.masstc.org/rme/basics/what-is-an-rme> Accessed February 2024.

¹⁷ "Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems." Environmental Protection Agency. March 2003. https://www.epa.gov/sites/default/files/2015-06/documents/septic_guidelines.pdf Accessed February 2024.

¹⁸ "Decentralized Wastewater Management Case Studies – Blacksburg, VA." Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-06/documents/decentralized-case-study_blacksburg-va-2.pdf Accessed February 2024.

the resident was to not dump fats, oils, grease, chemicals, or solids waste down the drains. If this happens, the RME is notified, and the resident must take corrective action. The users of the decentralized region pay the same water and sewer rates as those in the centralized region. Pumping occurs every seven years and costs \$150 per tank [2015 dollars].

Otter Tail Lake, Minnesota¹⁹: This RME follows Model 4 with the Otter Tail Water Management District (OTWMD) serving as the RME. The OTWMD was formed specifically to maintain individual and clustered systems. Like Bourne, this area has a fair number of seasonal residents. The OTWMD maintains systems for both the permanent residents which are inspected every two years and seasonal systems that are inspected every three years. The district contracts with service providers and provides a list of accepted pumpers and installers that homeowners can hire. The OTWMD staff includes one full-time and two part-time employees. The annual operating budget is \$200,000 funded by user fees of \$43 for seasonal residences and \$151 for permanent residences.

Phelps County, Missouri²⁰: This RME follows Model 5 with the Public Water Supply District #2 (PWSD2) serving as the RME. The system consists of septic tank effluent pumps (STEP) collection system and recirculating sand filter (RSF) treatment system. Owners with malfunctioning individual systems may voluntarily connect and PWSD2 offers incentives such as connection fee waivers to get homeowners to connect. PWSD2 charges a flat rate of \$46.50 per month to fund the program and has the power to terminate potable water for not paying.

RME's in New England

Barnstable County²¹ received a grant in September of 2022 to implement a regional RME over a 5-year period. In this case Massachusetts Alternative Septic System Test Center (MASSTC) would function as the RME. MASSTC is a well-established testing and research facility for innovative/alternative technologies. More information will become available as the process continues to move along.

Charlestown, RI has an On-Site Wastewater Management Program which is an RME following the Operation and Maintenance Model (Model 4). All of Charlestown relies on septic systems for sewage disposal.²² This model means that the ownership and the responsibility for the operation and

¹⁹ "Decentralized Wastewater Management Case Studies – Otter Tail Lake, Minnesota." Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-06/documents/decentralized-case-study_otter-tail-lake-mn-2.pdf Accessed February 2024.

²⁰ "Decentralized Wastewater Management Case Studies – Phelps County, Missouri." Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-06/documents/decentralized-case-study_phelps-county-mo-2.pdf Accessed February 2024.

²¹ "Barnstable County Receives EPA Grant to Develop a Low-Cost Wastewater Utility for Advanced Onsite Septic Systems." Barnstable County Department of Health and Environment. September 2022. <https://www.capecod.gov/2022/09/26/barnstable-county-receives-epa-grant-to-develop-a-low-cost-wastewater-utility-for-advanced-onsite-septic-systems/> Accessed February 2024.

²² "Town of Charlestown – On-Site Wastewater Management Program." Town of Charlestown Rhode Island. <https://charlestownri.gov/index.asp?SEC=57BE787A-1F23-406A-906B-4FBC5BCACF34&DE=96357C4D-96F6-49F6-8FA4-021E0B30C8FF> Accessed February 2024.

maintenance of the system still lies with the property owner. The Town provides information on service providers, when inspections need to occur, general information about the systems, and access to the septic history to the residents on the town website. The approved providers upload information about the inspection to the town's database. This allows the town to keep a comprehensive log of what systems are being inspected and if the property owners are being compliant.

RME Considerations

A RME will be required with Bourne's decision to move ahead with I/A systems as a major part of the Recommended Plan. While guidance documents exist presenting different models of RMEs, currently the only operational RMEs are in other states. The grant funded Barnstable County pilot RME may result in an option for a regional RME the Town of Bourne could be a part of for a fee. Otherwise, the Town would have to create a local RME. A regional RME would consolidate the oversight, inspections, and reporting while a local RME would require additional staff and efforts from the Town to implement and manage.

The Ownership Model (Model 5) benefits communities with a large seasonal residential population. Under Model 5 the RME would retain full responsibility and costs of the operations and maintenance and of the systems which would be in turn charged to the homeowner. This would reduce dependency on property owners during the off season for meeting TMDL limits and result in better control.

However, Model 5 type ownership would increase the costs significantly to the Town, as the Town would become responsible for maintenance in addition to permitting, testing, and tracking. Therefore, for the purposes of this plan, a Model 3 RME is assumed for cost estimation purposes of the GUIA program. As part of adaptive management planning, the expansion of an RME can be studied for future phases of CWMP implementation.

SECTION 6 COST ESTIMATE

SECTION 6.1 TRADITIONAL SOLUTIONS

Section 6.1.1 General Use I/A Onsite Systems

General Use I/A onsite system costs were used as the basis for the decentralized traditional solution. As of March 2022, there are five approved vendors on the I/A technology list which meet the 19 mg/L nitrogen effluent removal requirement. The number of general use approved technology vendors is expected to increase over time as more vendors can pilot and achieve provisional status. Therefore, the cost basis for this recommended plan is an average of the five available technologies, which may change over future revisions of this plan.

Capital Costs

Table 16 presents the prices for a Nitrogen Reducing filter from four different source companies (Norweco, Septi-Tech, Aquapoint, Orenco, and Bio-Microbics). This nitrogen reducing filter will be applied as a Typical Residential Installation for a 3-bedroom home in the town of Bourne. Prices for provided include the unit itself and do not include tax, delivery fees, any installation fees or materials, and any design or permitting fees as required by the Town of Bourne Health department. Unit prices are based for March 2024 at an ENR Index of 13532 . The information sheets and budgetary basis information from each vendor are included in **Appendix B**.

Table 19: GUIA Budgetary Capital Costs

Company	Model	Inclusions/Exclusions	Unit Price ¹
Aquapoint	Bioclere Model 16/12ss	Pricing includes delivery and tax. Pricing does not include tanks, electrical work, external connections or PVC piping, SAS, etc.	\$12,350
Bio-Microbics	MicroFAST® 0.5 – 9.0 HighStrengthFAST® 1.0 – 9.0 NitriFAST® 0.5 - 9.0	Pricing does not include tanks, electrical work, external connections or PVC piping, SAS, etc.	\$6,100
Septi-Tech	STAAR 0.5 Denite (M400N)	Pricing includes STAAR components, delivery to the site, setup into tanks, connections and PVC within treatment tanks, and system startup. Pricing does not include tanks, electrical work, external connections or PVC piping, SAS, etc.	\$10,200
Norweco	Singulair 960 DN models 600, 750, 1000, and 1500; Singulair 960 DN Green model 600	Pricing includes delivery and set-up. Pricing does not include any electrical work.	\$8,962
Orenco	Advantex AX20, AX20-RT, AX25-RT, AX100 <10,000 GPD	Pricing includes delivery, setup, electrical work, and external connections.	\$48,600

1. Massachusetts Sales Tax (6.25%) added to unit if not explicitly included by the vendor.

The systems do not include any design, permitting, or site work (i.e., site clearing, excavation, materials). A few include some electrical connections and installation, but no comprehensive installation (including pipe connections or inspecting existing leach fields). For the purposes of this plan, the design, permitting, construction, and the unit itself were included in an estimated capital cost. As the vendor unit prices vary, the average price was used. The contingency was carried at 10% of the subtotal cost, to account for any varying existing conditions or unforeseen challenges with each individual installation. Therefore, the range could be between \$38,000 and \$42,500 for an individual installation.

Table 20: GUIA Opinion of Probable Construction Cost (OPCC) – New Installation

GU I/A Individual System	OPCC³
Average GUIA Unit	\$ 15,850.00
Design & Permitting	\$ 3,170.00
Construction (Electrical and Sitework) ¹	\$ 19,020.00
Permits/Fees ²	\$ 525.00
Contingency (10%)	\$ 3,860.00
Total Each	\$ 42,425.00

1. Landscaping and/or asphalt pavement is not included in base estimate.

2. Includes current Bourne Permit fees for General Permit, I/A Technology, and one Percolation Test.

3. Opinion of annual cost is Class 5, conceptual cost (-50%/+100%) in March 2024 dollars (ENR 13532). This total does not include inflation.

Operation and Maintenance Costs

General use I/A systems include a power component as compared to Title 5 septic systems, which do not require power. The estimated power usage is modeled for each general use I/A system below, which is assumed to be paid by the property owner directly. The Operation, Maintenance, and Management costs are in addition to the estimated energy usage costs.

Estimated Energy Usage

Based on manufacturer cost sheets, the following power usage is estimated per system: estimated annual electricity cost based on 12-hour operation, 365 days a year, with a \$0.28 kW per hour electricity rate.²³ The overall cycling may occur in less frequent intervals, but each system is manufactured differently.

²³ "Average Energy Prices, Boston-Cambridge-Newton – October 2023." Northeast Information Office, Bureau of Labor Statistics. Web. https://www.bls.gov/regions/northeast/news-release/averageenergyprices_boston.htm

Table 21: General Use I/A Estimated Annual Energy Costs

Manufacturer/Model	Daily Usage	Annual Estimated Average Cost
Orenco Systems	2.4 kW/day	\$24.09
Aquapoint-Bioclere	4.25 kW/day	\$42.66
Bio-Microbics	3.96 kW/day	\$39.75
Norweco	6.24 kW/day	\$81.20
Septi-Tech	8.09 kW/day	\$62.63
Average		\$50.07

The energy costs are typically paid for by the homeowner, as it is added on to a typical residential meter.

Operation, Monitoring, and Maintenance:

Based on the 2010 Comparison of Costs for Wastewater Management Systems, the average annual cost to operate a GUIA onsite system was \$1,375 (April 2014, ENR 9750). In today's dollars, the cost is approximately \$1,910 (March 2024, ENR 13532). The baseline costs did not include municipal procurement or oversight of operations, which adds approximately 25% or \$480 per year for the GUIA costs. The monthly expense is approximately \$200 per household for Municipal Oversight and Maintenance related to the GUIA systems. This assumes a mid-level Responsible Maintenance Entity (RME) where the owner would still be responsible for system compliance and maintenance, and the Town would collect records and manage periodic inspections for compliance.

Table 22: GUIA Operation, Monitoring, and Maintenance Cost Estimate

O&M Category	Average Annual Cost per system (+100%/-50%)	Average Monthly Cost (+100%/-50%)
Regular Operating Costs (Energy, Seasonal Turnover as applicable, Replacement parts) ¹	\$ 1,910.00	\$ 160.00
Municipal RME (Inspection, Permitting, Monitoring)	\$ 480.00	\$ 40.00
Total Cost	\$ 2,390.00	\$ 200.00

1. Operating Cost from "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" (April 2014, ENR 9750) in today's dollars (March 2024, ENR 13532).

This amount is comparable to other national examples of decentralized operation and maintenance systems. For example, Chesapeake Bay's average operation and maintenance cost for decentralized systems is about \$2,140 per year (2018 cost \$1,744, updated to March 2024 dollars).²⁴ As listed in Section 4.3.4 above, the use of the Responsible Management Entity also has variable costs depending on the level of ownership that Bourne chooses to employ. For example, the Otter Trail Lake RME in Minnesota offers two types of RME service plans: Passive and Active.

²⁴ Chesapeake Assessment Scenario Tool. "Cost Effectiveness of BMPs." Chesapeake Bay Program Office. Phase 6 – 7.11.1. Web. <https://cast.chesapeakebay.net/Documentation/CostProfiles>

- The passive maintenance plan pays an administrative fee each year for being within the district boundaries, but the homeowner oversees any cost that is associated with the septic system. The district will provide record keeping and troubleshooting help, but any cost is the responsibility of the homeowner.
- The active maintenance plan is where the system is taken care of by the district. The user fee covers the maintenance and upkeep of the septic system from the inlet of the septic tank through the leach field (With the exception of freeze ups in the winter months and inappropriate use by the homeowner; those costs are incurred by the homeowner).

Using the Otter Trail RME options as an example, Bourne could develop their RME either through adding additional staff through their Health Department or by creating a separate utility such as a Septic Utility Program, like a Sewer Enterprise. The rates collected and assessed may be like a Stormwater Utility (where flat fees are assessed per size of home and therefore size of I/A system) or usage. The amount carried in Table 19 below assumes some element of municipal oversight, whether a County RME system is used or Local RME (i.e., Town RME).

Total Cost

The total cost for each individual GU I/A onsite system is calculated by adding O&M costs to the capital cost over the lifecycle of the technology. Assuming that the General Use I/A system is operated and maintained in accordance with manufacturer requirements, the assumed useful life is 20 years.

Table 23: GUIA Total Costs by Watershed

Watershed	Parcels (#)	Total Capital Cost (2024, No Inflation) (+100%/-50%)	Total O&M Cost (\$/year) (+100%/-50%)	Net Present Value (\$ Cost/year)⁶.
Megansett-Squeteague Harbor	285	\$ 12,092,000	\$ 681,150	\$ 1,652,000
Phinney's Harbor	1,135	\$ 48,153,000	\$ 2,712,650	\$ 6,577,000
Buttermilk Bay ¹ .	375/330	\$ 33,410,000	\$ 2,486,850	\$ 5,451,000
Pocasset Harbor	1,455	\$ 61,729,000	\$ 3,477,450	\$ 8,431,000
Pocasset River	645	\$ 27,365,000	\$ 1,541,550	\$ 3,738,000

1. Includes combination of 375 GUIA and 330 EIA. Both must be used to meet TMDL loading.

Section 6.1.2 Core Sewer Areas

As stated in the Alternatives Analysis, the Core Sewer Area originally identified for the CWMP is in Buttermilk Bay. The Select Board has requested that sewer alternatives be prepared (including cost estimates) for each watershed, in addition to the conventional GUIA, to provide cost comparison. The following table outlines the approximate cost breakdown for each core sewer area.

Capital Costs

Megansett-Squeteague Harbor & Phinney's Harbor Core Sewer Areas

The costs to install new core sewer areas in Megansett-Squeteague and Phinney's Harbor to meet the total nitrogen removal goal were determined by estimating the number of residential parcels that would need to connect from Title 5 systems to sewer to meet the wastewater load reduction. Next, the approximate collection system size was estimated to be 95% of the total length of roads between the parcels and the proposed facility. Based on a low-pressure collection system installation cost of \$2,581,000.00 per mile, and the following wastewater capacity treatment costs, the total capital costs were calculated.

Table 24: TMDL Watershed Core Sewer Area Capital Cost Calculations

Watershed	Parcels (#)	Average Daily Flow (gpd)	WWTF Location	Collection System (mi)	Total Capital Cost (\$, 2024) - No Inflation (+100%/-50%)
Megansett-Squeteague Harbor	150	30,400	TBD, Satellite	4.8	\$ 13,853,000
Phinney's Harbor	436	86,100	Bourne Schools WWTF ¹ .	12.6	\$ 37,497,000

1. Costs assume that evaluation, testing, and expansion of existing groundwater disposal field is allowable under Facility operating permit. Assumes that the additional flow will be able to be added to existing treatment facility footprint. Does not include capital upgrades to current facility, only expansion of existing facility to serve additional 87k gpd. Assumes flow expansion can be obtained within existing parcel (i.e., no land acquisition assumed).

Buttermilk Bay Core Sewer Areas

The costs to upgrade the sewer system in Buttermilk Bay to a low-pressure sewer system are outlined in Table 24 below based on a quote for E/One, a pump manufacturer. These style pumps are used in the existing collection system low pressure areas.

The following cost estimates are for the Core Sewer Area – Alternative 1, and Buttermilk Bay – Alternative 2 which encompasses Alternative 1 plus remaining parcels at the southwestern end of Buzzards Bay village. Core Sewer Area – Alternative 1 adds approximately 6 miles of low-pressure sewer to the collection system with a discharge point at the Buzzards Bay WWTF. Buttermilk Bay Alternative 2 adds a total of 12 miles of low-pressure sewer to the collection system, with a discharge point at the Buzzards Bay WWTF.

Table 25: Low Pressure Sewer System Costs, March 2024 OPCC

Item	Buttermilk Bay – Alternative 1 (~6 mi.)	Buttermilk Bay – Alternative 2 (12 mi.)
Low Pressure Sewer System ¹	\$10,950,000	\$21,900,000
Design, Permitting, Bidding	\$1,100,000	\$2,200,000
Construction ²	\$1,100,000	\$1,900,000
Contingency (20%)	\$2,200,000	\$4,400,000
Total	\$15,350,000	\$30,400,000

1. Based on the average of two vendors: E-One and Keen Pumps, who provided hydraulic designs of the entire Buttermilk Bay Core Sewer Area (including Sewer Alternative 1 and the remainder of the southern Buttermilk Bay shoreline). The cost for just Sewer Alternative 1 – Core Sewer Area is about half of the total estimated cost. Assumes discharge at Buzzards Bay WWTF in Bourne.

2. Construction estimated as 125% of construction materials cost.

As mentioned in Section 4.1.1., Buzzards Bay WWTF will need to be upgraded to accommodate either of the two Buttermilk Bay core sewer expansion areas. Based on the estimated cost to treat wastewater on Cape Cod, the average capital cost for centralized treatment is \$48.92 per gallon. Assuming the existing groundwater disposal field can be expanded and additional flow can be accommodated within the current treatment facility footprint (i.e. no land acquisition costs included or alternative locations for Buzzards Bay WWTF are considered), the total capital costs including cost per mile of collection system and cost per gallon of treatment are listed below.

Table 26: Buzzards Bay WWTF Capital Cost Estimate

Sewer Alternative	Parcels (#)	Average Daily Flow (gpd)	Collection System (mi.)	Total Capital Cost ¹
Buttermilk Bay – Sewer 1	330	60,000	8.0	\$ 24,171,000
Buttermilk Bay – Sewer 2	778	156,000	12.5	\$ 41,421,000

1. Opinion of annual cost is Class 5, conceptual cost (-50%/+100%) in March 2024 dollars (ENR 13532). This total does not include inflation.

Pocasset Harbor and Pocasset River Core Sewer Areas

Both Pocasset Harbor and Pocasset River will require a new, proposed Enhanced Satellite wastewater treatment facility based on their core sewer needs area size. The cost to treat wastewater to an Enhanced Satellite Facility is \$65.93 per gallon²⁵ in today's dollars (March 2024, ENR 13532). The core sewer collection areas were calculated according to the minimum required number of parcels to meet the 25% wastewater loading nitrogen removal goal as set forth in the

²⁵ Capital Cost from "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" (April 2014, ENR 9750)

Needs Assessment. Based on a density of 30 parcels per mile of sewer, the collection systems were estimated to be 10 miles for Pocasset River and 23.7 miles for Pocasset Harbor. The summary table below shows the core sewer area and wastewater treatment costs (based on Maximum Daily Flow and peaking factor of 2.4 from Average daily Flow). The costs do not assume any inflation and would need to be escalated according to the draft timelines for installation.

Table 27: Pocasset Harbor and Pocasset River Capital Costs

Watershed	Parcels (#)	Average Daily Flow (gpd)	Collection System (mi)	Total Capital Cost¹
Pocasset Harbor	710	125,250	23.7	\$ 69,341,000
Pocasset River	300	52,920	10.0	\$ 29,299,000

1. Opinion of annual cost is Class 5, conceptual cost (-50%/+100%) in March 2024 dollars (ENR 13532). This total does not include inflation.

Operation and Maintenance Costs

Buzzards Bay WWTF

The Town of Bourne maintains its own existing collection system serving the Downtown Buzzards Bay area. The Department of Public Works oversees the Sewer Division, funded by the Sewer Enterprise fund. The operation and maintenance costs include Personnel Expenses, Services (including energy, chemicals, and equipment), Supplies, Capital Assessments for Wareham IMA, Capital Outlay, and Debt Service (including Principal and Interest). The cost per gallon is about \$0.04 with the average sewer bill around \$150 per month.

Table 28: Buzzards Bay WWTF Existing Operation and Maintenance Costs

Item	FY23 Expended	FY24 Approved
Personnel Expenses	\$ 171,640.28	\$ 205,940.00
Purchase of Services	\$ 780,364.83	\$ 786,526.00
Supplies	\$ 9,152.70	\$ 20,700.00
Other Charges and Expenditures	\$ 224,128.88	\$ 329,681.00
Capital Outlay	\$ 132,672.84	\$ 95,000.00
Permanent Debt Service	\$ 11,400.00	\$ 164,118.00
Total	\$ 1,329,359.53	\$ 1,601,965.00
<i>Cost Per mile (8 miles)</i>	<i>\$167,000</i>	<i>\$200,250</i>
<i>Cost Per user (655 users)</i>	<i>\$2,100</i>	<i>\$2,500</i>

Based on the estimated new collection system mileage for the proposed sewer areas, the following estimates for additional operation and maintenance are provided in the Table below. The Operation and Maintenance (O&M) costs assume that the Town will continue to maintain their treatment and collection system using their current staff and subcontractors. The O&M costs also assume no significant increases in biosolids disposal costs. These costs assumed that any expansion of the existing Buzzards Bay WWTF treatment and would take place before adding either Sewer Alternative to the collection system. As design, permitting, and construction of WWTF upgrades takes at least 3 – 5 years, the earliest that Buttermilk Bay Sewer Alternatives would be installed is Plan Year 7 (2031) at the earliest.

Existing O&M budgets were escalated using an annual 5% inflation increase between 2025 and 2030. Next, the estimated O&M costs were calculated by multiplying the increase in annual wastewater flow treated by the planned cost per gallon (\$0.06 in 2030). The estimated Operation and Maintenance cost can be assumed to be \$200,250.00 per mile based on 2024 Budgeted Buzzards Bay WWTF Collection System area and Town-operated Collection System with Contract Operated Treatment Facility.

Table 29: Proposed Sewer Alternative Estimated New O&M Costs

Sewer Area	Collection System Length (mi.)	New Users	Estimated Annual O&M Cost (2024 \$)	
			Total (-50%/+100%)	Per New User
Megansett-Squeteague	4.8	150	\$961,200	\$6,408
Phinney's Harbor	12.6	436	\$2,523,150	\$5,787
Buttermilk Bay – Sewer 1	8	330	\$3,452,000	\$4,855
Buttermilk Bay – Sewer 2	12.5	778	\$2,503,125	\$3,218
Pocasset Harbor	23.7	710	\$4,739,250	\$6,675
Pocasset River	10	300	\$2,002,500	\$6,675

Section 6.1.3 Traditional Cost Summary

The following table summarizes the Total Annual Cost and the Total Annual Cost per individual for the three alternatives identified using the same calculation of costs as sections above. The Pilot EIA alternative costs are not included in this summary as Pilot and Provisional Approved I/A onsite systems are considered non-traditional technologies.

Table 30: Traditional Solution Cost Summary

Alternative	Total Annual Cost (\$M)	Individual Total Annual Costs¹	Estimated Nitrogen Removal (kg-N/yr.)	Approximate Cost per Kg N removed
General Use I/A Onsite System	\$22.5M	\$5,800	6,800 – 7,800	\$2,900- \$3,300
Phinney's Harbor Core Sewer Area				
Buttermilk Bay Sewer Alternative 1	\$6.1M	\$9,642	1,160	\$5,260
Buttermilk Bay Sewer Alternative 2	\$10.46M	\$16,830	3,000	\$3,490

1. For General Use I/A systems, the individual cost is the annual cost per parcel. For the sewer alternatives, the individual cost is the annual cost per new sewer user (which may also be per parcel, depending on property type). This does not include impacts in increased treatment costs for existing sewer users within the Buzzards Bay Collection System.

SECTION 6.2 NON-TRADITIONAL SOLUTIONS

Section 6.2.1 Pilot EIA Program

For consideration in place of the Buttermilk Bay Core Sewer Area - Sewer Alternative 1, the following costs were estimated for a potential Pilot Enhanced I/A program among the 330 parcels in the Queen Sewell Pond vicinity of the Buttermilk Bay Watershed. The Capital Cost of an EIA system is expected to be, on average, 30% more than the Capital Cost of GUIA. Therefore, the estimated full construction cost is \$53,000 per new EIA system.

Table 31: EIA Opinion of Probable Construction Cost (OPCC) – New Installation

EIA Individual System	OPCC March 2024 (+100%/-50%)
Estimated EIA Unit	\$21,000.00
Design & Permitting	\$7,000.00
Construction (Electrical and Sitework) ¹	\$ 19,020.00
Permits/Fees ²	\$ 525.00
Contingency (10%)	\$ 4,755.00
Total Each	\$ 53,000.00

1. Landscaping and/or asphalt pavement is not included in base estimate.

2. Includes current Bourne Permit fees for General Permit, I/A Technology, and one Percolation Test.

Based on the 2010 Comparison of Costs for Wastewater Management Systems (April 2014, ENR 9750), the average annual cost to operate an EIA onsite system in today's dollars is \$3,850 (March 2024, ENR 13532). The baseline costs exclude municipal procurement and operational oversight,

which adds about 25% or \$970 per year for the EIA costs. The monthly expense for Municipal Oversight and Maintenance related to the EIA systems is approximately \$400 per household.

Table 32: EIA Operation, Monitoring, and Maintenance Cost Estimate

O&M Category	Average Annual Cost per system (+100%/-50%)	Average Monthly Cost (+100%/-50%)
Regular Operating Costs (Energy, Seasonal Turnover as applicable, Replacement parts) ¹ .	\$ 3,850.00	\$ 320.00
Municipal RME (Inspection, Permitting, Monitoring)	\$ 970.00	\$ 80.00
Total Cost	\$ 4,820.00	\$ 400.00

1. Operating Cost from "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" (April 2014, ENR 9750) in today's dollars (March 2024, ENR 13532)

The capital costs for each individual EIA system are estimated to cost about 30% higher than those for a General Use I/A system. This is due to the technologies requiring extra maintenance, potential special monitoring or startup practices, and additional operational needs such as supervised wastewater treatment operator sampling, maintenance, and operation. If maintained in accordance with manufacturer requirements, the EIA system useful life is estimated to be 15 years.

Table 33: Buttermilk Bay EIA Pilot Total Cost

Buttermilk Bay EIA Pilot Cost	OPCC, 2024 (+100%/-50%)
Capital Cost (One Time)	\$17,260,000.00
Operation & Maintenance Cost (Annual)	\$1,590,600.00
Total	\$18,850,600.00

Section 6.2.2 Stormwater BMP

Typical expenditures include Capital and Operation and Maintenance Costs. For Bourne, the Engineering, Conservation, Public Works, and Health departments share the Stormwater duties, for public safety and right-of-way activities. The following outlines typical costs for stormwater activities.

Table 34: Typical Stormwater Costs

Cost Type	Capital	Operation and Maintenance
Fixed	Equipment	Staff Memberships (e.g., Buzzards Bay Stormwater Coalition, Massachusetts Maritime Agreement for MS4 Services)
Variable	Projects Consultant Assistance	Supplies Energy (Fuel) Materials Consumable Supplies (e.g., laboratory supplies)

Capital Costs

The Town of Bourne has the following expenditures planned for Stormwater related best management practices, including proactive maintenance, replacement of critical equipment, upgrades to existing outfalls and improvements related to nutrient removal. The Engineering and Public Works departments forecast \$3.29M in stormwater-related capital improvements over the next five years, for an average of \$658,000 per year.

Table 35: Bourne Capital Planned Spending - Stormwater

Item	Watershed	FY25	FY26	FY27	FY28	FY29
Electric Ave. Boat Ramp	Buttermilk Bay	\$99,000				
Queen Sewell Green Infrastructure	Buttermilk Bay		\$150,000			
Sagamore Beach Boat Ramp	Cape Cod Bay		\$150,000			
Circuit Ave. Roadway	Pocasset Harbor		\$500,000			
Wings Neck Roadway	Pocasset Harbor/Buzzards Bay		\$500,000			
Eel Pond Rd. Outfall	Phinney's Harbor			\$150,000		
Shore Rd. Park Outfall	Pocasset River			\$340,000		
Massasoit Ave. or Circuit Ave. Outfall	Pocasset Harbor			\$25,000	\$150,000	
Old Head of the Bay Outfall	Buttermilk Bay				\$25,000	\$150,000
Drainage Repairs (DPW)	Townwide		\$250,000			
Replace Street Sweeper (DPW)	Townwide					\$800,000
Subtotal		\$99,000	\$1,550,000	\$515,000	\$175,000	\$950,000

The implementation plan for the installation of structural BMPs is prioritized based on nitrogen loading. We recommend pursuing the proposed BMPs in the following order focusing on the area with the highest nitrogen loading first.

- Old Head of Bay Rd at Head of the Bay Rd,
- Barlows Landing Beach,
- Beach Access Rd off Squeteague Harbor Rd,
- End of Massasoit Ave, and
- Circuit Ave at Outfall 86

Operation and Maintenance Costs

The 2010 “Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod” by the Cape Cod Commission estimated the following costs per curb mile of roadway within the watershed. Based on standard street sweeping practices, care of roadway best management practices, and public education, the costs were able to be summarized per roadway curb mile.

Table 36: Annual O&M Cost for Stormwater, per Curb Mile

Annual O&M Cost¹	2014 Cost (per curb mi)	2024 Cost (per curb mi)
Low	\$ 3,740.00	\$ 5,200.00
High	\$ 9,020.00	\$ 12,520.00
Average	\$ 6,380.00	\$ 8,860.00

1. Curb-Mile Operating Cost from "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" (April 2014, ENR 9750) in today's dollars (March 2024, ENR 13532)

However, the disparity between -owned roadways and privately-owned roadways in the nitrogen sensitive areas made it challenging to calculate costs using the standard curb mile method. Consequently, the Total Annual Cost was determined based on the price per kg of nitrogen removed, as shown below.

Total Annual Cost

According to the Cape Cod 208 Plan Update in 2017, the removal cost per kg-N was \$695 (over the average life cycle of 20 years), which is \$900 per kg-N in today's (2024) dollars. The non-structural strategies include street sweeping, maintenance of stormwater utilities, education and public outreach, land use planning and impervious cover reduction/control. For Bourne, this means updating Town Stormwater Bylaws, enforcing regulations and policies, and supporting appropriate annual funding to meet the removal goal of 20% of controllable nitrogen load through stormwater runoff. The following table shows the approximate funding necessary to support the removal of nitrogen through Stormwater Best Management Practices, based on the Cape Cod 208 Plan Update for removal of nitrogen.

Table 37: Stormwater Removal Costs per Kg Nitrogen

Watershed	Bourne Load Removal	Stormwater Removal Maximum (20% of Controllable load)	Estimated Annual Cost³ (2024)
Megansett-Squeteague Harbor ¹ .	564	113	\$ 101,700
Phinneys Harbor ¹ .	1,706	341	\$ 306,900
Buttermilk Bay ² .	1,402	280	\$ 252,000
Pocasset Harbor ² .	3,120	624	\$ 561,600
Pocasset River ² .	1,289	258	\$ 232,200
Total	8,072	1,616	\$1,454,400

1. As required by TMDL.

2. Based on 20% removal of estimated total controllable load, subject to approval by MassDEP.

3. Opinion of probable cost is the total capital cost plus the estimated operation and maintenance cost per year in March 2024 dollars (ENR 13532).

Section 6.2.3 Non-Traditional Cost Summary

The following table summarizes the Total Annual Cost and the Total Annual Cost per individual for the two non-traditional alternatives identified. The Pilot EIA alternative costs are approximate as no specific vendor information was referenced at this time. The costs can be refined if the Town chooses to move forward with this alternative.

Table 38: Non-Traditional Solution Cost Summary

Alternative	Total Annual Cost (\$M)	Individual Total Annual Costs¹	Estimated Nitrogen Removal (kg-N/yr.)	Approximate Cost per Kg N removed
Pilot EIA Onsite System (Buttermilk Bay only)	\$3.5M	\$10,800	803	\$4,359
Stormwater BMP	\$1.45M	N/A	1,616	\$897

1. Stormwater BMP individual total annual costs are not applicable as Bourne does not have a stormwater utility where funds are collected townwide for the purposes of stormwater management.

SECTION 6.3 PLAN COST SUMMARY

The following table summarizes the traditional and non-traditional solution cost summaries into one comparison table by alternative. It is expected that either GUIA systems or Core Sewer Areas will be implemented townwide, although combinations can be considered on a watershed-by-watershed basis during future adaptive management strategies.

Table 39: Draft Recommended Plan Cost Summary

Alternative	Total Capital Cost (\$M, 2024) (-50%/+100%)	Total Operation & Maintenance Cost (per year, \$M, 2024) (-50%+100%)	Total Estimated Nitrogen Removal (kg-N/yr.)
GUIA Systems, Townwide ¹ .	\$182.7M	\$10.9M	8,700
Core Sewer Areas Townwide ² .	\$174.2M	\$11.8M	7,700
Stormwater BMP ³ .	\$1.45M	N/A	1,616

1. For Buttermilk Bay only, this includes the combination of 375 GUIA and 330 EIA.

2. For Core Sewer Areas, this includes the minimum cost to remove the TMDL and 25% removal goals (for non-TMDL watersheds). For Buttermilk Bay, this assumes the Sewer 1 option.

3. Stormwater BMP individual total annual costs are not applicable as Bourne does not have a stormwater utility where funds are collected townwide for the purposes of stormwater management.

It is important to note that the MassDEP maximum nitrogen credit allowed through the implementation of Stormwater BMP, is no more than 20% of the controllable load per watershed. Therefore, while the stormwater BMP solution may be the most cost effective, it cannot be expanded beyond its current estimated nitrogen removal allowance. Both GUIA and Core Sewer Areas, along with Stormwater BMP implementation, meet the townwide nitrogen removal goal of 8,072 kg-N per year.

SECTION 7 IMPLEMENTATION PLAN

SECTION 7.1 SCHEDULE

As requested by the Select Board, and for initial discussion of the draft recommended plan, two distinct timeframes for implementation were considered:

- Title 5 Regulation (default) timeline for Natural Resource Nitrogen Sensitive Area implementation and
- Watershed Permit (opt-in) timeline for Natural Resource Nitrogen Sensitive Area Implementation

To strike a balance between short-term needs and long-term goals, the General Use I/A implementation is staggered for non-designated watersheds. In other words, Tier 1 watersheds, or Designated Natural Resource Nitrogen Sensitive watersheds (Megansett-Squeteague Harbor and Phinney's Harbor) are prioritized for implementation first. Tier 2 watersheds, remaining nitrogen impaired watersheds without TMDLs (Buttermilk Bay, Pocasset Harbor and Pocasset River) are implemented second. Detailed implementation schedules are included in **Appendix D**.

SECTION 7.2 FUNDING SOURCES

This section of the report presents potential funding sources for implementation of the Comprehensive Wastewater Management Plan projects. The funding sources are divided into two main categories: Federal (national level organizations and programs) and State (including local loan programs).

Section 7.2.1 Federal

Economic Development Administration (USEDA)

Awards granted under this program aim to assist communities and regions develop and implement long-term economic development initiatives through a variety of construction and non-construction. Through its primarily construction-focused Public Works program, EDA provides catalytic investments to assist distressed communities in building, designing, or engineering essential infrastructure and facilities. These efforts support regional development strategies and advance grassroots economic development goals to foster regional prosperity.

USEPA Southeast New England Program (SNEP)

The program was created to foster coordination among numerous entities working in Southeast New England to restore coastal watersheds, address disparate funding sources, and implement targeted restoration projects. SNEP offers Watershed Implementation Grants (SWIG) to support for decentralized wastewater treatment and stormwater management. In order to apply for the competitive grant program, the community must submit a letter of interest each year by early April. The Request for Proposals is typically released after the Restore America's Estuaries funding is

announced in February of each year. After the Letter of Intent is sent, SNEP notifies recipients in May whether a full proposal is requested. If eligible, the community then submits a full proposal for the project. Typical awards range from \$100,000 to \$400,000 and are considered to be “shovel ready” projects, or projects ready to be constructed/implemented. The top funded priorities continue to be projects which:

- Restore Small Cities & Urban Environmental Resources;
- Conserve, Protect and Restore Rural and Natural Landscapes;
- Innovate to Improve Water Quality;
- Promote Environmental Justice and Equity;
- Address Environmental Change;
- Build & Sustain Local and Regional Partnerships; and
- Foster Regional Learning.

Work must be completed by the end of the calendar year in which they are awarded and requires a 33% (one third) match of the requested funding in non-federal funding. Matching funds can be cash or in-kind services from the Town. For more information, the program details can be found at the following website link: <https://estuaries.org/snep-watershed-grant/2024-snep-watershed-implementation-grants/>

In 2021, SNEP worked with Bourne to finalize a Climate Resilience Investment System and Implementation plan. The recommended plan should incorporate the next steps recommended under this plan to leverage stormwater BMPs for nitrogen reduction. Therefore, continued participation in SNEP programs is encouraged for future consideration of funding sources.

Section 7.2.2 State

The Town of Bourne has the following designations in the Commonwealth of Massachusetts, which gives the Town advantages in seeking state funding:

- **Disadvantage Community Tier 1:** Adjustable Per Capita Income (APCI) more than 80% but less than 100% of the State’s APCI.
 - *Eligible for loan principal forgiveness under Clean Water Trust (CWT) State Revolving Fund (SRF) Program.*
- **Member Community of the Cape Cod and Islands Water Protection Fund**
 - *Eligible for subsidies for qualified projects through CWT SRF program.*
- **MBTA Community Designation**
 - *Eligible for Community One Stop programs including Executive Office of Economic Development, Executive Office of Housing and Livable Communities and MassDevelopment funding programs.*

The following subsections outline two categories of example funding programs for loans (requiring repayment) and grants, which typically do not require repayment, but may require a local match of funding or in-kind services.

Loans

- Clean Water Trust (CWT) State Revolving Fund (SRF):

This program is designed to provide low-cost financing (2% interest rate loans) and principal forgiveness based on Disadvantage Community Tier designation, to assist communities meet the required water-quality standards of the Clean Water Act. The program's goal is to support projects with meaningful water quality and public health benefits while addressing the needs of the communities and watersheds across the Commonwealth. The program supports Watershed management priorities, Stormwater management, Green infrastructure and Treatment works and infrastructure.

To be eligible for SRF financing for construction projects, the initial step is to complete a Project Evaluation Form (PEF) during the annual project solicitation period (typically May through July). The PEF requires applicants to detail the project's significant benefits to public health or water quality and provide assurances that the project is ready to proceed. MassDEP will evaluate and rank the applications using a rating system that assigns points based on priority topics, which are updated annually by the SRF program. Common priority topics include:

- Has demonstrable water quality benefits
- Eliminates or mitigates a risk to public health or the environment
- Achieves or maintains compliance with water quality standards, applicable discharge permits, or water pollution control requirements
- Implements, or is consistent with, watershed management plans (or addresses a watershed priority), and local and regional growth or infrastructure plan

The following figure outlines the process and timing for most State Revolving Fund loan programs.

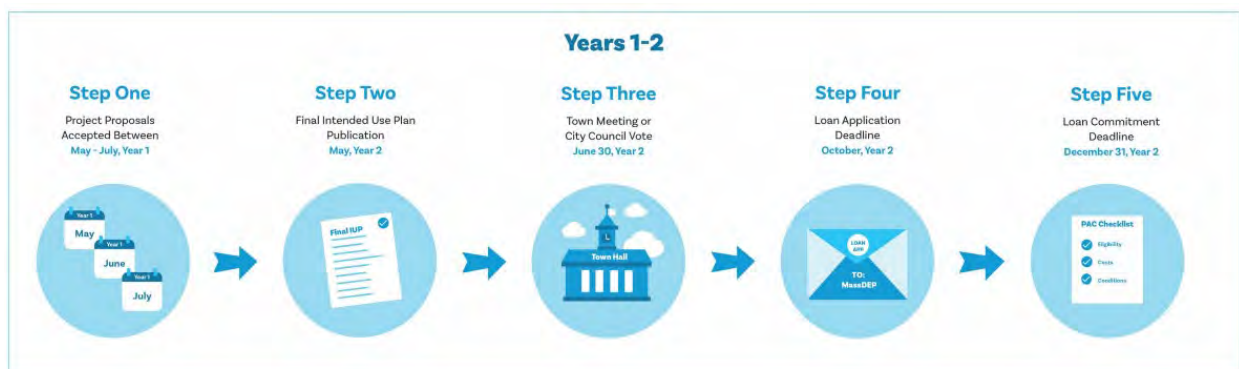


Figure 8: Massachusetts CWT State Revolving Fund (SRF) Loan Process

Step One requires conceptual or 30%-complete design of the project to be submitted with the PEF application. Step Two consists of the PEF review and determination of priority projects which will be funded. Step Three requires at least a 60%-complete design Opinion of Probable Construction Costs (OPCC), and Step Four requires 90%-complete design documents, or construction documents for submission for approval to Advertise the project. The average design cycle for most SRF

Construction projects is one year to eighteen months from conceptual design to final design. This typically requires projects which can be “shovel ready” or ready for construction by the Third Year.

Grants

- Asset Management Grant Program:

The Massachusetts Clean Water Trust (the Trust) and the Massachusetts Department of Environmental Protection (MassDEP) provide grant funds to qualifying applicants annually for the preparation of Asset Management Plans (AMP) for existing drinking water, wastewater, and/or stormwater infrastructure. The Trust will provide a grant award of \$150,000 or 60% of eligible project cost, whichever is less. The eligible entities will provide the remaining amount with In-Kind Services (IKS), a capital contribution, or an SRF loan. MassDEP will give priority to small communities and utilities (population less than 10,000 or small systems that service connections of less than 3,300), first-time AMP grant applicants, and AMP proposals that address the core components of an AMP, including an inventory and condition of current assets, level of services, criticality analysis, life cycle costs, and long-term financial planning.

- MassWorks Infrastructure Program (MassWorks, through Community One Stop):

A competitive grant program that provides the largest and most flexible source of capital funds to municipalities for public infrastructure projects to support and accelerate housing production, spur economic development, and create jobs throughout the commonwealth. Now part of Community One Stop for Growth, applicants can apply through a single portal to access a variety of grant programs.

- Natural Resource Nitrogen Sensitive Area Grant Program:

Through MassDEP, communities such as Bourne with Natural Resource Nitrogen Sensitive Areas are eligible for this program. The purpose of this grant program is to assist municipalities in a variety of activities which facilitate completion of a Watershed Management Plan (WMP) for the purpose of completing a Watershed Permit application or De Minimis Load application, each of which address solutions to cultural eutrophication caused by nitrogen pollution from wastewater and other sources. Only planning activities that contribute to or come from a Watershed Management Plan, Watershed Permit application, or De Minimis Load application (as defined in 314 CMR 21.00) will be considered for funding. For more information, please see the 2025 cycle document available here: <https://www.mass.gov/doc/request-for-responses-natural-resource-nitrogen-sensitive-area-fy25-grant-program/download>

- Water Quality Monitoring Grant Program:

Administered by MassDEP, this program is for federally recognized tribal nations located in the Commonwealth, community water quality monitoring groups, and other non-profit organizations to proposals supporting ongoing or new monitoring and data collection efforts to increase the amount of external data MassDEP uses for water quality assessments. While the Town of Bourne may not apply for this grant directly, the Town could offer a letter of support to its partner organizations application (such as the Buzzards Bay Coalition, Pocasset Water Quality Coalition, or others) for support in monitoring Bourne’s watersheds water quality. For more information, please see the 2025 cycle document available here: <https://www.mass.gov/doc/wqmg-sfy25-request-for-proposals/download>

SECTION 7.3 208 PLAN CONSISTENCY FOR ADAPTIVE MANAGEMENT

The CWMP is intended to be a living document, to be reviewed, revisited, and updated as phases are completed, and key performance indicators (KPIs) are recorded. Bourne intends to adaptively manage its CWMP by revisiting future phases based on the successful performance of past installations, or to pivot to an alternative technology if the original performance estimated is not met.

Adaptive Management allows Bourne to revisit its Recommended Plan and to be responsive to changes in environmental quality, relative effectiveness of implemented approaches, identification of new technology, and unforeseen community needs. This includes adjustments based on improvements to technology, changes in existing conditions or community plans, or to adapt to climate change and other phases. Timing, phasing, costs will evolve over the planning period and the goal of adaptive management is to hold commitment to improving water quality while adjusting the technology means and numbers as data is collected. For example, at the time of this report, there are only five technologies which are General Use Innovative/Alternative onsite systems as approved by MassDEP. The hope is that more technologies that are in development will become eligible for General Use approval and be able to be used more widely by residents in Bourne.

Five-year consistency determinations allow Bourne to change the course of action identified, based on the best available data and stakeholder feedback, and submit a modified implementation plan as part of an adaptive management report, if necessary.

Section 7.3.1 Data Monitoring

Bourne has two TMDL watersheds which each have multiple parameters which were monitored during the MEP process and can be duplicated for monitoring improvements in water quality, habitat, and other environmental indicators. There are also multiple nitrogen impaired watersheds that, while a linked-embayment model was not produced for, the regional and local water quality monitoring non-profit network allows for consistent data collection. Data sources for outside collaboration and monitoring are listed below:

Table 40: Stakeholder Data Monitoring Sources

Regional	Local
Buzzards Bay Coalition Buzzards Bay National Estuary Program Cape Cod Commission	Bourne Health Department Beach Monitoring Conservation Commission Studies Bourne Conservation Trust

Section 7.3.2 Quality Management Plan

The quality management plan defines the goals of the monitoring plan, the selected water quality parameters, the methods of monitoring to be employed, the sampling frequency, locations, timing, duration, and a quality assurance plan. Quality Assurance is the plan for specific monitoring of quality-control elements to be implemented to ensure data collected for Key Performance Indicators will be of known and documented quality to meet the CWMP needs.

For future adaptive management considerations, including reporting for Watershed Permit progress applications, laboratory certifications for outside testing will be included in the Quality Management Plan as well as any standards provided by the Massachusetts Maritime Academy, for samples tested and recorded as part of the Stormwater BMP monitoring agreement, and the Buzzards Bay Coalition, as part of the ongoing water quality monitoring testing taking place in each Buzzards Bay embayment.

Section 7.3.3 Reporting

Annual reporting will include data collected during the reporting period, such as technology performance monitoring and/or embayment monitoring data, and a progress update on implementation. Details on data submission requirements may vary based on the proposed project or plan and will be included in the Cape Cod Commission 208 Plan consistency determination. Example metrics include:

- Town Approved Funding or Funding Actions
- Grant Funding Received or Grant Funding Actions (i.e., grant applications)
- Local Regulatory Actions, including:
 - Zoning Changes
 - Adoption of Regulations
- Town Implementation Actions, including:
 - Project Status
 - Non-Traditional Projects Underway

Annual reports will be used to update watershed reports, which were issued as part of the 2017 Implementation Report. Annual reporting and watershed reports will be used to complete 208 compliance reports for the Cape Cod Commission, typically Spring.

The following headings are recommended for inclusion in the five-year Adaptive Management reporting template. This may be available on the CWMP Implementation website and possibly distributed to stakeholder organizations such as MassDEP, Cape Cod Commission, and other stakeholder websites as requested:

- Overall Status of Projects including:
 - Progress towards Phinney's Harbor Core Sewer Area feasibility.
 - Number of conversions from Septic Tank to General Use I/A in Megansett-Squeteague Harbor.
 - Townwide number of conversions from Septic Tank to General Use I/A.
- Updated future phase implementation schedule
- Continued inspection of existing I/A systems
- Progress towards General Use I/A onsite installations
- Proactive recruitment of voluntary General Use I/A conversion properties
- Installation of Stormwater BMPs
- Sharing of progress towards Stormwater BMP Installations

- Policy Changes or Implementation
- Updates to relevant Planning documents, such as Local Comprehensive Plan, Municipal Harbor Plan, or others.
- Status of collaboration with neighboring communities and regional stakeholders, including but not limited to:
 - Falmouth
 - Joint Base Cape Cod
 - Massachusetts Maritime Academy
 - Wareham

SECTION 7.4 WATERSHED PERMIT APPLICATION

The Town has the option to pursue a voluntary watershed permit for both of their Natural Resource designated Nitrogen Sensitive Areas (NSA) or TMDL watersheds: Megansett-Squeteague Harbor and Phinney's Harbor. The Town can complete a Notice of Intent Letter and then has two years to submit a full application. The watershed permit must be able to achieve at least 75% of the necessary nitrogen load reduction over the 20-year permit period.

Section 7.4.1 General Considerations

To apply for the Watershed Permit, a Massachusetts Registered Professional Engineer needs to stamp the Watershed Management Plan for the watershed or sub-watershed which includes maps, description of current and future nitrogen loading, as well as approved plans for removal of such controllable nitrogen loading. The following steps outline some initial analysis of the watershed permit process for these two Natural Resource NSAs.

Should the Town continue to pursue a Watershed Permit, the following will be included in their Annual Report to MassDEP, in accordance with 314 CMR 21.00 - Massachusetts Watershed Permit Regulations:

- Baseline Nitrogen Load
- Updated Nitrogen Load
- Updating 0 nitrogen loading area (for example, land released from Joint Base Cape Cod that may assist with upland aggregate nitrogen loading).

The Town will also be required to submit a five-year report to MassDEP, including the following:

- a description, including dates, of the installation of any treatment and control systems and facilities, or approaches taken, during the reporting period.
- a summary of results of any monitoring information that has been collected and analyzed during the reporting period.
- a performance evaluation of the treatment and control systems and facilities, and approaches taken during the reporting period, including identification of any non-compliance, performance shortcomings, or challenges along with recommended corrective actions and optimization activities, as necessary.

- A discussion of the activities planned, and the associated critical path for the next five-year reporting cycle, consistent with the implementation schedule.
- a self-assessment review of compliance with the terms and conditions of this permit during the reporting period; and
- a progress report which describes the progress made in achieving the Necessary Nitrogen Load Reductions and water quality and habitat quality restoration goals required to achieve the designated uses for the waterbody, including an evaluation of the results of the permittee's water quality management program to date, any proposed adjustments and modifications to the strategies and practices under the approved Watershed Management Plan, pertinent sampling and monitoring results, including sentinel station monitoring results (if applicable), as well as other data pertinent to the technologies installed and approaches taken under the approved Watershed Management Plan as of the date of the report, any proposed nitrogen reduction credits for Alternative Control Approaches and Technologies, any changes requested to the approved implementation schedule, and any other information requested by the Department.

As part of any Watershed Permit, there may be additional requirements which the Town may need to include, subject to MassDEP revisions (the items listed above are the standard provisions listed in the Watershed Permit regulations).

Section 7.4.2 Megansett-Squeteague Harbor

Megansett-Squeteague Harbor's loading is the smallest load removal of all the Bourne nitrogen impaired watersheds. After confirming the regulation deminimus load calculation methodology, it was determined that Megansett-Squeteague is ineligible for this exemption, as the controllable nitrogen load to remove is 7% for Bourne, greater than the 3% qualifier for deminimus.

$$564 \text{ kg N per year (removal required)} \div 7,611 \text{ kg N per year (controllable wastewater load)} = 7\%$$

Therefore, the Town of Bourne would need to prepare a Watershed Management Plan if the Watershed Permit route is pursued. The Town of Bourne has met with the Town of Falmouth to discuss potential for collaboration on a joint watershed permit for the shared Megansett-Squeteague watershed. Compliant with 314 CMR 21.03.2.c., an inter-municipal agreement confirming each permittee's percentage share of the aggregate pollutant reduction responsibility needs to be included in the application. A framework for administration including the implementation of the Watershed management plan, including funding and monitoring, needs to be included in the document.

Section 7.4.3 Phinney's Harbor

The Town of Bourne shares Phinney's Harbor with Joint Base Cape Cod upland and a small portion of Sandwich. Therefore, for the controllable nitrogen loading, Bourne has 100% of the loading within its jurisdiction. Other than potentially beneficial land returned from Joint Base Cape Cod, Bourne is solely responsible for wastewater nitrogen load removal from Phinney's Harbor watershed.

The loading is also considered much higher than the eligible 3% de minimus classification, requiring a watershed permit to show that within 20 years, 75% of the total controllable load can be removed.

SECTION 8 PUBLIC PARTICIPATION

Public Participation was initiated at the start of the project and was consistently executed throughout all phases of the CWMP. Bourne actively sought opportunities for public education, outreach, and participation throughout the project. The Town has a page on the Town's website specifically for the CWMP project, where information is regularly uploaded and shared with the public. This website information includes meeting and workshop agendas and minutes, presentations, deliverables, background documents, specific public information content related to the CWMP, and recordings of public meetings and hearings, and regular updates. Announcements related to public participation opportunities are posted on the town's CWMP website page (<https://www.townofbourne.com/comprehensive-wastewater-management-plan-cwmp>).

SECTION 8.1 PHASES 1 AND 2 SUMMARY

The following meetings were completed as part of the Needs Assessment and Alternatives Analysis. Meeting information, including handouts and any recorded minutes or agendas, can be found in the appendices of the Phase 1 Needs Assessment report or the Phase 2 Alternatives Analysis report, as published on the Town of Bourne CWMP website.

Table 41: Updated Stakeholder Meeting Schedule

Scope of Work Task	<i>Town wide Meeting Date</i>
Phase I - Needs Assessment (Year 1)	
a. Wastewater Conditions	May 2021
b. Wastewater Needs and Problem Identification	December 2021
Phase II - Identification and Screening of Alternatives (Year 2)	
a. Proposed Criteria	April 2022 (WAC)
b. Refine criteria and matrix	April 2022 (WAC)
c. Present Refinement	July 2022 (WAC)

SECTION 8.2 PHASE 3 (THIS PLAN)

Toward the end of Phase 4, when the comprehensive management strategy is drafted with the recommended plan, the Town plans to host three public hearings. The Recommended Plan and report will be presented. One public hearing will be with the Town and two with the Cape Cod Commission, to meet the requirements of the CWMP process. The Town will also prepare a summary report on the public participation activities of Phases I, II and III for inclusion in the final CWMP and Environmental Impact Report (FEIR).

Table 42: Phase 3 Public Participation Meeting Schedule

Scope of Work Task	<i>Town wide Meeting Date</i>
Phase 3 - Formulation of Plan (Year 2/3)	
a. Cost Allocation Discussion	One* (TBD)
b. Review the evaluation results and the plan	One (TBD)
c. Public Hearing	One (TBD)
Phase 4 - MEPA & CCC DRI Reviews (Year 3)	One** (TBD)

*Presented with Board of Sewer Commissioners, a public meeting.

**Considered Public Hearings, in accordance with CWMP process requirements. Two meetings will be held with the Cape Cod Commission.

APPENDIX A:
FULL PAGE WATERSHED RECOMMENDED PLAN FIGURES

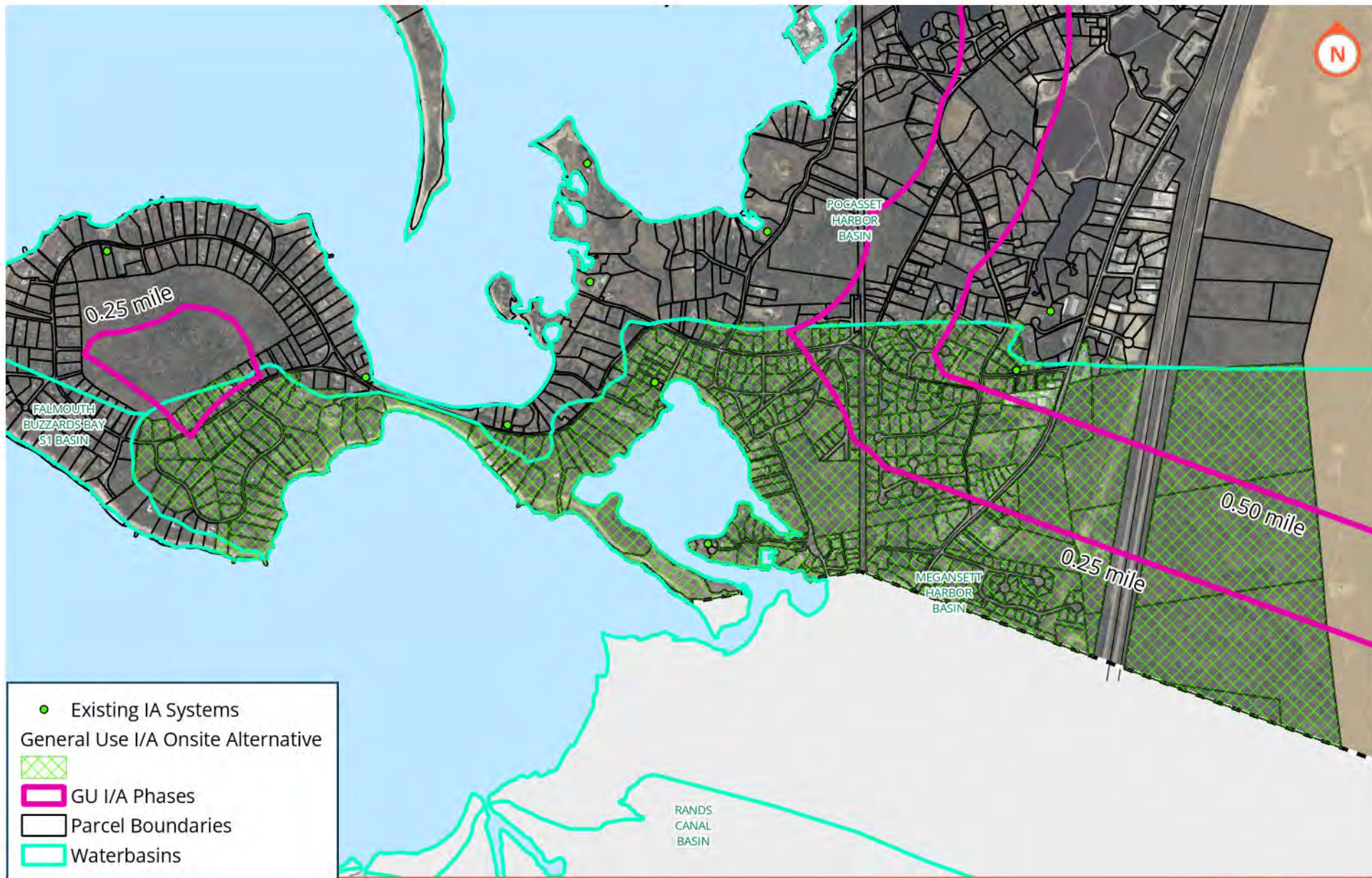


Figure 1
Megansett-Squeteague Harbor, GUIA

Bourne, MA

5/30/2024



ENVIRONMENTAL
PARTNERS
— An Aepel Company —



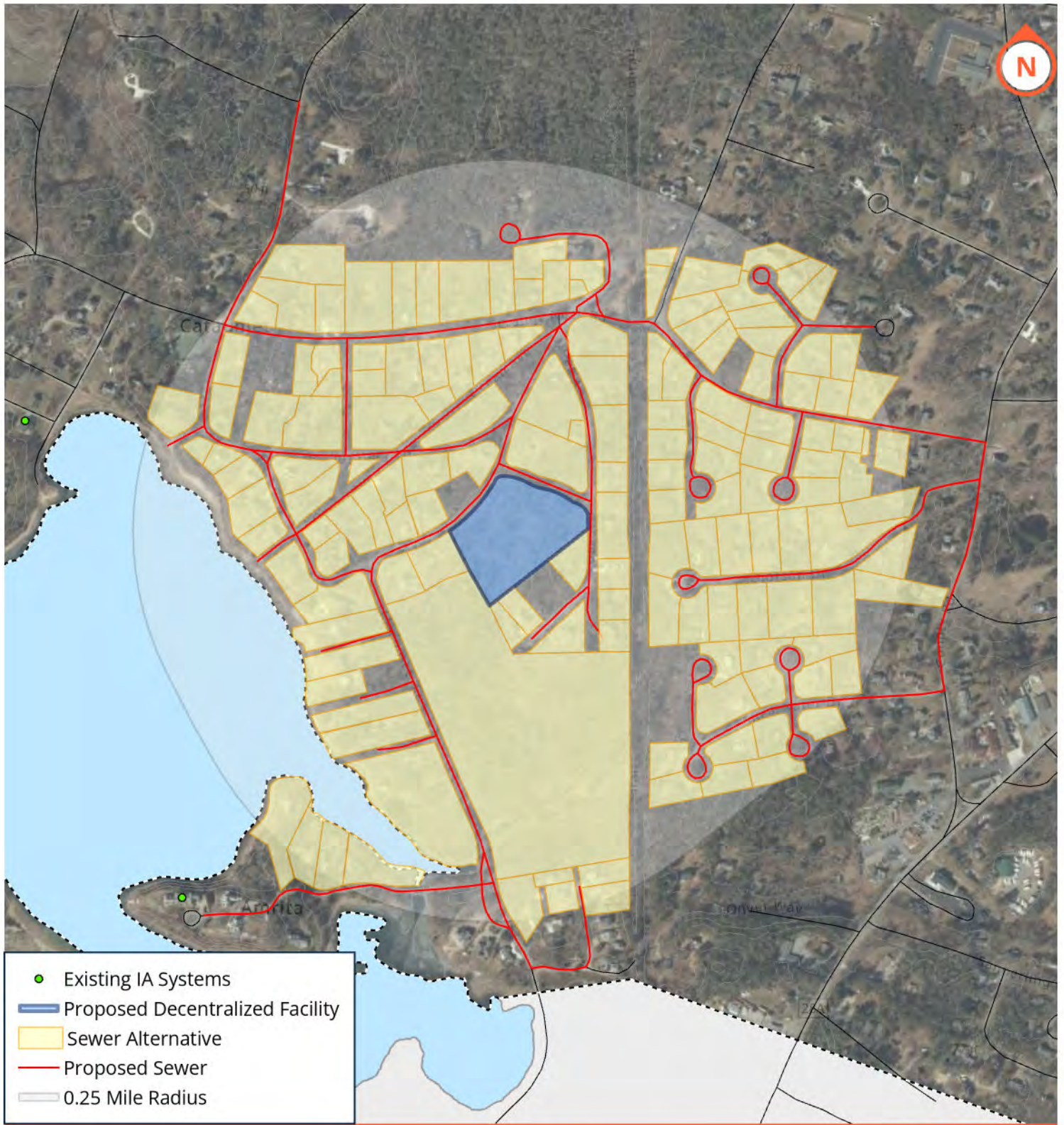


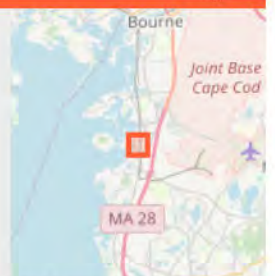
Figure 2
Megansett-Squeteague Harbor, Sewer

Bourne, MA

5/30/2024

ENVIRONMENTAL
PARTNERS
— An Apex Company —

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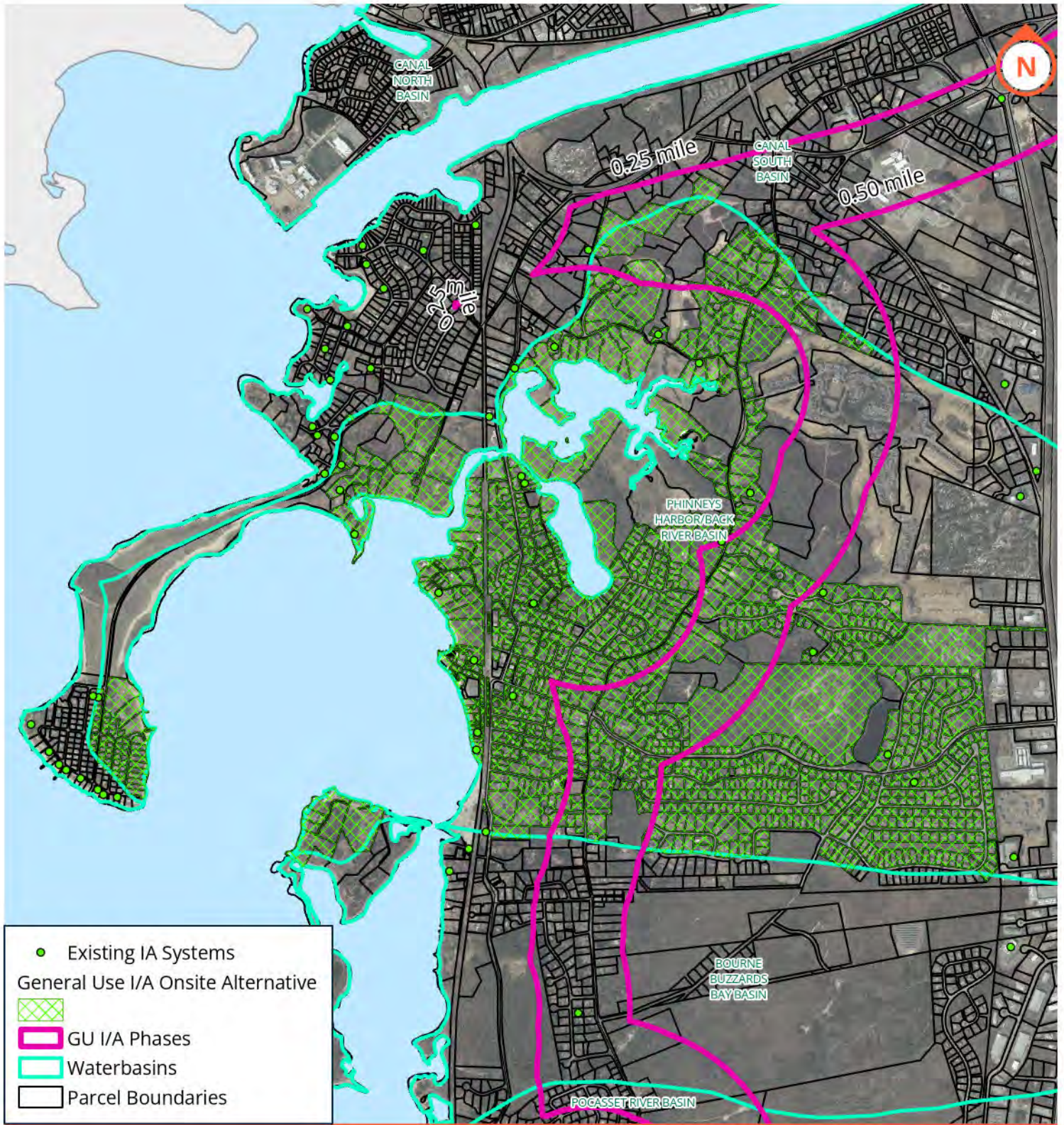


Figure 3
 Phinney's Harbor, GUIA
 Bourne, MA
 5/30/2024



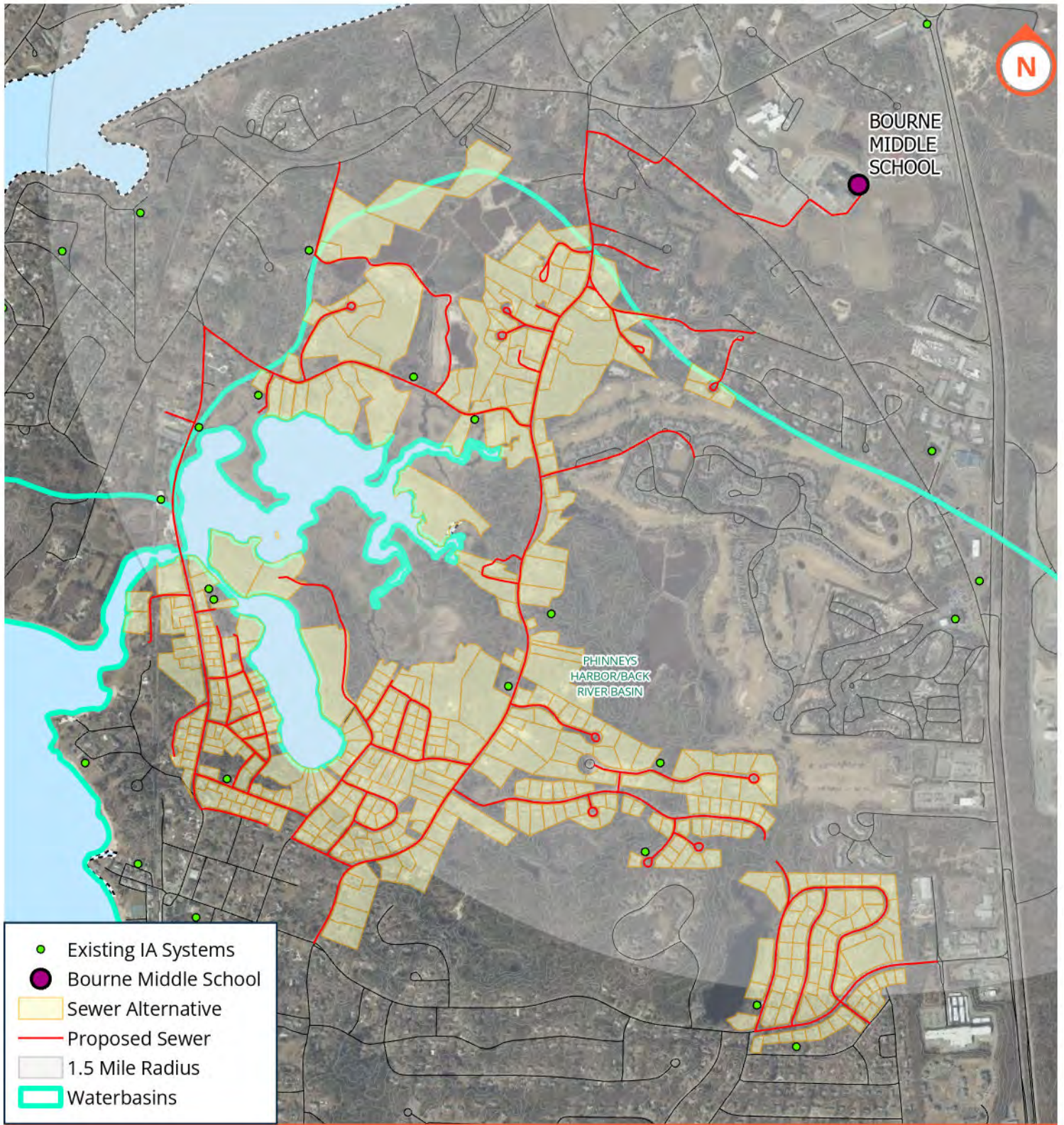
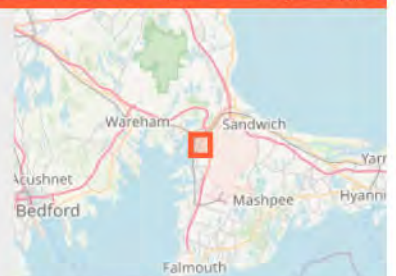


Figure 4
Phinney's Harbor, Sewer
Bourne, MA
5/30/2024

ENVIRONMENTAL
PARTNERS
— An Apex Company —

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Feet
1:2000



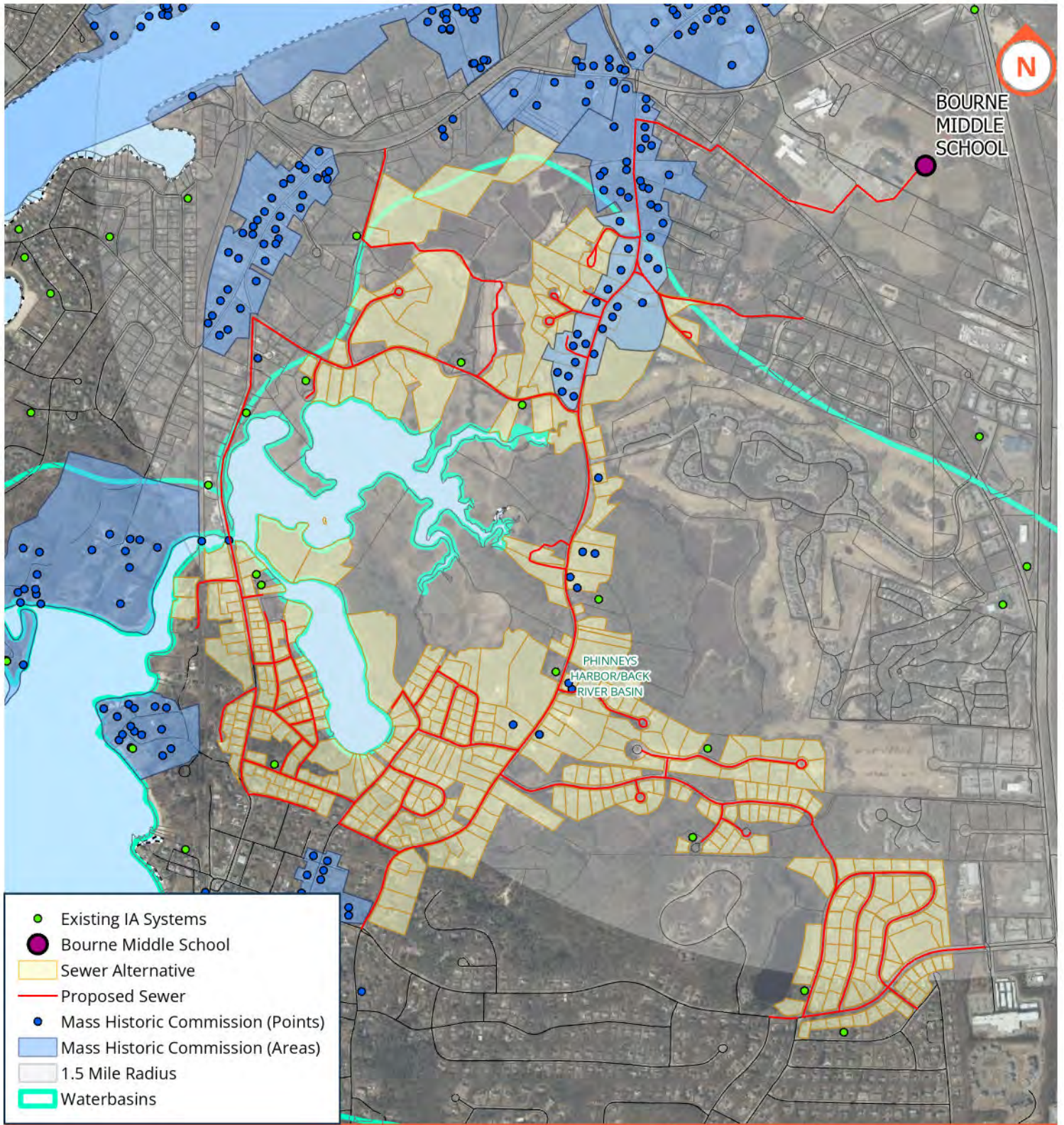
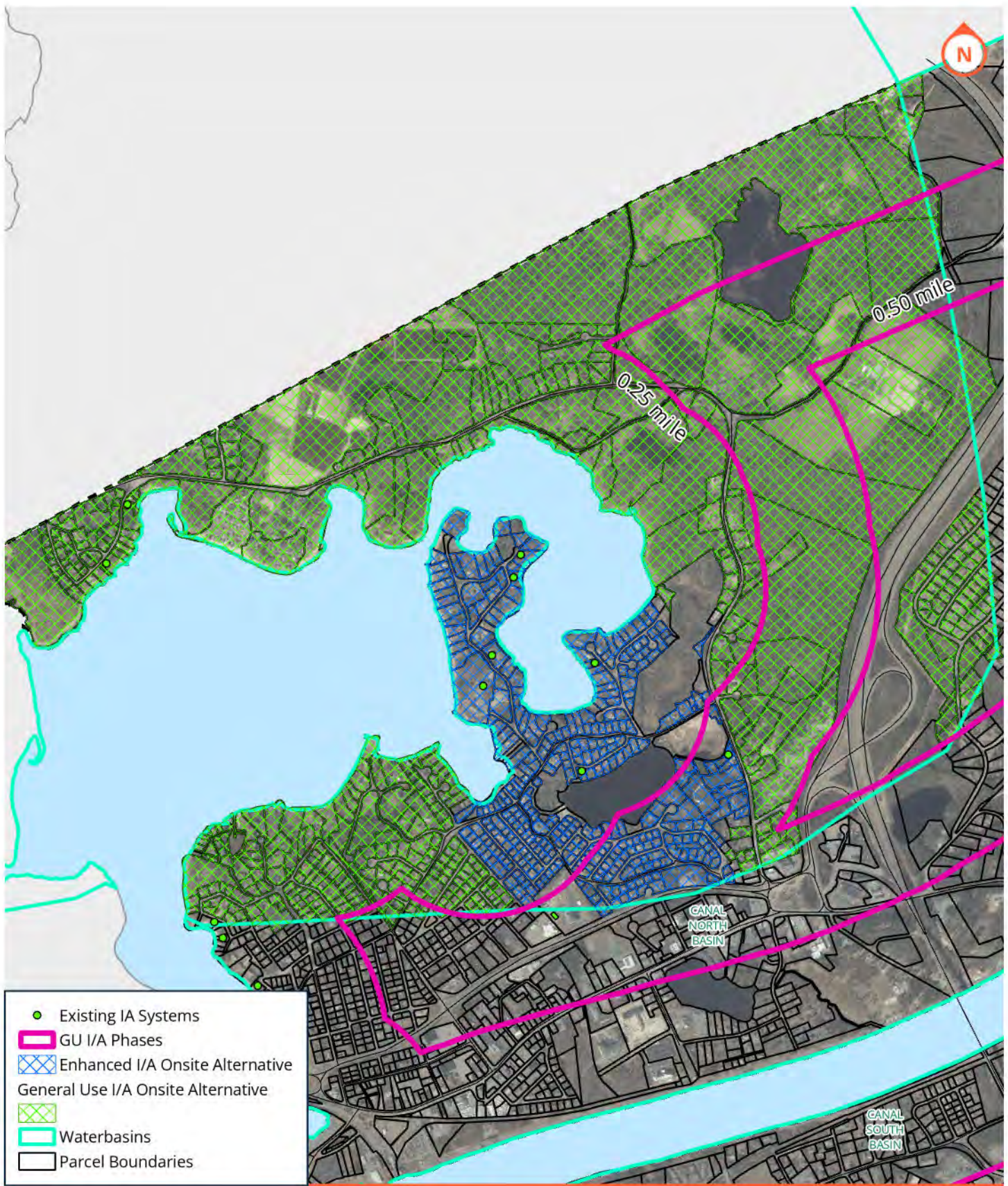


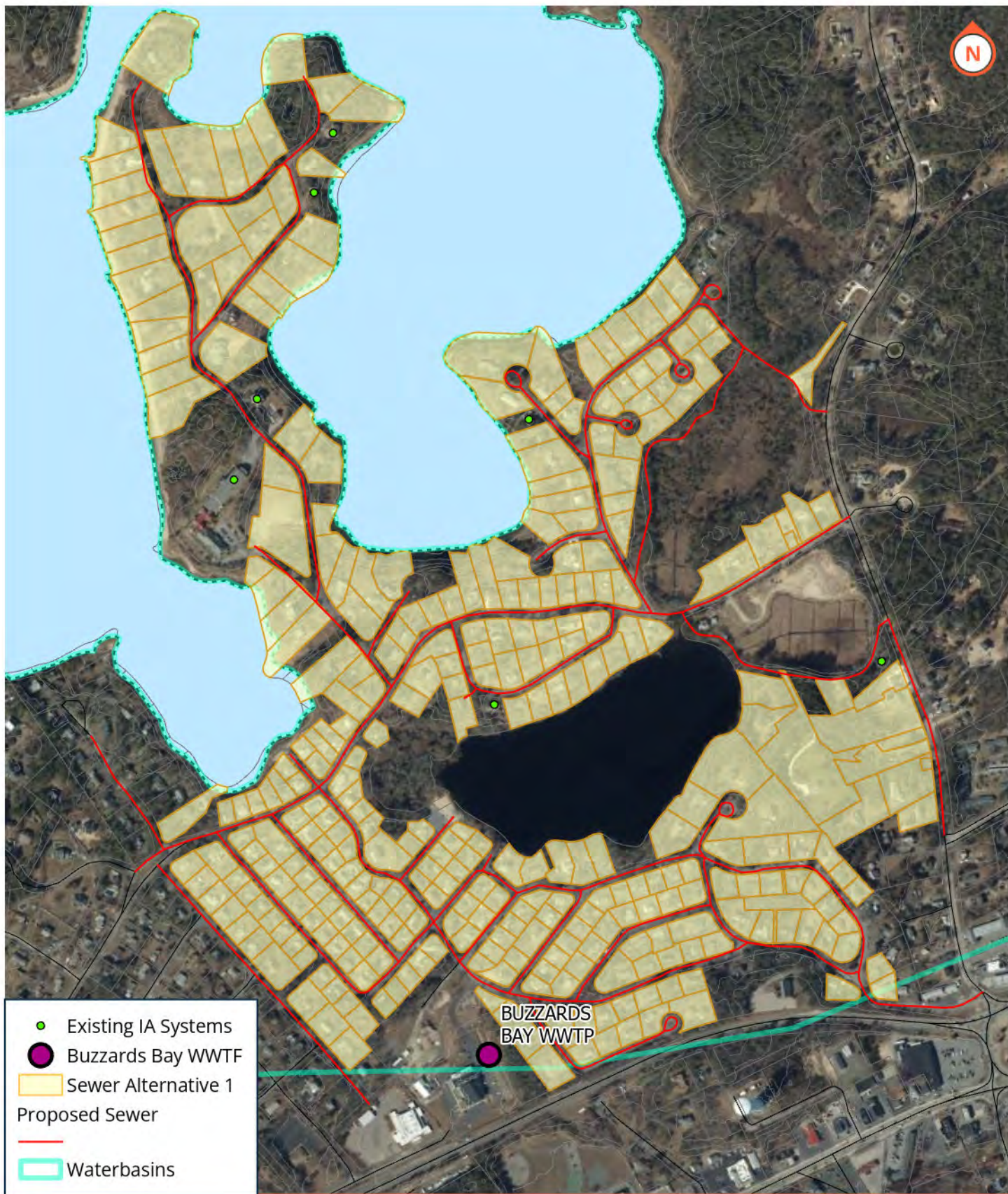
Figure 4
 Phinney's Harbor, Sewer
 Bourne, MA
 12/2/2024

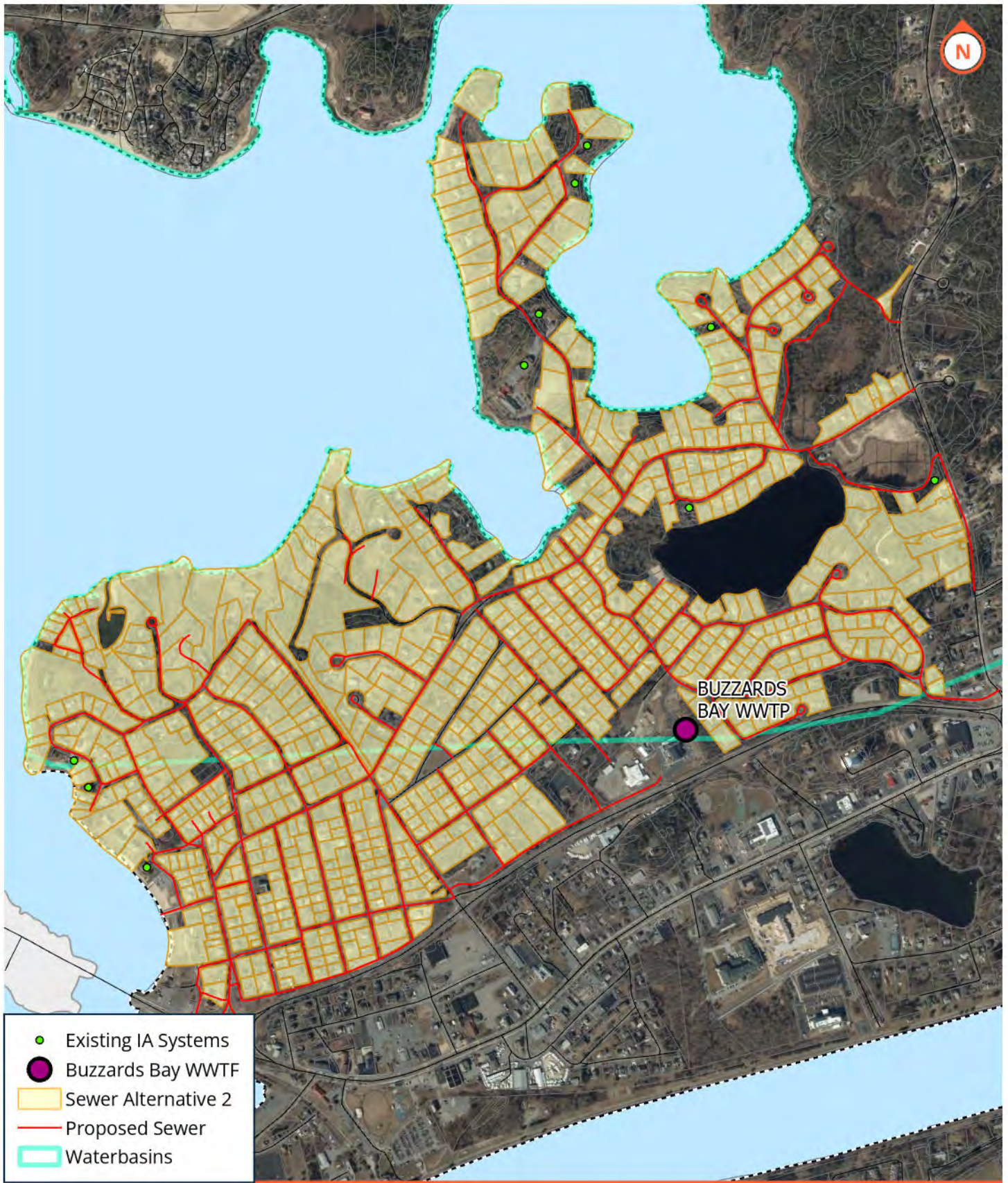


**ENVIRONMENTAL
PARTNERS**
— An Apex Company —

Figure 5
Buttermilk Bay, GUIA/EIA
Bourne, MA
5/30/2024

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Feet





- Existing IA Systems
- Buzzards Bay WWTF
- Sewer Alternative 2
- Proposed Sewer
- Waterbasins

**ENVIRONMENTAL
PARTNERS**
— An Apex Company —

Figure 7
Buttermilk Bay, Sewer 2
Bourne, MA
5/30/2024

0 500 1,000 2,000
Feet





0 1,000 2,000 4,000 Feet 1:2000

APPENDIX B:

GENERAL USE I/A VENDOR INFORMATION

BIOCLERE™

BIOLOGICAL WASTEWATER TREATMENT SYSTEM

OPERATION & MAINTENANCE MANUAL

**BIOCLERE MODELS:
16/12-SS, 16/12-LS,
16/15 & 16/19**



39 Tarkiln Place New Bedford, MA 02745 | Tel 508.985.9050 | Fax 508.985.9072 | Email sales@aquapoint.com

www.aquapoint.com



BIOLOGICAL TREATMENT SYSTEM

Congratulations on your purchase of a Bioclere biological treatment system. The Bioclere is a modification of the classic trickling filter. Trickling filters have been used for over one hundred years for the treatment of wastewater due to their reliability and simplicity of operation.

Naturally occurring microorganisms break down waste (organic matter) in the Bioclere and create harmless byproducts, mainly: water, carbon dioxide and additional microorganisms (sludge). The sludge created in the Bioclere is automatically returned and stored in your primary settling or sludge holding tank. Therefore, the Bioclere unit(s) do NOT require pumping.

However, regular pumping of your grease trap(s) (if applicable) and primary tank(s) is required. Failure to maintain a regular pumping schedule will have an adverse impact on the biology in the Bioclere system. If pumping is ignored for an extended period it may become costly to get the system back to efficient operation.

Aquapoint recommends that the grease trap(s) and primary tank(s) are checked every 3 and 6 months respectively by a certified operator or septic hauler and pumped as needed. For seasonal applications, pumping of the tanks should occur during mid-season to protect the microbiology in the filter. Failure to adhere to this pumping schedule will result in compromised treatment and will void the Bioclere warranty.

The Bioclere units are designed to reduce the effects of toxic substances that may enter the system from your facility. However, it is in your best interest to evaluate what is discharged to the system. Be aware of daily/weekly/monthly/annual activities and the quantities of chemicals that are being discharged. While the bacteria are resistant to many forms of toxic chemicals discharged in small quantities, large volumes or certain combinations of chemicals may have detrimental effects. Some items to be aware of include: cleaning agents, floor strippers, harsh chemicals, paints and solvents, as well as abnormal quantities of soaps and milk. If at any time you are unsure about using a particular chemical please call Aquapoint. If necessary, we will arrange a site meeting to evaluate your products.

Aquapoint wants you to have a good experience with your new Bioclere treatment system. If you treat the bugs with respect, they will treat you to decades of clean water and help to preserve the environment.

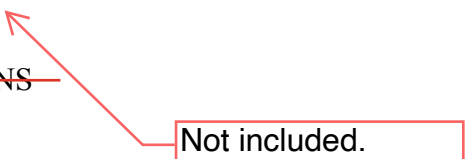
Please call our office if you have ANY questions concerning your new system.

Sincerely,

AQUAPOINT
(508) 985-9050

TABLE OF CONTENTS

SECTION	1.0	GENERAL DESCRIPTION AND FUNCTION
SECTION	2.0	SPECIFICATIONS & SCOPE OF SUPPLY
SECTION	3.0	INSTALLATION PROCEDURE
SECTION	4.0	START UP PROCEDURE
SECTION	5.0	SHUT DOWN PROCEDURE
SECTION	6.0	PROCESS CONTROL / OPERATION & MAINTENANCE
SECTION	7.0	TROUBLESHOOTING
SECTION	8.0	FINAL EFFLUENT QUALITY PROBLEMS
APPENDIX A:		BIOCLERE MODEL DRAWINGS
APPENDIX B:		BIOCLERE ELECTRICAL SCHEMATICS & PLR INSTRUCTIONS
APPENDIX C:		WARRANTY
APPENDIX D:		PUMP AND FAN SPECIFICATIONS
APPENDIX E:		MATERIAL REQUEST FORM



Not included.

This Technical Manual is supplied for the benefit of the user and is not applicable to any other customer. Aquapoint.3 LLC is not responsible for any other equipment used in conjunction with this installation. Please refer to contractor or other suppliers for information and use of their equipment.

1.0 GENERAL DESCRIPTION AND FUNCTION

1.1 The Bioclere is a secondary wastewater treatment system. The first stage of treatment occurs in the primary tank in which the solids are settled and partially digested. Wastewater then flows from the primary tank to the Bioclere where treatment by the natural process of biochemical oxidation takes place followed by final clarification prior to discharge.

1.2 The wastewater enters the baffled zone located in the clarifier beneath the Bioclere filter module. It is then pumped to the distribution assembly, which doses the surface of the filter media.

The oxidation process occurs as the water trickles over the biological film that grows on the media surface. The pump operates on a timed sequence that is specific to the individual facility wastewater characteristics to ensure that the dosing rate optimizes filter performance.

In the filter module the biological film thickens until carbonaceous material and oxygen no longer penetrate to the bacteria nearest the media surface. When this occurs the biological film sloughs from the media and passes through the media bed into the clarifier where it settles to the bottom. A sludge return pump periodically returns this sludge to the primary tank.

Thus, the filter media is self-purging and maintenance free.

1.3 Oxygen is provided by a fan located in the top housing of the Bioclere and is vented either through the effluent line of the system or the influent line to the biofilter. The fan is sized to provide the proper supply of oxygen to the treatment process.

1.4 Wastewater flows by gravity through the Bioclere. The pumps are used only for the treatment process. In the event of a power or pump failure the effluent will continue to pass by gravity through the sump portion of the Bioclere to its point of discharge. However, this situation should not be allowed to continue for an extended period of time because without the pumps operating the secondary treatment of the wastewater is no longer occurring.

2.0 SPECIFICATIONS & SCOPE OF SUPPLY

2.1 BIOCLERE MODELS 16/12-SS – 16/12-LS – 16/15 – 16/19

2.2 BIOCLERE EQUIPMENT SUPPLIED:

<u>Item</u>	<u>Quantity Per Unit</u>
Tank assembly	1 each
Filter media	1-4 cubic meters depending on model
Pipes, fittings & connectors	Misc.
Distribution system	1 each
Nozzles	3 each
Dosing pump	1 each
Recycle pump	1 each
Latches, Moore 702-L-C-SS	4 each
Baffle	1 each
Fan module assembly	1 each
Control panel	1 each
Misc. hardware	1 set
O & M manual	1 each
Padlocks, Abus	2 each
1 ½” key KA8302	2 each

2.3 PUMP TIMER SETTINGS:

Dosing pump <u>ON</u>	3 min.
Dosing pump <u>OFF</u>	5 min.
Recycle pump <u>ON</u>	2 min.
Recycle pump <u>OFF</u>	2.5 hrs.

2.4 SPECIFICATIONS (continued):

The following is a list of critical parts with specifications. It is recommended that the user have spare parts on hand at all times. They may be obtained through Aquapoint.

DOSING PUMPS:

Manufacturer:	Goulds
Type: LSP0311F	1/3 horsepower
# Required per unit:	One (1)
Electrical:	115v/1ph/60Hz

RECYCLE PUMPS:

Manufacturer:	Goulds
Type: LSP0311F	1/3 horsepower
# Required per unit:	One (1)
Electrical:	115v/1ph/60Hz

FAN:

Manufacturer:	Papst
Type: 4800X	58 cfm
# Required per unit:	One (1)
Electrical:	115v/1ph/60Hz

FLOAT SWITCH:

Manufacturer:	SJE Rhombus
Type: Vertical Master	1003778
# Required per unit:	One (1)
Electrical:	115v/1ph/60Hz

The above will assist when using the other sections of this manual and when ordering any spare parts.

3.0 INSTALLATION

3.1 INTRODUCTION:

This document establishes the installation procedures for the Bioclere secondary wastewater treatment system. It is recommended that these procedures be reviewed and approved by the engineer of record to ensure compatibility with specific site characteristics.

Aquapoint assigns a project manager for each installation to provide onsite supervision of the installation, the fresh water commissioning system and certification that the system is operational. Aquapoint will also arrange for the transportation of the system. Effective execution of these procedures requires coordination with the site contractor.

We request that the site contractor contact Aquapoint at 508-985-9050 to coordinate delivery, installation schedule and fresh water commissioning of the system.

3.2 PROCEDURE:

- A. Locate Bioclere from site engineering plans.
- B. Excavate to 16" below clarifier. De-water excavation if required.
- C. Add 12" (1.00 ft.) of clean 3/8" pea stone.
- D. Install pre-cast mounting pad approximately centered to Bioclere location. (See drawing PMW/AWT3015).
- E. Check to ensure mounting pad is level and elevation is correct.
- F. Carefully lower Bioclere into position with proper rigging and lifting techniques.
- G. Orient and align Bioclere to inlet and outlet directions. Confirm Bioclere is level.
- H. Fill Bioclere with clean fresh water to bottom of outlet pipe to stabilize unit.
- I. If Bioclere is installed in groundwater refer to anchoring requirements on site plan and/or contact site engineer.
- J. If Bioclere is not installed in groundwater backfill excavation with clean 3/8" pea stone and/or sand to within 12" of the inlet pipe. Check level of Bioclere.

NOTE: Use care while backfilling to prevent Bioclere movement and/or damage to Bioclere.

- K. Install inlet, outlet and vent/test port piping.

NOTE: If installation specifies venting through house stack, bring vent pipe to grade and cap.

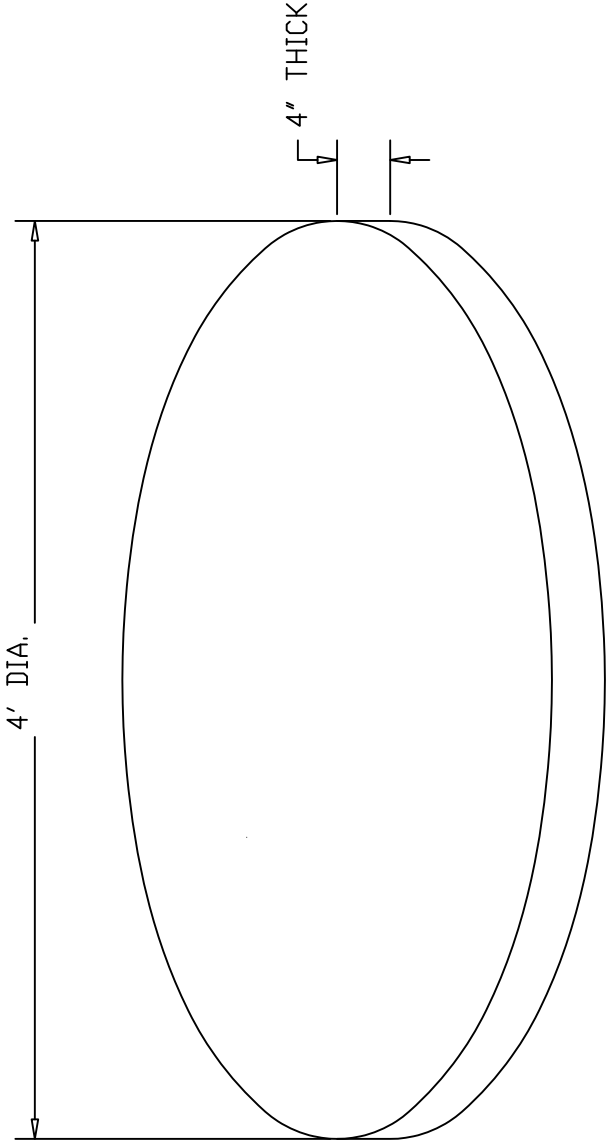
- L. Install recycle piping from Bioclere back to the inlet end of primary (septic) tank. The recycle line is 1 ½" Schedule 40 PVC from the Bioclere to the outside of the primary tank and Schedule 80 PVC inside the primary tank. Schedule 80 PVC to be installed against inside wall and at ½ the tank's liquid depth terminating with a 90° elbow. (See drawing PMW/1256-1). Use pressure fittings. If possible, slope recycle line to the primary tank to allow the recycle pipe to drain.
- M. Install wiring with watertight conduit from control location to Bioclere.
- N. Backfill around Bioclere with sand and/or pea stone to final grade.
- O. Install control box in protected location preferably on exterior of home or building to facilitate access by the operator. Connect power feed and Bioclere. (Drawing AWT 3308).

The following items are performed by the Aquapoint Authorized Representative unless otherwise specified:

- P. Install dosing and recycle pumps with safety ropes to the appropriate pipes.
- Q. Install pump wiring to junction box in fan module. (See drawing AWT 3308)

NOTES:

- 1) CONCRETE MINIMUM STRENGTH: 4000 PSI @ 28 DAYS
- STEEL REINFORCEMENT: 6 X 6 10 GA. STEEL WIRE MESH
- 2) 4' SQUARE PAD - OPTIONAL
- 3) PAD TO BE SUPPLIED AND INSTALLED BY CONTRACTOR



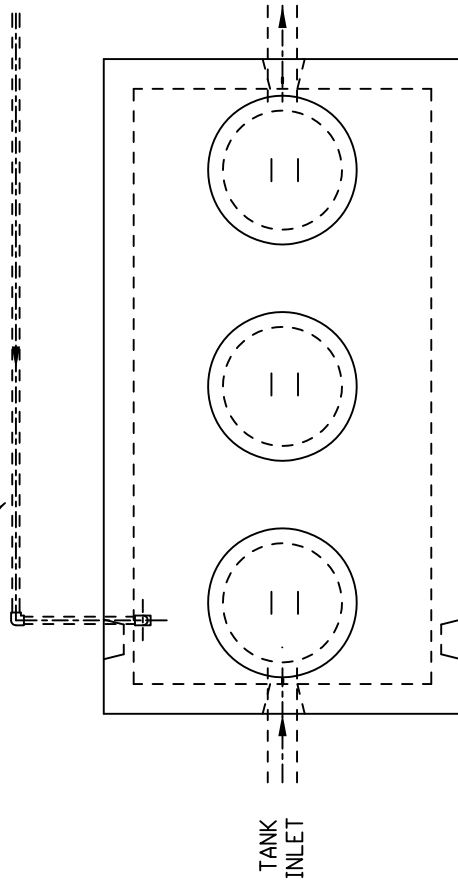
AQUAPOINT		TITLE: PRECAST MOUNTING PAD (SERIES 16 BIOFILTERS)
39 TARKILN PLACE NEW BEDFORD, MA 02745 (508) 985-9050 FAX (508) 985-9072		DRAWING NO: PMW/AVT3015
		REVISION: A
		DATE: 9 Feb 09
		DWN BY: P.VILLEY
		SCALE: N.T.S. SIZE: B/A3
		SHEET #: 1 of 1

1½" PVC SCHD 40
RECYCLE LINE FROM
BIODCLERE UNIT(S)

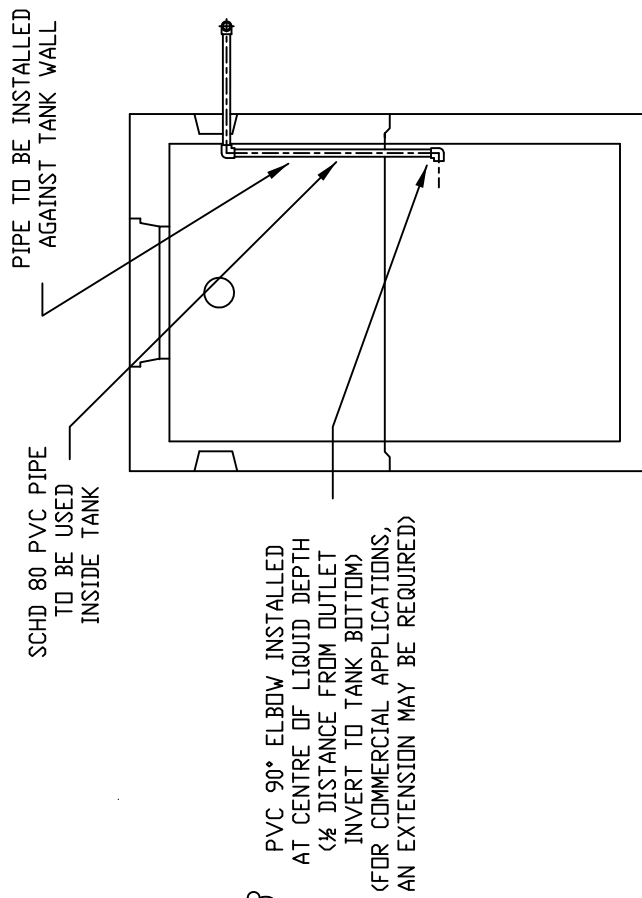
1½" Biofilter Recycle Line Installation at Primary Tank.

NOTES FOR CONTRACTOR:

1. SLOPE PIPE BACK TO SEPTIC TANK WITH NO LOW POINTS.
2. USE PRESSURE FITTINGS ONLY.



TYPICAL PRIMARY (SEPTIC) TANK



1.5BiofRecyc.dwg

TITLE: 1½" Recycle Line Installation.
(Primary Tank)

DRAWING NO.	PMW/1256-1
REVISION	B
DATE	9 Feb 09
DWN BY	P. WILLEY
SCALE	1 : 40
SHEET #	1 of 1

AQUAPOINT

39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

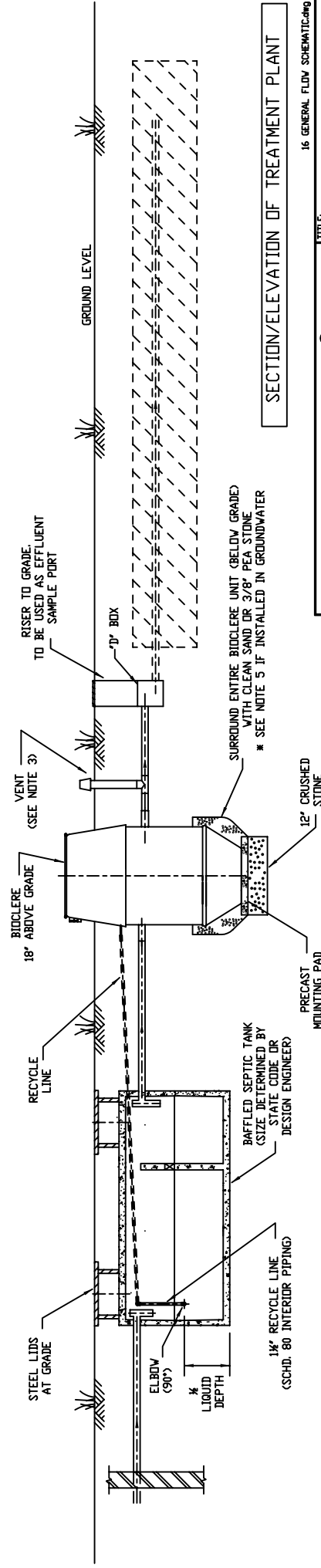
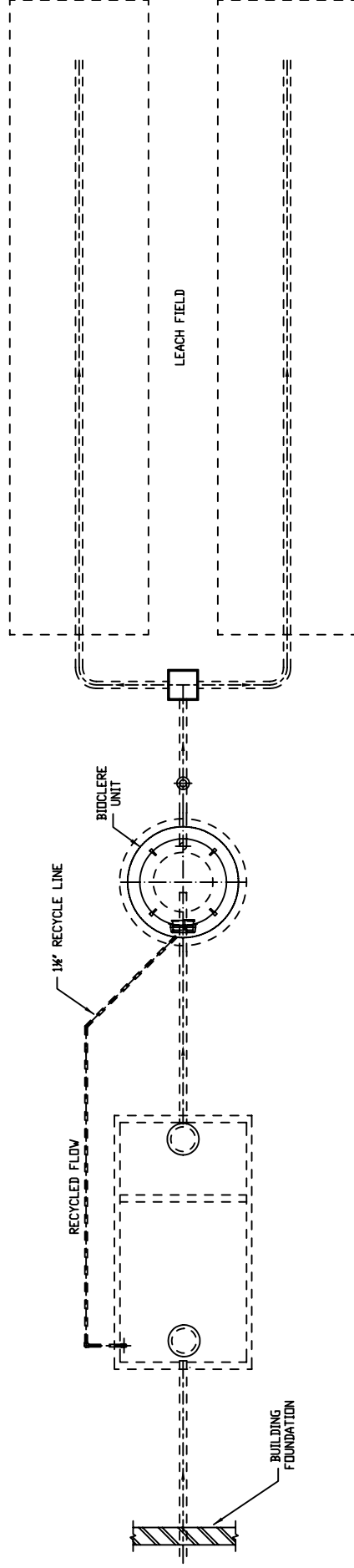
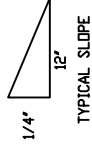
12" CRUSHED STONE

16 GENERAL FLOW SCHEMATIC

PLAN ON TREATMENT PLANT

NOTES: UNLESS OTHERWISE SPECIFIED:

1. THIS INSTALLATION REPRESENTS BIDCLERE MODEL 16 SERIES.
2. OTHER MODELS MAY BE SUBSTITUTED.
3. IF VENTING IS ACCOMPLISHED THROUGH BUILDING, VENT IS TO BE BROUGHT TO GRADE AND CAPPED.
4. IF INSTALLED IN GROUND WATER CONTACT SITE ENGINEER FOR ANCHORING REQUIREMENTS.
5. CONTRACTOR IS TO SUPPLY ALL CONCRETE STRUCTURES AND PERFORM INSTALLATION.



SECTION/ELEVATION OF TREATMENT PLANT

16 GENERAL FLOW SCHEMATIC.dwg

AquaPoint
Performance Based Wastewater Treatment Systems

39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

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DOCUMENT ARE PERMITTED WITHOUT PRIOR
WRITTEN PERMISSION

TITLE	TYPICAL GROUND INSTALLATION
DRAWING NO.	UK1265-4
REVISION	D
DATE	3/22/01
DWN BY	P.WILLEY
SCALE	1 : 60
SIZE	B / A3
SHEET #	1 of 1

0	3'	6'	9'	12'	15'	18'	21'	24'	27'	30'
---	----	----	----	-----	-----	-----	-----	-----	-----	-----

4.0 **BIOCLERE START-UP**

- A. During installation the Bioclere and primary tanks should be filled with potable water. Be certain that all water is clean and clear. Under no circumstances is silt laden or muddy water to be used in the Bioclere.
- B. Check that the dosing pump is immersed and that the pipe connected and the distribution assembly is level. Check that the sludge recycle pump is standing on the floor of the sump and that the discharge pipe is connected to the sludge recycle line.
- C. The Bioclere system is controlled by a Programmable Logic Relay (PLR) with integral HMI screen (interface). PLR operating instructions are provided in Appendix B of this manual and should be reviewed prior to proceeding with this startup procedure.
- D. Turn **ON** the toggle switch in the fan box module on the side of the Bioclere unit. When this is turned **OFF**, the fan and all pumps are disconnected and the alarm will sound if the main circuit breaker in the Bioclere control panel is **ON**.
- E. Turn the main power breaker in the control panel to **ON**. The green power light will turn **ON** and the PLR control screen will be illuminated. Note that the screen will go into sleep mode and the screen will go black after about 10 seconds if the PLR control buttons are not being used. To re-illuminate the screen press the (esc) key.
- F. Using the (+/-) navigation buttons on the PLR access the dosing pump and recycle pump timer setting screens and set the dosing and recycle pump timers to short test cycles for the initial startup process. We recommend the following settings.

	<u>ON</u>	<u>OFF</u>
Dosing	1 min.	1 min.
Recycle	1 min.	2 min.

- G. Access the recycle pump control screen and set the recycle pump to **AUTO**. The recycle pump should turn **ON** and **OFF** in a continuous cycle according to the above timer settings. The sludge recycle operation can be confirmed by observing flow from the recycle line at the head of the primary tank or at the tell tail hole in the recycle piping inside the Biocloere unit.
- H. Access the dosing pump control screen and set the dosing pump to **AUTO**. The dosing pump should turn **ON** and **OFF** in a continuous cycle according to the above timer settings. Dosing pump operation can be confirmed by observing flow from the Bioclere dosing array assembly inside the unit.
- I. Manually activate the float switch using by pulling one of the float switch wires out of the terminal strip in the control panel or by lowering the water level in the Bioclere clarifier. The

recycle pump operation should terminate when the float switch is in the extended position (open circuit).

- J. Confirm the Bioclere ventilation fan is operational.
- K. **ALARMS:** All alarm conditions are controlled by and logged in the PLR module. The alarm circuit consists of (1) current sensor (shared by the dosing and recycle pumps) and (1) AR power alarm relay. The PLR is set for a 3 second delay before the alarm will energize. This allows the pumps time to attain operating amperage. The visual alarm is a light on the top left side of the enclosure, while a Sonalert type audible alarm is located on the bottom right of the enclosure. Alarm conditions must be silenced by accessing the PLR interface screen and by pressing the **(A)** button. Acknowledging an alarm will reset the alarm function, stop the beacon and silences the horn. If applicable, a USP (United Security Products) autodialer is utilized to provide two functions:

1. Immediate notification of an alarm condition to a maximum of (4) telephone numbers and,
2. Weekly call-in to a telephone number verifying that the unit is on line and operating normally.

The current sensing relay (inside the control panel) senses when the dosing and/or recycle pump is running. If a pump fails, draws less current than normal or the circuit breakers trip, the alarm will be activated. These contacts are connected to an audio/visual alarm.

External alarm indication:

A dry contact between terminals 23 and 24 closes for an alarm condition and is used for connection to an automatic voice/ pager dialer system (120 VAC max).

Alarm conditions are as follows:

1. Fan circuit breaker trips/power loss: AR contact opens to indicate either condition and energizing local alarms.
2. Pump failure: Upon loss of amperage as detected by the current sensor the alarm will be initiated.
3. Power switch off in fan module at unit.

- L. Testing of dosing and sludge recycle pumps in **MANUAL** mode:

Turn **ON** system as described above and put dosing and recycle pumps in **MANUAL** position. When the pumps start observe the water flowing from the dosing array and into the inlet of the primary tank or observe flow through the recycle “telltale” inside the Bioclere.

- M. If any of the functions described above fail, check with the trouble shooting section of this manual (Section 7).
- N. Reset timers as described in section 2.3 “Timer Settings” of this manual.

- O. If the unit is ready for treatment it may be left in the operating condition with PLR screens set to **AUTO**.
- P. If there is some delay before the plant is needed it is recommended that the shut down procedure in Section 5 is followed.

5.0 **BIOCLERE SHUTDOWN**

- A. No action needs to be taken if there is a temporary cessation of flow to the plant for a period of time which does not exceed up to twelve (12) weeks. Leave the plant in operation with power **ON**.
- B. Should the plant not need to be operational for any period in excess of 12 weeks, the following shut down procedure will apply:
 - 1. Run the sludge recycle pump for 2 minutes to remove any secondary sludge from the Bioclere.
 - 2. If possible, keep the power **ON** to the Bioclere control panel and turn **OFF** the dosing and recycle pumps and leave the fan running. Otherwise, turn the power **OFF** and remove the fan unit. Reinstall the fan unit when the Bioclere is placed back in service.
 - 3. If “B” is not possible, turn the main power on the Bioclere control panel to **OFF** position.
- C. On resumption of wastewater flow to the plant the Bioclere should be re-started as described in Section 4.

6.0 MAINTENANCE PROCEDURES

6.1 INTRODUCTION:

The treatment system shall be operated by an Aquapoint Certified Wastewater Treatment Plant Operator. The treatment system shall also be operated in accordance with the Manufacturers recommendations contained in the Bioclere System Technical Manual. Reporting of test analyses will be done in conformance with applicable rules and local regulations for the use of the system.

Turn the main power switch to **OFF** before servicing the pump, fan or electrical panel box.

6.2 FREQUENCY OF MAINTENANCE:

- A. Initial start-up visit to ensure proper commissioning and system operation
- B. Weekly (first two weeks): Check pump and fan operation visually via access hatch. Check the accuracy of the timers through two (2) complete cycles.
- C. Standard Quarterly Maintenance:
 - 1. Check general condition/appearance of Bioclere unit.
 - 2. Check vent flow, odor.
 - 3. Check general condition of fan box including internal and external wiring, lock, latch, gaskets, etc.
 - 4. Check for quiet fan operation.
 - 5. Check condition of cover locks, latches, gaskets.
 - 6. Check and characterize biomass growth (thickness, color, uniformity).
 - 7. Check recycle pump operation and timing
 - 8. Check dosing pump operation, timing and spray pattern.
 - 9. Check general condition of dosing assembly and clean spray nozzles as necessary.
 - 10. Check general condition of control box including locks, gaskets, etc.
 - 11. Check control panel switches, alarms, timers, etc.
 - 12. Complete and maintain service report file.

See attached Bioclere field report for complete O&M procedures.

6.3 PROCESS CONTROL FOR CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND (CBOD₅) REMOVAL WITH THE BIOCLERE SYSTEM:

Wastewater flows from the primary settling tank into a baffled chamber in the clarifier of the Bioclere. Dosing pumps located in this clarifier intermittently dose the PVC filter media bed with the wastewater.

In the Bioclere trickling filter the organic material in the wastewater is reduced by a population of microorganisms which attach to the filter media and form a biological slime layer. In the outer portion of the slime layer treatment is accomplished by aerobic microorganisms. As the microorganisms multiply the biological film thickens and diffused oxygen and organic substrate are consumed before penetrating the full depth of the slime layer. Consequently the biological film develops aerobic, anoxic and anaerobic zones.

Absent oxygen and a sufficient organic carbon source (CBOD₅) the microorganisms near the media surface lose their ability to cling to the media. The wastewater flowing over the media washes the slime layer off the media and a new slime layer begins to form. This process of losing the slime layer is called “sloughing” and it is primarily a function of organic and hydraulic loading on the filter. This natural process allows a properly designed media bed to be self-purging and maintenance free.

The sloughed biomass settles to the bottom of the clarifier as sludge. This secondary sludge is periodically pumped back to the primary tank to enhance the digestion and denitrification processes which is further discussed in **Section 6.4.2 below**.

6.3.1 *Bioclere Trickling Filter Dosing Rates:*

The Bioclere uses a dosing pump to distribute wastewater over the trickling filter. It is critical to periodically clean the nozzles of excess biomass using a bottle brush to ensure uniform distribution. The Bioclere dosing rates that were set at the time of commissioning are listed in **Section 2.0** of this Technical Manual. The dosing rates are set so that the flow of water and pollutants (CBOD₅ and ammonium) over the biofilm are maximized. This in turn, will maximize the pollutant removal efficiencies and facilitate biomass sloughing through the filter. Therefore, it is not necessary to adjust the dosing timers. In fact, the dosing timers should only be adjusted if the Bioclere receives little or no flow for extended periods.

6.3.2 *Bioclere Recirculation Rates:*

Recirculation of sludge and treated effluent is accomplished in each unit using a submersible stainless steel pump controlled by a fully adjustable timer. The biological solids generated in the filter are returned to the sludge storage facility at regular intervals, typically every hour or two. Therefore, the sludge will not collect in the secondary settling tank and a sludge blanket will not form.

The benefits of recirculation are numerous and include: 1) removing biological sludge from the Bioclere so that only the primary tank(s) need periodic pumping, 2) diluting the influent pollutant concentrations which results in a thinner and more effective biofilm on the media bed, 3) odors are reduced in the primary tanks and the treatment components, 4) diluting biological inhibitors (cleaning agent, sanitizers, etc.) that may exist in the wastewater, 5) achieving nitrogen removal through denitrification due to the recirculation of nitrate to the primary tank.

The recirculation rates that were set at the time of commissioning are listed in **Section 2.0** of the Technical Manual. These rates may need adjusting depending on the 1) actual average daily flow, and 2) actual measured strength of the wastewater (concentrations of influent BOD₅, TKN etc.). Please contact AquaPoint prior to adjusting the recirculation rates.

6.4 PROCESS CONTROL FOR NITROGEN REMOVAL WITH THE BIOCLERE SYSTEM:

Below is a brief description of how nitrogen removal is accomplished in the Bioclere unit.

6.4.1 Nitrification:

Nitrification is the sequential biological oxidation of $\text{NH}_4\text{-N}$, first to nitrite ($\text{NO}_2\text{-N}$) by *Nitrosomonas* bacteria then to nitrate ($\text{NO}_3\text{-N}$) by *Nitrobacter* bacteria according to the following overall equation:



Oxidation of 1 mg/l of $\text{NH}_4\text{-N}$ requires approximately 4.6 mg/l of dissolved oxygen and produces acid resulting in the consumption of approximately 7.1 mg alkalinity as CaCO_3 /mg $\text{NH}_4\text{-N}$ oxidized. Alkalinity is the inorganic carbon source nitrifying bacteria require to oxidize ammonia. **Therefore it is critical that alkalinity is monitored on a regular basis to ensure complete nitrification.** Alkalinity concentrations in the Bioclere effluent must remain above 75 mg/l as CaCO_3 to allow nitrification to proceed. If the alkalinity drops below this value then it is likely that nitrification will be inhibited and the effluent may not meet permit requirements. It is best to measure the alkalinity in the Bioclere effluent with a field test kit each time you are onsite to inspect the treatment system. Bioclere effluent can be collected from the final pump chamber. Effluent can be collected with a bailer.

If required, alkalinity can be added in the form of baking soda (sodium bicarbonate). It can be purchased as a powder in 50 pound bags. Contact Aquapoint if assistance is required to determine the alkalinity dosing rate.

Please note that nitrifying bacteria require a stable and consistent environment because of their sensitivity to numerous inhibitory and toxic substances and an array of environmental factors including temperature, pH, dissolved oxygen, and alkalinity. If nitrification is not being achieved then it will be necessary to verify the influent average daily flow, pH, BOD_5 , TSS, TKN. It may also be necessary to conduct an inventory of the type and quantity of cleaning and process solutions that are used that may impact the microorganisms in the Bioclere units (i.e. daily, weekly, monthly, yearly).

6.4.2 Denitrification:

Dissimilating denitrification, the biological reduction of nitrate ($\text{NO}_3\text{-N}$) to nitrite ($\text{NO}_2\text{-N}$) and ultimately nitrogen gas in an anoxic environment (dissolved oxygen <0.5 mg/l), involves the transfer of electrons from a reduced electron donor (organic carbon substrate) to an oxidized electron acceptor ($\text{NO}_3\text{-N}$). It is an important reaction as it restores approximately (3.57 mg alkalinity/mg of $\text{NO}_3\text{-N}$ reduced), and partially offsets the effects of nitrification in a combined nitrification/denitrification process. The microorganisms responsible for completing the reaction are facultative heterotrophic aerobes contained in the wastewater that are also responsible for CBOD_5 oxidation in the Bioclere.

Denitrification in the Bioclere system is accomplished by periodically recirculating secondary sludge and treated nitrified effluent to the septic tank which provides an anoxic environment. Recirculation typically occurs several minutes every hour via a timer in the control panel. See **Section 2** of the Bioclere Technical Manual for Bioclere recycle and dosing rates. For typical residential strength wastewater, recirculation of treated effluent from the Bioclere to the septic tank will achieve $>70\%$ removal of total nitrogen. This is because weight ratios of carbon to nitrogen, as measured as **BOD:TKN** in the influent wastewater are usually greater than the generally accepted ratio of **4:1** in which denitrification has been proven to proceed without an external carbon source.

FIELD REPORT

Date	
Client	
Address	
City	
State	
Inspector	
Bioclere Model #(s)	

Reason For Site Visit:

☐ O & M ☐ Commissioning

☐ Testing ☐ Other:

(1) Odor
1) Is there odor around the site? ☐ Yes ☐ No

2) Where is the source of odor?

3) If odor is present, check all that apply: ☐ Mild ☐ Medium ☐ Strong

☐ Musty ☐ Septic
(2) Sludge & Scum Depth Measurements

	Scum	Sludge
Grease Trap		
Primary Tank #1		
Primary Tank #2 (if applicable)		
Bioclere 1A		
Bioclere 1B (if applicable)		

	Scum	Sludge
Bioclere 2A (if applicable)		
Bioclere 2B (if applicable)		
Effluent Tank		
Other: _____		

(3) Bioclere Venting

1) Record the Bioclere fan model #(s):

2) Is air passing through the vent(s)? ☐ Yes ☐ No

(if in doubt, put a small plastic bag around vent and allow to fill)

3) Is the fan operating and in good condition...

for Bioclere 1A? ☐ Yes ☐ No

for Bioclere 2A? (if applicable) ☐ Yes ☐ No

for Bioclere 1B? (if applicable) ☐ Yes ☐ No

for Bioclere 2B? (if applicable) ☐ Yes ☐ No

(Please provide necessary details in the report summary section)

FIELD REPORT

(4) General

	Bioclere 1A	Bioclere 1B (IF APPLICABLE)	Bioclere 2A (IF APPLICABLE)	Bioclere 2B (IF APPLICABLE)
Are there any filter flies in the unit?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If so, how many?	☐ Many ☐ Few	☐ Many ☐ Few	☐ Many ☐ Few	☐ Many ☐ Few
Is the lid gasket in good condition?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Locks/latches/handles in good condition?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Is there any external damage to the units?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Cover, fan box, & control panel securely locked?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Does the fan box contain standing water?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

(Please provide necessary details in the report summary section)

Were influent/effluent samples taken for lab analysis? ☐ Yes ☐ No					
If process control test samples were taken, please provide the following information:					
Alkalinity (as CaCO ₃)		pH		Turbidity (NTU)	
Sample Locations:		Temperature (F)		DO (mg/l)	
		NO ₃ -N (mg/l)		NH ₃ -N (mg/l)	
		Other:			

(5) Biomass Characterization

	Bioclere 1A	Bioclere 1B (IF APPLICABLE)	Bioclere 2A (IF APPLICABLE)	Bioclere 2B (IF APPLICABLE)
What is the color of the biomass?	☐ White	☐ White	☐ White	☐ White
	☐ White/Gray	☐ White/Gray	☐ White/Gray	☐ White/Gray
	☐ Gray	☐ Gray	☐ Gray	☐ Gray
	☐ Gray/Brown	☐ Gray/Brown	☐ Gray/Brown	☐ Gray/Brown
	☐ Brown	☐ Brown	☐ Brown	☐ Brown
	☐ Red/Brown	☐ Red/Brown	☐ Red/Brown	☐ Red/Brown
	☐ Black	☐ Black	☐ Black	☐ Black
Classify the growth of the biomass 6-12 inches below the media surface. 1=light 2=medium 3=heavy				

(6) Nozzle Spray Pattern

	Bioclere 1A	Bioclere 1B (IF APPLICABLE)	Bioclere 2A (IF APPLICABLE)	Bioclere 2B (IF APPLICABLE)
1) Does spray cover the entire media surface area?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
(If not, clean each nozzle with a bottle brush)				
2) Does the spray now cover entire surface area?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If not, then: a. remove nozzles and soak them in a bleach solution. b. manually engage both dosing pumps for 2 min. c. replace nozzles				
3) Does the spray now cover entire surface area?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If not, consult AQUAPOINT				

FIELD REPORT

(7) Pumps and Control Panel

	Bioclere 1A		Bioclere 1B (IF APPLICABLE)		Bioclere 2A (IF APPLICABLE)		Bioclere 2B (IF APPLICABLE)	
What is the dosing pump timer setting?	min on:		min off:		min on:		min off:	
What is the recycle pump timer setting?	min on:		hrs off:		min on:		hrs off:	

For the following checklist, set dosing and recycle timers to a test cycle.

What is the amperage of dosing pump 1?	Amps	Amps	Amps	Amps
What is the amperage of dosing pump 2?	Amps	Amps	Amps	Amps
What is the amperage of recycle pump?	Amps	Amps	Amps	Amps
Is dosing pump operating according to test cycle?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Is recycle pump operating according to test cycle?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Are the dosing pumps alternating?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

(Please provide necessary details in the report summary section)

(8) Plumbing

Are the unions in the Bioclere leaking?
(If "yes", then tighten with pipe wrench) ☐ Yes ☐ No

Is the recycle siphon break weep hole operating as designed?
(If "no", clean weep hole) ☐ Yes ☐ No

(9) Final Check

- ☐ Main Power set to "On" and toggle for all pumps set to "Normal" (or "Auto")
- ☐ Alarm toggle set to the "On" position
- ☐ Recycle and dosing pump timers are set back to original cycles in control panel
- ☐ Control panel, Bioclere cover, and fan box locked
- ☐ Record daily flow rate or water meter reading (if possible):

(10) Report Summary:

Note: Contact Aquapoint for pump, fan and control component replacement parts.

Signature: _____

7.0 TROUBLE SHOOTING

- 7.1 Before conducting any repair work on the fan or pump, replacing fuses, or doing any work on the panel or fan module:

SWITCH THE MAIN BIOCLERE BREAKER AND POWER PANEL TOGGLE SWITCH TO OFF

<u>FAULT</u>	<u>POSSIBLE CAUSE</u>	<u>CORRECTIVE ACTION</u>
Fan not working	Power failure	Check circuit breaker and replace if necessary.
	Fan motor failure	Check wiring and terminal connections. Replace fan if necessary.
Dosing pump not working	Power failure	As for fan above.
	Low-level protection	Check that pump is fully submerged.
	Timer control failure.	Check that power switch is ON Replace timer if necessary.
	Pump failure	Check pump in accordance with manufacturer's instructions supplied.
Excessive build-up of biomass	Plant overload	Check that hydraulic and organic load are within design limits. Contact Aquapoint Inc. if capacity is to be increased.
	High sludge levels	Check sludge levels in each unit and de-sludge as necessary.
No biomass in filter	Excess shedding of biomass.	investigate and eliminate any source of biofilm poisoning such as disinfectant, household bleach, acids, etc. showing up in waste.
Odorous	Inefficient treatment.	Check that dosing assembly sprinkles evenly over media surface. Clean dosing assembly.
	Inadequate air supply	Check fan and air intake. See fan not working above.

8.0 FINAL EFFLUENT QUALITY PROBLEMS

8.1 HIGH SUSPENDED SOLIDS

If effluent levels are exceeded carry out the following checks:

1. Examine primary settlement tank. If excessive sludge or floating matter in the chamber is discharging to the Bioclere arrange for the primary tank to be de-sludged.
2. Inspect sludge recycle pump, clean and test to ensure pump is operating satisfactorily.
3. Consult distributor for assistance.

8.2 HIGH C.B.O.D. (Carbonaceous Biochemical Oxygen Demand)

If effluent levels are exceeded carry out the following checks:

1. Check for signs of excessive sludge in the system and for suspended solids.
2. Check that the fan is operating continuously and that the air inlet to the fan is unobstructed. Clean and replace as necessary.
3. Check that the spray distribution system is clean and that the effluent is being distributed evenly to the filter media.
4. Check whether the loading to the plant has increased beyond the design basis. Consult distributor if loading has increased.
5. Ensure that there are no toxic or concentrated cleansing chemicals being discharged to the plant.

8.3 HIGH NH₃N (ammonia-nitrogen)

Carry out check procedure as for Item 8.2.

8.4 HIGH NO₃ (Nitrate-nitrogen)

If effluent levels are exceeded carry out the following checks:

1. Check the recirculation pump and confirm it is operating properly.
2. Check the dissolved oxygen (DO) concentration in the primary settling tank effluent tee. The conditions should be anoxic (between 0.2 and 0.5 mg/l DO). If the DO concentration is high, reduce the recycle rate. If the DO concentration is low, increase the recycle rate.

For additional assistance contact:

AQUAPOINT.3 LLC
39 Tarkiln Place
New Bedford, MA 02745
Tel. 508-985-9050
Fax 508-985-9072

8.5 TOXIC MATERIALS WARNING

In order to maintain proper Bioclere operation the following must be noted:

This Bioclere system is designed to provide treatment for a specific waste stream. Its fixed film biological process is exceptionally stable and will tolerate shocks of high strengths of organic loading. However, toxic shock loading may adversely impact effluent characteristics.

None of the following should be introduced into the Bioclere plant:

1. Gasoline, kerosene, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid or gas.
2. Any non-latex paints, paint thinners, paint removers, or strippers.
3. Any organic solvent or any liquid containing any organic solvent.
4. Any quaternary ammonium sanitizers.
5. Any photographic fluids including waste developer, fixer and rinse water.
6. Any pesticide including insecticides, fungicides, rodenticide, and herbicides of any sort.
7. Any water or wastes containing toxic poisonous solids, liquids, or gases, in sufficient quantity to interfere with the sewage treatment process, constitute a hazard to humans or animals, create a public nuisance, or create any hazard in the ground water.
8. Any waters or wastes having a pH higher than 9.5 or lower than 5.5.
9. Solid or viscous substances in quantities capable of causing obstruction to the flow in sewers, or other interference with the proper operation of the sewage works such as, but not limited to, ash, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, ungrounded garbage, whole blood, paunch, manure, hair, fleshing, and entrails, and paper dishes, cups, milk containers, etc. either whole or in parts.
10. Any water or waste containing fats, wax, grease, or oils, whether emulsified or not, in excess of 100 mg/l, or containing substances which may solidify or become viscous at temperatures between 32 and 150 degrees Fahrenheit (0-65 degrees Celsius).
11. Any shredded garbage. The installation and operation of any garbage grinders in systems using the Bioclere is prohibited.
12. Any storm water, surface water, roof runoff, or subsurface drainage unless the system is designed to accept such sources of water.
13. Rubber gloves, gauze pads, etc. which are typical from medical facilities.

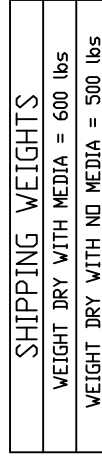
Similarly, substances, which might enhance or inhibit biological activity, should not be discharged into the system.

In the event these or other inhibiting substances inadvertently enter the waste stream contact Aquapoint immediately.

APPENDIX A

BIOCLERE DRAWINGS

2. SEE DRAWING PMW/AWT3015 FOR MOUNTING PAD CONSTRUCTION DETAILS.



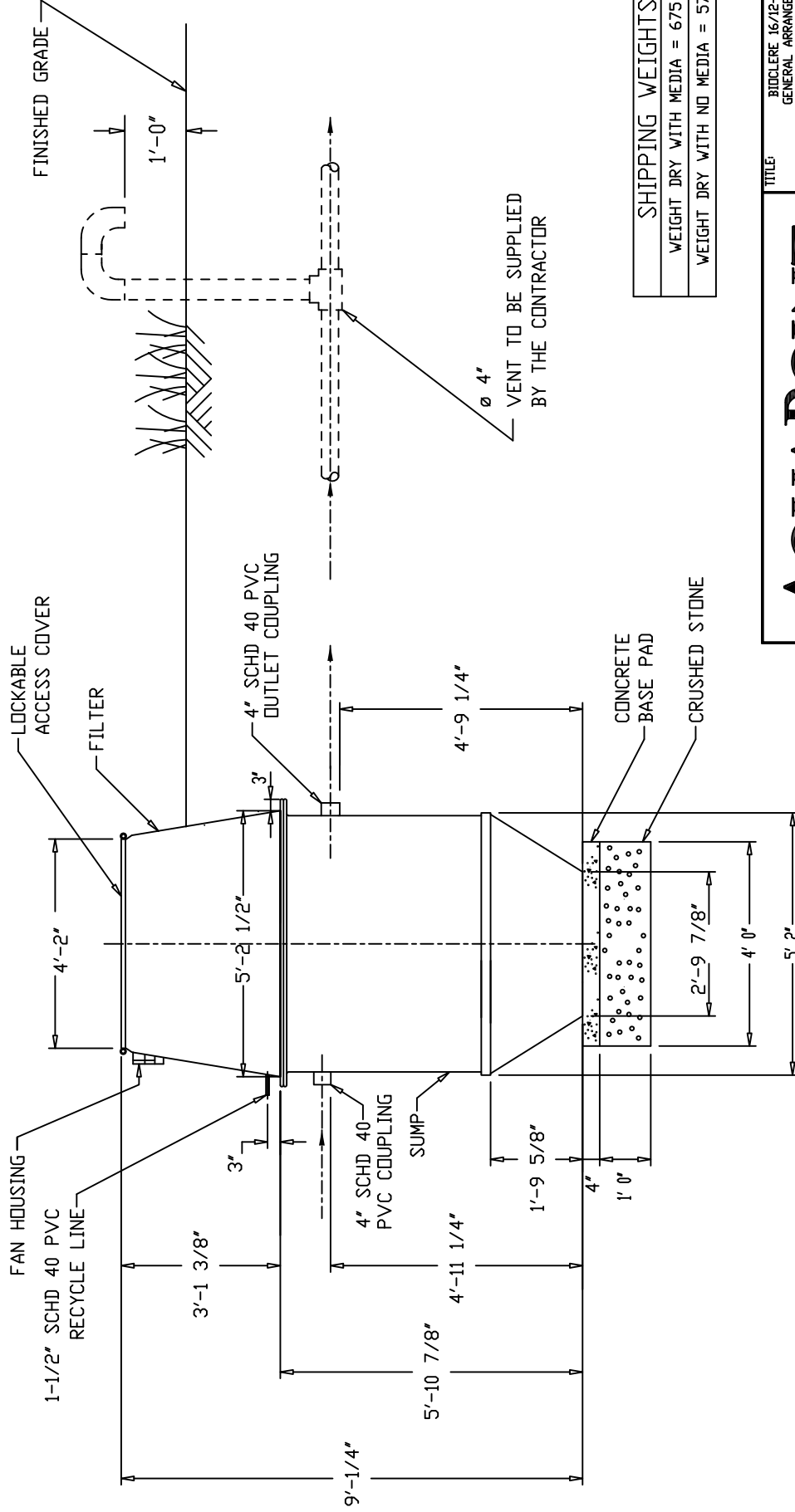
TITLE:	BIDCLERE 16/12-SS GENERAL ARRANGEMENT		
DRAWING NO:	UK.1259-1		
REVISION:	B		
DATE:	10/25/00		
DRAWN BY:	P.Willey		
SCALE:	1 : 25	SIZE:	B
SHEET #	1 of 1		

39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

BIOCLERE MODEL 16/12-SS

NOTES:

1. VENT MAY BE RUN UP THE SIDE OF BUILDING.
2. SEE DRAWING PMW/AWT3015 FOR MOUNTING PAD CONSTRUCTION DETAILS.



SHIPPING WEIGHTS	
WEIGHT DRY WITH MEDIA = 675 lbs	
WEIGHT DRY WITH NO MEDIA = 575 lbs	

16.12-LS.dwg

TITLE:	BIDCLERE 16/12-LS
DRAWING NO:	GENERAL ARRANGEMENT
REVISION:	UK1259-2
DATE:	B
DWN BY:	10/25/00
SCALE:	P. WILLEY
SHEET #:	1 : 25
	SIZE: B
	1 of 1

AQUAPOINT

39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

MODEL 16/12-LS

DISTRIBUTION STATEMENT
THIS DESIGN AND DRAWING IS THE PROPERTY OF AQUAPOINT
AND ARE NOT TO BE USED EXCEPT IN
CONNECTION WITH OUR WORK DESIGN AND
INVENTION RIGHTS ARE RESERVED. NO FURTHER
DUPLICATION NOR DISTRIBUTION OF THIS
DOCUMENT ARE PERMITTED WITHOUT PRIOR
WRITTEN PERMISSION

1. VENT MAY BE RUN UP THE SIDE OF BUILDING.

2. SEE DRAWING PMW/AWT3015 FOR MOUNTING PAD CONSTRUCTION DETAILS.



16-15 std GAdmg

TITLE:	BIOCLERE 16/15 GENERAL ARRANGMENT		
DRAWING NO:	UK.1259-3		
REVISION:	A		
DATE:	10/25/00		
DRAWN BY:	P.Willey		
SCALE:	1 : 25	SIZE:	B
SHEET #:	1 of 1		

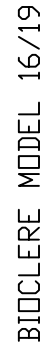
AQUAPOINT

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NEW BEDFORD, MA 02745
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DISTRIBUTION STATEMENT
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DOCUMENT ARE PERMITTED WITHOUT PRIOR
WRITTEN PERMISSION.

BIOCLERE MODEL 16/15

2. SEE DRAWING PMW/AWT3015 FOR MOUNTING PAD CONSTRUCTION DETAILS.



AQUAPOINT

39 TARKILN PLACE
NEW BEDFORD, MA 02745
(508) 985-9050 FAX (508) 985-9072

TITLE:	BIDCLERE 16/19 GENERAL ARRANGEMENT		
DRAWING NO:	UK.1259-4		
REVISION:	B		
DATE:	10/25/00		
DWN BY:	P.Willey		
SCALE:	1 : 25	SIZE:	B
SHEET #:	1 of 1		

16-19 std CADMO

SHIPPING WEIGHTS
WEIGHT DRY WITH MEDIA = 840 lbs
WEIGHT DRY WITH NO MEDIA = 640 lbs

Septi-Tech

Hi Mila,

Below please find the pricing you requested for the SeptiTech STAAR treatment systems. I've listed the model number, with the corresponding gallons per day, below. And attached are system drawings.

STAAR 0.5 Denite (M400N) – 1-4 bedrooms – up to 500 gpd : \$9,550.00 plus MA tax

STAAR 0.75 Denite (M550N) – 5-6 bedrooms – up to 750 gpd: \$10,865.00 plus MA tax

STAAR 1.0 Denite (M750N) – 7-9 bedrooms – up to 1,000 gpd: \$14,150.00 plus MA tax

STAAR 1.2 Denite (M1200N) – 10-11 bedrooms – up to 1,200 gpd: \$19,200.00 plus MA tax

STAAR 1.5 Denite (M1500N) – 12-14 bedrooms – up to 1,500 gpd: \$22,750.00 plus MA tax

STAAR 3.0 Denite (M2500N) – up to 3,000 gpd: \$36,600.00 plus MA tax

STAAR 4.5 Denite (M3000N) – up to 4,500 gpd: \$64,750.00 plus MA tax

Pricing includes STAAR components, delivery to the site, setup into tanks, connections and PVC within treatment tanks, and system startup.

Pricing does not include tanks, electrical work, external connections or PVC piping, SAS, etc.

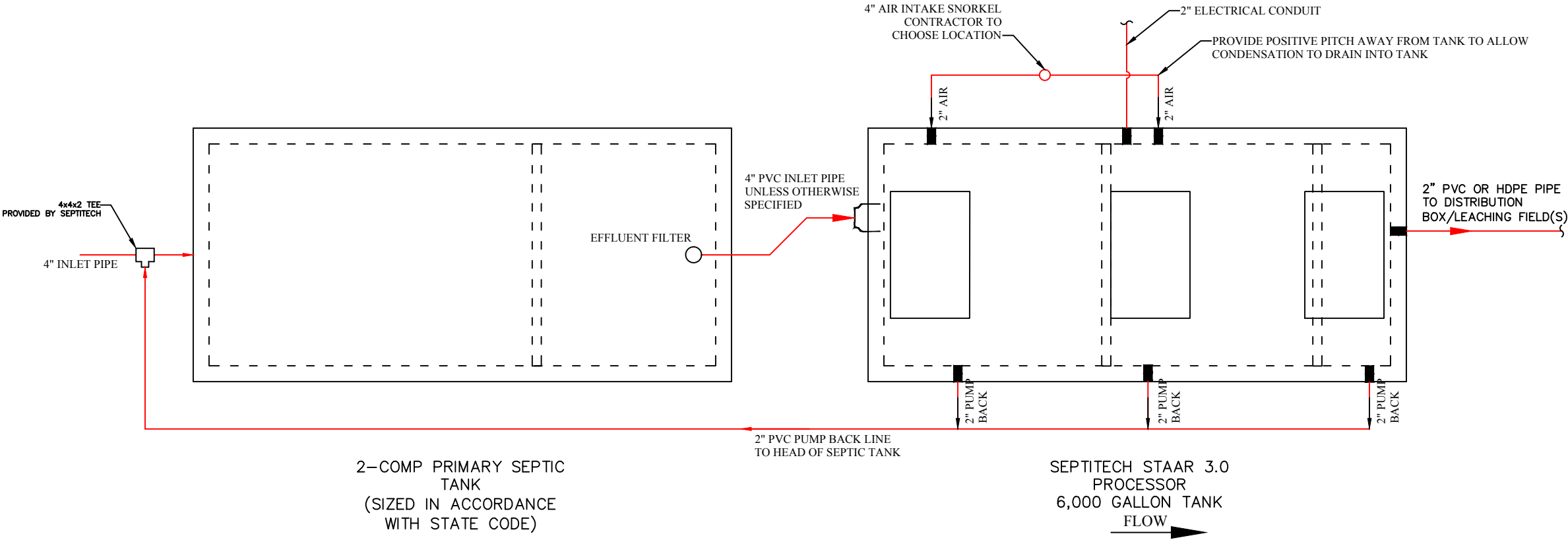
BioMicrobics/SeptiTech requests approval of treatment tanks prior to system being ordered.

Please let me know if you have any questions or would like additional information.

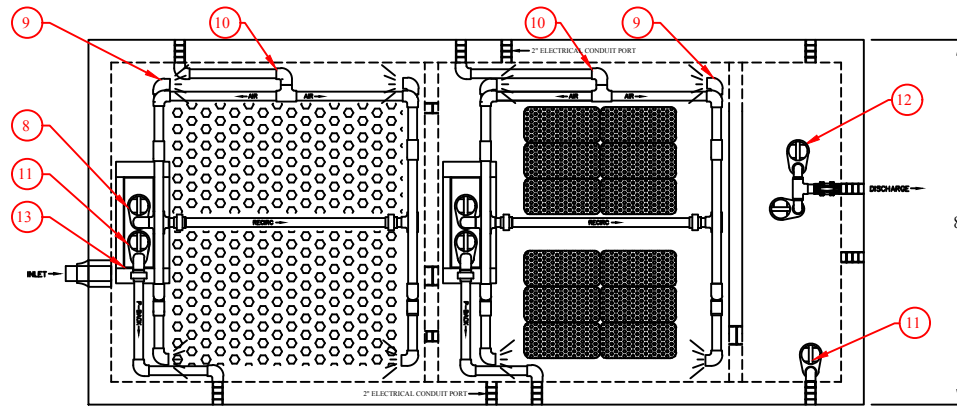
Thanks,
Lauren

GENERAL NOTES

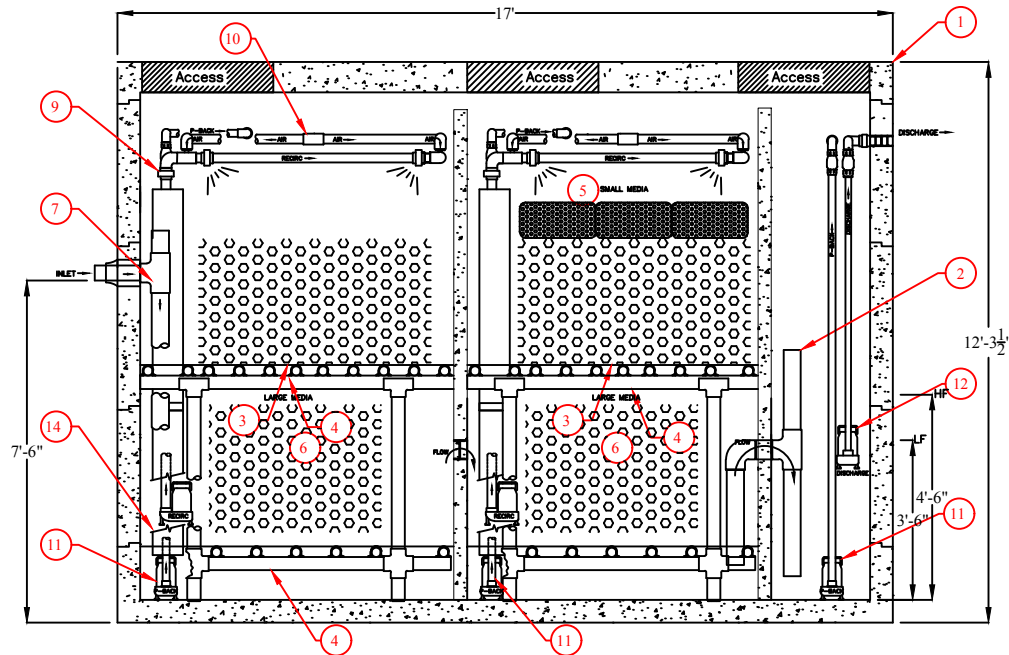
- Tank(s) shall not be installed at a depth any greater than 24-inches. Tank installations requiring a depth greater than 24-inches shall do so with prior approval by SeptiTech only. Any risers required to bring the aluminum hatches to grade are the responsibility of the contractor.
 - Tank(s) shall be installed with a minimum of 12-inches of compacted crushed stone bedding. Select fill shall be used for backfilling around tanks. Native material may be used if approved by the design engineer.
 - Water Testing: Contractor is responsible for water testing the concrete tank(s) once the tank(s) installation has been completed and allowed to set overnight. Water testing shall be conducted in accordance with ASTM C1227.9.2. Installing contractor shall be responsible for providing clean water for the testing, filling the tanks, and pumping the tanks dry once testing is completed.
 - Exterior Piping: Contractor is responsible for supplying and installing all exterior piping per SeptiTech installation drawings.
 - Air Intake Piping: Air intake snorkel shall be installed within 100 feet of the processor tank. Air intake piping shall be installed such that a positive pitch is provided back towards the processor tank such that any condenstaion build up is free to drain.
 - Pipe Insulation: Contractor is responsible for insulating all piping exterior to the SeptiTech processor including the discharge line from the processor to the disposal field.
 - Tank Insulation: After concrete tanks have been installed and water testing is completed, contractor shall insulate the top and sides of the processor tank below frost depth (4-foot minimum) down the sides of the tank with 2" rigid foam (blue) board insulation and then complete backfilling. Contractor is also responsible for installing insulation over the top of the forcemain from the SeptiTech system to the disposal field if not buried below frost level in order to prevent freezing.
 - Electrical: All electrical work is the responsibility of the contractor's licensed electrician and is not provided by SeptiTech. System Controller should be installed in a heated building where an ambient temperature range of 60 to 90 degrees F is maintained. If the control panel must be located outside, please notify SeptiTech, Inc. so a heater may be installed within the enclosure.
- SeptiTech processors can also be built to 3-phase power requirements. If 3-phase is required, please notify SeptiTech at the time of contract signing.
- Internet: Contractor is responsible for installing a internet line to the processor control panel for the Telemetry. Any work performed on the system without the installation of the internet line shall be at the expense of the owner.



SeptiTech [®] a subsidiary of Bio-Microbics, Inc.	DES.BY: JSC
	DR.BY: JSC
	CK.BY: DRR
PROJECT NO.:	
STAAR 3.0 PROCESSOR INSTALLATION PLAN	
DATE: 03/16/07	DWG. NO.:
SCALE: 1/4"=1'-0"	REV.: 1



TOP VIEW



ELEVATION VIEW

FLOW

14	2	#####	Pump Back Chute Assembly
13	2	#####	Pump Chute Assembly
12	1	#####	Dual Discharge Pump Assembly
11	3	#####	Pump Back Pump
10	2	#####	Blaster Air Header Assembly
9	2	#####	Blaster Assembly
8	2	#####	Recirc Pump
7	1	#####	Inlet Piping Assembly
6	2	#####	Large Media
5	2	#####	Small Media
4	4	#####	Support Structure
3	2	#####	Screening Assembly
2	1	#####	Interior Piping Assembly
1	1	#####	6000 Gal. Concrete Tank
ITEM	QTY.	PART NO.	DESCRIPTION

SeptiTech®
a subsidiary of Bio-Microbics, Inc.

DES.BY: DRR
DR.BY: JSC
CK.BY: WDR

PROJECT NO.:

STAAR 3.0
TOTAL TANK LAYOUT

DATE:	03/04/02	DWG. NO.:	
SCALE:	1/4"=1'-0"	REV.:	1

Orenco

EIA Capital Cost (\$) per Home

Sources: MASSTC, Water Industry and Provisional Permit Vendors

BHW - December 19, 2023

EIA costs are currently borne entirely by the homeowner. This analysis works to identify all the costs that would go into an installation.

Retrofit - Many installations can take advantage of components already installed at the home. At the Shubael Pond project, 60% of homes could still use the septic tank and/or the leach field, sometimes with modification. This had a material effect on total project costs and is basis for weighted average calculation.

For a 2-4 bedroom home we look at ranges and make a final assumption.

	<u>Full Installation</u>	<u>Retrofit</u>
Design (1)	5,000-7,000	5,000-7,000
Permitting (2)	400-600	400-600
N Removing Equipment (3)	20,000-35,000	20,000-35,000
Installation (4)	17,000-20,000	7,000-15,000
RME Mgt Fee (5)	500-700	500-700
Total Capital Cost (6)	42,900-63,300	32,900-58,300

Weighted Average (7) - Low 36,900, High 60,300. Average \$48,600. Assume \$50,000.

Notes

- (1) Soil evaluation included. Design costs should be subject to learning curve pricing as project goes into production mode.
- (2) Permitting costs should be consistent from town to town.
- (3) Remote sensors are expected to be limited at this point to indications of whether or not a blower or pump is operating and are assumed to be in the equipment cost.
- (4) Installation includes other components like piping, wiring and Title 5 level equipment. Includes pulling and/or decommissioning old tanks/cesspools. Includes water meter to monitor water use.
- (5) Assumes purchase and installation will be managed by RME, rather than the owner.
- (6) Main variable is balance between Equipment and Installation. When combined, vendor totals were reasonably comparable.
- (7) $(42.9k-63.3k) @ 40\% + (32.9k-58.3k @ 60\%) = \text{Range } \$36.9k-60.3k. \text{ Average } \$48.6.$

Bio-Microbics

BIOMICROBICS

Model: FAST Treatment Systems with Nitrogen Reduction MicroFAST® 0.5, 0.75, 0.9, 1.5, 3.0, 4.5, 9.0 ; HighStrengthFAST® 1.0, 1.5, 3.0, 4.5, 9.0; NitriFAST® 0.5, 0.75, 1.0, 1.5, 3.0, 4.5, 9.0

Nitrogen Reducing Aerobic Treatment system. Nitrogen reducing 25 mg/l for 550 gpda; 19 mg/l for 660 gpda Residential < 2000 gpd Approval: 12/29/10, revised 3/20/15

Budget Quotes:

\$5,710 (tax NOT included)

Additional installation Guidance:

Instead of a 1500-gallon septic tank, this is a 1500-gallon FAST tank. The tank is different due to its configuration, it is configured so that it can accept a fast system to be installed inside of it.

There are two models which are the same price.

H-20: this system goes inside the tank.

H-10: this system requires a rectangular cut out at the top of the tank where the unit can be installed and supported with a flange. Requires venting and air lines. A blower would be hooked up to the air line and would require power.

APPENDIX C:

LOW PRESSURE CORE SEWER AREA VENDOR INFORMATION



Environment One Corporation

Pressure Sewer Preliminary

Cost and Design Analysis

For

Bourne, MA Low Pressure Sewer Design

Prepared For:
EPG

MA

Tel:

Fax:

Prepared By: M. Crowley

February 14, 2024

Bourne, MA Low Pressure Sewer Design

Prepared by : M. Crowley

On: February 14, 2024

Notes :

Elevations estimated using Google Earth. Station and valve quantities approximate. Analysis based upon drawings and data provided. Station recommendations are preliminary. GPD values impact retention times only, not line sizing or hydraulics. GP laterals to be 1.25".

Analysis valid only with pipe type listed. General recommendations for valve placement are: clean out valves at intervals of approximately 1,000 ft and at branch ends and junctions; isolation valves at branch junctions; and air release valves at peaks of 25 ft or more and/or at intervals of 2,000 to 2,500 ft. Lateral kits comprised of a ball and check valve are required to be installed between the pump discharge and street main on all installations. Laterals should be located as close to the public right of way as possible.

Quantities of grinder pumps, pipe, and valves are indicated on the cost page. The model of grinder pump(s) indicated is based upon the initial information provided to us but may not be the most appropriate for the specific location or requirements of the project. Costs of these items and their installation are best obtained from sources in your region.

We recommend you contact your local distributor of Environment One products for additional recommendations.

07.01.2020 - Initial analysis.

02.13.2024 - Rev1.

<<<< END OF NOTES >>>>

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M. Crowley

Bourne, MA Low Pressure Sewer Design

February 14, 2024

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness "C" of: 150							
1.00	2.00	9	9	200	11.00	3	33.00	2.00	3.57	510.00	2.52	12.85	81.73	41.00	16.00	25.00	106.73
2.00	3.00	9	18	200	11.00	4	44.00	3.00	2.19	718.00	0.65	4.67	68.88	41.00	23.00	18.00	86.88
3.00	6.00	8	26	200	11.00	5	55.00	3.00	2.74	1,093.00	0.98	10.74	64.21	41.00	23.00	18.00	82.21
4.00	6.00	4	4	200	11.00	3	33.00	2.00	3.57	291.00	2.52	7.33	60.80	41.00	23.00	18.00	78.80
5.00	6.00	4	4	200	11.00	3	33.00	2.00	3.57	676.00	2.52	17.03	70.50	41.00	25.00	16.00	86.50
6.00	8.00	8	42	200	11.00	6	66.00	3.00	3.29	960.00	1.38	13.22	53.47	41.00	14.00	27.00	80.47
7.00	8.00	7	7	200	11.00	3	33.00	2.00	3.57	1,155.00	2.52	29.10	69.35	41.00	8.00	33.00	102.35
8.00	20.00	0	49	200	11.00	6	66.00	3.00	3.29	161.00	1.38	2.22	40.25	41.00	12.00	29.00	69.25
9.00	11.00	3	3	200	11.00	2	22.00	2.00	2.38	128.00	1.19	1.52	65.60	41.00	15.00	26.00	91.60
10.00	11.00	3	3	200	11.00	2	22.00	2.00	2.38	229.00	1.19	2.72	66.80	41.00	8.00	33.00	99.80
11.00	13.00	3	9	200	11.00	3	33.00	2.00	3.57	287.00	2.52	7.23	64.08	41.00	17.00	24.00	88.08
12.00	13.00	3	3	200	11.00	2	22.00	2.00	2.38	198.00	1.19	2.35	59.20	41.00	17.00	24.00	83.20
13.00	15.00	9	21	200	11.00	5	55.00	3.00	2.74	528.00	0.98	5.19	56.85	41.00	9.00	32.00	88.85
14.00	15.00	3	3	200	11.00	2	22.00	2.00	2.38	212.00	1.19	2.52	54.18	41.00	14.00	27.00	81.18
15.00	17.00	1	25	200	11.00	5	55.00	3.00	2.74	192.00	0.98	1.89	51.66	41.00	16.00	25.00	76.66
16.00	17.00	8	8	200	11.00	3	33.00	2.00	3.57	517.00	2.52	13.03	62.80	41.00	12.00	29.00	91.80
17.00	19.00	6	39	200	11.00	6	66.00	3.00	3.29	396.00	1.38	5.45	49.77	41.00	13.00	28.00	77.77
18.00	19.00	5	5	200	11.00	3	33.00	2.00	3.57	388.00	2.52	9.78	54.10	41.00	12.00	29.00	83.10
19.00	20.00	1	45	200	11.00	6	66.00	3.00	3.29	457.00	1.38	6.29	44.32	41.00	13.00	28.00	72.32
20.00	23.00	17	111	200	11.00	8	88.00	4.00	2.65	982.00	0.69	6.79	38.03	41.00	13.00	28.00	66.03
21.00	22.00	9	9	200	11.00	3	33.00	2.00	3.57	545.00	2.52	13.73	48.55	41.00	21.00	20.00	68.55
22.00	23.00	9	18	200	11.00	4	44.00	3.00	2.19	551.00	0.65	3.58	34.82	41.00	27.00	14.00	48.82
23.00	34.00	7	136	200	11.00	9	99.00	4.00	2.98	440.00	0.86	3.78	31.24	32.00	25.00	7.00	38.24
24.00	27.00	8	8	200	11.00	3	33.00	2.00	3.57	647.00	2.52	16.30	87.78	32.00	8.00	24.00	111.78
25.00	26.00	9	9	200	11.00	3	33.00	2.00	3.57	366.00	2.52	9.22	84.64	32.00	23.00	9.00	93.64
26.00	27.00	5	14	200	11.00	4	44.00	3.00	2.19	606.00	0.65	3.94	75.42	32.00	23.00	9.00	84.42
27.00	29.00	6	28	200	11.00	5	55.00	3.00	2.74	647.00	0.98	6.36	71.48	32.00	32.00	0.00	71.48
28.00	29.00	9	9	200	11.00	3	33.00	2.00	3.57	837.00	2.52	21.09	86.21	32.00	28.00	4.00	90.21
29.00	31.00	14	51	200	11.00	7	77.00	3.00	3.83	1,473.00	1.83	26.99	65.12	32.00	12.00	20.00	85.12
30.00	31.00	3	3	200	11.00	2	22.00	2.00	2.38	393.00	1.19	4.67	42.80	32.00	26.00	6.00	48.80
31.00	33.00	6	60	200	11.00	7	77.00	3.00	3.83	378.00	1.83	6.93	38.13	32.00	28.00	4.00	42.13
32.00	33.00	3	3	200	11.00	2	22.00	2.00	2.38	382.00	1.19	4.54	35.74	32.00	24.00	8.00	43.74
33.00	34.00	1	64	200	11.00	7	77.00	3.00	3.83	204.00	1.83	3.74	31.20	32.00	25.00	7.00	38.20
34.00	58.00	12	212	200	11.00	11	121.00	4.00	3.65	618.00	1.25	7.70	27.46	32.00	26.00	6.00	33.46
35.00	36.00	9	9	200	11.00	3	33.00	2.00	3.57	1,064.00	2.52	26.81	54.49	31.00	18.00	13.00	67.49

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M. Crowley

Bourne, MA Low Pressure Sewer Design

February 14, 2024

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness "C" of: 150							
36.00	37.00	9	18	200	11.00	4	44.00	3.00	2.19	706.00	0.65	4.59	27.68	31.00	18.00	13.00	40.68
37.00	40.00	6	24	200	11.00	5	55.00	3.00	2.74	420.00	0.98	4.13	23.09	31.00	17.00	14.00	37.09
38.00	39.00	9	9	200	11.00	3	33.00	2.00	3.57	359.00	2.52	9.04	30.21	31.00	10.00	21.00	51.21
39.00	40.00	4	13	200	11.00	4	44.00	3.00	2.19	340.00	0.65	2.21	21.17	31.00	18.00	13.00	34.17
40.00	42.00	3	40	200	11.00	6	66.00	3.00	3.29	229.00	1.38	3.15	18.96	31.00	23.00	8.00	26.96
41.00	42.00	9	9	200	11.00	3	33.00	2.00	3.57	962.00	2.52	24.24	40.05	31.00	30.00	1.00	41.05
42.00	44.00	0	49	200	11.00	6	66.00	3.00	3.29	105.00	1.38	1.45	15.81	31.00	20.00	11.00	26.81
43.00	44.00	9	9	200	11.00	3	33.00	2.00	3.57	478.00	2.52	12.04	26.40	31.00	20.00	11.00	37.40
44.00	46.00	2	60	200	11.00	7	77.00	3.00	3.83	296.00	1.83	5.42	14.36	31.00	15.00	16.00	30.36
45.00	46.00	7	7	200	11.00	3	33.00	2.00	3.57	315.00	2.52	7.94	16.88	31.00	15.00	16.00	32.88
46.00	140.00	1	68	200	11.00	7	77.00	3.00	3.83	232.00	1.83	4.25	8.94	31.00	15.00	16.00	24.94
47.00	48.00	9	9	200	11.00	3	33.00	2.00	3.57	542.00	2.52	13.66	40.30	47.00	38.00	9.00	49.30
48.00	50.00	6	15	200	11.00	4	44.00	3.00	2.19	490.00	0.65	3.18	26.64	31.00	16.00	15.00	41.64
49.00	50.00	3	3	200	11.00	2	22.00	2.00	2.38	312.00	1.19	3.71	27.17	31.00	15.00	16.00	43.17
50.00	51.00	9	27	200	11.00	5	55.00	3.00	2.74	546.00	0.98	5.36	23.46	31.00	12.00	19.00	42.46
51.00	53.00	7	34	200	11.00	6	66.00	3.00	3.29	610.00	1.38	8.40	18.10	31.00	11.00	20.00	38.10
52.00	53.00	2	2	200	11.00	2	22.00	2.00	2.38	81.00	1.19	0.96	10.66	31.00	9.00	22.00	32.66
53.00	140.00	7	43	200	11.00	6	66.00	3.00	3.29	364.00	1.38	5.01	9.70	31.00	10.00	21.00	30.70
54.00	140.00	5	23	200	11.00	5	55.00	3.00	2.74	262.00	0.98	2.57	7.26	31.00	24.00	7.00	14.26
55.00	54.00	6	6	200	11.00	3	33.00	2.00	3.57	399.00	2.52	10.05	17.31	31.00	8.00	23.00	40.31
56.00	54.00	9	12	200	11.00	4	44.00	3.00	2.19	651.00	0.65	4.23	11.49	31.00	22.00	9.00	20.49
57.00	56.00	3	3	200	11.00	2	22.00	2.00	2.38	211.00	1.19	2.51	14.00	31.00	10.00	21.00	35.00
58.00	60.00	3	215	200	11.00	12	132.00	4.00	3.98	208.00	1.46	3.05	19.76	31.00	27.00	4.00	23.76
59.00	141.00	9	236	200	11.00	12	132.00	4.00	3.98	357.00	1.46	5.23	7.71	31.00	31.00	0.00	7.71
60.00	59.00	12	227	200	11.00	12	132.00	4.00	3.98	615.00	1.46	9.00	16.71	31.00	29.00	2.00	18.71
61.00	64.00	3	3	200	11.00	2	22.00	2.00	2.38	253.00	1.19	3.01	11.10	31.00	27.00	4.00	15.10
62.00	142.00	9	488	200	11.00	20	220.00	6.00	3.06	446.00	0.57	2.56	4.09	31.00	30.00	1.00	5.09
63.00	62.00	9	479	200	11.00	20	220.00	6.00	3.06	422.00	0.57	2.42	6.51	31.00	30.00	1.00	7.51
64.00	63.00	5	470	200	11.00	19	209.00	6.00	2.90	303.00	0.52	1.58	8.09	31.00	27.00	4.00	12.09
65.00	64.00	2	462	200	11.00	19	209.00	6.00	2.90	236.00	0.52	1.23	9.32	31.00	23.00	8.00	17.32
66.00	67.00	9	9	200	11.00	3	33.00	2.00	3.57	338.00	2.52	8.52	21.50	31.00	13.00	18.00	39.50
67.00	65.00	9	18	200	11.00	4	44.00	3.00	2.19	563.00	0.65	3.66	12.98	31.00	23.00	8.00	20.98
68.00	65.00	0	442	200	11.00	18	198.00	6.00	2.75	101.00	0.47	0.48	9.80	31.00	23.00	8.00	17.80
69.00	70.00	9	9	200	11.00	3	33.00	2.00	3.57	677.00	2.52	17.06	37.29	31.00	19.00	12.00	49.29
70.00	70.10	3	12	200	11.00	4	44.00	3.00	2.19	164.00	0.65	1.07	20.23	31.00	26.00	5.00	25.23

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M. Crowley

Bourne, MA Low Pressure Sewer Design

February 14, 2024

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness "C" of: 150							
70.10	71.00	6	67	200	11.00	7	77.00	3.00	3.83	390.00	1.83	7.14	19.16	31.00	25.00	6.00	25.16
71.00	68.00	4	93	200	11.00	8	88.00	4.00	2.65	321.00	0.69	2.22	12.02	31.00	24.00	7.00	19.02
72.00	68.00	2	349	200	11.00	16	176.00	6.00	2.45	229.00	0.38	0.87	10.67	31.00	23.00	8.00	18.67
73.00	74.00	4	4	200	11.00	3	33.00	2.00	3.57	1,053.00	2.52	26.53	58.36	47.00	44.00	3.00	61.36
74.00	72.00	4	8	200	11.00	3	33.00	2.00	3.57	840.00	2.52	21.16	31.83	31.00	22.00	9.00	40.83
75.00	72.00	7	339	200	11.00	15	165.00	6.00	2.29	445.00	0.34	1.50	12.17	31.00	21.00	10.00	22.17
76.00	75.00	9	9	200	11.00	3	33.00	2.00	3.57	764.00	2.52	19.25	31.42	31.00	20.00	11.00	42.42
77.00	75.00	7	323	200	11.00	15	165.00	6.00	2.29	452.00	0.34	1.52	13.69	31.00	20.00	11.00	24.69
78.00	77.00	4	4	200	11.00	3	33.00	2.00	3.57	419.00	2.52	10.56	24.25	31.00	20.00	11.00	35.25
79.00	77.00	6	312	200	11.00	15	165.00	6.00	2.29	403.00	0.34	1.36	15.05	31.00	18.00	13.00	28.05
80.00	81.00	9	9	200	11.00	3	33.00	2.00	3.57	501.00	2.52	12.62	36.92	33.00	17.00	16.00	52.92
81.00	82.20	5	14	200	11.00	4	44.00	3.00	2.19	211.00	0.65	1.37	24.30	33.00	33.00	0.00	24.30
82.00	82.10	9	9	200	11.00	3	33.00	2.00	3.57	411.00	2.52	10.35	37.25	34.00	34.00	0.00	37.25
82.10	82.20	4	35	200	11.00	6	66.00	3.00	3.29	288.00	1.38	3.97	26.90	32.00	32.00	0.00	26.90
82.20	70.10	0	49	200	11.00	6	66.00	3.00	3.29	274.00	1.38	3.77	22.93	31.00	30.00	1.00	23.93
83.00	82.10	6	22	200	11.00	5	55.00	3.00	2.74	477.00	0.98	4.69	31.59	32.00	28.00	4.00	35.59
84.00	85.00	9	9	200	11.00	3	33.00	2.00	3.57	600.00	2.52	15.12	48.26	32.00	18.00	14.00	62.26
85.00	83.00	5	14	200	11.00	4	44.00	3.00	2.19	239.00	0.65	1.55	33.14	32.00	26.00	6.00	39.14
86.00	83.00	2	2	200	11.00	2	22.00	2.00	2.38	136.00	1.19	1.62	33.21	32.00	25.00	7.00	40.21
87.00	71.00	9	22	200	11.00	5	55.00	3.00	2.74	677.00	0.98	6.65	18.67	31.00	27.00	4.00	22.67
88.00	87.00	8	13	200	11.00	4	44.00	3.00	2.19	617.00	0.65	4.01	22.68	31.00	25.00	6.00	28.68
89.00	88.00	5	5	200	11.00	3	33.00	2.00	3.57	174.00	2.52	4.38	27.06	31.00	16.00	15.00	42.06
90.00	91.00	9	9	200	11.00	3	33.00	2.00	3.57	608.00	2.52	15.32	35.66	31.00	19.00	12.00	47.66
91.00	94.00	3	12	200	11.00	4	44.00	3.00	2.19	280.00	0.65	1.82	20.34	31.00	17.00	14.00	34.34
92.00	93.00	9	9	200	11.00	3	33.00	2.00	3.57	579.00	2.52	14.59	36.89	31.00	16.00	15.00	51.89
93.00	94.00	9	18	200	11.00	4	44.00	3.00	2.19	582.00	0.65	3.78	22.30	31.00	16.00	15.00	37.30
94.00	79.00	2	32	200	11.00	6	66.00	3.00	3.29	252.00	1.38	3.47	18.52	31.00	17.00	14.00	32.52
95.00	79.00	3	274	200	11.00	13	143.00	6.00	1.99	263.00	0.26	0.68	15.73	31.00	16.00	15.00	30.73
96.00	97.00	9	9	200	11.00	3	33.00	2.00	3.57	555.00	2.52	13.98	35.90	31.00	13.00	18.00	53.90
97.00	98.00	9	18	200	11.00	4	44.00	3.00	2.19	407.00	0.65	2.64	21.92	31.00	13.00	18.00	39.92
98.00	95.00	5	23	200	11.00	5	55.00	3.00	2.74	361.00	0.98	3.55	19.28	31.00	14.00	17.00	36.28
99.00	95.00	2	248	200	11.00	13	143.00	6.00	1.99	293.00	0.26	0.76	16.49	31.00	17.00	14.00	30.49
100.00	101.00	9	9	200	11.00	3	33.00	2.00	3.57	417.00	2.52	10.51	34.23	31.00	11.00	20.00	54.23
101.00	102.00	9	18	200	11.00	4	44.00	3.00	2.19	431.00	0.65	2.80	23.72	31.00	15.00	16.00	39.72
102.00	99.00	5	23	200	11.00	5	55.00	3.00	2.74	451.00	0.98	4.43	20.92	31.00	17.00	14.00	34.92

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M. Crowley

Bourne, MA Low Pressure Sewer Design

February 14, 2024

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE										Friction loss calculations were based on a Constant for inside roughness "C" of: 150							
103.00	99.00	3	223	200	11.00	12	132.00	4.00	3.98	280.00	1.46	4.10	20.59	31.00	21.00	10.00	30.59
104.00	105.00	9	9	200	11.00	3	33.00	2.00	3.57	496.00	2.52	12.50	39.08	32.00	18.00	14.00	53.08
105.00	106.00	9	18	200	11.00	4	44.00	3.00	2.19	429.00	0.65	2.79	26.58	32.00	23.00	9.00	35.58
106.00	103.00	5	23	200	11.00	5	55.00	3.00	2.74	326.00	0.98	3.20	23.79	32.00	30.00	2.00	25.79
107.00	103.00	3	197	200	11.00	11	121.00	4.00	3.65	278.00	1.25	3.46	24.05	32.00	32.00	0.00	24.05
108.00	109.00	9	9	200	11.00	3	33.00	2.00	3.57	58.00	2.52	1.46	31.33	36.00	30.00	6.00	37.33
109.00	110.00	9	18	200	11.00	4	44.00	3.00	2.19	321.00	0.65	2.09	29.87	35.00	35.00	0.00	29.87
110.00	107.00	5	23	200	11.00	5	55.00	3.00	2.74	380.00	0.98	3.73	27.78	33.00	33.00	0.00	27.78
111.00	112.00	9	9	200	11.00	3	33.00	2.00	3.57	771.00	2.52	19.42	62.64	40.00	21.00	19.00	81.64
112.00	117.00	9	18	200	11.00	4	44.00	3.00	2.19	893.00	0.65	5.80	43.22	32.00	23.00	9.00	52.22
113.00	115.00	5	5	200	11.00	3	33.00	2.00	3.57	214.00	2.52	5.39	50.90	32.00	24.00	8.00	58.90
114.00	115.00	3	3	200	11.00	2	22.00	2.00	2.38	445.00	1.19	5.29	50.80	32.00	31.00	1.00	51.80
115.00	116.00	9	17	200	11.00	4	44.00	3.00	2.19	765.00	0.65	4.97	45.51	32.00	23.00	9.00	54.51
116.00	117.00	4	21	200	11.00	5	55.00	3.00	2.74	318.00	0.98	3.12	40.54	32.00	23.00	9.00	49.54
117.00	121.00	7	46	200	11.00	6	66.00	3.00	3.29	483.00	1.38	6.65	37.42	32.00	22.00	10.00	47.42
118.00	119.00	9	9	200	11.00	3	33.00	2.00	3.57	406.00	2.52	10.23	49.62	34.00	21.00	13.00	62.62
119.00	120.00	9	18	200	11.00	4	44.00	3.00	2.19	810.00	0.65	5.26	39.39	34.00	15.00	19.00	58.39
120.00	121.00	6	24	200	11.00	5	55.00	3.00	2.74	342.00	0.98	3.36	34.13	32.00	20.00	12.00	46.13
121.00	107.00	0	70	200	11.00	7	77.00	3.00	3.83	367.00	1.83	6.72	30.77	32.00	22.00	10.00	40.77
122.00	107.00	3	101	200	11.00	8	88.00	4.00	2.65	364.00	0.69	2.52	26.57	32.00	24.00	8.00	34.57
123.00	125.00	7	7	200	11.00	3	33.00	2.00	3.57	354.00	2.52	8.92	68.22	32.00	13.00	19.00	87.22
124.00	125.00	6	6	200	11.00	3	33.00	2.00	3.57	212.00	2.52	5.34	64.64	32.00	16.00	16.00	80.64
125.00	128.00	6	19	200	11.00	5	55.00	3.00	2.74	942.00	0.98	9.25	59.30	32.00	24.00	8.00	67.30
126.00	127.00	9	9	200	11.00	3	33.00	2.00	3.57	597.00	2.52	15.04	69.16	32.00	16.00	16.00	85.16
127.00	128.00	7	16	200	11.00	4	44.00	3.00	2.19	626.00	0.65	4.07	54.12	32.00	16.00	16.00	70.12
128.00	130.00	3	38	200	11.00	6	66.00	3.00	3.29	307.00	1.38	4.23	50.05	32.00	18.00	14.00	64.05
129.00	130.00	8	8	200	11.00	3	33.00	2.00	3.57	525.00	2.52	13.23	59.05	32.00	10.00	22.00	81.05
130.00	132.00	6	52	200	11.00	7	77.00	3.00	3.83	401.00	1.83	7.35	45.82	32.00	13.00	19.00	64.82
131.00	132.00	7	7	200	11.00	3	33.00	2.00	3.57	454.00	2.52	11.44	49.91	32.00	13.00	19.00	68.91
132.00	134.00	4	63	200	11.00	7	77.00	3.00	3.83	307.00	1.83	5.62	38.47	32.00	13.00	19.00	57.47
133.00	134.00	4	4	200	11.00	3	33.00	2.00	3.57	314.00	2.52	7.91	40.76	32.00	13.00	19.00	59.76
134.00	122.00	2	69	200	11.00	7	77.00	3.00	3.83	343.00	1.83	6.28	32.85	32.00	18.00	14.00	46.85
135.00	122.00	2	29	200	11.00	5	55.00	3.00	2.74	161.00	0.98	1.58	28.15	32.00	24.00	8.00	36.15
136.00	137.00	9	9	200	11.00	3	33.00	2.00	3.57	935.00	2.52	23.56	56.69	32.00	17.00	15.00	71.69
137.00	135.00	10	27	200	11.00	5	55.00	3.00	2.74	507.00	0.98	4.98	33.13	32.00	30.00	2.00	35.13

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M. Crowley

Bourne, MA Low Pressure Sewer Design

February 14, 2024

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Friction Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Friction loss calculations were based on a Constant for inside roughness "C" of: 150										
138.00	137.00	2	2	200	11.00	2	22.00	2.00	2.38	312.00	1.19	3.71	36.84	32.00	30.00	2.00	38.84
139.00	137.00	6	6	200	11.00	3	33.00	2.00	3.57	833.00	2.52	20.99	54.12	32.00	28.00	4.00	58.12
140.00	141.00	0	134	200	11.00	9	99.00	4.00	2.98	257.00	0.86	2.21	4.69	31.00	24.00	7.00	11.69
141.00	142.00	0	370	200	11.00	16	176.00	6.00	2.45	250.00	0.38	0.95	2.48	31.00	30.00	1.00	3.48
142.00	142.00	0	858	200	11.00	31	341.00	8.00	2.80	428.00	0.36	1.53	1.53	16.00	16.00	0.00	1.53

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME(HR)

Bourne, MA Low Pressure Sewer Design

Prepared By:

M. Crowley

February 14, 2024

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
1.00	2.00	9	2.00	15.40	510.00	78.55	1,800	22.91	1.05	6.95
2.00	3.00	18	3.00	33.47	718.00	240.29	3,600	14.98	1.60	5.90
3.00	6.00	26	3.00	33.47	1,093.00	365.79	5,200	14.22	1.69	4.30
4.00	6.00	4	2.00	15.40	291.00	44.82	800	17.85	1.34	3.95
5.00	6.00	4	2.00	15.40	676.00	104.12	800	7.68	3.12	5.73
6.00	8.00	42	3.00	33.47	960.00	321.28	8,400	26.15	0.92	2.61
7.00	8.00	7	2.00	15.40	1,155.00	177.90	1,400	7.87	3.05	4.74
8.00	20.00	49	3.00	33.47	161.00	53.88	9,800	181.88	0.13	1.69
9.00	11.00	3	2.00	15.40	128.00	19.72	600	30.43	0.79	5.07
10.00	11.00	3	2.00	15.40	229.00	35.27	600	17.01	1.41	5.69
11.00	13.00	9	2.00	15.40	287.00	44.21	1,800	40.72	0.59	4.28
12.00	13.00	3	2.00	15.40	198.00	30.50	600	19.67	1.22	4.91
13.00	15.00	21	3.00	33.47	528.00	176.70	4,200	23.77	1.01	3.69
14.00	15.00	3	2.00	15.40	212.00	32.65	600	18.37	1.31	3.99
15.00	17.00	25	3.00	33.47	192.00	64.26	5,000	77.81	0.31	2.68
16.00	17.00	8	2.00	15.40	517.00	79.63	1,600	20.09	1.19	3.57
17.00	19.00	39	3.00	33.47	396.00	132.53	7,800	58.86	0.41	2.37
18.00	19.00	5	2.00	15.40	388.00	59.76	1,000	16.73	1.43	3.40
19.00	20.00	45	3.00	33.47	457.00	152.94	9,000	58.85	0.41	1.97
20.00	23.00	111	4.00	55.31	982.00	543.18	22,200	40.87	0.59	1.56
21.00	22.00	9	2.00	15.40	545.00	83.95	1,800	21.44	1.12	3.32
22.00	23.00	18	3.00	33.47	551.00	184.40	3,600	19.52	1.23	2.20
23.00	34.00	136	4.00	55.31	440.00	243.38	27,200	111.76	0.21	0.97
24.00	27.00	8	2.00	15.40	647.00	99.66	1,600	16.06	1.49	4.72
25.00	26.00	9	2.00	15.40	366.00	56.37	1,800	31.93	0.75	5.72
26.00	27.00	14	3.00	33.47	606.00	202.81	2,800	13.81	1.74	4.96
27.00	29.00	28	3.00	33.47	647.00	216.53	5,600	25.86	0.93	3.23
28.00	29.00	9	2.00	15.40	837.00	128.92	1,800	13.96	1.72	4.02
29.00	31.00	51	3.00	33.47	1,473.00	492.96	10,200	20.69	1.16	2.30
30.00	31.00	3	2.00	15.40	393.00	60.53	600	9.91	2.42	3.56
31.00	33.00	60	3.00	33.47	378.00	126.50	12,000	94.86	0.25	1.14
32.00	33.00	3	2.00	15.40	382.00	58.84	600	10.20	2.35	3.24
33.00	34.00	64	3.00	33.47	204.00	68.27	12,800	187.49	0.13	0.88
34.00	58.00	212	4.00	55.31	618.00	341.84	42,400	124.04	0.19	0.76
35.00	36.00	9	2.00	15.40	1,064.00	163.89	1,800	10.98	2.19	5.46

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME(HR)

Bourne, MA Low Pressure Sewer Design

Prepared By:
M. Crowley

February 14, 2024

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
36.00	37.00	18	3.00	33.47	706.00	236.27	3,600	15.24	1.58	3.28
37.00	40.00	24	3.00	33.47	420.00	140.56	4,800	34.15	0.70	1.70
38.00	39.00	9	2.00	15.40	359.00	55.30	1,800	32.55	0.74	2.78
39.00	40.00	13	3.00	33.47	340.00	113.79	2,600	22.85	1.05	2.05
40.00	42.00	40	3.00	33.47	229.00	76.64	8,000	104.39	0.23	1.00
41.00	42.00	9	2.00	15.40	962.00	148.18	1,800	12.15	1.98	2.74
42.00	44.00	49	3.00	33.47	105.00	35.14	9,800	278.89	0.09	0.77
43.00	44.00	9	2.00	15.40	478.00	73.63	1,800	24.45	0.98	1.66
44.00	46.00	60	3.00	33.47	296.00	99.06	12,000	121.14	0.20	0.68
45.00	46.00	7	2.00	15.40	315.00	48.52	1,400	28.85	0.83	1.31
46.00	140.00	68	3.00	33.47	232.00	77.64	13,600	175.16	0.14	0.48
47.00	48.00	9	2.00	15.40	542.00	83.48	1,800	21.56	1.11	4.64
48.00	50.00	15	3.00	33.47	490.00	163.99	3,000	18.29	1.31	3.53
49.00	50.00	3	2.00	15.40	312.00	48.06	600	12.49	1.92	4.14
50.00	51.00	27	3.00	33.47	546.00	182.73	5,400	29.55	0.81	2.22
51.00	53.00	34	3.00	33.47	610.00	204.15	6,800	33.31	0.72	1.41
52.00	53.00	2	2.00	15.40	81.00	12.48	400	32.06	0.75	1.43
53.00	140.00	43	3.00	33.47	364.00	121.82	8,600	70.60	0.34	0.69
54.00	140.00	23	3.00	33.47	262.00	87.68	4,600	52.46	0.46	0.80
55.00	54.00	6	2.00	15.40	399.00	61.46	1,200	19.53	1.23	2.03
56.00	54.00	12	3.00	33.47	651.00	217.87	2,400	11.02	2.18	2.98
57.00	56.00	3	2.00	15.40	211.00	32.50	600	18.46	1.30	4.28
58.00	60.00	215	4.00	55.31	208.00	115.05	43,000	373.75	0.06	0.56
59.00	141.00	236	4.00	55.31	357.00	197.47	47,200	239.03	0.10	0.32
60.00	59.00	227	4.00	55.31	615.00	340.18	45,400	133.46	0.18	0.50
61.00	64.00	3	2.00	15.40	253.00	38.97	600	15.40	1.56	2.03
62.00	142.00	488	6.00	119.90	446.00	534.75	97,600	182.52	0.13	0.25
63.00	62.00	479	6.00	119.90	422.00	505.97	95,800	189.34	0.13	0.38
64.00	63.00	470	6.00	119.90	303.00	363.29	94,000	258.74	0.09	0.47
65.00	64.00	462	6.00	119.90	236.00	282.96	92,400	326.55	0.07	0.55
66.00	67.00	9	2.00	15.40	338.00	52.06	1,800	34.57	0.69	2.50
67.00	65.00	18	3.00	33.47	563.00	188.42	3,600	19.11	1.26	1.80
68.00	65.00	442	6.00	119.90	101.00	121.10	88,400	729.99	0.03	0.58
69.00	70.00	9	2.00	15.40	677.00	104.28	1,800	17.26	1.39	2.98
70.00	70.10	12	3.00	33.47	164.00	54.89	2,400	43.73	0.55	1.59

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME(HR)

Bourne, MA Low Pressure Sewer Design

Prepared By:
M. Crowley

February 14, 2024

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
70.10	71.00	67	3.00	33.47	390.00	130.52	13,400	102.67	0.23	1.04
71.00	68.00	93	4.00	55.31	321.00	177.56	18,600	104.76	0.23	0.81
72.00	68.00	349	6.00	119.90	229.00	274.57	69,800	254.22	0.09	0.67
73.00	74.00	4	2.00	15.40	1,053.00	162.19	800	4.93	4.87	7.48
74.00	72.00	8	2.00	15.40	840.00	129.38	1,600	12.37	1.94	2.61
75.00	72.00	339	6.00	119.90	445.00	533.55	67,800	127.07	0.19	0.86
76.00	75.00	9	2.00	15.40	764.00	117.68	1,800	15.30	1.57	2.43
77.00	75.00	323	6.00	119.90	452.00	541.94	64,600	119.20	0.20	1.06
78.00	77.00	4	2.00	15.40	419.00	64.54	800	12.40	1.94	3.00
79.00	77.00	312	6.00	119.90	403.00	483.19	62,400	129.14	0.19	1.25
80.00	81.00	9	2.00	15.40	501.00	77.17	1,800	23.33	1.03	2.90
81.00	82.20	14	3.00	33.47	211.00	70.61	2,800	39.65	0.61	1.87
82.00	82.10	9	2.00	15.40	411.00	63.31	1,800	28.43	0.84	2.44
82.10	82.20	35	3.00	33.47	288.00	96.38	7,000	72.63	0.33	1.60
82.20	70.10	49	3.00	33.47	274.00	91.70	9,800	106.87	0.22	1.27
83.00	82.10	22	3.00	33.47	477.00	159.64	4,400	27.56	0.87	2.47
84.00	85.00	9	2.00	15.40	600.00	92.42	1,800	19.48	1.23	4.39
85.00	83.00	14	3.00	33.47	239.00	79.98	2,800	35.01	0.69	3.15
86.00	83.00	2	2.00	15.40	136.00	20.95	400	19.10	1.26	3.72
87.00	71.00	22	3.00	33.47	677.00	226.57	4,400	19.42	1.24	2.04
88.00	87.00	13	3.00	33.47	617.00	206.49	2,600	12.59	1.91	3.95
89.00	88.00	5	2.00	15.40	174.00	26.80	1,000	37.31	0.64	4.59
90.00	91.00	9	2.00	15.40	608.00	93.65	1,800	19.22	1.25	3.75
91.00	94.00	12	3.00	33.47	280.00	93.71	2,400	25.61	0.94	2.50
92.00	93.00	9	2.00	15.40	579.00	89.18	1,800	20.18	1.19	4.05
93.00	94.00	18	3.00	33.47	582.00	194.77	3,600	18.48	1.30	2.86
94.00	79.00	32	3.00	33.47	252.00	84.34	6,400	75.89	0.32	1.57
95.00	79.00	274	6.00	119.90	263.00	315.33	54,800	173.78	0.14	1.39
96.00	97.00	9	2.00	15.40	555.00	85.49	1,800	21.06	1.14	4.07
97.00	98.00	18	3.00	33.47	407.00	136.21	3,600	26.43	0.91	2.93
98.00	95.00	23	3.00	33.47	361.00	120.81	4,600	38.08	0.63	2.02
99.00	95.00	248	6.00	119.90	293.00	351.30	49,600	141.19	0.17	1.56
100.00	101.00	9	2.00	15.40	417.00	64.23	1,800	28.02	0.86	4.16
101.00	102.00	18	3.00	33.47	431.00	144.24	3,600	24.96	0.96	3.31
102.00	99.00	23	3.00	33.47	451.00	150.93	4,600	30.48	0.79	2.35

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Bourne, MA Low Pressure Sewer Design

Prepared By:

M. Crowley

February 14, 2024

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
103.00	99.00	223	4.00	55.31	280.00	154.88	44,600	287.97	0.08	1.64
104.00	105.00	9	2.00	15.40	496.00	76.40	1,800	23.56	1.02	4.19
105.00	106.00	18	3.00	33.47	429.00	143.57	3,600	25.07	0.96	3.17
106.00	103.00	23	3.00	33.47	326.00	109.10	4,600	42.16	0.57	2.21
107.00	103.00	197	4.00	55.31	278.00	153.77	39,400	256.23	0.09	1.73
108.00	109.00	9	2.00	15.40	58.00	8.93	1,800	201.49	0.12	3.23
109.00	110.00	18	3.00	33.47	321.00	107.43	3,600	33.51	0.72	3.11
110.00	107.00	23	3.00	33.47	380.00	127.17	4,600	36.17	0.66	2.40
111.00	112.00	9	2.00	15.40	771.00	118.76	1,800	15.16	1.58	5.94
112.00	117.00	18	3.00	33.47	893.00	298.86	3,600	12.05	1.99	4.36
113.00	115.00	5	2.00	15.40	214.00	32.96	1,000	30.34	0.79	5.57
114.00	115.00	3	2.00	15.40	445.00	68.54	600	8.75	2.74	7.52
115.00	116.00	17	3.00	33.47	765.00	256.02	3,400	13.28	1.81	4.78
116.00	117.00	21	3.00	33.47	318.00	106.42	4,200	39.47	0.61	2.97
117.00	121.00	46	3.00	33.47	483.00	161.64	9,200	56.92	0.42	2.37
118.00	119.00	9	2.00	15.40	406.00	62.54	1,800	28.78	0.83	5.16
119.00	120.00	18	3.00	33.47	810.00	271.08	3,600	13.28	1.81	4.32
120.00	121.00	24	3.00	33.47	342.00	114.46	4,800	41.94	0.57	2.52
121.00	107.00	70	3.00	33.47	367.00	122.82	14,000	113.99	0.21	1.95
122.00	107.00	101	4.00	55.31	364.00	201.34	20,200	100.33	0.24	1.97
123.00	125.00	7	2.00	15.40	354.00	54.53	1,400	25.68	0.93	5.93
124.00	125.00	6	2.00	15.40	212.00	32.65	1,200	36.75	0.65	5.65
125.00	128.00	19	3.00	33.47	942.00	315.25	3,800	12.05	1.99	4.99
126.00	127.00	9	2.00	15.40	597.00	91.96	1,800	19.57	1.23	5.80
127.00	128.00	16	3.00	33.47	626.00	209.50	3,200	15.27	1.57	4.57
128.00	130.00	38	3.00	33.47	307.00	102.74	7,600	73.97	0.32	3.00
129.00	130.00	8	2.00	15.40	525.00	80.86	1,600	19.79	1.21	3.89
130.00	132.00	52	3.00	33.47	401.00	134.20	10,400	77.50	0.31	2.68
131.00	132.00	7	2.00	15.40	454.00	69.93	1,400	20.02	1.20	3.57
132.00	134.00	63	3.00	33.47	307.00	102.74	12,600	122.64	0.20	2.37
133.00	134.00	4	2.00	15.40	314.00	48.36	800	16.54	1.45	3.62
134.00	122.00	69	3.00	33.47	343.00	114.79	13,800	120.22	0.20	2.17
135.00	122.00	29	3.00	33.47	161.00	53.88	5,800	107.64	0.22	2.20
136.00	137.00	9	2.00	15.40	935.00	144.02	1,800	12.50	1.92	4.87
137.00	135.00	27	3.00	33.47	507.00	169.68	5,400	31.83	0.75	2.95

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Bourne, MA Low Pressure Sewer Design

Prepared By:
M. Crowley

February 14, 2024

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11HDPE							Gals per Day per Dwelling		200	
138.00	137.00	2	2.00	15.40	312.00	48.06	400	8.32	2.88	5.83
139.00	137.00	6	2.00	15.40	833.00	128.31	1,200	9.35	2.57	5.52
140.00	141.00	134	4.00	55.31	257.00	142.15	26,800	188.53	0.13	0.35
141.00	142.00	370	6.00	119.90	250.00	299.75	74,000	246.87	0.10	0.22
142.00	142.00	858	8.00	203.19	428.00	869.65	171,600	197.32	0.12	0.12

APPENDIX D: IMPLEMENTATION SCHEDULE



**Town of Bourne CWMP - Preliminary Implementation Schedule
Based on Draft Recommended Plan**

[illegible]

Assumptions:

2. Single PEF with all Phinney's Harbor improvements. If separate applications are filed, they follow same deadlines as noted. PEF assumed to be for 2028 IUP.

APPENDIX E: IMPLEMENTATION COST ESTIMATE

	Inflation	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Calendar Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034					
	Plan Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10					
Tier 1 - Number of Installations (Parcels)																
Megansett Squeteague ¹		57	57	57	57	57										
Phinney's Harbor ²							218	218								
Tier 1 Subtotal		57	57	57	57	57	218	218	0	0	0					
Tier 2 - Number of Installations (Parcels)																
Buttermilk Bay - Sewer 1 (TN Removal Goal only)																
Pocasset Harbor																
Pocasset River																
Tier 2 Subtotal		0	0	0	0	0	0	0	0	0	0					
Total Installations		57	57	57	57	57	218	218	0	0	0					
Tier 1 - Capital Costs																
Megansett Squeteague ³		\$ 2,423,000	\$ 2,544,000	\$ 2,665,000	\$ 2,786,000	\$ 2,907,000	\$ -	\$ -	\$ -	\$ -	\$ -					
Phinney's Harbor ⁴		\$ 200,000	\$ 1,000,000	\$ 800,000	\$ 300,000	\$ 18,748,500	\$ 19,529,688	\$ 20,310,875	\$ -	\$ -	\$ -					
Tier 1 Capital Cost Subtotal		\$ 2,623,000	\$ 3,544,000	\$ 3,465,000	\$ 3,086,000	\$ 21,655,500	\$ 19,529,688	\$ 20,310,875	\$ -	\$ -	\$ -					
Tier 2 - Capital Costs ⁵																
Buttermilk Bay - Sewer 1 (TN Removal Goal only)									\$ 2,500,000	\$ 1,200,000	\$ 17,523,975					
Pocasset Harbor																
Pocasset River																
Tier 2 Capital Cost Subtotal		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,500,000	\$ 1,200,000	\$ 17,523,975					
Annual Capital Subtotal		\$ 2,623,000	\$ 3,544,000	\$ 3,465,000	\$ 3,086,000	\$ 21,655,500	\$ 19,529,688	\$ 20,310,875	\$ 2,500,000	\$ 1,200,000	\$ 17,523,975					
Tier 1 - Operation & Maintenance Costs																
Megansett Squeteague		\$ 136,230	\$ 279,272	\$ 429,125	\$ 585,789	\$ 749,265	\$ 974,045	\$ 1,314,960	\$ 1,380,708	\$ 1,449,743	\$ 1,522,231					
Phinney's Harbor							\$ 1,261,575	\$ 2,649,308	\$ 2,781,773	\$ 2,920,862	\$ 3,066,905					
Tier 1 Operation & Maintenance Cost Subtotal		\$ 136,230	\$ 279,272	\$ 429,125	\$ 585,789	\$ 749,265	\$ 2,235,620	\$ 3,964,268	\$ 4,162,481	\$ 4,370,605	\$ 4,589,135					
Tier 2 - Operation & Maintenance Costs																
Buttermilk Bay - Sewer 1 (TN Removal Goal only)															\$ 1,161,450	
Pocasset Harbor																
Pocasset River																
Tier 2 Operation & Maintenance Cost Subtotal		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -					
Annual Operation & Maintenance Subtotal		\$ 136,230	\$ 279,272	\$ 429,125	\$ 585,789	\$ 749,265	\$ 2,235,620	\$ 3,964,268	\$ 4,162,481	\$ 4,370,605	\$ 5,750,585					
Annual Cost Total		\$ 2,759,230	\$ 3,823,272	\$ 3,894,125	\$ 3,671,789	\$ 22,404,765	\$ 21,765,307	\$ 24,275,143	\$ 6,662,481	\$ 5,570,605	\$ 23,274,560					

1. Megansett-Squeteague Installations assume all GUIA parcels.
2. Phinney's Harbor Installations assume sewer required to meet a conservative TMDL estimate (assuming 10 mg/L discharge into Phinney's Harbor.) Total number may be reduced after detailed groundwater modeling to indicate direction of groundwater flow from Bourne Middle School WWTF groundwater discharge beds.
3. Megansett-Squeteague Capital Costs include estimate to design, procure, and install each onsite system, according to estimated 2024 cost of \$42,500 per GUIA system (Class 5 conceptual cost estimates, values may fluctuate - 50%/+100%) Costs are inflated to the construction year by increasing 5% annually. This is not a CWSRF Eligible cost as of 2024.
4. Phinney's Harbor Capital Costs include: Existing Bourne Middle School WWTF GWD Expansion Permit Assessment and Filing, Preliminary BWS WWTF Design, SRF Support, Filing Watershed Permit, Final Design, Permitting, Bidding, and Construction of the Bourne Middle School WWTF and sewer expansions from Phinney's Harbor to BWS WWTF.
intenance Subtotal, accounting for inflation. Class 5 Conceptual Cost, -50%/+100%.
5. Tier 2 Parcels assume sewerred alternatives (Core Sewer Area in Buttermilk Bay using existing Buzzards Bay WWTF, a new Core Sewer Area in Pocasset Harbor and Pocasset River, using a new satellite WWTF with new GW discharge permit). Costs include WWTF Treatment Construction, Sewer Expansion, Preliminary Modeling and Design, Final Design, Bidding, and Construction Services. Costs do not include any land acquisition as part of WWTF construction.

Inflation Calendar Year Plan Year	5% 2035 Year 11	5% 2036 Year 12	5% 2037 Year 13	5% 2038 Year 14	5% 2039 Year 15	5% 2040 Year 16	5% 2041 Year 17	5% 2042 Year 18	5% 2043 Year 19	5% 2044 Year 20
Tier 1 - Number of Installations (Parcels)										
Megansett Squeteague ¹ .										
Phinney's Harbor ² .										
<i>Tier 1 Subtotal</i>	0	0	0	0	0	0	0	0	0	0
Tier 2 - Number of Installations (Parcels)										
Buttermilk Bay - Sewer 1 (TN Removal Goal only)	330									
Pocasset Harbor						355	355			
Pocasset River			300							
<i>Tier 2 Subtotal</i>	330	0	300	0	0	355	355	0	0	0
Total Installations	330	0	300	0	0	355	355	0	0	0
Tier 1 - Capital Costs										
Megansett Squeteague ³ .	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Phinney's Harbor ⁴ .	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Tier 1 Capital Cost Subtotal</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Tier 2 - Capital Costs⁵.										
Buttermilk Bay - Sewer 1 (TN Removal Goal only)	\$ 18,400,174									
Pocasset Harbor				\$ 5,893,985	\$ 11,787,970	\$ 58,939,850	\$ 61,886,843			
Pocasset River	\$ 4,541,345	\$ 22,706,725	\$ 23,842,061							
<i>Tier 2 Capital Cost Subtotal</i>	\$ 22,941,519	\$ 22,706,725	\$ 23,842,061	\$ 5,893,985	\$ 11,787,970	\$ 58,939,850	\$ 61,886,843	\$ -	\$ -	\$ -
Annual Capital Subtotal	\$ 22,941,519	\$ 22,706,725	\$ 23,842,061	\$ 5,893,985	\$ 11,787,970	\$ 58,939,850	\$ 61,886,843	\$ -	\$ -	\$ -
Tier 1 - Operation & Maintenance Costs										
Megansett Squeteague	\$ 1,598,342	\$ 1,678,259	\$ 1,762,172	\$ 1,850,281	\$ 1,942,795	\$ 2,039,935	\$ 2,141,931	\$ 2,249,028	\$ 2,361,479	\$ 2,479,553
Phinney's Harbor	\$ 3,220,250	\$ 3,381,262	\$ 3,550,325	\$ 3,727,842	\$ 3,914,234	\$ 4,109,945	\$ 4,315,443	\$ 4,531,215	\$ 4,757,776	\$ 4,995,664
<i>Tier 1 Operation & Maintenance Cost Subtotal</i>	\$ 4,818,592	\$ 5,059,522	\$ 5,312,498	\$ 5,578,123	\$ 5,857,029	\$ 6,149,880	\$ 6,457,374	\$ 6,780,243	\$ 7,119,255	\$ 7,475,218
Tier 2 - Operation & Maintenance Costs										
Buttermilk Bay - Sewer 1 (TN Removal Goal only)	\$ 2,439,045	\$ 2,560,997	\$ 2,689,047	\$ 2,823,499	\$ 2,964,674	\$ 3,112,908	\$ 3,268,554	\$ 3,431,981	\$ 3,603,580	\$ 3,783,759
Pocasset Harbor						\$ 4,265,325	\$ 8,957,183	\$ 9,405,042	\$ 9,875,294	\$ 10,369,058
Pocasset River				\$ 3,304,125	\$ 3,469,331	\$ 3,642,798	\$ 3,824,938	\$ 4,016,185	\$ 4,216,994	\$ 4,427,844
<i>Tier 2 Operation & Maintenance Cost Subtotal</i>	\$ 2,439,045	\$ 2,560,997	\$ 2,689,047	\$ 6,127,624	\$ 6,434,006	\$ 11,021,031	\$ 16,050,674	\$ 16,853,207	\$ 17,695,868	\$ 18,580,661
Annual Operation & Maintenance Subtotal	\$ 7,257,637	\$ 7,620,519	\$ 8,001,545	\$ 11,705,747	\$ 12,291,034	\$ 17,170,911	\$ 22,508,048	\$ 23,633,450	\$ 24,815,123	\$ 26,055,879
Annual Cost Total	\$ 30,199,156	\$ 30,327,244	\$ 31,843,606	\$ 17,599,732	\$ 24,079,004	\$ 76,110,761	\$ 84,394,890	\$ 23,633,450	\$ 24,815,123	\$ 26,055,879

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ENR CCI	Mar-24	13532.01	
Company	Model	Cost	Notes
Aquapoint	Bioclere Model 16/12ss	\$ 12,349.00	MA Sales Tax added
Bio-Microbics	MicroFAST® 0.5 – 9.0, HighStrengthFAST® 1.0 – 9.0, NitriFAST® 0.5 - 9.0	\$ 6,052.60	MA Sales Tax added
Septi-Tech	STAAR 0.5 Denite (M400N)	\$ 10,123.00	MA Sales Tax added
Norweco	Singulair 960 DN models 600, 750, 1000, and 1500;	\$ 8,962.00	Tax Included
	Singulair 960 DN Green model 600	\$ 8,962.00	Tax Included
Orenco	Advantex AX20, AX20-RT, AX25-RT, AX100 <10,000 GPD	\$ 48,600.00	Tax Included
		\$ 15,841.43	

GU I/A System Capital Cost	OPCC (March 2024)	EIA Unit
Average GUIA Unit	\$ 15,850.00	\$ 19,812.50
Design & Permitting	\$ 3,170.00	\$ 3,962.50
Construction (Electrical and Sitework) ¹	\$ 19,020.00	\$ 23,775.00
Permits/Fees ²	\$ 525.00	\$ 656.25
Contingency (10%)	\$ 3,860.00	\$ 4,825.00
Total	\$ 42,500.00	\$ 53,100.00

1. Landscaping and/or asphalt pavement is not included in base estimate.
2. Includes current Bourne Permit fees for General Permit, I/A Technology, and one Percolation Test

Embayment	Nitrogen Removal Goal (Kg-N/yr.)	Number of GUIA Parcels	Estimated Nitrogen Removal GUIA (kg-N/yr.)	Estimated Stormwater BMP Removal (kg-N/yr.)*
Megansett-Squeteague Harbor	564	285 - 357	504 - 631	113
Phinneys Harbor	1,706	1,133 - 1,235	2,001 – 2,182	341
Buttermilk Bay	1,402	374 - 704	588 – 1,245	280
Pocasset Harbor	3,120	1,450	2,562	624
Pocasset River	1,289	650	1,148	258
Total	8,072	3,892 – 4,396	6,803 – 7,768	1,616



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