Chapter 9

Identification and Evaluation of Alternative Management Plans

CHAPTER 9

IDENTIFICATION AND EVALUATION OF ALTERNATIVE MANAGEMENT PLANS

9.1 DEVELOPMENT OF ALTERNATIVE MANAGEMENT PLANS

A. **Introduction.** This Chapter summarizes the various means of addressing nitrogen in the Areas of Concern (AOCs) and identifies the various technologies (as discussed in Chapters 5, 6, 7, and 8) being evaluated for use in Chatham to achieve the TMDLs. It has been well-established that there is a pressing need to remove a large percentage of wastewater nitrogen from the Town's coastal embayments. The goal of the CWMP is to provide a recommended plan to address the wastewater needs of the Town.

As discussed previously in this Report, the following areas were identified as AOCs.

<u>Stage Harbor</u>

- Oyster Pond
- Oyster River
- Stage Harbor
- Mitchell River
- Mill Pond
- Little Mill Pond

<u>Sulphur Springs</u>

- Sulphur Springs
- Bucks Creek
- Cockle Cove Creek

<u>Taylors Pond</u>

- Taylors Pond
- Mill Creek

<u>Pleasant Bay</u>

- Crows Pond
- Ryders Cove
- Frost Fish Creek
- Bassing Harbor
- Lower Muddy Creek
- Upper Muddy Creek

<u>Site Specific Areas (located within the above identified AOCs)</u>

- Eliphamets Lane
- Enterprise Drive Industrial Area
- Commerce Park Industrial Area

The purpose of this section is to summarize the findings of four alternatives evaluated for addressing the Town's wastewater needs within the AOCs and Town-wide:

1. The no action alternative
2. The "Combination" alternative to address the TMDLs.
3. The "Sewer" alternative to address the TMDLs (Phase I Implementation).
4. The "Town-wide Sewer" alternative (Phase I and II Implementation).

The focus of alternatives 2, 3 and 4 is the control and treatment of wastewater. In addition to controlling wastewater nitrogen, there are other ways the Town can actively manage nitrogen. Most of these are discussed in detail in Chapter 8 and deal with public education, fertilizers, stormwater, improved embayment flushing, and other zoning and growth controls.

B. **Muddy Creek Restoration for Nitrogen Reduction.** In 2006, MEP evaluated a scenario which examined the possible restoration of Muddy Creek into a partial freshwater system. The goal of this evaluation was to determine the amount of nitrogen uptake the restored freshwater system would provide and how that would impact the identified septic/wastewater loads that need to be removed.

As discussed in Chapter 4, upwards of 75 to 100 percent of the septic/wastewater loads contributed within the Muddy Creek watershed need to be removed. MEP modeled two scenarios, one where 30 percent of the watershed, atmospheric and benthic nitrogen are reduced, and one where 30 percent of the watershed and atmospheric nitrogen are reduced and the benthic nitrogen flux is zeroed. The scenarios were intended to represent a transitional period following any restoration action and stable freshwater flow respectively. As a result of this alternative, the MEP findings indicated that removal rates for septic and wastewater loads could be reduced by 1/3 if Muddy Creek were restored in this way.

The Towns of Chatham and Harwich are actively pursuing this alternative, outside of the CWMP process. Because the CWMP will be developed in an adaptive management style (as monitoring of embayments, combined with implementation of the recommended plan), the Town of Chatham may have greater flexibility in areas of the Muddy Creek watershed that are recommended for sewering to reduce the size of the area if the restoration results are realized.

C. **Summary of Technology Evaluations.** Chapters 5 through 7 discuss the various centralized, decentralized, and treated water recharge systems that could be used in Chatham.

1. **Centralized Technologies.** The following technologies were identified for further consideration in Chapter 5:

Wastewater Treatment

- Oxidation Ditches with Pre and Post anoxic zones
- Effluent polishing filters

Disinfection

- UV disinfection (if required by MassDEP)

Residuals Management

- Thickening
- Dewatering
- Disposal at regional facility

Wastewater Collection:

- Gravity sewers and pumping stations
- Pressure sewers with grinder pumps

As discussed in Chapters 2 and 5, a preliminary design was also performed as part of this process. During the development of that preliminary design, specific technologies were selected and are the recommended technologies for any alternative that involves the upgrade of the existing WWTF, as described later in this Chapter.

D. **Purpose and Overview of Preliminary Design.** The preliminary design was prepared to illustrate how a town-wide wastewater collection, treatment, and recharge system should be planned and designed for the Town's build-out condition and for consideration as an option for the CWMP. The preliminary design was developed to accommodate the complete sewering of Chatham under the build-out condition. It was also developed in a flexible manner to accommodate the possibility that the entire Town may never become sewered in the future, or to allow that expansion over several phases as might be recommended as part of a CWMP.

1. **Wastewater Collection System.** The wastewater collection preliminary design was developed to define the individual wastewater drainage areas (sewersheds) in Chatham based on the Town's desire to maximize the use of gravity collection systems and to minimize capital and operation and maintenance (O&M) costs. Sewersheds developed as part of the preliminary design were linked together to efficiently convey the wastewater to the Chatham WWTF while trying to allow for the greatest amount of flexibility in implementation. This flexibility is critical

for development of the CWMP alternatives, allowing various orders of implementation (priority) and combinations. This also provides the Town flexibility in implementation depending on the Town's priorities and funding opportunities. The preliminary Town-wide sewer layout is shown on Figure 9-1.

As identified in Chapter 5 and as part of the preliminary design, it was identified that the most feasible collection system would be a combination of gravity and pressure sewers with grinder pumps.

2. **Wastewater Treatment System.** Operation and control considerations weighed heavily in the decision making process of selecting a technology to be considered for any upgrade to the Chatham WWTF. Both SBRs and oxidation ditch type technologies offer various benefits. SBRs provide smaller tanks and eliminate the need for clarifiers. However, oxidation ditch processes can have greater process flow flexibility and more traditional control structure. Both can and are often run through a SCADA type system.

Some of the goals/preferences identified by the Town and the WWTF staff included:

- Minimizing pumping within the system (SBRs are often fed from an equalization tank that requires pumps).
- Simpler operation (less reliance on timing sequences to maximize fill, settle, and decant cycles). Oxidation ditch type processes are considered more "traditional" systems where processes are not combined in one tank, but are performed in several distinct tanks. These processes are "flow-through" processes using gravity to advance the flow to the next component.

Both systems (SBR and oxidation ditches) require preliminary treatment, no primary treatment, effluent filtration and UV disinfection to meet MassDEP guidelines for recharge within a Zone II. However, based on the evaluations done in Chapter 5 and using these goals as a guide, oxidation ditches are more favorable and, therefore, are recommended for this application.

During the preliminary design, additional evaluations were made to compare Orbal® to Carrousel® for the selection of an oxidation ditch type process. Again, both systems were similar as to the need for a secondary anoxic zone and reaeration (in addition to those items

discussed above); however the Orbal® has greater process flexibility and greater ability to handle the large variations in flow conditions from startup to build-out. The Orbal® also allows for expansion through the addition of outer rings instead of additional treatment trains. The Orbal® also provides biological phosphorus removal.

The wastewater treatment system (with Orbal®) is illustrated in Figure 9-2 and was developed to treat the Town's wastewater to an effluent total nitrogen concentration of 3 milligrams per liter (mg/L). It was designed to be expanded through phased implementation, to treat all the wastewater generated by the properties in town for the build-out condition, as well as the inflow and infiltration (I/I) that could be collected by sewers as they age and as may occur during extended wet and high groundwater periods as identified in Chapter 2 of this Report. It is also designed to be flexible and treat the relatively low wintertime startup conditions as well as the high build-out summertime conditions.

The improvements to the treatment plant are comprised of the following individual treatment processes:

a. Influent screening and grit removal (headworks).

b. Biological treatment for nitrogen removal, initial phosphorus removal, and treatment of oxygen demand and pathogens.

c. Additional phosphorus treatment (if needed) through ferric or alum addition.

d. Effluent filtration to remove fine suspended solids in the effluent and nitrogen and phosphorus contained in the solids.

e. Effluent disinfection (through ultraviolet light radiation) for final elimination of pathogens and fecal coliform (if required by MassDEP).

The preliminary design took into consideration expansion to accommodate sewering the entire town and provisions/space requirements for additional treatment processes that would be needed to treat the effluent to concentrations less than 3 mg/L if it is needed in the future, and to provide additional phosphorus removal.

The workhorse of the treatment system is the biological treatment process that is configured as a series on concentric rings. The construction of three rings is recommended for the implementation of Phase 1 to treat an average-annual future flow of 1.3 million gallons per day (mgd). This configuration will allow the Town to reduce the treatment volume (take one ring out of service) during times of low flow to save costs and meet treatment requirements. A fourth ring would be added as part of a Phase 2 implementation if the collection system does expand Town-wide to a potential future/build-out condition of 1.9 mgd on an average-annual basis. The process also has the flexibility of taking various aeration components and process rings off line for repair and maintenance.

3. **Treated Water Recharge Facilities.** The treated water recharge facilities were potentially laid out during preliminary design and were comprised of a series of 12 sand infiltration beds (as shown in Figure 9-3), in order to maximize the recharge area at the site

As discussed in Chapter 6, significant testing and groundwater modeling was completed to determine an appropriate design infiltration rate. Hydraulic load testing and detailed groundwater modeling indicated that a design loading of 30 gallons per day per square foot (gpd/sf) was appropriate and has a significant safety factor. (This design rate is six times greater than the design rate typically required by MassDEP for projects where detailed testing and modeling are not completed.) As a result, a maximum of 200,000 square feet of bed area would be needed in the event that sewers are extended to the whole Town. This sizing allows a 100 percent redundancy of beds to allow half of the beds to be "resting" at the design (maximum month) condition. This area could be met with the implementation of beds 1, 2, 3, 4, 7 and portions of beds 5 and 8 as illustrated in Figure 9-3.

4. **Costs.** Costs for centralized collection and treatment and recharge were developed on a Town-wide basis, with estimates broken down by sewershed and WWTF phase for comparison to decentralized facilities. The overall cost estimate for a town-wide collection system combined with multiple technologies is summarized in Table 9-1. Costs were developed as part of the preliminary design based on year 2006 values, the bottom line total has been adjusted for 2007. Collection system costs were developed by sewershed (included in Table 9-2) and are used as the basis of the development of alternative plans.

Table 9-3 summarizes the costs for WWTF improvements for the two WWTF alternatives:

- Alternative 3 is for Phase I improvements to allow sewer extension to meet the nitrogen TMDLs in the future.
- Alternative 4 is for Phases I and II to allow sewer extension Town-wide.

Table 9-4 summarizes the costs for the 5 proposed treated water recharge beds (and flow distribution structures) as illustrated in Figure 9-4.

E. **Decentralized Technologies.** Evaluations of decentralized technologies are discussed in Chapter 6. The following is a summary of the findings of that evaluation.

Because I/A technologies are regulated by MassDEP, selection of any I/A technology to be used will be made by the individual property owner unless the Town regulations are modified to dictate otherwise. The selection process will depend on the particular application (i.e. for repair, nitrogen removal, variance, etc.) and the current MassDEP status of the technology.

A major difficulty with individual I/A systems is the maintenance requirements and costs. Currently, the Town of Chatham, like most towns, is dealing with how to best manage and track their existing I/A systems. Improper maintenance, significant down times due to seasonal use, and owner inexperience all contribute to poor performance and possible system failures. If properly operated and maintained, those systems approved by MassDEP can achieve moderate effluent quality (approximately 50 percent nitrogen removal) and provide a significant improvement over standard Title 5 septic systems. Broad application of these technologies to address the needs of an AOC could severely tax Town resources requiring increased accounting of systems, inspections, and routine operations and maintenance and monitoring to ensure that the systems are performing properly and achieving the goals associated with large-scale implementation to meet the MEP nitrogen loading thresholds. Even when these I/A systems are well operated and maintained they cannot provide the type of nitrogen removal performance needed to address the nitrogen overloads currently occurring in the entire Stage Harbor AOC. These systems may be better suited addressing localized problem areas in an AOC, where other alternative may not be feasible.

A second difficulty is that individual I/A systems do not remove phosphorus which is a concern within the watersheds to freshwater ponds. They also do not provide disinfection and are not monitored frequently. If a new public-health or environmental-health threat appears in the future (phosphorus loading to fresh and brackish waters, undegraded pharmaceutical products or "endocrine disruptors" in the effluent, etc.); the individual systems will be very difficult to upgrade to meet the threat. These systems would be difficult/costly to upgrade if the nitrogen TMDLs change (become more stringent) in the future versus an upgrade at one centralized location.

I/A technologies have advantages, and based on Board of Health and Planning Department recommendations and the Town's Nitrogen Loading Regulation, may be required to address specific site conditions and issues (i.e., high groundwater, setback requirements, repair or replacement of existing systems, or limited nitrogen removal in sensitive watersheds). However, each application should be evaluated on a site-by-site basis for those areas not considered for sewers.

Cluster systems were not considered feasible options in most areas of Town (described in Chapter 6) based on lack of available space, costs, implementation considerations, and ownership and operational and maintenance considerations. Additionally, the regional septic system test facility on Cape Cod and performance of systems in Chatham and neighboring towns has shown that smaller facilities have struggled to achieve less than 10 mg/L total nitrogen. Therefore, the management and operation of these facilities to consistently achieve 3 mg/L total nitrogen is not realistic. These systems would not provide adequate treatment to meet the TMDLs for the Town's embayments and therefore, as discussed previously, have been ruled out.

Although, individual I/A systems have many of the same issues associated with them as the cluster systems, they have less space and ownership constraints than sighting several small wastewater treatment facilities. As a result, individual I//A systems are used in combination with sewers in Alternative 2 (the combination alternative) for areas that require a lower wastewater nitrogen removal to meet the TMDL. It is noted that the technology evaluations completed on a watershed by watershed basis resulted in the recommendation of sewer extension to meet the TMDLs with possible extension Town-wide to meet other wastewater issues. These recommendations were received well by the CAC and Board of Selectmen. Even with the acceptance of the recommendations; there was a desire to develop a detailed alternative that

utilized individual I/A systems to meet the TMDLs to illustrate the cost difference and non-monitoring (performance, uncertainty, operations and maintenance, etc.) factors.

Based on the TMDL requirements as stated in Chapter 4, the following AOCs were evaluated for the combination alternative:

- Mitchell River
- Mill Pond
- Sulphur Springs
- Taylors Pond
- Ryders Cove

The following sections describe the four main alternative scenarios evaluated as part of this DCWMP and DEIR:

9.2 NO ACTION ALTERNATIVE – ALTERNATIVE # 1

This alternative would limit future wastewater treatment at the Chatham WWTF to 150,000 gpd as directed by the current Administrative Consent Order (ACO) agreed to by the Town of Chatham and MassDEP. No-action would mean that the majority of the Town's wastewater generation would be treated using on-site septic systems. The entire Town was declared an "Area of Nitrogen Concern", requiring new construction to be regulated by the Town's Nitrogen Loading Regulations developed by the Board of Health. However, existing facilities will continue to treat wastewater with on-site systems, typically not designed for nitrogen removal.

The impacts of nutrients and pathogens on coastal waters, drinking water supplies, and other natural resources are well documented. Without addressing these needs, Chatham will continue to lose natural and economical resources, including declines in the fin-fishing and shell-fishing resources, loss of property values, continued algal blooms in coastal embayments and ponds, beach closures, and potential declines in tourism as the aesthetic impacts continue to impair the Town's water resources (coastal, fresh, and drinking). For example, Chatham is currently experiencing the loss of naturally occurring oysters in Oyster Pond, increased algal blooms in Oyster Pond and Little Mill Pond (among other embayments), loss of eel grass in the majority of

the Town's coastal embayments, impacts to freshwater ponds and the potential for impacts to the Town's drinking water supply and sole source aquifer.

In addition, the existing ACO requires completion of the CWMP and implementation of the recommendations of the plan. If the Town does not comply with the Consent Order, it could be fined up to $10,000 per day by MassDEP, as stipulated in the ACO.

In the No-Action Alternative scenario, substandard on-site systems would be identified by means of property transfer inspections or system failures. Upgrading to meet the Title 5 standards and the local Board of Health regulations would not result in significant nitrogen removal. Current regulations only address nitrogen loading to coastal embayments for new systems, so the Town's coastal embayments would continue to be impacted by nitrogen discharges within the embayment's watershed.

The Town of Chatham is currently in receipt of the TMDLs for all of its coastal embayment systems. The TMDLs set the daily nutrient load limit for these embayments to improve or preserve their quality. Therefore, failure to address nitrogen loading to the embayments in Chatham under the No-Action Alternative would be in violation of the TMDL and subject to the enforcement regulations as stipulated by MassDEP.

Nitrogen loading assessments performed as part of the MEP have determined that existing and future nitrogen loading into Muddy Creek, the Stage Harbor System, Bassing Harbor System, Taylor Pond/Mill Creek, and Sulphur Springs Watersheds exceed the nitrogen loading thresholds for those embayments. This indicates that continuation of nitrogen loading into these watersheds at current levels will further degrade water quality in these embayments.

9.3 COMBINATION ALTERNATIVE – ALTERNATIVE # 2

A. **Alternative #2 – General.** Based on the TMDL requirements as stated in Chapter 4, the following AOCs were evaluated for the combination alternative:

- Mitchell River subwatershed
- Mill Pond subwatershed
- Sulphur Springs subwatershed

- Taylors Pond subwatershed
- Ryders Cove subwatershed

These areas (see Figure 9-5) have the potential, based on the percent removals of septic system wastewater nitrogen, to be addressed with a combination of I/A technologies and sewering. As mentioned earlier, presentations (to the TAG, CAC and Board of Selectmen) of the technology evaluations on a watershed by watershed basis indicate that the TMDLs could not be met in most watersheds with the use of I/A systems alone. There were a few subwatersheds where the TMDL could be met by I/A systems with an assumed wastewater nitrogen performance of 50 percent. Only with a combination of individual I/A's and sewers (with treatment and discharge outside of the watershed) is it possible to implement I/A technologies and achieve the TMDL goals. For the purpose of cost evaluations, it was assumed that up to 50 percent of these watersheds (AOC) would be addressed with I/A's and the balance of the wastewater nitrogen to be removed would be addressed by a centralized collection system.

Use of individual I/A systems within these areas still assumes an average annual performance of 19 mg/L for each unit, as regulated by MassDEP (or approximately 50 percent removal).

The remaining AOCs as part of a combination alternative would be addressed through sewering:

- Oyster Pond and Oyster Pond River
- Stage Harbor
- Little Mill Pond
- Mill Creek
- Frost Fish Creek
- Eliphamets Lane
- Commerce Park and Enterprise Drive

Each of these areas has either a TMDL or other need or advantage (in the case of the industrial parks) that requires the use of sewers to address these areas.

Upper and Lower Muddy Creek provide a unique opportunity to evaluate nitrogen reduction by natural means. The costs of implementation and permitting are difficult to assess at this stage, however, as modeled by MEP, there is a potential for a 34 percent reduction in the septic load

that would need to be addressed by pursuing this option and therefore approximately 1/3 of this watershed sewering could be reduced.

The remaining areas of Town, although not specially targeted for nitrogen removal, may be addressed through the centralized treatment alternative and the Town's nitrogen loading regulations and therefore will not be evaluated as part of this analysis. Many of these areas fall within sewershed areas that are critical to other AOCs and therefore any additional sewering within these areas will aid in the reduction of septic system effluents on these embayments.

The findings of this alternative from both a monetary and non-monetary analysis indicate that sewering remains a more favorable alternative.

Advantages of this alternative:

- Number of sewered parcels is reduced.
- Home owners can select the technology that best suits their needs (aesthetics, space, cost) based on the MassDEP approved technologies available

Disadvantages of this alternative are:

- Inconsistent performance of I/A technologies
- Requires creation of a management structure to regulate I/A performance locally relative to TMDL requirements
- Higher present value cost.
- Homeowners will be responsible for purchasing, installing, operating and maintaining (or paying for such services) as required by the Town.

B. **Alternative #2 - Development and Costs.** This alternative would include upgrade of the existing WWTF to a flow less than 1.3 mgd (average annual developed from the Phase I Sewers) to address TMDLs in Chatham. It would also include the creation of a management district and installation of one or more types of I/A technologies on up to 50 percent of individual properties within an AOC watershed. Several different technologies were evaluated for use as I/A systems, collection systems, and centralized facilities at the existing WWTF as discussed and evaluated

earlier in this Report. Only five watersheds have TMDL requirements low enough to apply I/A technology to achieve TMDLs, if combined with sewering.

1. **Cost Basis.** Implementation of individual nitrogen removal systems for each area evaluated for the use of I/A's would require property-owner installation or upgrade of their systems. This evaluation considered up to 50 percent of the future wastewater generated within the watershed to be managed with individual I/A systems and the balance of the wastewater nitrogen to be addressed by a centralized collection system. The use of large scale, individual I/As would require the establishment of a decentralized wastewater management district or service area to assist in operations, maintenance and monitoring of these systems. Costs for the development and operation of such a district are difficult to estimate with precision because there is no precedent on Cape Cod of such a system and are not included in the costs summarized below. These costs could be developed if there is an interest in proceeding with Alternative #2.

Installation and upgrade of the on-site systems would have a capital cost of approximately $13,000-$25,000 for each system based on cost estimates prepared by Barnstable County Department of Health as part of the 2007 study for the Town of Eastman, MA. The capital costs have been increased by 25% to account for construction contingency. These costs are based on the following factors:

- Average of typical I/A technologies equipment costs, engineering and permitting.
- Some cost savings can be obtained if components of the existing Title 5 systems can be reused.
- I/A performance based on achieving 19 mg/L total nitrogen in the system effluent.

O&M costs are estimated at $2,600 per year for each, generating a total present worth cost (20 years) for each system at approximately $38,000-$50,000. Costs do not include Town costs associated with creating a management district to manage a large number of I/A technologies.

Costs for centralized collection systems, used in combination with I/A systems, were based on the percentage of the watershed serviced by the sewersheds described in Chapter 5, the percent of flow being contributed to the WWTF, and the percent of nitrogen needed to be removed within the watershed by sewers after I/A technologies are installed in 50 percent of the watershed's parcels.

2. **Basis for Ryder's Cove Subwatershed.** A nitrogen assessment was performed as part of the Bassing Harbor/Pleasant Bay System as part of the MEP Project. Based on the estimated flows and results of the MEP report, this system could be served by sewers or a combination of sewers and I/A type onsite systems.

- Individual nitrogen removal systems only when combined with partial sewering of this watershed. Based on 32 percent I/As and 68 percent sewers.
- Connection to the Chatham WWTF for the sewered areas.

Table 9-5 summarizes the costs for this watershed.

3. **Basis for Mitchell River Subwatershed.** A nitrogen assessment was performed for Mitchell River as part of the Stage Harbor System as part of the MEP Project. Based on the estimated flows and results of the MEP report, this system could be served by sewers or a combination of sewers and I/A type onsite systems.

- Individual nitrogen removal systems only when combined with partial sewering of this watershed. Based on 50 percent I/As and 45 percent sewers.
- Connection to the Chatham WWTF for the sewered areas.

Table 9-5 summarizes the costs for this watershed.

4. **Basis for Mill Pond Subwatershed.** A nitrogen assessment for Mill Pond was performed as part of the Stage Harbor System as part of the MEP Project. Based on the estimated flows and results of the MEP report, this system could be served by sewers or a combination of sewers and I/A type onsite systems.

The wastewater treatment alternatives identified for this AOC are listed below:

- Individual nitrogen removal systems only when combined with partial sewering of this watershed. Based on 50 percent I/As and 42 percent sewers.
- Connection to the Chatham WWTF for the sewered areas.

Table 9-5 summarizes the costs for this watershed.

5. **Sulphur Springs.** A nitrogen assessment of Sulphur Springs was performed as part of the Sulphur Springs System as part of the MEP Project. Based on the estimated flows and results of the MEP report, this system could be served by sewers or a combination of sewers and I/A type onsite systems.

The wastewater treatment alternatives identified for this AOC are listed below:

- Individual nitrogen removal systems only when combined with partial sewering of this watershed. Based on 36 percent I/As and 64 percent sewers.
- Connection to the Chatham WWTF.

Table 9-5 summarizes the costs for this watershed.

6. **Taylors Pond.** A nitrogen assessment for Taylors Pond was performed as part of the Taylors Pond System as part of the MEP Project. Based on the estimated flows and results of the MEP report, this system could be served by sewers or a combination of sewers and I/A type onsite systems.

The wastewater treatment alternatives identified for this AOC are listed below:

- Individual nitrogen removal systems only when combined with partial sewering of this watershed. Based on 50 percent I/As and 48 percent sewers.
- Connection to the Chatham WWTF.

Table 9-5 summarizes the costs for this watershed.

9.4 SEWER ALTERNATIVE TO MEET TMDL – ALTERNATIVE #3

This alternative is based on addressing the TMDL needs of the Town by extending sewers to those areas identified by MEP, the two industrial parks, and Eliphamets Lane. Other major components of this alternative are:

- Implementation of WWTF expansion at the existing WWTF site to treat approximately 1.3 mgd on an average annual basis to meet TMDL requirements in Stage Harbor, Pleasant Bay, Sulphur Springs, and Taylor's Pond watershed areas. WWTF Flows are summarized on Table 9-6
- Expansion of the existing collection system to match the WWTF expansion. Sixty-one (61) of the 94 sewersheds identified would need to be sewered in order to address the TMDL requirements as shown on Figure 9-6.
- Further investigation into the freshwater restoration of the upper reaches of Muddy Creek which could provide a quicker remediation of the nitrogen impacts of this waterbody and to Pleasant Bay as a whole.
- Implementation of the coastal embayment water quality monitoring program for TMDL compliance.
- Continued public education on fertilizer use and management of other controllable sources of nitrogen within the Town.
- Continued enforcement of the Town of Chatham Board of Health Nitrogen Loading Regulation in those areas not designated for immediate (next 5 to 10 years) connection to the WWTF as part of addressing the Town's TMDLs.
- Continued implementation of storm water improvements and management.

A. **Process/Equipment Description and Design Criteria for WWTF Upgrade**. The proposed process equipment and facilities are based on the preliminary design developed and discussed previously, as illustrated on Figure 9-4.

The following wastewater treatment processes have been identified throughout the development of the CWMP. The following list is a summary of the core technologies that will make up the new WWTF's major components.

Preliminary Treatment:

- Complete plant pre-engineered system for screening and grit removal.

Secondary Treatment

- Orbal® process with post anoxic tanks and reaeration constructed in a modular design to allow Phase II expansion as the flow increases.
- Three secondary clarifiers (2 for Phase 1, third for Phase 2).

Filtration

- Continuous backwash sand filters.

Disinfection

- Filtration in the sand infiltration beds. (A UV system has been considered and may be required by MassDEP)

Sludge Processing

- 2.0 m Belt Filter Presses.

Odor Control

- Activated Carbon.

Support Facilities

- RAS and WAS pumping (centrifugal pumps).
- Plant water (pumps and hydropneumatic tank).
- Sodium hypochlorite for nocardia control – chemical tank and pumps.
- Sodium hydroxide for alkalinity addition – chemical tank and pumps.
- Methanol –for supplemental carbon.

Other considerations as requested by the Town for flexible future site operations.

- Provide space for a physical/chemical TP removal system, and a possible additional anaerobic zone for TP removal.
- Provide space for RAS processing for the possible consideration of a Cannibal® sludge minimization process.

Table 9-7 Inventory of Existing and Proposed Facilities and Process Equipment summarizes the equipment that would be included as part of this alternative.

The collection system will be phased over 30 or more years. The first 20 years will include the expansion of the existing collection system to address those areas in Town identified as AOCs in order to achieve the TMDLs. This will include the extension of sewers within 61 sewersheds shown on Figure 9-6 and Table 9-8.

9.5 TOWN-WIDE SEWER - ALTERNATIVE #4 – NEW WWTF TO TREAT 1.9 MGD AVERAGE ANNUAL

Alternative #4 is the expansion of Alternative #3 to treat the wastewater for the entire Town (average annual flow of 1.9 mgd). The evaluation and technology selection are the same for both alternatives. Alternative #4 also provides some additional sludge handling facilities to handle future conditions and may require expansion of the effluent disposal facilities.

- Two-phased implementation of WWTF expansion. Phase I is as described in alternative #3. Phase II would expand this facility to 1.9 mgd on an average annual basis and serve the entire Town of Chatham. WWTF Flows are summarized on Table 2-8.
- Expansion of the existing collection system to match the two Phases of the WWTF expansion with the possibility of sewering all of the 94 sewersheds identified during preliminary design.
- Continuation of management items as identified in Alternative #3.

A. WWTF Expansion

The following wastewater treatment processes have been identified throughout the development of the CWMP. The following list is a summary of the core technologies that would be added as part of Phase II and to those identified as part of Alternative #3.

<u>Preliminary Treatment:</u>

- Complete plant pre-engineered system for screening and grit removal.

<u>Secondary Treatment</u>

- Orbal® process expansion with 4th ring.
- Third secondary clarifier (2 for Phase 1, third for Phase 2).
- New post anoxic and reaeration tank.

Filtration

- Continuous backwash sand filters expanded as required.

Disinfection

- Filtration in the sand infiltration beds. (A UV system has been considered and may be required by MassDEP)

Sludge Processing

- A second 2.0 m Belt Filter Press.

Support Facilities (as needed) to Handle Additional Flows

B. Collection System

The collection system extended for the 33 remaining sewersheds over the ten years following the Phase I implementation as shown in Figure 9-1 and Table 9-9.

The total length of proposed Town-wide sewer is approximately 110 miles, 88 miles of which are proposed gravity and 18 of proposed low pressure, compared to the existing system of approximately 5 miles of gravity mains. The total number of low pressure grinder pumps is estimated at 1,200. This amount estimates one grinder pump per building/property. There are grinder pump units suitable for multiple buildings; however, these installations can become difficult to manage if buildings are owned by different parties; therefore this plan is based on 1 pump per property.

Of the 1,200 grinder pumps, approximately 530 belong to buildings where a gravity main travels by, but the elevation of the building is lower than the gravity main; therefore a pump is needed to convey the wastewater to the higher elevation in the main. The remaining 670 grinder pumps belong to buildings that have low pressure sewers based on review discussions and the cost analysis with the Town.

9.6 SUMMARY

Costs developed for Alternate #2 were then compared to the costs of addressing those same watersheds with a centralized collection system as identified in Alternative No. 3 to achieve TMDL limits. See Table 9-10. Comparisons were based on Present Worth Value and only considered the sewer and WWTF improvement costs associated with the specific watershed in order to provide an even comparison.

For the five watersheds where a combination of technologies were considered, the total present worth cost of sewering for Ryders Cove, Sulphur Springs, and Taylor's Pond to achieve TMDLs was less than the present worth value of using a combination of sewers and I/A technologies.

Cost analysis of the Mitchell River and Mill Pond watersheds showed use of individual I/A technologies could be cost effective (on a present worth basis) when combined with sewers. However, these present worth costs do not include the cost of managing these systems through the Town's existing departments, or the creation of and management through a new department or management district. In addition, the proximity of these areas to the existing collection system and the level of effort and management necessary to verify that these systems consistently achieve permit limits so TMDLs can be achieved, makes this a less attractive alternative to the use of a centralized collection system. Based on this analysis, the lowest cost alternative to be considered is a centralized collection system.

The findings from both a monetary and non-monetary analysis indicate that sewering remains the more favorable alternative.

The following alternatives are being carried forward for evaluation as part of the environmental impact analysis in Chapter 10:

- Alternative #1 – No Action Alternative (MEPA requirement)
- Alternative #3 – Sewer to Meet TMDL
- Alternative #4 – Town-wide Sewer

Tables

TABLE 9-1

ESTIMATED CAPITAL COSTS FOR TOWN-WIDE COLLECTION SYSTEM

COST COMPONENT	UNITS	PRICE	QUANTITY	ITEM COST	TOTAL
GENERAL ITEMS					**$3,000,000**
Record Drawings & Construction Photos	ea	$5,000	84	$420,000	
Erosion Control	ea	$10,000	84	$840,000	
Final Clean Up and Site Restoration	ea	$5,000	84	$420,000	
Test Pits	cy	$55	23,250	$1,278,750	
Sewer Testing	lf	$2	720,000	$1,440,000	
GRAVITY SEWER					**$81,000,000**
8" Gravity Sewer, 0 to 12 Feet Deep, Town Road	lf	$90	286,000	$25,740,000	
8" Gravity Sewer, 0 to 12 Feet Deep, State Road	lf	$150	13,000	$1,950,000	
8" Gravity Sewer, 12+ Feet Deep, Town Road	lf	$120	156,000	$18,720,000	
8" Gravity Sewer, 12+ Feet Deep, State Road	lf	$180	10,000	$1,800,000	
Dewatering	lf	$105	49,800	$5,229,000	
Service Lateral	ea	$700	5,100	$3,570,000	
Lateral Fittings	ea	$300	5,100	$1,530,000	
4' Manhole	ea	$4,200	2,250	$9,450,000	
Connection to Existing System	ea	$1,250	14	$17,500	
By-Pass Pumping for Connections	ea	$4,000	14	$56,000	
Misc. (chimneys, clean outs)	ea	$5,000	94	$470,000	
Upgrade C.H.A.P.S.	ea	$2,000,000	1	$2,000,000	
Upgrade Queen Anne P.S.	ea	$2,000,000	1	$2,000,000	
Upgrade Stage Harbor P.S.	ea	$2,000,000	1	$2,000,000	
Pipe Line Improvements to Existing Collection System	lf	$150	40,000	$6,000,000	
FORCE MAIN					**$8,000,000**
Force Main, Town Road	lf	$65	139,000	$9,035,000	
Force Main, State Road	lf	$100	15,000	$1,500,000	
Credit for Sharing Trench	*lf*	*-$45*	*100,000*	*-$4,500,000*	
Air Release / Flushing Manholes	ea	$6,100	300	$1,830,000	
LOW PRESSURE SEWER					**$18,000,000**
Small Diameter Pressure Main, Town Road	lf	$45	100,000	$4,500,000	
Small Diameter Pressure Main, State Road	lf	$80	1,000	$80,000	
Air Release / Flushing / End Manholes	ea	$4,500	149	$668,382	
Connection to Manhole	ea	$2,800	41	$114,800	
Grinder Pump	ea	$10,500	1,200	$12,600,000	
Pump, Panel, Lateral Kit (Model # 2010-93)		*$3,000*			
Installation of Pump		*$3,000*			
Installation of Lateral		*$3,000*			
Engineering		*$1,500*			
PUMP STATIONS					**$19,000,000**
0 - 100 gpm (0.14 mgd)	ea	$175,000	63	$11,025,000	
100 - 500 gpm (0.72 mgd)	ea	$425,000	16	$6,800,000	
500 - 1000 gpm (1.44 mgd)	ea	$1,500,000	1	$1,500,000	
RESTORATION					**$17,000,000**
4" Trench Base (T-base)	cy	$17	57,640	$979,880	
2" Trench Binder	ton	$75	58,688	$4,401,600	
1" Trench Top Course	ton	$75	29,344	$2,200,800	
1-1/2" Top Course - Full Width Overlay	ton	$58	156,240	$9,061,920	
Misc Paving Items (Paving Cont.)	%	3%	$16,644,200	$499,326	
SUBTOTAL					**$140,000,000**
GENERAL CONDITIONS	%	5%	$140,000,000	5%	$7,000,000
BONDS AND INSURANCE	%	3%	$140,000,000	3%	$4,000,000
MOBILIZATION / DEMOBILIZATION	%	5%	$140,000,000	5%	$7,000,000
ESTIMATED CONSTRUCTION COST					**$160,000,000**
CONTINGENCY	%	25%	$160,000,000	25%	$40,000,000
DESIGN	%	10%	$160,000,000	10%	$16,000,000
FISCAL, LEGAL, & ENGINEERING	%	15%	$160,000,000	15%	$24,000,000
ESTIMATED PROJECT COST (2006)					**$240,000,000**
ESTIMATED PROJECT COST (2007)					**$250,000,000**

NOTES:

1. Costs are referenced to construction in March 2006 based on Engineering News Record (ENR) index of 7692, except final total (May 2007 ENR 7942) .
   Costs must be increased by a ratio of the appropriate ENR indices for construction costs in subsequent years.
2. Record drawings, erosion control, and final site clean based on lump sum cost of $15,000 per sewer shed.
3. Trench work (gravity, low pressure and force mains) in town roads to include: excavation, backfill, and traffic control.
   State Roads also include control density fill (CDF).
4. Dewatering based on 50% length of all mains over 15 feet deep.
5. Gravity service lateral based on $50 per foot considering 14 feet to property line.
6. Lift stations are based on Gormann-Rupp suction pump stations with generator and instrumentation.
7. Cost of grinder pumps based on quote from E-1 . Large scale purchases may be a reduction in unit cost.
8. Low pressure lateral based on $34 per lf and average distance of 80 feet with $275 per connection.
9. Trench width based on the following:
   6 feet for low pressure, force mains, and gravity mains less than 12' deep
   12 feet for gravity mains greater than 12 feet deep
10. Full width overlay based on 27 foot wide right of way.
11. Misc. paving items to include aprons, saw-cutting, curb repair and other contingencies.
12. Estimated Project Cost does not include utility relocation (stormwater drains and other).
13. Estimated Project Cost does not include allowance for hazardous waste removal.
14. Pump station cost based on base architectural design. Custom modification to architectural appearance may be extra.

TABLE 9-2

ESTIMATED SEWER COSTS PER SEWERSHED

Sewershed	Est Capt Cost 2007	Estimated O&M	O&M Present Value	Total Present Worth (Capital and &O&M)
1	$ 2,300,000.00	$ 15,000	$223,000.00	$2,520,000.00
2	$ 5,000,000.00	$ 19,000	$283,000.00	$5,280,000.00
3	$ 7,800,000.00	$ 22,000	$327,000.00	$8,130,000.00
4	$ 2,200,000.00	$ 15,000	$223,000.00	$2,420,000.00
5	$ 1,400,000.00	$ 14,000	$208,000.00	$1,610,000.00
6	$ 2,300,000.00	$ 15,000	$223,000.00	$2,520,000.00
7	$ 4,300,000.00	$ 19,000	$283,000.00	$4,580,000.00
8	$ 2,000,000.00	$ 15,000	$223,000.00	$2,220,000.00
9	$ 2,300,000.00	$ 15,000	$223,000.00	$2,520,000.00
10	$ 2,000,000.00	$ 15,000	$223,000.00	$2,220,000.00
11	$ 4,500,000.00	$ 19,000	$283,000.00	$4,780,000.00
12	$ 2,800,000.00	$ 16,000	$238,000.00	$3,040,000.00
13	$ 3,000,000.00	$ 17,000	$253,000.00	$3,250,000.00
14	$ 3,700,000.00	$ 18,000	$268,000.00	$3,970,000.00
15	$ 2,600,000.00	$ 16,000	$238,000.00	$2,840,000.00
16	$ 2,200,000.00	$ 15,000	$223,000.00	$2,420,000.00
17	$ 4,400,000.00	$ 19,000	$283,000.00	$4,680,000.00
18	$ 1,800,000.00	$ 15,000	$223,000.00	$2,020,000.00
19	$ 3,700,000.00	$ 17,000	$253,000.00	$3,950,000.00
20	$ 8,300,000.00	$ 25,000	$372,000.00	$8,670,000.00
21	$ 1,800,000.00	$ 15,000	$223,000.00	$2,020,000.00
22	$ 3,500,000.00	$ 18,000	$268,000.00	$3,770,000.00
23	$ 3,000,000.00	$ 16,000	$238,000.00	$3,240,000.00
24	$ 3,000,000.00	$ 16,000	$238,000.00	$3,240,000.00
25	$ 2,700,000.00	$ 15,000	$223,000.00	$2,920,000.00
26	$ 2,000,000.00	$ 15,000	$223,000.00	$2,220,000.00
27	$ 3,300,000.00	$ 17,000	$253,000.00	$3,550,000.00
28	$ 2,800,000.00	$ 16,000	$238,000.00	$3,040,000.00
29	$ 1,000,000.00	$ 13,000	$193,000.00	$1,190,000.00
30	$ 5,300,000.00	$ 19,000	$283,000.00	$5,580,000.00
31	$ 3,900,000.00	$ 19,000	$283,000.00	$4,180,000.00
32	$ 1,000,000.00	$ 13,000	$193,000.00	$1,190,000.00
33	$ 1,500,000.00	$ 14,000	$208,000.00	$1,710,000.00
34	$ 3,700,000.00	$ 17,000	$253,000.00	$3,950,000.00
35	$ 2,600,000.00	$ 15,000	$223,000.00	$2,820,000.00
36	$ 2,200,000.00	$ 15,000	$223,000.00	$2,420,000.00
37	$ 7,000,000.00	$ 23,000	$342,000.00	$7,340,000.00
38	$ 2,500,000.00	$ 16,000	$238,000.00	$2,740,000.00
39	$ 2,800,000.00	$ 16,000	$238,000.00	$3,040,000.00
40	$ 2,500,000.00	$ 16,000	$238,000.00	$2,740,000.00
41	$ 2,800,000.00	$ 16,000	$238,000.00	$3,040,000.00
42	$ 1,300,000.00	$ 14,000	$208,000.00	$1,510,000.00
43	$ 7,700,000.00	$ 23,000	$342,000.00	$8,040,000.00
44	$ 3,800,000.00	$ 18,000	$268,000.00	$4,070,000.00
45	$ 1,400,000.00	$ 14,000	$208,000.00	$1,610,000.00
46	$ 3,800,000.00	$ 19,000	$283,000.00	$4,080,000.00
47	$ 1,500,000.00	$ 14,000	$208,000.00	$1,710,000.00
48	$ 1,900,000.00	$ 14,000	$208,000.00	$2,110,000.00
49	$ 1,500,000.00	$ 14,000	$208,000.00	$1,710,000.00
50	$ 4,500,000.00	$ 19,000	$283,000.00	$4,780,000.00
51	$ 4,000,000.00	$ 18,000	$268,000.00	$4,270,000.00
52	$ 2,300,000.00	$ 15,000	$223,000.00	$2,520,000.00
53	$ 3,900,000.00	$ 18,000	$268,000.00	$4,170,000.00
54	$ 1,700,000.00	$ 14,000	$208,000.00	$1,910,000.00
55	$ 1,500,000.00	$ 14,000	$208,000.00	$1,710,000.00
56	$ 4,700,000.00	$ 19,000	$283,000.00	$4,980,000.00
57	$ 1,300,000.00	$ 14,000	$208,000.00	$1,510,000.00
58	$ 700,000.00	$ 13,000	$193,000.00	$890,000.00
59	$ 3,300,000.00	$ 17,000	$253,000.00	$3,550,000.00
60	$ 1,200,000.00	$ 14,000	$208,000.00	$1,410,000.00
61	$ 2,800,000.00	$ 17,000	$253,000.00	$3,050,000.00
62	$ 1,800,000.00	$ 15,000	$223,000.00	$2,020,000.00
63	$ 1,500,000.00	$ 14,000	$208,000.00	$1,710,000.00
64	$ 1,200,000.00	$ 14,000	$208,000.00	$1,410,000.00
65	$ 1,000,000.00	$ 13,000	$193,000.00	$1,190,000.00
66	$ 4,900,000.00	$ 21,000	$312,000.00	$5,210,000.00
67	$ 1,200,000.00	$ 14,000	$208,000.00	$1,410,000.00
68	$ 1,100,000.00	$ 13,000	$193,000.00	$1,290,000.00
69	$ 800,000.00	$ 13,000	$193,000.00	$990,000.00
70	$ 800,000.00	$ 13,000	$193,000.00	$990,000.00
71	$ 2,600,000.00	$ 16,000	$238,000.00	$2,840,000.00
72	$ 1,000,000.00	$ 13,000	$193,000.00	$1,190,000.00
73	$ 5,900,000.00	$ 22,000	$327,000.00	$6,230,000.00
74	$ 1,300,000.00	$ 14,000	$208,000.00	$1,510,000.00
75	$ 2,300,000.00	$ 16,000	$238,000.00	$2,540,000.00
76	$ 900,000.00	$ 13,000	$193,000.00	$1,090,000.00
77	$ 1,700,000.00	$ 15,000	$223,000.00	$1,920,000.00
78	$ 1,400,000.00	$ 14,000	$208,000.00	$1,610,000.00
79	$ 1,000,000.00	$ 13,000	$193,000.00	$1,190,000.00
80	$ 900,000.00	$ 13,000	$193,000.00	$1,090,000.00
CTE-1	$ 2,800,000.00	$ 6,000	$89,000.00	$2,890,000.00
CTE-2	$ 2,700,000.00	$ 6,000	$89,000.00	$2,790,000.00
CTE-3	$ 1,700,000.00	$ 2,000	$30,000.00	$1,730,000.00
CTE-4	$ 2,100,000.00	$ 2,000	$30,000.00	$2,130,000.00
CTE-5	$ 3,300,000.00	$ 4,000	$60,000.00	$3,360,000.00
CTE-6	$ 1,700,000.00	$ 2,000	$30,000.00	$1,730,000.00
CTE-7	$ 2,100,000.00	$ 2,000	$30,000.00	$2,130,000.00
CTE-8	$ 1,900,000.00	$ 6,000	$89,000.00	$1,990,000.00
CTE-9	$ 3,800,000.00	$ 5,000	$74,000.00	$3,870,000.00
CTE-10	$ 5,900,000.00	$ 12,000	$179,000.00	$6,080,000.00
CTE-11	$ 1,700,000.00	$ 2,000	$30,000.00	$1,730,000.00
CTE-12	$ 1,800,000.00	$ 6,000	$89,000.00	$1,890,000.00
CTE-13	$ 1,900,000.00	$ 2,000	$30,000.00	$1,930,000.00
CTE-14	$ 2,800,000.00	$ 15,000	$223,000.00	$3,020,000.00
Total	$ 250,000,000.00	$ 1,400,000.00	$20,000,000.00	$ 270,000,000.00

NOTES:

1. All costs are referenced to construction in May 2007 based on Engineering News Record (ENR) index of 7942. Costs must be increased by a ratio of the appropriate ENR indices for construction costs in subsequent years.
2. Record drawings, erosion control, and final site clean based on lump sum cost of $15,000 per sewer shed.
3. Trench work (gravity, low pressure and force mains) in town roads to include: excavation, backfill, and traffic control. State Roads also include control density fill (CDF).
4. Dewatering based on 50% length of all mains over 15 feet deep.
5. Gravity service lateral based on $50 per foot considering 14 feet to property line.
6. Lift stations are based on Gormann-Rupp suction pump stations with generator and instrumentation.
7. Cost of grinder pumps based on quote from E-1 . Large scale purchases may be a reduction in unit cost.
8. Low pressure lateral based on $34 per lf and average distance of 80 feet with $275 per connection.
9. Trench width based on the following:
   6 feet for low pressure, force mains, and gravity mains less than 12' deep
   12 feet for gravity mains greater than 12 feet deep
10. Full width overlay based on 27 foot wide right of way.
11. Misc. paving items to include aprons, saw-cutting, curb repair and other contingencies.
12. Estimated Project Cost does not include utility relocation (stormwater drains and other).
13. Estimated Project Cost does not include allowance for hazardous waste removal.
14. Pump station cost based on base architectural design. Custom modification to architectural appearance may be extra.

TABLE 9-3

COST ESTIMATE CHATHAM
WWTF IMPROVEMENTS EFFLUENT RECHARGE BEDS

DESCRIPTION	COST(1)	COST(2)
PRELIMINARY TREATMENT	**ALTERNATIVE 3**	**ALTERNATIVE 4**
Headworks	$2,000,000	$2,000,000
Activated Sludge Secondary Treatment System		
Oxidation Ditch (ORBAL)	$4,100,000	$5,700,000
Post Anoxic/Reaeration Tanks	$1,200,000	$1,800,000
Clarifier Flow Distribution Box and Scum Pumping	$210,000	$230,000
RAS & WAS	$1,200,000	$1,400,000
Clarifiers	$2,000,000	$3,000,000
Methanol Storage/Feed System	$180,000	$180,000
Effluent Filters		
Effluent Filters and Recycle Pump Station	$2,700,000	$2,900,000
Disinfection		
UV Disinfection and Effluent Flow Monitoring	$730,000	$730,000
Odor Control		
Odor Control	$340,000	$400,000
Solids Handling		
Sludge Holding Tank and Equipment	$420,000	$1,100,000
Solids Processing Building and Equipment	$750,000	$2,000,000
Electrical Power Distribution and Auxiliary Power		
Major Electrical Power Distribution	$1,800,000	$1,800,000
Instrumentation		
Major Instrumentation/SCADA	$720,000	$720,000
Buildings		
Chemical Storage/Feed System (Caustic, Hypo, Blowers & Compressor)	$1,400,000	$1,400,000
Operations Building	$3,200,000	$3,200,000
General modifications to existing buildings	$220,000	$220,000
Other		
Yard piping	$1,600,000	$2,000,000
General Electrical and Instrumentation	$2,600,000	$3,200,000
Site work	$920,000	$1,100,000
HVAC	$690,000	$860,000
Painting, Plumbing	$460,000	$570,000
Miscellaneous Metals	$340,000	$420,000
Construction Cost Subtotal	**$30,000,000**	**$37,000,000**
Contingency (20%)	$6,000,000	$7,400,000
Design Engineering	$1,100,000	$1,800,000
Fiscal, Legal and Engineering (15%)	$4,500,000	$5,600,000
Total Project Cost	**$41,000,000**	**$51,000,000**

NOTES:
1. Alternative 3 is for the Phase I Improvements to allow sewer extension to meet the Nitrogen TMDLs in the future.
2. Alternative 4 is for Phases I and II to allow sewer extension Town-wide.
3. All costs are referenced to construction in March 2006 based on Engineering News Record (ENR) index of 7692. Costs must be increased by a ratio of the appropriate ENR indices for construction costs in subsequent years.
4. Costs do not include any allowance for vehicles.
5. Borings and a survey were not part of the scope of the project. Information obtained when this work is conducted could result in cost increases.
6. All costs (except construction costs subtotal) are rounded to 2 significant digits.

TABLE 9-4

COST ESTIMATE
CHATHAM WWTF IMPROVEMENTS
EFFLUENT RECHARGE BEDS

DESCRIPTION	COST
Distribution	
Distribution Structure	$90,000
New Effluent Recharge Beds	$1,100,000
Subtotal	**$1,200,000**
Contingency (20%)	$240,000
Design Engineering (10%)	$120,000
Fiscal, Legal and Engineering (15%)	$180,000
Total Project Cost	**$1,700,000**

NOTES:

1. All costs are referenced to construction in March 2006 based on Engineering News Record (ENR) index of 7692. Costs must be increased by a ratio of the appropriate ENR indices for construction costs in subsequent years.
2. Costs do not include any allowance for vehicles.
3. Borings and a survey were not part of the scope of the project. Information obtained when this work is conducted could result in cost increases.
4. All costs (except construction costs subtotal) are rounded to 2 significant digits.

TABLE 9-5

COST AND PERFORMANCE OF TECHNOLOGIES FOR WATERSHEDS

	TOTAL PRESENT WORTH OF I/A	TOTAL PRESENT WORTH OF SEWERS	TOTAL PRESENT WORTH COMBINED
RYDER'S COVE TECHNOLOGY			
Combination of Individual On-site Nitrogen Removal Systems and Sewers -All new components	$8,000,000	$20,000,000	$28,000,000
Combination of Individual On-site Nitrogen Removal Systems and Sewers -Reuse of septic tank and leaching area	$6,000,000	$20,000,000	$26,000,000
MITCHELL RIVER TECHNOLOGY			
Combination of Individual On-site Nitrogen Removal Systems and Sewers -All new components	$3,200,000	$3,600,000	$6,800,000
Combination of Individual On-site Nitrogen Removal Systems and Sewers -Reuse of septic tank and leaching area	$2,400,000	$3,600,000	$600,000
MILL POND TECHNOLOGY			
Combination of Individual On-site Nitrogen Removal Systems and Sewers -All new components	$4,400,000	$5,900,000	$10,000,000
Combination of Individual On-site Nitrogen Removal Systems and Sewers -Reuse of septic tank and leaching area	$3,300,000	$5,900,000	$9,200,000
SULPHUR SPRINGS TECHNOLOGY			
Combination of Individual On-site Nitrogen Removal Systems and Sewers -All new components	$10,000,000	$17,000,000	$27,000,000
Combination of Individual On-site Nitrogen Removal Systems and Sewers -Reuse of septic tank and leaching area	$7,900,000	$17,000,000	$25,000,000
TAYLORS POND TECHNOLOGY			
Combination of Individual On-site Nitrogen Removal Systems and Sewers -All new components	$11,000,000	$9,400,000	$20,000,000
Combination of Individual On-site Nitrogen Removal Systems and Sewers -Reuse of septic tank and leaching area	$8,300,000	$9,400,000	$18,000,000

Notes:

1. Costs based on Barnstable County Department of Health and Environment, May 2007 Report for Eastham with 25% Contingency added to capital costs.
2. Costs include collection systems.
3. All values rounded to two significant figures

TABLE 9-6

PHASE I AND II WWTF DESIGN FLOWS [1]

CONDITION	PHASE I FLOWS (MGD)	PHASE II FLOWS (MGD)
Startup Minimum Month Flow	0.08	0.8
Average Annual Flow	1.3	1.9
Average Summer Design Flow	1.8	2.7
Minimum Month Design Flow	0.8	1.2
Maximum Month Design Flow	2.1	3.1
Peak Day Design Flow	2.3	3.5
Peak Hourly Design Flow	3.5	5.1

TABLE 9-7

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT

(All equipment is NEW unless identified as "existing")

PRELIMINARY FACILITIES	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Pre-engineered System	
Number of Units	2
Location	Influent Building
Capacity	2.8 MGD
Screen Spacing	6-mm (1/4-inch)
Grit Removal Efficiency	80% removal for 65 mesh
Dewatered Screenings and Grit Conveyor	
Number of Units	1
Location	Influent Building
Approximate Length	40 feet
Manual Bar Rack	
Number of Units	1
Location	Influent Building
Screen Spacing	1-inch
Influent Sampler	
Number of Units	1
Location	Influent Building
SECONDARY TREATMENT FACILITIES	
Reactor Flow Distribution	
Type	Slide/Sluice Gates
Number of Units	4
Location	Reactor Junction Box
Oxidation Ditch Reactor	
Process Type	Orbal® Process (Nitrification-Denitrification)
Number of Channels	3
MLSS	4,000 mg/L (max month)
Overall Dimensions	170 ft (L) x 118 ft (W) x 11.5 ft (D)
Oxidation Ditch Aeration System	
Type	Horizontal Rotary Disc Aerators
Location	Oxidation Ditch
Number of Units	2 - 50 HP serving inner and middle channels
Number of Units	2 - 75 HP serving all channels
Oxidation Ditch Nitrate Recycle Pump	
Type	Submersible In-Line Propeller
Location	Inner Channel (Orbal® Oxidation Ditch)
Number of Units	1

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

SECONDARY TREATMENT FACILITIES	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Post Anoxic / Reaeration Tank	
Reactor Scum Pump	
Type	Submersible Centrifugal Chopper Pump
Location	Reactor scum box
Number of Units	1
Capacity, each	150 gpm
Post Anoxic Zone	
Number of Tanks	2
Dimensions, each	36 ft (L) x 33 ft (W) x 10.8 ft side water depth
Volume, each	0.096 MG
Post Anoxic Mixers	
Type	Submersible
Location	Post Anoxic Tanks
Number of Units	2
Reaeration Zone	
Number of Tanks	2
Dimensions, each	33 ft (L) x 13.5 ft (W) x 10.2 ft side water depth
Volume, each	0.033 MG
Reaeration System	
Type	Coarse Bubble Diffusers
Location	Reaeration Tanks
Reaeration Blower	
Type	Positive Displacement, Tri-Lobe with Sound Enclosure
Location	Chemical and Blower Building
Number of Units	3 (including 1 installed spare)
Secondary Clarifier Flow Distribution Slide Gate	
Type	Slide Gates
Location	Clarifier Distribution Box
Number of Units	2
Secondary Clarifier	
Type	Circular, Center Feed with EDI, Peripheral Overflow
Number of Units	2
Tank Diameter	55 feet
Side Water Depth	13 feet
Surface Overflow Rate (Peak)	800 gpd/sf (all units in service)

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

SECONDARY TREATMENT FACILITIES	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Post Anoxic / Reaeration Tank	
Return Activated Sludge Pump	
Type	Centrifugal Non-Clog
Location	RAS/WAS Pump Building
Number of Units	3 (including 1 installed spare)
Capacity, each	On VFD; 860 gpm
Return Activated Sludge Flow Meter	
Type	Magnetic Type
Location	RAS/WAS Pump Building
Number of Units	3
Size	6-inch
Waste Activated Sludge Pump	
Type	Centrifugal Non-Clog
Location	RAS/WAS Pump Building
Number of Units	2 (including 1 installed spare)
Capacity, each	150 gpm
Waste Activated Sludge Flow Meter	
Type	Magnetic Type
Location	RAS/WAS Pump Building
Number of Units	2
Size	3-inch
Secondary Clarifier Scum Pump	
Type	Submersible Centrifugal Chopper Pump
Location	Secondary Scum Box
Number of Units	2
Capacity, each	150 gpm
Methanol Facilities	
Methanol Storage Tank	
Type	Aboveground Concrete Encased Steel
Location	Methanol Facility
Capacity	6,000 gallons
Methanol Feed Pump	
Type	Peristaltic, on VFD
Location	Methanol Facility
Number of Units	2 (plus an uninstalled spare)
Flow Range	0.002 to 34.8 gph

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

SECONDARY TREATMENT FACILITIES	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
FILTRATION	
Effluent Filters	
Type	Continuous Backwashing Sand Filters
Location	Effluent Sand Filter Building Plan
Capacity	3.7 mgd
Number of Cells	9
Number of Modules per Cell	2
Filtration Area Per Cell	100 sq. feet
Total Filtration Area	700 sq. feet
Loading Rate (all cells in service)	3.94 gpm/ft^2
Compressed Air Required	42 scfm
Air Compressor	
Type	Reciprocating
Location	Chemical and Blower Building
Number of Units	1
Motor HP	20
DISINFECTION	
Ultraviolet Disinfection System	
Type	Low Pressure High Intensity
Location	UV and Parshall Flume Structure
Lamp Orientation	Vertical
Capacity	3.7 mgd
Number of Channel	1
Number of Modules	3 (including 1 redundant module)
ODOR CONTROL	
Activated Carbon Odor Control System	
Type	Radial Flow
Location	Adjacent to Sludge Dewatering Building
Media	High Capacity Activated Carbon
Capacity	20,000 cfm
Fan HP	50
Fan Note	Fan provided with weather protection enclosure
Sludge Treatment Facilities	
Waste Activated Sludge Holding Tank	
Note	Reuse Existing
Number of Units	2
Dimensions, each	37 feet x 37 feet x 10.2 feet side water depth

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

ODOR CONTROL	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Sludge Treatment Facilities	
Waste Activated Sludge Holding Tank Aeration System	
Type	Removable Coarse Bubble Diffusers
Location	Waste Activated Sludge Holding Tanks
Design Air Flow	425 scfm for each tank
Waste Activated Sludge Holding Tank Blower	
Type	Positive Displacement, Tri-Lobe with Sound Enclosure
Location	Chemical and Blower Building
Number of Units	2 (including 1 installed spare)
Capacity, each	On VFD
Belt Filter Press Feed Pump	
Type	Double Disc
Location	Control Building
Number of Units	2 (including 1 installed spare)
Capacity, each	On VFD; 370 gpm
Belt Filter Press Feed Flow Meter	
Type	Magnetic Type
Location	Control Building
Number of Units	2
Size	4-inch
Sludge Dewatering Equipment	
Type	Belt Filter Press
Location	Sludge Dewatering Building
Number of Units	1 new + 1 existing
Size	New: 2-meter; Existing: 1-meter
Water Booster Pump	
Location	Sludge Dewatering Building
Number of Units	1
Capacity, each	90 gpm @ 120 psi
Dewatered Sludge Conveyor	
Type	Belt Conveyor
Location	Sludge Dewatering Building
Number of Units	1
Approximate Length	22 feet

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

ODOR CONTROL	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Other Facilities	
Plant Water Pumps	
Type	Skid-Mounted
Location	RAS/WAS Pump Building
Number of Units	3
Plant Water Hydropneumatic Tank	
Number of Units	1
Location	RAS/WAS Pump Building
Recycle Flow Pumps	
Type	Submersible Non-Clog Centrifugal
Location	Recycle Flow Pump Station
Number of Units	2
Parshall Flume	
Type	FRP
Number of Units	1
Location	UV and Parshall Flume Structure
Size (Throat Width)	12-inches
Capacity	320 gpm
Influent Sampler	
Number of Units	1
Location	Outside of the Influent Building
Effluent Sampler	
Number of Units	1
Location	UV and Parshall Flume Structure
Sodium Hypochlorite Storage Tank	
Type	FRP Cylindrical
Location	Chemical and Blower Building
Number of Units	1
Capacity	6,000 gallons
Tank Diameter	10 feet
Sodium Hypochlorite Feed Pumps	
Type	Peristaltic
Location	Chemical and Blower Building
Number of Units	3 (including 1 installed spare)

TABLE 9-7 (continued)

INVENTORY OF EXISTING AND PROPOSED FACILITIES AND PROCESS EQUIPMENT
(All equipment is NEW unless identified as "existing")

ODOR CONTROL	
COMPONENT	**PRELIMINARY DESIGN PHASE I**
Other Facilities	
Sodium Hydroxide Storage Tank	
Type	FRP Cylindrical
Location	Chemical and Blower Building
Number of Units	1
Capacity	6,000 gallons
Tank Diameter	10 feet
Sodium Hydroxide Feed Pumps	
Type	Peristaltic
Location	Chemical and Blower Building
Number of Units	2 (including 1 installed spare)
Effluent Disposal	
Sand Beds	
Number of Existing Sand Beds	2
Area (sf) each	30,000
Area (sf) total	60,000
Capacity, total (30gpd/sf)	1.8 mgd
Number of New Sand Beds	4
Area (sf) total	148,000
Capacity, total (30gpd/sf)	4.4 mgd
Total Capacity	6.2 mgd
Capacity with 50% beds resting	3.1 mgd

TABLE 9-8

SEWERSHEDS NECESSARY TO ACHIEVE TMDL GOALS

SEWERSHED	Estimated Wastewater Flows (gpd)				Estimated Capital Cost
	Average Existing (NO I/I)	Average Future (No I/I)	I/I Total	Average Future (with I/I)	
3	22,000	32,000	16,000	48,000	$ 7,800,000.00
4	6,000	9,000	4,000	14,000	$ 2,200,000.00
5	4,000	5,000	3,000	8,000	$ 1,400,000.00
6	6,000	10,000	3,000	13,000	$ 2,300,000.00
7	9,000	11,000	10,000	20,000	$ 4,300,000.00
8	5,000	7,000	4,000	11,000	$ 2,000,000.00
9	7,000	9,000	4,000	13,000	$ 2,300,000.00
10	7,000	8,000	5,000	13,000	$ 2,000,000.00
11	18,000	21,000	12,000	33,000	$ 4,500,000.00
14	14,000	16,000	8,000	25,000	$ 3,700,000.00
17	15,000	19,000	11,000	30,000	$ 4,400,000.00
18	5,000	7,000	4,000	11,000	$ 1,800,000.00
20	38,000	48,000	21,000	68,000	$ 8,300,000.00
27	19,000	23,000	8,000	31,000	$ 3,300,000.00
29	5,000	7,000	2,000	9,000	$ 1,000,000.00
30	24,000	31,000	6,000	37,000	$ 5,300,000.00
31	15,000	18,000	5,000	23,000	$ 3,900,000.00
33	4,000	5,000	3,000	8,000	$ 1,500,000.00
34	13,000	21,000	4,000	25,000	$ 3,700,000.00
35	9,000	14,000	5,000	19,000	$ 2,600,000.00
36	8,000	13,000	6,000	18,000	$ 2,200,000.00
37	35,000	48,000	16,000	63,000	$ 7,000,000.00
38	8,000	10,000	5,000	15,000	$ 2,500,000.00
39	10,000	14,000	6,000	20,000	$ 2,800,000.00
40	7,000	9,000	4,000	13,000	$ 2,500,000.00
41	8,000	11,000	8,000	19,000	$ 2,800,000.00
43	33,000	48,000	19,000	67,000	$ 7,700,000.00
44	7,000	12,000	6,000	17,000	$ 3,800,000.00
45	4,000	6,000	3,000	9,000	$ 1,400,000.00
46	15,000	23,000	12,000	34,000	$ 3,800,000.00
47	4,000	8,000	4,000	11,000	$ 1,500,000.00
48	7,000	9,000	3,000	12,000	$ 1,900,000.00
50	21,000	29,000	13,000	41,000	$ 4,500,000.00
51	25,000	31,000	10,000	41,000	$ 4,000,000.00
52	6,000	10,000	4,000	14,000	$ 2,300,000.00
56	17,000	24,000	12,000	36,000	$ 4,700,000.00
59	10,000	18,000	7,000	25,000	$ 3,300,000.00
63	7,000	10,000	3,000	14,000	$ 1,500,000.00
67	3,000	5,000	3,000	8,000	$ 1,200,000.00
68	1,000	2,000	2,000	4,000	$ 1,100,000.00
69	2,000	3,000	1,000	4,000	$ 800,000.00
70	1,000	3,000	2,000	4,000	$ 800,000.00
71	10,000	12,000	6,000	18,000	$ 2,600,000.00
72	1,000	2,000	1,000	4,000	$ 1,000,000.00
73	21,000	25,000	10,000	35,000	$ 5,900,000.00
74	3,000	4,000	3,000	7,000	$ 1,300,000.00
75	6,000	9,000	5,000	14,000	$ 2,300,000.00
76	5,000	5,000	2,000	7,000	$ 900,000.00
77	5,000	7,000	4,000	11,000	$ 1,700,000.00
79	3,000	4,000	1,000	6,000	$ 1,000,000.00
80	3,000	4,000	2,000	6,000	$ 900,000.00
CTE-1	11,000	13,000	5,000	18,000	$ 2,800,000.00
CTE-2	6,000	8,000	3,000	11,000	$ 2,700,000.00
CTE-3	1,000	1,000	0	1,000	$ 1,700,000.00
CTE-4	5,000	6,000	1,000	8,000	$ 2,100,000.00
CTE-5	11,000	13,000	6,000	19,000	$ 3,300,000.00
CTE-6	1,000	1,000	0	2,000	$ 1,700,000.00
CTE-7	3,000	3,000	1,000	4,000	$ 2,100,000.00
CTE-8	1,000	1,000	1,000	2,000	$ 1,900,000.00
CTE-12	1,000	1,000	1,000	2,000	$ 1,800,000.00
CTE-14	10,000	12,000	4,000	16,000	$ 2,800,000.00
Sewershed Total	590,000	800,000	340,000	1,100,000	$ 170,000,000.00
Existing Sewered Parcel	100,000	110,000	20,000	130,000	
Downtown infilling	8,000	10,000	0	10,000	
Baileys Path	0	3,000	0	3,000	
CBI	14,000	14,000	0	14,000	
Laundrymat Dev.	1,000	2,000	0	2,000	
TOTAL	**700,000**	**900,000**	**360,000**	**1,300,000**	**$ 170,000,000.00**

Notes:

1. All values rounded to two significant figures
2. Costs based on 2007 (ENR index of 7942)

TABLE 9-9

SEWERSHED ESTIMATED WASTEWATER FLOWS AND CAPITAL COSTS

SEWERSHED	Estimated Wastewater Flows (gpd)						ESTIMATED CAPITAL COST
	AVERAGE EXISTING (NO I/I)	AVERAGE FUTURE (No I/I)	I/I TOTAL	AVERAGE FUTURE (with I/I)	I/I SEWERS	I/I LATERALS	
1	10,000	12,000	6,000	18,000	4,000	2,000	$ 2,300,000.00
2	21,000	29,000	13,000	41,000	8,000	5,000	$ 5,000,000.00
3	22,000	32,000	16,000	48,000	11,000	5,000	$ 7,800,000.00
4	6,000	9,000	4,000	14,000	3,000	1,000	$ 2,200,000.00
5	4,000	5,000	3,000	8,000	2,000	1,000	$ 1,400,000.00
6	6,000	10,000	3,000	13,000	2,000	1,000	$ 2,300,000.00
7	9,000	11,000	10,000	20,000	7,000	3,000	$ 4,300,000.00
8	5,000	7,000	4,000	11,000	3,000	1,000	$ 2,000,000.00
9	7,000	9,000	4,000	13,000	3,000	1,000	$ 2,300,000.00
10	7,000	8,000	5,000	13,000	4,000	1,000	$ 2,000,000.00
11	18,000	21,000	12,000	33,000	8,000	4,000	$ 4,500,000.00
12	10,000	13,000	6,000	18,000	4,000	2,000	$ 2,800,000.00
13	13,000	17,000	6,000	23,000	5,000	1,000	$ 3,000,000.00
14	14,000	16,000	8,000	25,000	6,000	2,000	$ 3,700,000.00
15	10,000	12,000	6,000	18,000	4,000	2,000	$ 2,600,000.00
16	7,000	7,000	3,000	11,000	2,000	1,000	$ 2,200,000.00
17	15,000	19,000	11,000	30,000	8,000	3,000	$ 4,400,000.00
18	5,000	7,000	4,000	11,000	3,000	1,000	$ 1,800,000.00
19	23,000	26,000	7,000	32,000	5,000	2,000	$ 3,700,000.00
20	38,000	48,000	21,000	68,000	14,000	7,000	$ 8,300,000.00
21	15,000	19,000	4,000	23,000	3,000	1,000	$ 1,800,000.00
22	7,000	8,000	7,000	16,000	5,000	2,000	$ 3,500,000.00
23	12,000	20,000	6,000	25,000	4,000	2,000	$ 3,000,000.00
24	9,000	15,000	6,000	22,000	4,000	2,000	$ 3,000,000.00
25	18,000	19,000	6,000	25,000	4,000	2,000	$ 2,700,000.00
26	10,000	13,000	5,000	18,000	3,000	2,000	$ 2,000,000.00
27	19,000	23,000	8,000	31,000	5,000	3,000	$ 3,300,000.00
28	11,000	14,000	6,000	19,000	4,000	2,000	$ 2,800,000.00
29	5,000	7,000	2,000	9,000	1,000	1,000	$ 1,000,000.00
30	24,000	31,000	6,000	37,000	4,000	2,000	$ 5,300,000.00
31	15,000	18,000	5,000	23,000	4,000	1,000	$ 3,900,000.00
32	4,000	5,000	2,000	8,000	1,000	1,000	$ 1,000,000.00
33	4,000	5,000	3,000	8,000	2,000	1,000	$ 1,500,000.00
34	13,000	21,000	4,000	25,000	3,000	1,000	$ 3,700,000.00
35	9,000	14,000	5,000	19,000	3,000	2,000	$ 2,600,000.00
36	8,000	13,000	6,000	18,000	4,000	2,000	$ 2,200,000.00
37	35,000	48,000	16,000	63,000	11,000	5,000	$ 7,000,000.00
38	8,000	10,000	5,000	15,000	4,000	1,000	$ 2,500,000.00
39	10,000	14,000	6,000	20,000	4,000	2,000	$ 2,800,000.00
40	7,000	9,000	4,000	13,000	3,000	1,000	$ 2,500,000.00
41	8,000	11,000	8,000	19,000	5,000	3,000	$ 2,800,000.00
42	4,000	6,000	3,000	8,000	2,000	1,000	$ 1,300,000.00
43	33,000	48,000	19,000	67,000	12,000	7,000	$ 7,700,000.00
44	7,000	12,000	6,000	17,000	4,000	2,000	$ 3,800,000.00
45	4,000	6,000	3,000	9,000	2,000	1,000	$ 1,400,000.00
46	15,000	23,000	12,000	34,000	8,000	4,000	$ 3,800,000.00
47	4,000	8,000	4,000	11,000	3,000	1,000	$ 1,500,000.00
48	7,000	9,000	3,000	12,000	2,000	1,000	$ 1,900,000.00
49	7,000	9,000	3,000	13,000	2,000	1,000	$ 1,500,000.00
50	21,000	29,000	13,000	41,000	9,000	4,000	$ 4,500,000.00
51	25,000	31,000	10,000	41,000	7,000	3,000	$ 4,000,000.00
52	6,000	10,000	4,000	14,000	3,000	1,000	$ 2,300,000.00
53	14,000	22,000	8,000	29,000	5,000	3,000	$ 3,900,000.00
54	5,000	9,000	5,000	13,000	3,000	2,000	$ 1,700,000.00
55	5,000	8,000	3,000	11,000	2,000	1,000	$ 1,500,000.00
56	17,000	24,000	12,000	36,000	8,000	4,000	$ 4,700,000.00
57	6,000	7,000	3,000	10,000	2,000	1,000	$ 1,300,000.00
58	2,000	3,000	0	3,000	0	0	$ 700,000.00
59	10,000	18,000	7,000	25,000	5,000	2,000	$ 3,300,000.00
60	3,000	4,000	2,000	6,000	1,000	1,000	$ 1,200,000.00
61	10,000	16,000	7,000	23,000	5,000	2,000	$ 2,800,000.00
62	4,000	7,000	4,000	12,000	3,000	1,000	$ 1,800,000.00
63	7,000	10,000	3,000	14,000	2,000	1,000	$ 1,500,000.00
64	3,000	4,000	2,000	6,000	1,000	1,000	$ 1,200,000.00
65	3,000	4,000	2,000	6,000	1,000	1,000	$ 1,000,000.00
66	13,000	22,000	13,000	35,000	9,000	4,000	$ 4,900,000.00
67	3,000	5,000	3,000	8,000	2,000	1,000	$ 1,200,000.00
68	1,000	2,000	2,000	4,000	1,000	1,000	$ 1,100,000.00
69	2,000	3,000	1,000	4,000	1,000	0	$ 800,000.00
70	1,000	3,000	2,000	4,000	1,000	1,000	$ 800,000.00
71	10,000	12,000	6,000	18,000	4,000	2,000	$ 2,600,000.00
72	1,000	2,000	1,000	4,000	1,000	0	$ 1,000,000.00
73	21,000	25,000	10,000	35,000	7,000	3,000	$ 5,900,000.00
74	3,000	4,000	3,000	7,000	2,000	1,000	$ 1,300,000.00
75	6,000	9,000	5,000	14,000	4,000	1,000	$ 2,300,000.00
76	5,000	5,000	2,000	7,000	1,000	1,000	$ 900,000.00
77	5,000	7,000	4,000	11,000	3,000	1,000	$ 1,700,000.00
78	4,000	7,000	3,000	10,000	2,000	1,000	$ 1,400,000.00
79	3,000	4,000	1,000	6,000	1,000	0	$ 1,000,000.00
80	3,000	4,000	2,000	6,000	1,000	1,000	$ 900,000.00
CTE-1	11,000	13,000	5,000	18,000	3,000	2,000	$ 2,800,000.00
CTE-2	6,000	8,000	3,000	11,000	2,000	1,000	$ 2,700,000.00
CTE-3	1,000	1,000	0	1,000	0	0	$ 1,700,000.00
CTE-4	5,000	6,000	1,000	8,000	1,000	0	$ 2,100,000.00
CTE-5	11,000	13,000	6,000	19,000	4,000	2,000	$ 3,300,000.00
CTE-6	1,000	1,000	0	2,000	0	0	$ 1,700,000.00
CTE-7	3,000	3,000	1,000	4,000	1,000	0	$ 2,100,000.00
CTE-8	1,000	1,000	1,000	2,000	1,000	0	$ 1,900,000.00
CTE-9	12,000	15,000	8,000	23,000	5,000	3,000	$ 3,800,000.00
CTE-10	23,000	30,000	15,000	45,000	10,000	5,000	$ 5,900,000.00
CTE-11	0	1,000	0	1,000	0	0	$ 1,700,000.00
CTE-12	1,000	1,000	1,000	2,000	1,000	0	$ 1,800,000.00
CTE-13	2,000	2,000	2,000	4,000	1,000	1,000	$ 1,900,000.00
CTE-14	10,000	12,000	4,000	16,000	3,000	1,000	$ 2,800,000.00
Sewershed Total	890,000	1,200,000	510,000	1,700,000	350,000	160,000	$ 250,000,000.00
Existing Sewered Parcel	100,000	110,000	20,000	130,000	20,000	0	
Downtown infilling	8,000	10,000	0	10,000	0	0	
Baileys Path	0	3,000	0	3,000	0	0	
CBI	14,000	14,000	0	14,000	0	0	
Laundrymat Dev.	1,000	2,000	0	2,000	0	0	
TOTAL	**1,000,000**	**1,300,000**	**530,000**	**1,900,000**	**720,000**	**320,000**	**$ 250,000,000.00**

Notes:

1. All values rounded to two significant figures
2. Costs based on 2007 (ENR index of 7942)

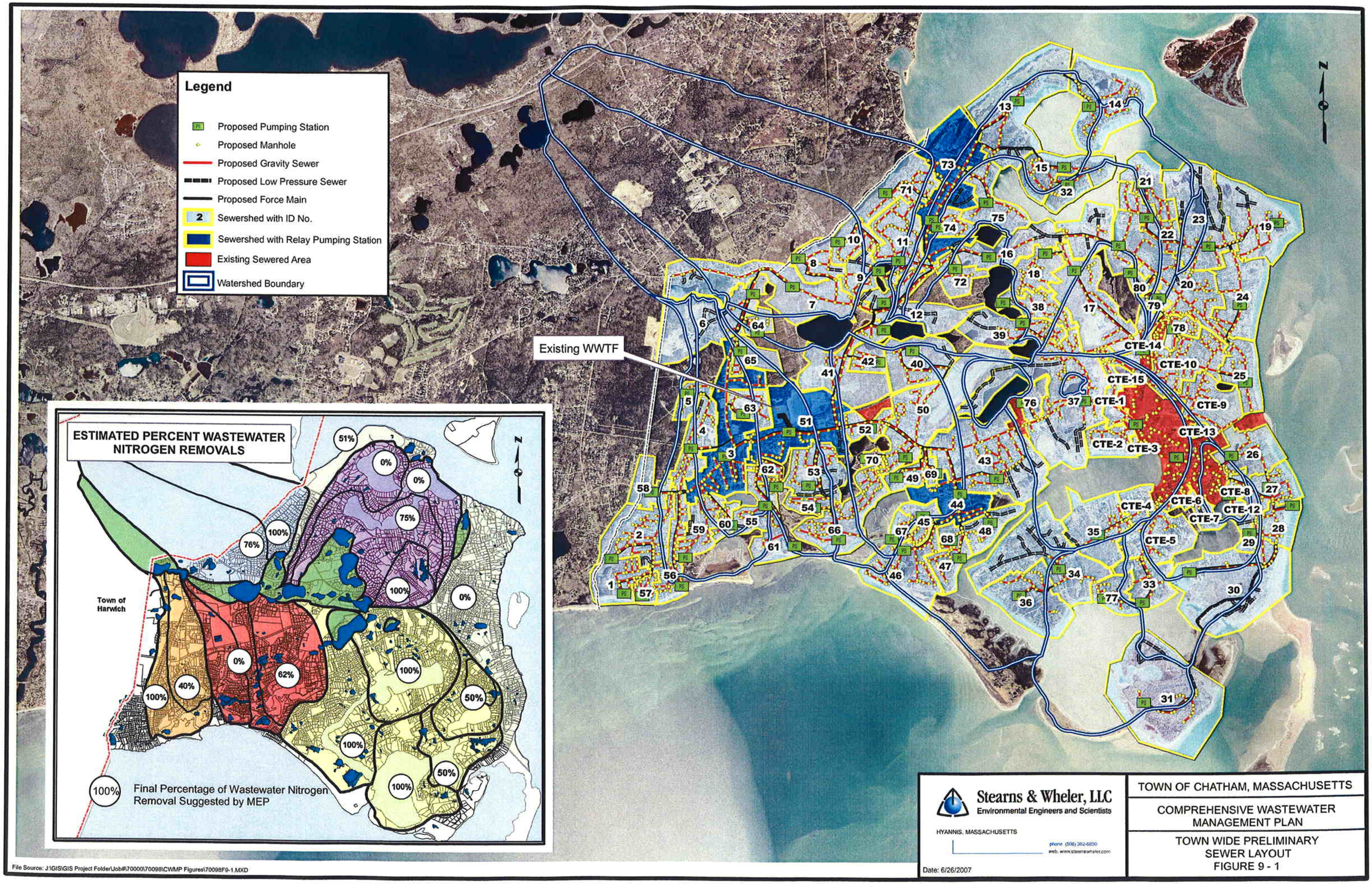
TABLE 9-10

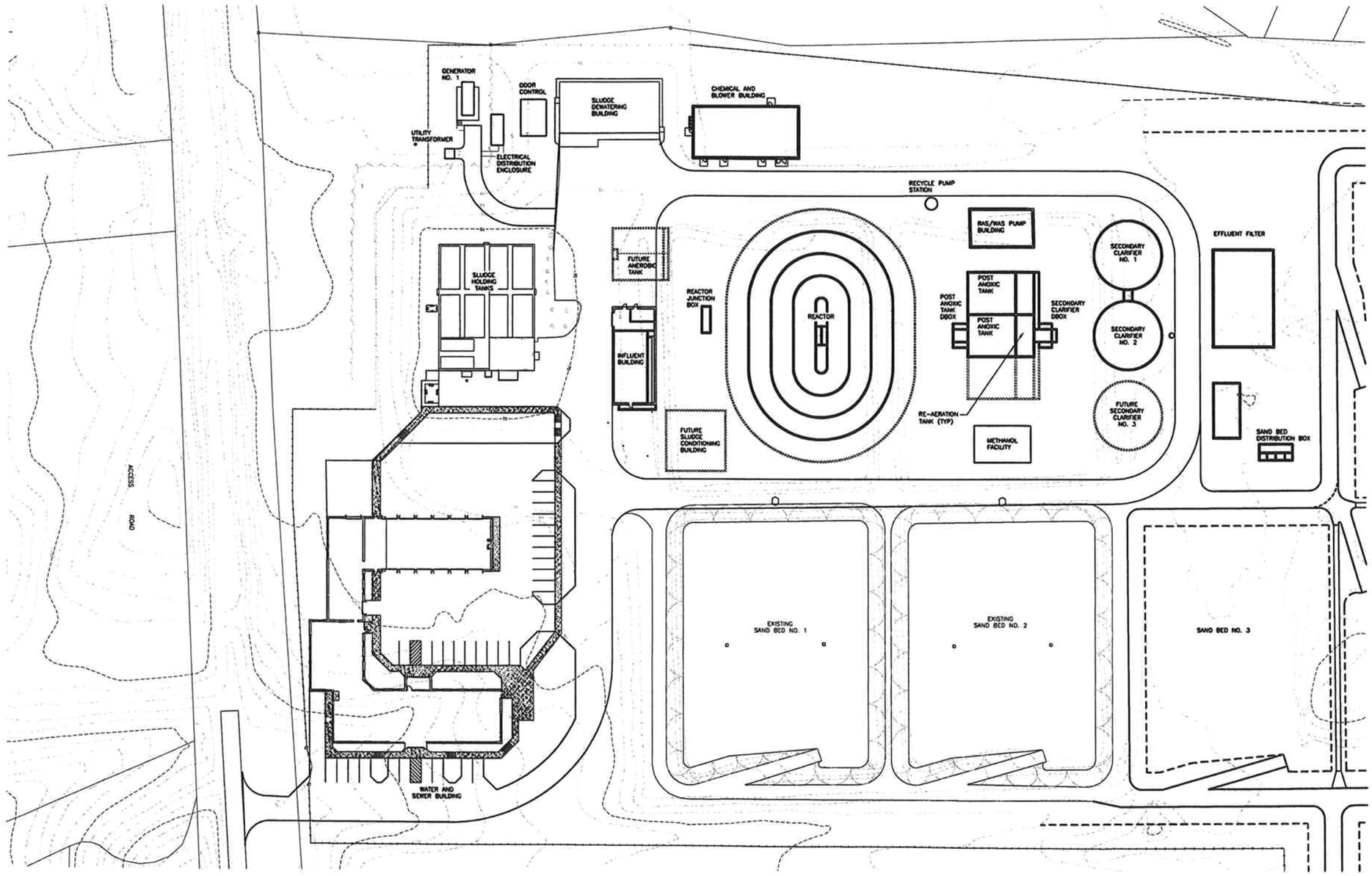
TOTAL PRESENT WORTH COMPARISON
FIVE WATERSHEDS ALTERNATIVE #2
VS.
CONNECTION TO THE WWTF

ALTERNATIVE	TOTAL PRESENT WORTH				
	RYDER'SCOVE	MITCHELL RIVER	MILL POND	SULPHUR SPRINGS	TAYLORS POND
Alternative #2 -All new components	$28,000,000	$6,800,000	$10,000,000	$27,000,000	$20,000,000
Alternative #2 -reuse of septic tank and leaching area	$26,000,000	$6,000,000	$9,200,000	$25,000,000	$18,000,000
Alternative #3 -Connection to the WWTF (2)(3)	$23,000,000	$7,900,000	$10,000,000	$20,000,000	$15,000,000

Notes:
1. Costs based on 2007 (ENR index of 7942)
2. Costs include collection systems. Costs do not include development of a management district or structure for individual I/As.
3. Connection to the WWTF includes the costs associated with upgrade at that facility (as a percentage of flow contributed from that watershed).
4. All values rounded to two significant figures

Figures


Legend
Proposed Pumping Station
Proposed Manhole
Proposed Gravity Sewer
Proposed Low Pressure Sewer
Proposed Force Main
Sewershed with ID No.
Sewershed with Relay Pumping Station
Existing Sewered Area
Watershed Boundary
Existing WWTF
ESTIMATED PERCENT WASTEWATER NITROGEN REMOVALS
Town of Harwich
Final Percentage of Wastewater Nitrogen Removal Suggested by MEP
Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS
Date: 6/26/2007
TOWN OF CHATHAM, MASSACHUSETTS
COMPREHENSIVE WASTEWATER MANAGEMENT PLAN
TOWN WIDE PRELIMINARY SEWER LAYOUT
FIGURE 9 - 1
File Source: J:\GIS\GIS Project Folder\Job#\70000\70098\CWMP Figures\70098F9-1.MXD



SITE PLAN – OVERALL
SCALE: 1"= 40'-0"

1"=60'-0" 60 0 60 120

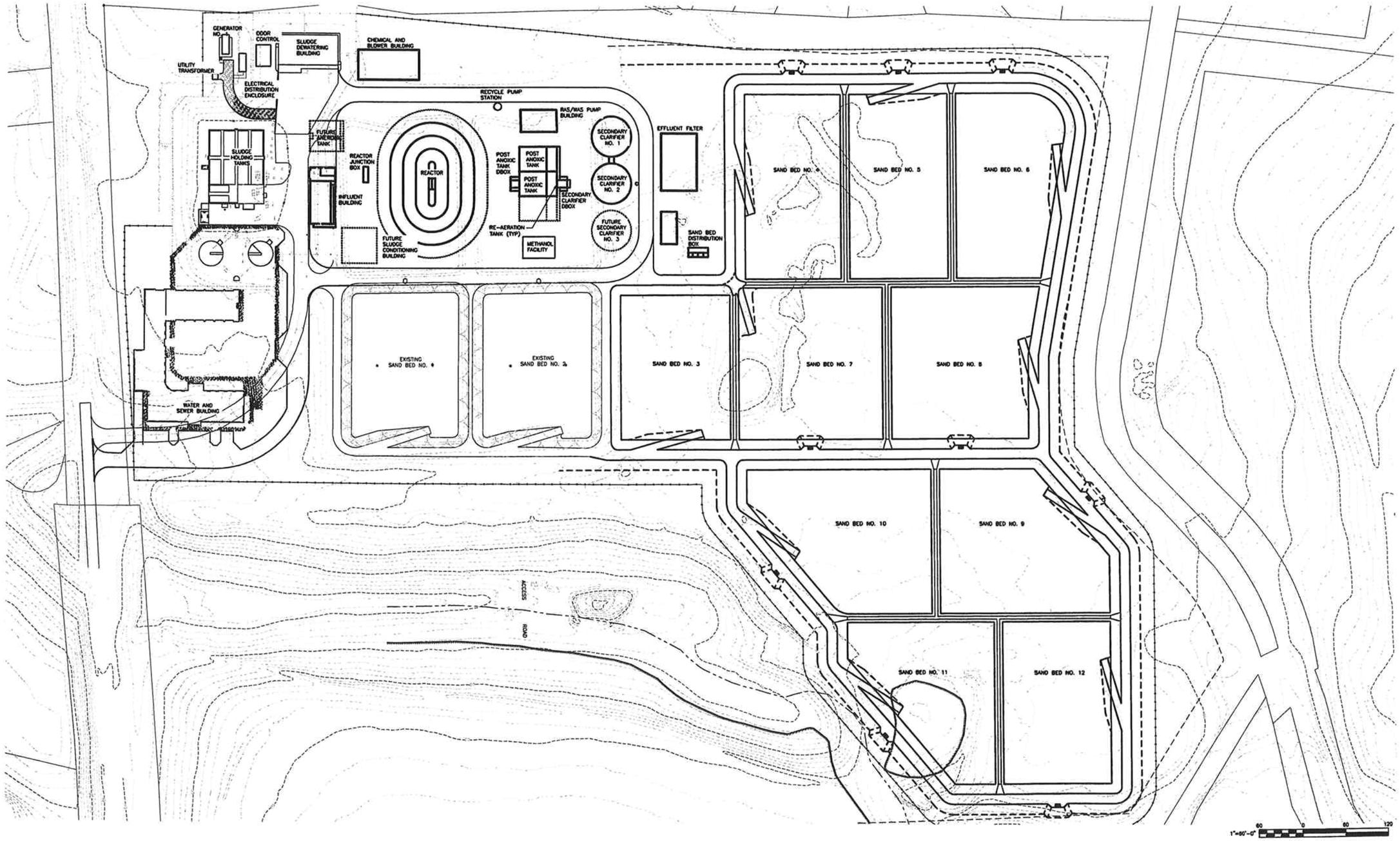
Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

DATE: 06/28/07

TOWN OF CHATHAM, MASSACHUSETTS

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

WWTF PRELIMINARY DESIGN
FIGURE 9-2



SITE PLAN – OVERALL
SCALE: 1"= 60'-0"

Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

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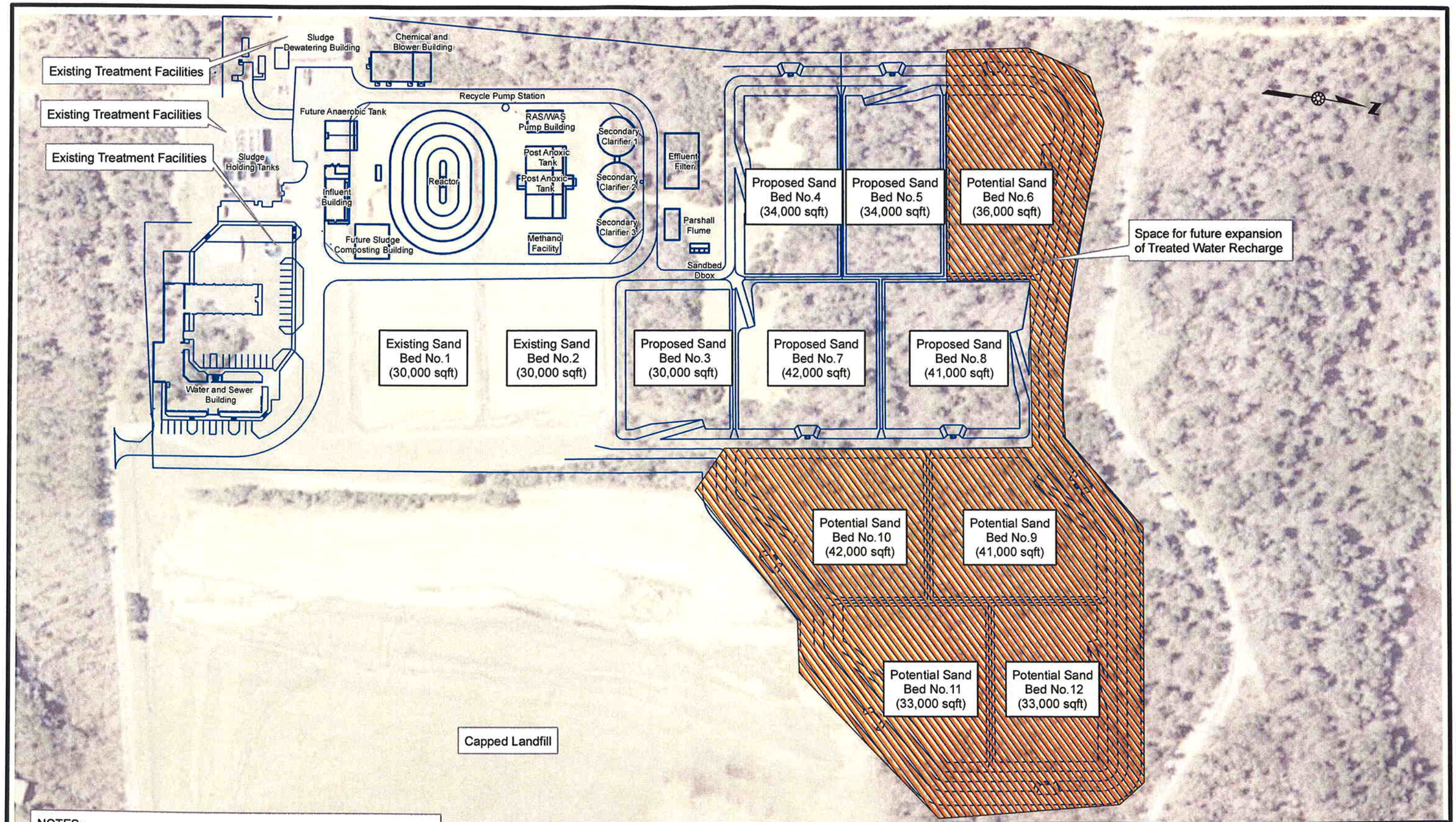
TOWN OF CHATHAM, MASSACHUSETTS

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

WWTF PRELIMINARY DESIGN WITH POTENTIAL TREATED WATER RECHARGE AREA
FIGURE 9-3



NOTES:
Sand Beds 1,2,3,4, and portions of Bed 5 are needed for the Phase I flows; and sand beds 1,2,3,4,7, and portions of beds 5 and 8 are needed for the Phase II flows for a total of 200,000 sf of bed area. The final bed area for beds 3,4,5,7, and 8 will be finalized during design.

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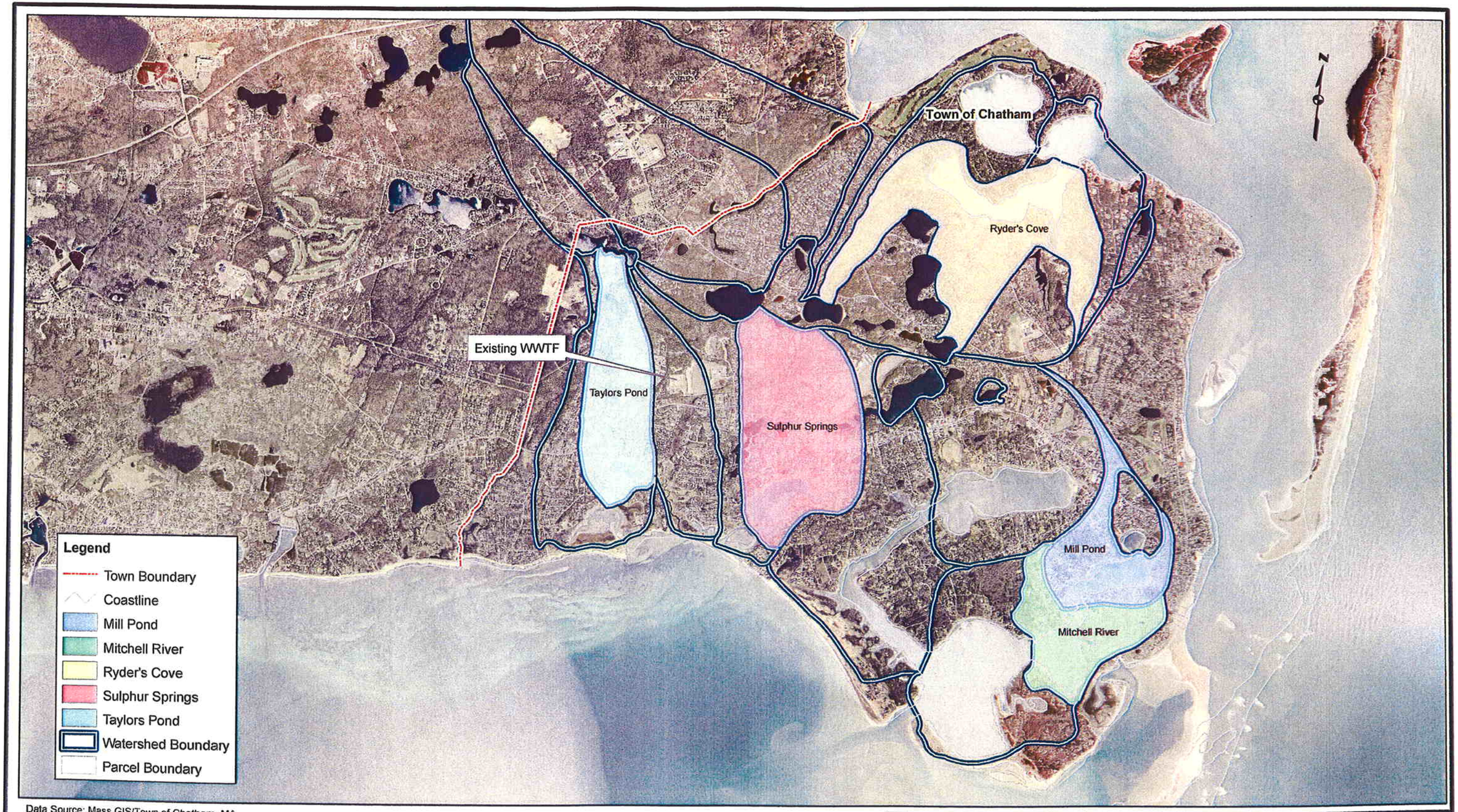
Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

Date: 06/04/2007

TOWN OF CHATHAM, MASSACHUSETTS

COMPREHENSIVE WASTEWATER MANAGEMENT PLANNING

WWTF Treated Water Recharge
Sand Beds @ 30 gpd/sf
FIGURE 9-4



Data Source: Mass GIS/Town of Chatham, MA

0 0.4 0.8 1.6 Miles

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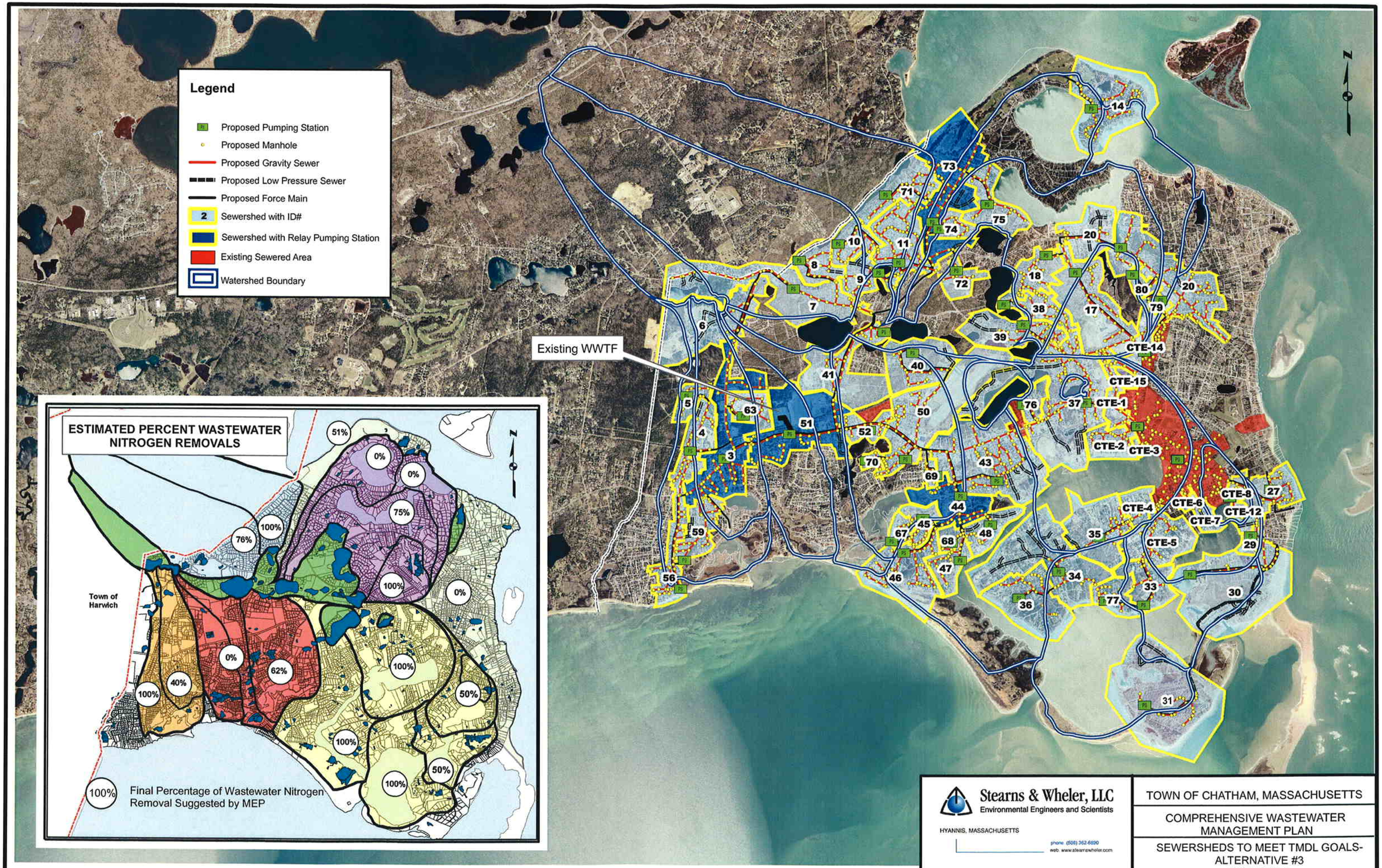
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS

Date: 06/14/07

TOWN OF CHATHAM, MASSACHUSETTS

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

COMBINATION ALTERNATIVE-ALTERNATIVE #2
FIGURE 9 - 5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Sewershed with ID#
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Date: 6/26/2007
TOWN OF CHATHAM, MASSACHUSETTS
COMPREHENSIVE WASTEWATER MANAGEMENT PLAN
SEWERSHEDS TO MEET TMDL GOALS-ALTERNATIVE #3
FIGURE 9-6
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