# SECTION 7

# EVALUATION OF ALTERNATIVE PLANS

## 7.1 INTRODUCTION

Section 6 of this report describes the three wastewater management plans that have been considered in detail, and the No Action Plan which serves as a benchmark for comparison. This section of the report presents a detailed comparison of the plans in the following 20 categories:

- Transfer of water among watersheds
- Transfer of nitrogen among watersheds
- Extent of sewer system
- Need for land purchases and easements
- Capital costs
- Operation and maintenance costs
- Net present worth
- Impacts on user charges and tax rate
- Environmental impacts
- Energy consumption
- Suitability of treatment facility sites
- Truck traffic at Tri-Town site
- Expandability
- Flexibility for phasing
- Potential for water reuse
- Regulatory acceptability
- Ease in implementation
- Potential for impacting town growth rate
- Potential for public works facility at Tri-Town site
- Overall public acceptability

Most of these evaluative criteria were considered by the WMSC in narrowing the investigation from nine general plans to the three plans that were then considered in detail. With more information available on the three plans, these criteria were applied again with more specificity.

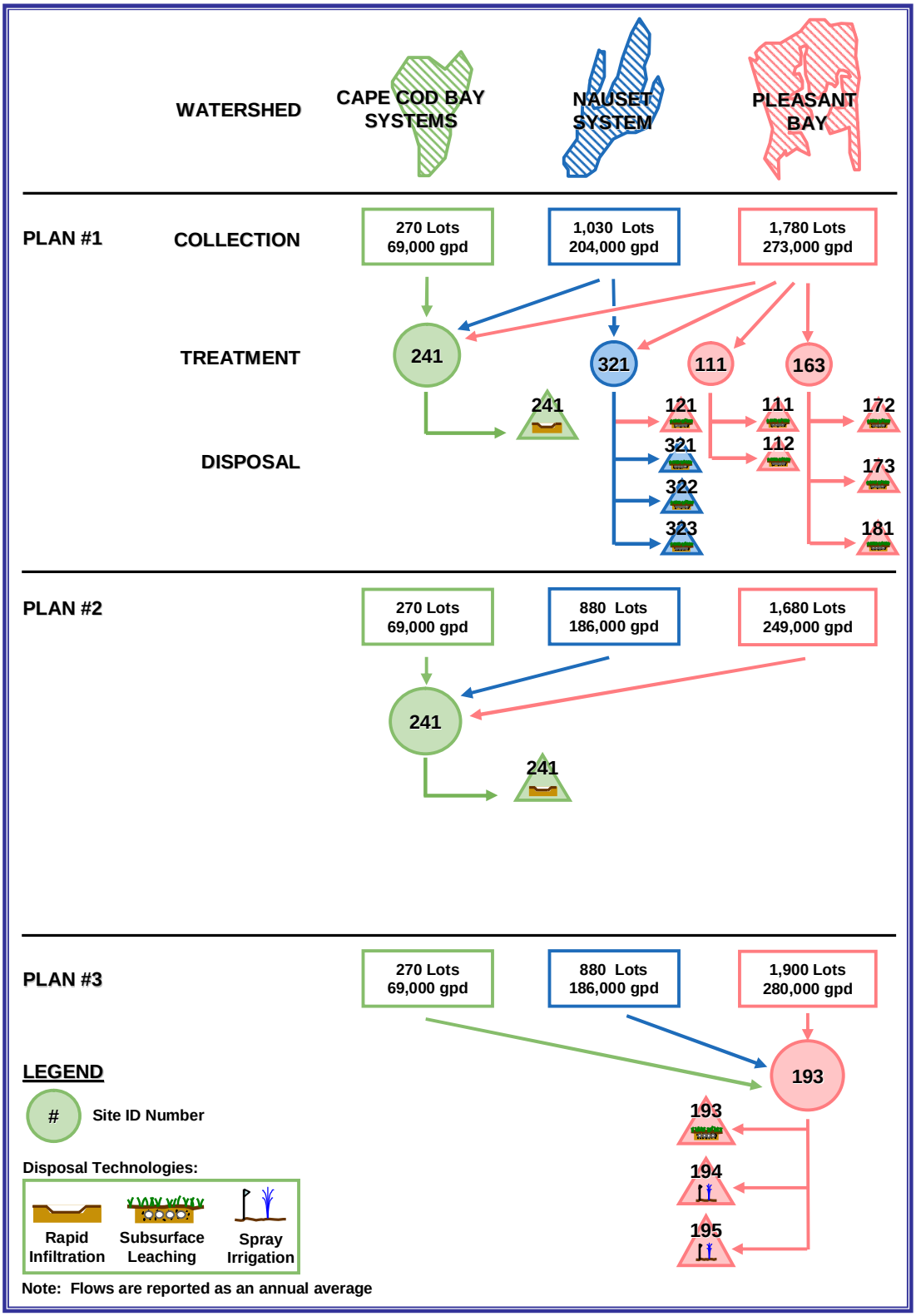
## 7.2 TRANSFER OF WATER AMONG WATERSHEDS

Over 95 percent of the homes and businesses in Orleans are served by the municipal water system, which withdraws water from the Pleasant Bay watershed and distributes it all across town. Wastewater that is produced in Orleans today receives rudimentary treatment (through on-site septic systems) and is recharged in the watershed where the wastewater is produced. Each of the public wastewater plans under consideration would eliminate a portion of the existing septic systems and convey the collected wastewater to one or more sites for treatment. Effluent would then be recharged at the treatment plant site or at nearby sites. Given this change from fully-dispersed discharges to more concentrated discharges, it is important to consider the overall disposition of wastewater by major watershed.

Figure 7-1 is a schematic representation of the three wastewater plans, constructed to illustrate the watershed location of each component. Facilities in the Cape Cod Bay watersheds are shown in green; those in the Nauset watershed are depicted in blue, and red is used to portray facilities in the Pleasant Bay watershed. The geographic diversity of the three plans is apparent from Figure 7-1. Treatment and disposal in the Cape Cod Bay watersheds would occur in Plans 1 and 2. Facilities are located in the Nauset watershed only in Plan 1. Plans 1 and 3 include facilities in the Pleasant Bay watershed. None of the plans include facilities in the watershed directly tributary to the Atlantic Ocean.

Table 7-1 illustrates the disposition of wastewater by major watershed for all three plans. The first block of data in Table 7-1 presents estimates of the annual average recharge from wastewater disposal in the year 2030, assuming a continuation of current practices (the "No Action Plan"), that is, without public wastewater infrastructure. The term "wastewater recharge" is used to describe the liquid entering the groundwater from either septic systems that remain in

**FIGURE 7-1**
**SCHEMATIC REPRESENTATION OF WASTEWATER MANAGEMENT PLANS**



service, existing private wastewater plants, new public wastewater facilities, or the Tri-Town Septage Treatment Facility. In the No Action Plan, the vast majority of the recharge would be from private septic systems, about 930,000 gpd. Table 7-1 includes the projected discharge from the Tri-Town facility, treating septage from just the three District towns. Discharges from two private wastewater plants (Community of Jesus and Skaket Corner) are also included. In the absence of public sewers, the three major watersheds each receive nearly equal percentages of the total wastewater recharge: from 27% in the Cape Cod Bay watersheds to 39% in the Pleasant Bay watershed.

**TABLE 7-1**
**DISPOSITION OF EFFLUENT**

| | Major Watershed | | | | |
|---|---|---|---|---|---|
| **Wastewater Recharge at Planning Horizon (gpd, annual average)** | **Cape Cod Bay** | **Nauset System** | **Atlantic Ocean** | **Pleasant Bay** | **Total** |
| **No Action Plan** | | | | | |
| Total Wastewater Recharge | 266,000 | 299,000 | 28,000 | 376,000 | 969,000 |
| Distribution by Watershed, % | *27%* | *31%* | *3%* | *39%* | *100%* |
| **Plan 1** | | | | | |
| Total Wastewater Recharge | 488,000 | 220,000 | 28,000 | 233,000 | 969,000 |
| Distribution by Watershed, % | *50%* | *23%* | *3%* | *24%* | *100%* |
| Change from No Action | +222,000 | -79,000 | 0 | -143,000 | 0 |
| **Plan 2** | | | | | |
| Total Wastewater Recharge | 701,000 | 113,000 | 28,000 | 127,000 | 969,000 |
| Distribution by Watershed, % | *72%* | *12%* | *3%* | *13%* | *100%* |
| Change from No Action | +435,000 | -186,000 | 0 | -249,000 | 0 |
| **Plan 3** | | | | | |
| Total Wastewater Recharge | 197,000 | 113,000 | 28,000 | 631,000 | 969,000 |
| Distribution by Watershed, % | *20%* | *12%* | *3%* | *65%* | *100%* |
| Change from No Action | -69,000 | -186,000 | 0 | +255,000 | 0 |
| **Non-Wastewater Recharge** | | | | | |
| **Annual Average, mgd** | 7.40 | 4.46 | 0.52 | 31.0 | 43.4 |
| **Change in Wastewater Recharge as % of Non-Wastewater Recharge** | | | | | |
| Plan 1 | +3.0% | -1.8% | +0.0% | -0.5% | |
| Plan 2 | +5.9% | -4.2% | +0.0% | -0.8% | |
| Plan 3 | -0.9% | -4.2% | +0.0% | +0.8% | |

**Plan 1**

Table 7-1 shows how that distribution of wastewater recharge would change if the decentralized plan were implemented. There would be a net reduction of 79,000 gpd in the Nauset watershed and 143,000 gpd in the Pleasant Bay watershed. (Greater quantities of wastewater would be collected from these watersheds, and some would be disposed of there; these figures represent the net effect.) The Cape Cod Bay watershed would see an increase in wastewater recharge of 222,000 gpd, the net of wastewater collected there and the discharge at the Tri-Town site. This plan would shift the percentage distribution of wastewater recharge to about 50% in the Cape Cod Bay watersheds and 47% in Nauset and Pleasant Bay combined.

**Plan 2**

For the centralized plan involving a single facility at the Tri-Town site, wastewater recharge would be reduced by 186,000 gpd in the Nauset watershed and by 249,000 gpd in the Pleasant Bay watershed. The additional recharge of 435,000 gpd in the Cape Cod Bay watershed would result in 72% of the total wastewater recharge occurring in that watershed, an increase of 160% over the No Action option.

**Plan 3**

With a centralized facility in South Orleans, wastewater recharge would be decreased by 69,000 gpd in the Cape Cod Bay watersheds and by 186,000 gpd in the Nauset watershed, with a 255,000 gpd increase in Pleasant Bay. This is an increase of 68% over the No Action wastewater recharge in Pleasant Bay. In this plan, the Pleasant Bay watershed would receive 65% of the Town-wide wastewater recharge.

**Comparison With Natural Recharge**

All of the figures discussed above are related to wastewater recharge, from either septic systems that remain in service, existing private wastewater plants, new public wastewater facilities, or the Tri-Town septage facility. It is important to put those recharge quantities in perspective by also considering the recharge that occurs from precipitation on vegetated or paved surfaces. The data shown at the bottom of Table 7-1 under the heading of "Non-Wastewater Recharge" address this

issue, by presenting the precipitation-related recharge for each watershed based on the land surface area (excluding ponds) and 30 inches of recharge per year. While the annual average wastewater recharge is projected to be 969,000 gpd in 2030, the precipitation recharge will be over 40 million gallons per day (mgd), also expressed as an annual average. Therefore, wastewater recharge would represent about 2% of the average precipitation recharge town-wide. Precipitation recharge will vary significantly year-to-year, and the typical annual variation in precipitation recharge is larger than the projected wastewater recharge.

Table 7-1 shows the distribution of the precipitation recharge by major watershed. It also compares the change in wastewater recharge for each plan with the precipitation recharge. The increased wastewater recharge in the Cape Cod Bay watersheds represents about 3% of the average precipitation recharge in Plan 1 and 6% in Plan 2. In Plan 3, the increase in wastewater recharge in the Pleasant Bay watershed would be about 1% of the precipitation recharge. The Nauset system would see a reduction in wastewater recharge in all plans that represents 2% to 4% of the average precipitation recharge there.

The land-based disposal of effluent from one or more wastewater treatment plants will increase groundwater levels in the vicinity of the disposal sites and increase the freshwater discharge at the downgradient end of the watershed such as the shore of the embayment or salt marsh. These impacts would be evaluated in detail as part of the groundwater discharge permitting required by DEP. Given the relatively small increases compared to natural recharge, especially compared with normal variability in precipitation, these impacts are expected to be very small.

The removal of septic system recharge from areas to be sewered will lower groundwater levels in those areas. As shown in Table 7-1, the decreases in recharge volumes are all less than about 4%, and are not significant given the annual variation in precipitation. It is also important to realize that water tables in most areas in Orleans are slightly higher than they were prior to the advent of the public water supply system, which removes water from the Pleasant Bay watershed and distributes all across town.

While there are subtle differences among the plans, none would cause any significant problems in terms of the overall water balance in any watershed. Localized impacts from effluent disposal

would be assessed by site-specific groundwater modeling. (The data in Table 7-1 do not include extraneous flows (infiltration and inflow) that can enter a sewer system. To the extent that these extraneous flows occur, they would slightly alter the water balance data in Table 7-1, but not enough to change the general conclusions.)

## 7.3 TRANSFER OF NITROGEN AMONG WATERSHEDS

The principal purposes of the public wastewater management systems considered here are to:

- collect the nitrogen that is impacting coastal waters,
- bring the nitrogen to a wastewater treatment facility that can convert most of it to harmless nitrogen gas; and
- recharge the effluent, and the residual nitrogen it contains, in locations that respect the nitrogen control needs of the various watersheds.

Table 7-2 presents data on the annual wastewater nitrogen loads (expressed in pounds of nitrogen per year) that are projected to occur at the end of the planning horizon under each of the wastewater plans. Like Table 7-1, Table 7-2 first presents data on the No Action Plan which includes septic systems loads, the effluent nitrogen load from the Tri-Town Septage Treatment Facility, and the effluent loads from the two private wastewater facilities in Orleans that are greater than 10,000 gpd in capacity. The remainder of Table 7-2 shows how the nitrogen loads would be reduced in each of the plans.

Table 7-2 shows that the projected town-wide nitrogen load from wastewater sources is about 100,000 pounds per year. In the absence of public sewers, the three major watersheds would each receive nearly equal percentages of the total nitrogen load: from 26% in the Cape Cod Bay watersheds to 40% in the Pleasant Bay watershed.

Table 7-2 also shows how the three wastewater plans would reduce the town-wide nitrogen load from wastewater sources to a range of 50,000 pounds per year (Plan 3) to 54,000 pounds per year (Plan 2). These figures indicate a 45% reduction from current loads and a 50% reduction from what the loads would become at the end of the planning horizon. The percentage reductions from current nitrogen loads all match the nitrogen removal needs established in MEP technical reports or projected needs estimated by MEP staff.

**TABLE 7-2**
**DISPOSITION OF WASTEWATER NITROGEN**

| | Major Watershed | | | | |
|---|---|---|---|---|---|
| **Nitrogen Loads at Planning Horizon (lb/yr)** | **Cape Cod Bay** | **Nauset System** | **Atlantic Ocean** | **Pleasant Bay** | **Total** |
| **No Action Plan** | | | | | |
| Total Nitrogen Load | 26,640 | 31,860 | 2,980 | 40,060 | 101,540 |
| Distribution by Watershed, % | *26* | *31* | *3* | *40* | |
| **Plan 1** | | | | | |
| Total Nitrogen Load | 23,890 | 13,170 | 2,980 | 14,140 | 54,180 |
| Distribution by Watershed, % | *44* | *24* | *6* | *26* | |
| Reduction from No Action Plan, % | -10 | -59 | 0 | -66 | -47 |
| **Plan 2** | | | | | |
| Total Nitrogen Load | 25,110 | 12,040 | 2,980 | 13,530 | 53,660 |
| Distribution by Watershed, % | *47* | *22* | *6* | *25* | |
| Reduction from No Action Plan, % | -6 | -62 | 0 | -66 | -47 |
| **Plan 3** | | | | | |
| Total Nitrogen Load | 19,390 | 12,040 | 2,980 | 15,110 | 49,520 |
| Distribution by Watershed, % | *39* | *22* | *6* | *28* | |
| Reduction from No Action Plan, % | -27 | -62 | 0 | -62 | -51 |

With regard to nitrogen control, all three plans are equivalent. Indeed, they were formulated with that equality in mind. While Plan 2 removes the least amount of septic system nitrogen, that is not a flaw of this plan. The benefit of Plan 2 is the reduced need for nitrogen reduction due to the favorable location of the effluent nitrogen recharge.

## 7.4 EXTENT OF SEWER SYSTEM

As discussed in Section 4.4, the extent of the wastewater collection system in each plan is determined by the location of recharge of the residual nitrogen remaining after treatment. The extent of the sewers varies with the plan:

| | | |
|---|---|---|
| Plan 1 | 3,800 properties served | 420,000 feet of collection pipe |
| Plan 2 | 2,830 properties served | 390,000 feet of collection pipe |
| Plan 3 | 3,050 properties served | 420,000 feet of collection pipe |

The residual nitrogen in Plan 2 would be discharged in the watersheds of coastal systems that are not nitrogen limited and the added nitrogen does not cause the nitrogen thresholds to be exceeded. By contrast, the residual nitrogen discharged in Plans 1 and 3 would eventually reach nitrogen-sensitive embayments, requiring the elimination of more septic systems in those watersheds.

The less extensive sewer system associated with Plan 2 is a distinct advantage. Not only are the collection costs reduced compared with the other plans, but a smaller volume of collected wastewater translates to reduced treatment and disposal costs.

## 7.5 NEED FOR LAND PURCHASES AND EASEMENTS

Plan 1 requires the acquisition of numerous privately-owned parcels to accommodate the wastewater treatment facilities and associated effluent disposal systems. Plan 2 could be constructed entirely on the site of the Tri-Town Septage Treatment Facility, where the land is owned by the Town of Orleans. Plan 3 would require the Town of Orleans to acquire land or easements from property owners in Brewster, including the Town of Brewster. The extent of land purchase or easements is estimated as follows:

| | | |
|---|---|---|
| Plan 1 | 11 parcels | 2007 assessed value: $13 million |
| Plan 2 | none | none |
| Plan 3 | 3 parcels | value: not determined |

Given the availability of Town-owned land at the Tri-Town site, Plan 2 has the distinct advantage of not requiring land purchases. This benefit is reflected in capital costs as well as in ease in implementation. Land for pump stations is not included above, but the costs are about the same for each plan.

## 7.6 CAPITAL COSTS

The Town of Orleans will be faced with costs in two categories, regardless of the plan that is implemented. The first category, presented here, is "capital cost", the cost to design and build

the needed facilities. The second category is "operation and maintenance (O&M) costs" which include the ongoing annual expenses to run the facilities.

**Basis For Estimates**

Key technical data were compiled for all three plans, based on conceptual designs. Next, typical "unit costs" were applied (dollars per foot of pipe, or dollars per pump station, for example) using recent experience from publicly-bid wastewater projects across New England. More generalized costs were also derived from a cost model that predicts treatment and disposal costs for a range of facility sizes. Once basic construction costs were estimated, allowances were added for contingencies, engineering and legal expenses, site investigation costs, and land costs. Then construction cost indices were used to adjust these estimates to mid 2008 dollars. It was assumed that all the facilities would be built at one time. While that is not likely, it does provide the simplest basis for comparison and creates a platform for later phasing analyses. For each plan, costs were estimated in the standard categories of wastewater collection, transport-to-treatment, wastewater treatment, transport-to-disposal, effluent disposal and sludge/septage handling.

**Estimates for Each Plan**

Table 7-3 presents a summary of the cost estimates. Capital costs, expressed in mid 2008 dollars, are estimated to be:

| | |
|---|---|
| Plan 1: | $204 million |
| Plan 2: | $145 million |
| Plan 3: | $170 million |

Plan 2 has the least cost by a significant margin. Plan 3 is about 17% more expensive and Plan 1 is about 40% higher.

For the centralized plans (Plans 2 and 3), collection and transport costs represent about two-thirds of the total, treatment about 20%, and land about 5%. For the decentralized plan (Plan 1), the costs for land and for effluent transport and disposal are more significant.

**TABLE 7-3**
**SUMMARY OF CAPITAL COST ESTIMATES**

| | Capital Costs in Millions of Dollars | | |
|---|---|---|---|
| **Cost Category** | **Plan 1 Decentralized (4 Plants)** | **Plan 2 Centralized (Tri-Town)** | **Plan 3 Centralized (So. Orleans)** |
| Collection | 67.9 | 60.3 | 65.2 |
| Transport to Treatment | 45.6 | 42.1 | 46.2 |
| Treatment | 41.3 | 27.1 | 31.6 |
| Transport to Disposal | 10.8 | 0.4 | 2.1 |
| Disposal | 15.4 | 7.4 | 12.6 |
| Septage/Sludge Handling | 3.6 | 3.1 | 3.6 |
| Land | 19.3 | 4.8 | 8.4 |
| | | | |
| **Total--Jul 2008 dollars** | **204** | **145** | **170** |

**Comparison of Costs--Plan 1 Versus Plan 2**

It is instructive to consider the specific reasons why Plan 2 is expected to be the least expensive. The cost premiums for Plan 1 over Plan 2 are as follows:

| | |
|---|---|
| Collection | + $ 7.6 million |
| Transport to treatment | + $ 3.5 million |
| Treatment | + $14.2 million |
| Transport to disposal | + $10.4 million |
| Disposal | + $ 8.0 million |
| Septage/sludge handling | + $ 0.5 million |
| Land | + $14.5 million |
| Total | + $58.7 million (+40%) |

Collection costs are about 11% higher with Plan 1, which collects about 8% more wastewater. Despite the dispersed location of the facilities in the decentralized plan, there are higher transport costs to reach the plants due to the need to balance the flows by watershed. Similarly, the few disposal sites are all quite remote from the treatment plant locations, and there is little

opportunity to dispose of effluent at the treatment plant sites. The much higher treatment costs reflect two factors: the cost per gallon treated is nearly twice as high as in Plans 2 and 3 due to "diseconomies of scale", and there is a slightly higher volume of wastewater to be treated. Disposal costs are similarly influenced by "diseconomies of scale". Next to treatment costs, the largest cost premium is for land; the sites that are available for Plan 1 are all prime real estate, while the Town already owns the land at the Tri-Town site.

**Comparison of Costs--Plan 3 Versus Plan 2**

It is also interesting to compare Plan 3 costs against those of Plan 2. The cost premiums for Plan 3 over Plan 2 are as follows:

| | |
|---|---|
| Collection | + $ 4.9 million |
| Transport to treatment | + $ 4.1 million |
| Treatment | + $ 4.5 million |
| Transport to disposal | + $ 1.7 million |
| Disposal | + $ 5.2 million |
| Septage/sludge handling | + $ 0.5 million |
| Land | + $ 3.6 million |
| Total | +$24.5 million (+17%) |

The largest cost premium is associated with wastewater collection; costs are about 9% higher than Plan 2, which collects less wastewater. Transport costs are somewhat higher due to the long distance to South Orleans. The higher treatment costs reflect two factors: there is a slightly higher volume of wastewater (about 6%) to be treated, and this plan must meet the higher treatment requirements necessary to spray irrigate the effluent. There is a significant premium for disposal, because of the requirement to have traditional disposal back-up for any reuse plan. Further, it was assumed that subsurface disposal would be used for the back-up system, compared with the less expensive rapid infiltration system at the Tri-Town site. The cost premium for land is based on our assumptions on how much Brewster would charge for land it now owns and the cost of easements to use the two golf courses for irrigation.

Section 8 of the report presents cost estimates for adding a reuse component to Plans 1 and 2, in order to provide a more balanced comparison among the options. The capital cost for reuse facilities for either Plan 1 or Plan 2 would be approximately $7 million. If the capital cost were added to Plan 2, then Plan 3 would be only about $18 million more expensive than Plan 2, a 10% difference. Inclusion of reuse costs would not change the relative difference between Plans 1 and 2.

These cost estimates do not consider any potential cost savings associated with non-structural measures or regional solutions for the three plans. The cost estimates utilize the same percentage cost contingency for all three plans; however, given the additional complexities and uncertainties associated with Plan 1 and Plan 3, a higher percentage cost contingency could be justified (which would further increase the cost differential between Plan 2 and Plans 1 and 3).

## 7.7 OPERATION AND MAINTENANCE COSTS

Estimates were prepared for the ongoing costs to operate, maintain and replace the wastewater facilities that would be built in each plan. These costs were estimated for the following types of expenses:

- Labor, including fringe benefits
- Electrical energy for powering pumps and treatment equipment
- Fuel for building heating and vehicular use
- Chemicals
- Disposal of dewatered sludge
- Laboratory testing and other permit compliance costs
- Administrative costs such as insurance
- Equipment maintenance and replacement

Based on current unit costs, the three plans are projected to have operation and maintenance requirements as follows:

| | |
|---|---|
| Plan 1 | $1.60 million per year |
| Plan 2 | $1.35 million per year |
| Plan 3 | $1.49 million per year |

Plans 1 and 3 treat higher volumes of wastewater than Plan 2, a factor that adds to the operation and maintenance costs in many ways. Plan 1 has higher labor costs due to the need to staff multiple facilities and a higher laboratory cost for monitoring multiple facilities. There is also a cost premium for Plan 3 because it includes more treatment equipment to meet the Water Reuse Standards that apply to spray irrigation of effluent, and associated laboratory and administrative expenses.

The inclusion of a water reuse component in Plans 1 and 2 would add about $120,000 to their annual O&M costs. The estimates for each plan include an allowance for septage management.

## 7.8 NET PRESENT WORTH COSTS

A "present worth analysis" is a standard economic tool that allows the calculation of a single "cost" to represent the combination of capital costs and annual expenses for operation and maintenance. In essence, the "present worth" represents the amount of money that one would invest to be able to pay the capital costs at the beginning of the project and allow periodic withdrawals to pay the annual O&M expenses over a certain period at a given interest rate. For the purposes of this study, the present worth has been computed assuming a 4% interest rate and a 20-year planning period. The results are:

| | Plan 1 | Plan 2 | Plan 3 |
|---|---|---|---|
| Capital cost | $204 million | $145 million | $170 million |
| Present worth of O&M costs | $24 million | $20 million | $22 million |
| Total present worth | $228 million | $165 million | $193 million |

Since Plan 2 has the lowest capital cost and the least O&M expense, it naturally follows that it has the lowest present worth. The inclusion of a water reuse component in Plans 1 and 2 would not change the ranking of the three plans with respect to net present worth.

## 7.9 IMPACTS OF USER CHARGES AND TAX RATE

Capital costs for municipal wastewater systems are traditionally recovered through increases in property taxes and the assessment of betterment charges against parcels served by the system. User fees are employed to cover O&M costs, and are typically charged in proportion to a property owner's use of the system, based on a wastewater flow rate as estimated from water billing.

At the time of this evaluation, the Town of Orleans had not yet reached any final decision about methods for recovering capital cost or sharing O&M expenses. Regardless of the system selected, however, it is likely that tax increases, betterment assessments and user fees will fall in the following order:

| | |
|---|---|
| Plan 1: | most |
| Plan 2: | least |
| Plan 3: | middle |

The Town has since established a policy on how much of the capital costs of any of the plans would be recovered by property taxes (80%) and how much would be recovered by betterments (20%). Setting that policy allows projections to be made of the necessary tax increases and allows sample betterment charges to be estimated; see Section 11.

## 7.10 ENVIRONMENTAL IMPACTS

The three plans would have a range of environmental impacts related to both construction and long-term operation. There are no significant differences in the environmental impacts of the three plans. Section 8 of this report separately addresses these impacts.

## 7.11 ENERGY CONSUMPTION

In addition to the energy consumed in constructing the wastewater facilities, energy would be used in the day-to-day operations as follows:

- Electricity to run pumps in the collection and transport systems;

- Electricity to run equipment at the wastewater treatment plant;
- Fuel to heat the occupied buildings; and
- Fuel consumed by vehicles, including liquid sludge hauling.

In the final design of the recommended plan, every effort would be made to select energy-efficient processes and equipment, regardless of which plan is chosen. In this planning stage of the project, it is possible to predict which plans will have the least and the most energy consumption based on the conceptual elements of each plan. Table 7-4 summarizes that analysis, in the standard categories of wastewater facilities.

**TABLE 7-4**
**EVALUATION OF ENERGY USAGE**

| Function | Plan 1 Decentralized (4 Plants) | Plan 2 Centralized (Tri-Town) | Plan 3 Centralized (So. Orleans) |
|---|---|---|---|
| Wastewater Collection | Slightly More | Least | Slightly More |
| Transport to Treatment | Slightly More | Least | Slightly More |
| Wastewater Treatment | Somewhat More | Least | Significantly More |
| Transport to Disposal | Significantly More | Least | Slightly More |
| Effluent Disposal | Same | Same | Same |
| Sludge Hauling | Somewhat More | Least | Significantly More |

**Wastewater Collection**

The sewer systems for the three plans collect different volumes of wastewater, based on the nitrogen sensitivity of the coastal waters that ultimately receive the effluent nitrogen. Plan 1 collects about 8 percent more wastewater than Plan 2, and Plan 3 collects about 6 percent more than Plan 2. Since Plan 2 moves the lowest volume, it will have the least energy consumption for pumping within the collection system. Plans 1 and 3 would use slightly more energy in pumping.

**Transport to Treatment**

Additional pumping is required to move the collected wastewater to the treatment plant site. The energy consumption is a function of the volume conveyed and the elevation of the treatment

plant site. Considering both factors, Plan 2 would have the least energy consumption, and Plans 1 and 3 would each have slightly more.

**Wastewater Treatment**

The amount of energy used in wastewater treatment is a function of the level of treatment provided and the volume treated. All plans would involve a high level of treatment, but meeting the Water Reuse Standards in Plan 3 would entail an energy premium. Plan 1 would use slightly more energy than Plan 2 because of the multiple treatment facilities involved.

**Transport to Disposal**

Plan 2 would use little or no energy for transport of effluent, since the disposal area is at the same site as the treatment plant. Plan 1 involves considerable distances from the decentralized treatment plants to their multiple disposal areas. Plan 3 would use less energy than Plan 1, but more than Plan 2.

**Disposal**

The only energy required in effluent disposal would be for golf course irrigation in Plan 3. Since the golf courses are now irrigated anyway, there would be no net increase. Therefore, the three plans are essentially equal.

**Sludge Hauling**

Energy is required to run trucks used in transport of sludge, the solid material removed during the treatment of septage and wastewater. Two types of trucking are involved; tanker trucks would haul liquid sludge from remote treatment facilities to Tri-Town for dewatering, and dump trucks that would take dewatered sludge out of town for ultimate disposal.

Data on the quantities of liquid sludge that would be transported for each plan are presented in detail later in Section 7.13 of the report. Plan 1 would entail 220 truck trips per year, compared with 460 trips for Plan 3 and none for Plan 2. Plan 3 would also have the longest hauling distance. The number of trucks leaving Orleans with dewatered sludge would be about the same

for all three plans. Plan 2 is clearly the least energy intensive in this category, and Plan 3 is the most energy intensive.

**Overall**

For all six functions, Plan 2 would have the same or less energy consumption than the other two plans. Therefore the wastewater plan involving the centralized facility at the Tri-Town property would be the most energy efficient overall. Plan 1 would consume about the same amount of energy as Plan 3.

## 7.12 SUITABILITY OF TREATMENT FACILITY SITES

Among the three wastewater management options, there are five prospective sites for wastewater treatment plants, each with its own strengths and weaknesses as the location for such a facility. Table 7-5 summarizes important features of each of the sites. An ideal site would have the following characteristics:

- Publicly-owned, in an industrial setting, far from public water supply recharge areas;
- 20 acres or more in size to allow sufficient on-site wooded buffer zones;
- No homes or business within 500 feet and very few within 1000 feet;
- Ready access to state and major local roads; and
- Adequate depth to groundwater and no wetlands issues on site.

Given these criteria, two of the candidate sites stand out as most favorable: Sites 241 and 193. They are publicly-owned, of sufficient size to allow adequate buffer zones, and have limited nearby development. Site 241 is particularly attractive because of its close proximity to Route 6 and its great distance from water supply Zone IIs.

The remaining three sites (Site 111, Site 321 and Site 163) are less desirable because they are either quite small, located in residential areas with many nearby homes, require travel on minor local roads, or are located close to water supply Zone IIs.

Considering only the sites for wastewater treatment, this analysis shows the advantages of Plan 2, (which involves Site 241) and Plan 3 (Site 193). Significant disadvantages of Plan 1, the decentralized plan, are the less-than-optimum nature of the associated treatment facility sites, their cost and uncertainties about their availability.

## 7.13 TRUCK TRAFFIC AT TRI-TOWN SITE

One important aspect of wastewater management is the proper handling of the sludges that are produced as a byproduct of treatment. Each of the three wastewater plans under consideration would rely on sludge dewatering facilities at the Tri-Town site, followed by out-of town disposal of the dewatered sludge. In Plan 1 (decentralized) and Plan 3 (centralized, South Orleans), liquid sludge would be trucked to the Tri-Town site from treatment facilities elsewhere in town. In Plan 2 (centralized, Tri-Town), the new wastewater facilities would include dewatering equipment for both septage and the liquid sludge produced there, so no liquid sludge transport would occur.

In each of the three wastewater plans, a large number of septic systems will be eliminated in Orleans, resulting in a reduction of septage requiring disposal. The plans would collect 48% to 51% of the total wastewater currently produced in Orleans, and 53% to 58% at the planning horizon. Comparable percentages would apply to the quantities of septage that would be eliminated by public sewering. It has been projected that the Tri-Town facility would receive about 14% less septage (1.7 to 1.8 million gallons per year) than in the No Action Plan at the planning horizon.

On one hand, the Tri-Town site would see fewer deliveries of septage. On the other hand, Plans 1 and 3 would involve deliveries of liquid sludge from other sites. The net effect is as follows at the end of the planning period:

| | Plan 1 | Plan 2 | Plan 3 |
|---|---|---|---|
| Liquid sludge deliveries per year | 220 | none | 460 |
| Change in septage deliveries per year | -850 | -780 | -830 |
| Net | -630 | -780 | -370 |

**TABLE 7-5**
**COMPARISON OF WASTEWATER TREATMENT SITES**

| | Plan 1 | | | Plans 1 & 2 | Plan 3 |
|---|---|---|---|---|---|
| | **Site 111** | **Site 321** | **Site 163** | **Site 241** | **Site 193** |
| **Watershed Location** | Pleasant Bay | Nauset | Pleasant Bay | Namskaket | Pleasant Bay |
| **Total Lot Area, acres** | 1.5 | 24 | 4.5 | 26 | 30 |
| **Portion of Lot Required** | All | < 50% | About 50% | About 50% | < 50% |
| **Current Ownership** | Private | Private | Private | Town of Orleans | Town of Brewster |
| **Number of Nearby Homes Or Businesses** | | | | | |
| Within 100 feet | 0 | 0 | 0 | 0 | 0 |
| Within 250 feet | 4 | 0 | 2 | 0 | 0 |
| Within 500 feet | 19 | 1 | 7 | 4 | 0 |
| Within 750 feet | 50 | 4 | 16 | 6 | 1 |
| **Zoning District** | Rural Business | Residential | Residential | Gen. Business Historic | Industrial |
| **Close to Water Supply Zone IIs?** | No | No | Yes | No | Yes |
| **Availability of 3-phase Power** | Yes ? | No ? | Yes ? | Yes | Yes ? |
| **Depth to Groundwater, ft** | 30 | 85 | 65 | 30 | > 50 |
| **Access Roadways** | On Barley Neck Rd. | 2,300 feet off Beach Rd. | On Rt 28 | 2,300 feet off Rt 6A | On Freemans Way |
| **Distance from Route 6, ft** | | | | | |
| State road | 1,200 | 1,200 | 9,200 | 1,000 | 7,700 |
| Major local road | 10,100 | 10,100 | 3,700 | | 3,500 |
| Minor local road | 300 | 4,100 | | 2,300 | 6,000 |
| Private road | | 1,000 | | | 2,000 |
| Total | 11,600 | 16,400 | 12,900 | 3,300 | 19,200 |
| **On-Site Wetlands?** | No | Yes | No | Yes | No |

In all plans, the reduction in septage deliveries more than offsets the increased truck traffic related to liquid sludge handling. Plan 2 has the greatest reduction in truck traffic because there would be no liquid sludge deliveries.

## 7.14 EXPANDABILITY

This evaluation of wastewater management options is based on both current wastewater flows and those expected at the end of a 20-year planning period (2030). While this is a prudent basis for planning, it is important to also consider scenarios where it might be necessary to collect greater quantities of wastewater or provide more capacity for treatment and disposal. Those scenarios include:

- Land use changes or market forces may generate more rapid development toward build-out than is now expected;
- Greater nitrogen removal could be required for estuary protection than is now expected, due to possible "under-prediction" in the embayment modeling, natural changes in flushing rates (for example, movement in the North Beach "breach"), or yet incomplete MEP studies that later show current nitrogen removal "placeholders" to be too low.
- Wastewater treatment capacity might be provided to neighboring towns to take advantage of the economies of scale that occur in regional systems.
- Political, environmental or economic factors might cause the Town to elect to extend the sewer system beyond that assumed in this evaluation, including town-wide sewering.

If more capacity for wastewater collection, treatment and disposal is needed, which of the three plans under consideration is most easily expanded?

In Plan 1, three of the four decentralized facilities are not easily expanded due to limited treatment plant site area or limited nearby effluent disposal capacity. The wastewater facilities that would be built at the Tri-Town site in Plan 1 would not use all of the space available there, and space would remain that would allow as much as 75% increase in overall wastewater flows.

Plan 2 relies solely on the Tri-Town site for both treatment and disposal. An early estimate of the site's capacity for effluent disposal indicates the potential for that site to accept at least a 50% increase over the wastewater flows expected at the planning horizon.

There is insufficient information available on the capacity of the treatment and disposal sites included in Plan 3 to be able to predict potential expansion capacity. Nonetheless, there appears to be more capability for expansion than in Plan 2.

Based on the above discussion, the three plans can be rated as follows with respect to their ability to be expanded for possible future flow increases:

| | |
|---|---|
| Plan 1 | significant expansion possible |
| Plan 2 | some expansion possible |
| Plan 3 | some potential for expansion, but not yet quantified |

The analysis discussed above is based on the apparent physical characteristics of the treatment and disposal sites included in each plan. Plan 3 has an added potential for expansion in that its implementation would require close coordination with the Town of Brewster. That joint effort could form the basis for developing a future regional facility.

A more detailed evaluation of regionalization is presented in Section 9 and Appendix K of this report. Later in this Section 7 is a discussion of the potential to use a portion of the Tri-Town site for a public works facility.

## 7.15 FLEXIBILITY FOR PHASING

In light of the magnitude of the expense and potential disruption of the construction of an extensive wastewater project in Orleans, it would be prudent to develop any of the three plans in segments over time. By implementing the project in phases, the Town can spread out the capital costs and institute "mid-course corrections" as more information is available on nitrogen control needs, as neighboring towns make progress on their wastewater management plans, and as growth rates result in increased nitrogen control needs.

Any of the three plans can be implemented in phases. However, there are some practical limitations related to the geography of the treatment and disposal sites.

Because Plan 1 involves four treatment plant sites and 10 effluent disposal locations, it is the most amenable to phased development. One of the reasons the WMSC included this decentralized plan for further consideration is its ability to be implemented in segments with focus on the "headwaters" sub-embayments of Pleasant Bay, such as Meetinghouse Pond and Areys Pond. The first phase of Plan 1 could include the decentralized facilities needed to address Meetinghouse Pond nitrogen control needs, and the second phase could include analogous facilities for the Areys Pond watershed. If those two watersheds are deemed to be most important, Plan 1 would allow the lowest cost approach to achieving those goals as soon as possible.

Plan 2 involves treatment and disposal at the Tri-Town site, (in the northwest corner of Orleans). Since any collected wastewater would require transport to that location, this plan requires the sewering of nearby areas first. If providing wastewater collection to the downtown area is a high priority, this plan could easily accommodate that goal. Conversely, providing collection services to the Meetinghouse Pond and Areys Pond watersheds would require that trunk lines be built through the northerly portions of town first, in order to access the Tri-Town site.

Similar conclusions can be drawn about Plan 3. It involves treatment and disposal at a site in the far southerly area of Orleans/Brewster. Since any collected wastewater would require transport to that location, this plan requires the sewering of nearby areas first. If providing wastewater collection service to the watershed of Pleasant Bay proper (or to the areas upgradient of the ponds in South Orleans) were a high priority, this plan could easily accommodate that goal. Conversely, providing collection services to the Meetinghouse Pond watersheds or to the downtown area would require that trunk lines be built through the southerly and central portions of town first, in order to access the Plan 3 treatment facility site.

Given these geographic realities, the three plans can be rated as follows:

| | |
|---|---|
| Plan 1 | most flexible |
| Plan 2 | less flexible |
| Plan 3 | less flexible |

Because of the fact that more wastewater is generated in the north and central parts of Orleans, that are closer to the Tri-Town site than the South Orleans site, Plan 2 has a slight advantage over Plan 3.

## 7.16 POTENTIAL FOR WATER REUSE

As demand rises for potable water, the ability to reuse effluent for irrigation and other purposes will become more and more important. Under current regulations, the added treatment needed to produce reuse-quality water imposes a cost premium on this practice. That premium must be weighed against the many benefits of reuse, and that balancing of costs and benefits may change in the future. Thus it is pertinent to look at each of the three wastewater plans in terms of their ability to allow current or future effluent reuse.

Plan 3 is the most amenable to effluent reuse. This practice is a fundamental part of this plan, which was structured to include significant spray irrigation of one or two golf courses located just south of Orleans's southern border. In that the facilities to produce reuse-quality water are built into this plan, it is also readily modified to provide more reuse for other potential activities such as private lawn watering.

Water reuse is not part of either Plans 1 or 2, but could be added in the future if demand warranted. Facilities at the Tri-Town site would be most amenable to such future modifications, because more space exists at that site, and reuse opportunities in the public sector are nearby. Since Plans 1 and 2 both involve facilities at the Tri-Town site, neither of these two plans has an advantage over the other in this regard.

A more detailed evaluation of reuse opportunities and costs is presented in Section 10 of this report.

## 7.17 REGULATORY ACCEPTABILITY

Once the Town decides on a single wastewater plan, it must proceed to gain the approval of county, state and federal entities related to a number of issues. While the three plans involve

mostly conventional technology, there are some differences that may impact regulatory acceptability.

The three plans are comparable with respect to the following concerns:

- All plans are technically feasible and include features that have been employed elsewhere in Massachusetts;
- All plans will fully comply with nitrogen-based TMDLs, as currently exist or as projected based on ongoing MEP work;
- The plans are equal with respect to compliance with Title 5, in that their collection systems serve the same number of parcels with sanitary needs; and
- None of the plans includes significant construction activities within the designated Areas of Critical Environmental Concern.

All of the plans involve groundwater discharges that are regulated under 310 CMR 5. A permit would be needed for each disposal site, so Plan 1 has the disadvantage of much more permitting work and related engineering and hydrogeologic evaluations. Plan 3 requires a groundwater discharge permit for a year-round disposal area with enough capacity to fully back up the summer spray irrigation operation. Sufficient detail on the Plan 3 site is not available to gauge the difficulty of permitting that groundwater discharge. Plan 2 involves the Tri-Town site which already has a groundwater discharge permit. A new permit would be needed, but some background information is already in hand that would make this permitting effort somewhat easier.

In addition to a groundwater discharge permit, Plan 3 must comply with the DEP Reclaimed Water Guidelines related to spray irrigation of the golf courses. In that those regulations are evolving, and experience with golf course irrigation in Massachusetts is limited, there may be somewhat more permitting effort associated with Plan 3.

Publicly-owned wastewater treatment plants must go through the DEP site assignment process, as required by Section 6 of Chapter 83 of the Massachusetts General Laws. The essence of this state requirement is to formally notify all abutters of the proposed project, conduct a public hearing to review the project design, and place a record in the Registry of Deeds to alert all future purchasers of nearby properties of the permanent wastewater-related nature of activities on the site. The Tri-Town property is already site-assigned, but all other sites would be subject to this requirement. Given the fact that Plan 1 involves eleven sites and the other plans include just one or three each, Plan 1 requires somewhat more permitting effort in this regard.

In light of all of these factors, the three plans are rated as follows:

| | |
|---|---|
| Plan 1 | more permitting effort than Plan 2 |
| Plan 2 | most readily permitted |
| Plan 3 | more permitting effort than Plan 2 |

## 7.18 EASE IN IMPLEMENTATION

Any municipal wastewater system faces some hurdles for smooth implementation, especially with a fairly extensive sewer system, purchase of private land, and possible sharing of facilities in adjacent towns.

Plan 2 is clearly the easiest to implement because it involves a site owned by the Town of Orleans that has historically been in wastewater-related uses and is in the watershed of a coastal waterbody that is not nitrogen limited.

Plan 1 would be more difficult to implement because it involves three treatment plants in residential neighborhoods on land that would be required from private owners. Plan 1 would also involve nine effluent disposal sites, including eight that are privately owned. The process of acquiring 11 sites for wastewater treatment and/or disposal could present numerous challenges.

Plan 3 also involves land acquisition issues. The treatment plant site is publicly owned, but the owner is the Town of Brewster, not the Town of Orleans. One of the golf courses is owned by the Town of Brewster and one is privately owned. Plan 3 would be considered the most difficult to implement primarily because there are property acquisition issues in multiple towns, technical matters related to golf course irrigation and fertilization, and the need for inter-municipal coordination. In the simplest case, the Town of Brewster could be viewed as a land-owner comparable to the owners of private sites. However, Brewster should consider the benefits of a joint facility as part of Plan 3, and that requires a fair degree of wastewater planning that has not yet begun in Brewster.

For all of these reasons, the plans should be rated in the following order, with respect to ease in implementation:

| | |
|---|---|
| Plan 1 | more difficult |
| Plan 2 | easiest |
| Plan 3 | most difficult |

All three plans involve coordination between the Town and the Tri-Town District. In Plans 1 and 3, the Tri-Town Septage Facility would be upgraded. In Plan 2 it would be demolished and its functions included in the new wastewater facility located at that site. The necessary coordination with the District adds complexity to the implementation of any of the plans. That coordination may be most difficult in Plan 2, due to the need to restructure existing inter-municipal agreements and deal with the salvage value of jointly-funded existing facilities.

## 7.19 POTENTIAL FOR IMPACTING TOWN GROWTH RATE

One of the most frequently-stated reasons in opposition to municipal sewerage is the fear that sewers will unleash unwanted growth. The potential for unwanted growth exists in two areas: either sewer service allows an otherwise undevelopable lot to be built upon, or existing development, which is now constrained by effluent disposal area, can then be expanded once a sewer connection is available.

The Town of Orleans is considering bylaws and regulations that would protect against both potential mechanisms for unwanted growth.

First, special legislation has been introduced to the state legislature that would allow Orleans to implement a "checkerboard" sewer system. In such a system, the Town would select in advance those lots that will be connected to the public sewer and which ones will not be allowed to connect. In essence this new bylaw would give the Town the ability to reject a request for sewer service for any property that need not be sewered.

Second, the Board of Health has drafted a nutrient control regulation that would help limit redevelopment of properties. This regulation will impose restriction on the amount of additional nitrogen load from a given property and it could be expanded to limit wastewater flow from sewered lots so there would be no increase over that allowed under Title 5.

Third, a provision has been drafted for inclusion in the future sewer use regulations that will prohibit sewered flow that exceeds what could have been discharged under Title 5.

These tools can be adapted to limit any unintended growth related to a public sewer system. They can be applied regardless of the wastewater plan that is selected. Therefore there is no real difference among the plans in this regard. See Section 11 for updated information on these growth management tools and steps the Town has taken since this evaluation was conducted.

## 7.20 POTENTIAL FOR SITING A PUBLIC WORKS FACILITY AT THE TRI-TOWN SITE

Located at the far northern corner of the Tri-Town site is an abandoned composting building. That building is situated within a 5.5-acre parcel where the Town of Orleans has obtained permission from Brewster and Eastham to implement other uses. The Town of Orleans is beginning to plan for a new public works facility, and has considered using that portion of the Tri-Town site where the composting building is located. One of the three wastewater plans would require that land and two would not.

With Plan 2, current site layouts and predicted soil permeability indicate that nearly all of the Tri-Town site would be needed for either wastewater treatment or effluent disposal. While it is conceivable that further soil explorations could reveal better soils than currently predicted, it is unlikely that the effluent disposal area could be reduced enough to allow another use of the full 5.5-acre parcel where the compost building is located.

With Plan 1, a portion of the collected wastewater flow would be treated and disposed of elsewhere. This would result in much more unused space at the Tri-Town site, compared with Plan 2. The design of the effluent disposal system would probably allow another use of the area around the composting building, with the caveat that confirming soil explorations are needed.

Plan 3 involves centralized treatment and disposal facilities in South Orleans and the upgrading of the Tri-Town plant for septage and sludge handling. This plan could definitely accommodate another use in the vicinity of the compost building.

In summary, the plans provide the following possibilities for use of the area near the existing composting building:

| | |
|---|---|
| Plan 1 | likely |
| Plan 2 | not likely |
| Plan 3 | most likely |

The reuse of the compost shed itself may be easier than alternate uses of the 5.5 acres on which it sits. The shed could be used for truck storage and wash down up until the point where its smaller footprint is needed for a future phase of effluent disposal in Plans 1 or 2.

Earlier in this Section 5 is a discussion of expansion capabilities of each plan, which must be considered when evaluating other potential uses of the Tri-Town site.

## 7.21 OVERALL PUBLIC ACCEPTABILITY

One of the most important features of any public-works-type project is its acceptability to the general public. The public may be concerned about some or all of the factors discussed in this section of the report. The intention of this evaluation is to provide objective information to the Town staff and officials, and to the general public, so that all can become familiar with the issues that interest them, and the Town can move toward a consensus as to the best plan for Orleans.

The WMSC conducted two public meetings at which this evaluation was discussed (both on May 22, 2008), which were followed by a series of weekly workshops in July and August of 2008. The public feedback obtained during those meetings and workshops is summarized in Section 11 of this report and detailed in Appendix C.

## 7.22 SUMMARY OF EVALUATION

Twenty criteria have been selected for evaluation of the three wastewater options. The evaluation is summarized in Table 7-6. One criterion, public acceptability, is discussed in Section 11. Of the 19 other criteria evaluated to date, the plans are essentially equal in four cases, and Plan 2 appears to be superior with respect to 10 factors.

As noted in Section 3, wastewater management in the future may also need to consider contaminants of emerging concern (e.g., pharmaceuticals and personal care products) in wastewater. If these compounds must be treated, then centralized facilities will be best able to provide treatment as well as disposal outside of water supply Zone II's and wellhead protection areas.

The principal advantages and disadvantages of the three plans are summarized as follows.

## TABLE 7-6

## SUMMARY OF EVALUATIVE CRITERIA

| Evaluative Criteria | Plan 1 Decentralized (4 Plants) | Plan 2 Centralized (Tri-Town) | Plan 3 Centralized (So. Orleans) |
|---|---|---|---|
| **7.2** Transfer of Water Among Watersheds | No Significant Impacts | | |
| **7.3** Transfer of Nitrogen Among Watersheds | No Significant Impacts | | |
| **7.4** Extent of Sewer System | Largest | **Smallest** | Middle |
| **7.5** Need for Land Purchases and Easements | Greatest | **Least** | Middle |
| **7.6** Capital Cost | Highest | **Lowest** | Middle |
| **7.7** Operation & Maintenance Cost | Highest | **Lowest** | Middle |
| **7.8** Net Present Worth | Highest | **Lowest** | Middle |
| **7.9** Impact on Taxes and User Fees | Highest | **Lowest** | Middle |
| **7.10** Environmental Impacts | No Significant Differences | | |
| **7.11** Energy Consumption | More | **Lowest** | More |
| **7.12** Suitability of Treatment Facility Sites | Less Suitable | **Most Suitable** | **Most Suitable** |
| **7.13** Truck Traffic at Tri-Town Site | Middle | **Least** | Most |
| **7.14** Expandability | **Best** | Least | Middle |
| **7.15** Flexibility for Phasing | **Most Flexible** | Less Flexible | Less Flexible |
| **7.16** Potential for Water Reuse | Less | Less | **Best** |
| **7.17** Regulatory Acceptability | Somewhat Less | **Highest** | Somewhat Less |
| **7.18** Ease in Implementation | More Difficult | **Easiest** | Most Difficult |
| **7.19** Potential for Impacting Town Growth Rate | No Significant Differences | | |
| **7.20** Potential for Public Works at Tri-Town | Likely | Not Likely | **Most Likely** |
| **7.21** Overall Public Acceptability | Determined through public meetings and workshops between May and August 2008; see Section 11. | | |

**Plan 1: Decentralized (4 Plants)**

Advantages

- Allows least expensive early implementation of solutions for headwaters sub-embayments (Meetinghouse Pond and Areys Pond)
- Most amenable to phasing
- Reduces local impacts of larger centralized options

Disadvantages

- Has the highest cost to build and operate
- Requires acquisition of 11 sites that are now privately owned
- More sites means more potential for neighbor impacts and/or disputes
- Requires more permitting (groundwater discharge permits, site assignment, etc.)
- Some disposal of wastewater in sensitive watersheds means greater extent of sewering compared with Plan 2
- Requires liquid sludge hauling from decentralized facilities to Tri-Town

**Plan 2: Centralized (Tri-Town)**

Advantages

- Treatment facility site is already in wastewater-related use in largely industrial area of Orleans
- Treatment facility site is already in Town ownership
- Site is close to downtown (largest concentration of wastewater to be collected)
- All effluent is disposed in the watershed to Namskaket Marsh, which has less nitrogen sensitivity than other embayments in Orleans. This translates to a smaller sewer system compared with Plans 1 and 3
- Has the lowest cost to build and operate
- Uses the least amount of energy of all plans
- Produces better effluent quality than Plan 1 due to size of plant
- Amenable to regionalization with Eastham and Brewster
- Most readily permitted plan

Disadvantages

- Concentrates all wastewater at one location, increasing chances of odor/noise impacts at one location
- Full use of the Tri-Town site precludes co-siting of a public works facility

**Plan 3: Centralized (South Orleans)**

Advantages

- Recycling of water and nutrients at golf courses is the most environmentally-acceptable disposal option
- Produces better effluent quality than Plan 1 due to size of facility, and better effluent quality than Plan 2 due to compliance with Water Reuse Standards
- Allows reduction in groundwater withdrawals and commercial fertilizer use at golf courses
- Tri-Town Septage Treatment Facility stays in operation for septage and liquid sludge, and sufficient land is available for possible public works facility
- Amenable to regionalization with Brewster, Harwich and Chatham

Disadvantages

- Treatment facility sites in So. Orleans are all small; may require site in Brewster
- Concentrates all wastewater at one location, increasing chances of odor/noise impacts at one location
- All effluent is disposed in Pleasant Bay watershed, which means larger sewer system compared with Plans 1 and 2
- More expensive than Plan 2 to build and operate
- Requires cooperation of Town of Brewster and thus may be more difficult to implement
- Requires more effluent disposal capacity that Plans 1 and 2 due to need for winter back-up for spray irrigation
- Requires highest level of wastewater treatment of all plans, and meeting reuse standards involves some new technology
- Requires liquid sludge hauling to Tri-Town