Task 2.0: Septage and Food Waste Market Study Technical Memorandum 2.0

Report Description

Stantec

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Town of Orleans

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Sign-off Sheet

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Executive Summary

The purpose of this Technical Memorandum (TM) is to review the current and future state of septage and food waste volumes in the Mid, Lower and Outer Cape and the options for handling these materials in Orleans. The following were reviewed:

- Current and future septage quantities;
- Current and future food waste quantities;
- Septage treatment alternatives;
- Alternatives for septage solids handling;
- Tri-Town tip fee evaluation; and
- Food waste processing alternatives.

Cape wide, the population growth rate has been steadily declining for decades and from 2000 to 2010 the growth rate was -3.8%. In addition the population is ageing. Residential development and tourism have remained steady with minor fluctuation due to economic conditions. Based on the indicators neither septage or food waste is expected to increase significantly in the future (up to 2040). On an annual basis septage volumes will likely decline due to changes in sewering in Orleans and Eastham dictated by the CWMP's for both communities. Table ES12 lists the projected septage quantities through 2040.

Table ES1: Projected Annual Septage Quantities

Town	2010 thru 2013	2014 thru 2020	2021 thru 2025	2026 thru 2030	2031 thru 2035	2036 thru 2040
Orleans	2,211,043	2,212,000	1,836,000	1,571,000	1,372,000	1,173,000
Brewster	2,119,460	2,120,000	2,120,000	2,120,000	2,120,000	2,120,000
Eastham	1,339,122	1,340,000	1,340,000	1,340,000	1,139,000	1,139,000
P-Town	1,051,803	1,052,000	1,052,000	1,052,000	1,052,000	1,052,000
Wellfleet	804,476	805,000	805,000	805,000	805,000	805,000
Harwich	668,587	669,000	669,000	669,000	603,000	483,000
Truro	615,003	616,000	616,000	616,000	616,000	616,000
Dennis	207,908	208,000	208,000	208,000	208,000	208,000
Other	190,419	191,000	191,000	191,000	191,000	191,000
Total	*9,207,819*	*9,213,000*	*8,837,000*	*8,572,000*	*8,106,000*	*7,787,000*

Under new MA DEP regulations commercial institutions that generate one ton or more of food waste in any given week must separate the food waste from other refuse for potential recycling. THE DEP and the US EPA performed a survey of all cities and towns in Massachusetts. The total annual amount of food waste meeting the requirements of the new regulations on Cape Cos is between 14,000 and 15,000 tons. This is insufficient for a third party processor to build a facility for anaerobic digestion and electricity production. It is also not cost effective for the Town of Orleans to construct and operate an anaerobic digester on its' own.

A review of available treatment options for septage revealed that there is not sufficient septage treatment capacity on the Cape to replace Tri-Town. There is plenty of capacity off Cape. An economic review of rehabbing Tri-Town to continue treatment operations or converting Tri-Town into a septage transfer station was performed. The high cost of transportation makes the transfer station alternative far more expensive than upgrading Tri-town and continuing operation to 2040.

With septage treatment continuing at Tri-Town, alternatives were examined for handling the solids generated from the treatment process. A non-economic review reduced the options to composting the solids on site, working with Yarmouth-Dennis (YD) to reopen their composting facility cooperatively or continue the current third party handling of the solids. The Town of Yarmouth was contacted and after discussions decided they were not interested in reopening the YD septage composting facility. The third party handling was found to be more economical than constructing and operating a composting facility within Orleans.

The tip fee charged by Tri-Town was also examined for potential to increase revenue. Two alternatives were examined; the first was reducing the tip fee to encourage additional septage to be delivered to Tri-Town. The second was to increase the tip fee in the high tourism months. It was found that reducing the tip fee to $0.10 per gallon for all loads delivered to Tri-Town would generate an increase in annual septage deliveries of 861,000 gallons. There is only 323,000 gallons of capacity available in the busy months of the year. In the slow months Tri-town already reduces the tip fee to $0.08 per gallon to attract deliveries.

Increasing the tip fee on all loads delivered to Tri-Town would increase revenue by $45,457 per year based on the current septage delivery amounts. However, a loss of deliveries of 362,000 gallons (3.8% of the annual flow) would eliminate this additional revenue. The tip fee amounts to 40% to 60% of the cost of having a septic system pumped out. In the busy months septage haulers are less likely to shop the tip fee because it is more cost effective to have a fast turnaround time and be pumping the next job. However, in the off season, time is more available and shopping the tip fee is more likely. Under these conditions the 3.8% is too small of a margin to make raising the tip fee viable.

Abbreviations

CCC	Cape Cod Commission
CWMP	Comprehensive Wastewater Management Plan
DEP	Department of Environmental Protection
EPA	Environmental Protection Agency
FOG	Fats, Oils and Grease
FTE	Full Time Equivalent
kw	Kilowatt
US EPA	United States Environmental Protection Agency
MA DEP	Massachusetts Department of Environmental Protection
STF	Septage Treatment Facility
STP	Septage Treatment plant
YD	Yarmouth Dennis
WWTF	Wastewater Treatment facility
WWTP	Wastewater Treatment Plant

1.0 PURPOSE

The purpose of this Technical Memorandum (TM) is to review the current and future state of septage and food waste volumes in the Mid, Lower and Outer Cape and the options for handling these materials in Orleans. There are four significant events that will impact this review:

The first is the status of the Tri-Town septage treatment facility (Tri-Town). Tri-Town was constructed in 1996 and has operated under an agreement between the towns of Brewster, Orleans and Eastham. This agreement expires at the end of 2016. In addition the plant is in need of major upgrades to continue operations.

The second is the potential future construction of a new wastewater treatment plant (WWTP) in Orleans. It is possible that a new WWTP will be constructed to treat sewage from at least the downtown area of Orleans. If such facility is constructed, it will significantly impact the economics of treating septage in Orleans.

Thirdly, other communities in the Mid, Lower and Outer Cape that deliver septage to Tri-town have undertaken similar Comprehensive Wastewater Management Plans (CWMP). The implementation of these plans will impact the amount of septage requiring treatment.

Lastly, the State of Massachusetts has recently enacted new rules for the collection of food waste from commercial establishments that generate one ton or more of food waste in any given week. The new rules require these establishments to separate the food waste from the rest of their waste and attempt to reuse it. There are technologies available that can treat both waste water solids and food waste and these will be examined as a potential part of any wastewater treatment plant in Town.

2.0 CURRENT SEPTAGE VOLUMES

The Tri-Town facility operates five days a week or approximately 250 days per year. The facility has a daily capacity of 45,000 gallons per day (11,250,000 gallons per year). **Table 1** below shows the actual flows treated by Tri-Town from 2010 through 2013 by town:

Based on the flow records the facility is operating at an annual average of 81% of current capacity. However, given the seasonal fluctuations in population, the facility is at capacity during the tourism season and below capacity during the winter months. This is evident by the pricing structure the facility charges, most of the year Tri-Town charges; $0.10 per gallon for in district septage (Orleans, Brewster and Eastham), $0.14 per gallon for other towns and $0.15 per gallon for porta potties. However, during the winter, the rates drop to $0.08 per gallon for all deliveries to encourage enough deliveries to keep the plant operating well.

In a 2005 study "Tri-Town Septage Treatment Facility Evaluation" Wright Pierce estimated the septage generation for the entire Cape at 59 million gallons per year. The Tri-Town facility has the capacity to treat about 19% of the 59 million gallons and is actually treating about 15.4%.

Table 1 Tri-Town Septage Flows (gallon per year)

Town	Year			
	2010	2011	2012	2013
Orleans	2,015,607	2,321,426	2,406,478	2,090,155
Brewster	1,997,729	1,892,441	2,208,429	2,346,479
Eastham	1,235,867	1,165,547	1,512,696	1,253,271
P-town	1,034,612	1,096,689	1,091,111	1,006,916
Harwich	860,476	798,493	476,698	527,875
Wellfleet	740,558	772,828	848,559	898,394
Truro	499,862	433,049	796,957	542,490
Dennis	335,809	358,565	56,950	72,628
Other	297,861	328,722	52,112	65,871
Tri-Town Total	*9,018,381*	*9,167,760*	*9,449,990*	*8,804,079*

2.1 FUTURE SEPTAGE VOLUMES

There are several items that in general influence the generation of septage:

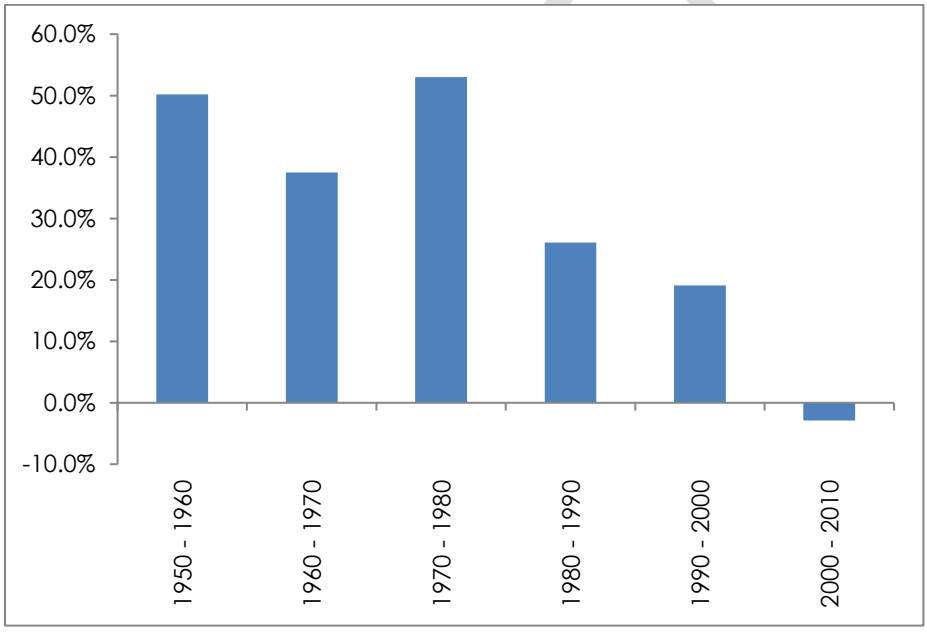
- Size of the population
- Amount of new residential and commercial construction

In addition to these, planned changes in wastewater management in the Towns served by Tri-Town will also impact the amount of septage generated in the future.

The United States Census performed in 2010 showed that all of Cape Cod underwent a 2.9% decrease in population from 2000 to 2010. In addition the population aged with an 18.03% decrease in the population under age 18 for this same time frame. According to the 2000 US Census the three towns associated with the Tri-Town facility ranked among the highest percentage of population over 65 years old in the State; Orleans was number one with 36% Brewster was 6th with 26.2% and Eastham was 7th with 26%.

Figure 1 shows the rate of population change each decade since 1950. What can be seen in **Figure 1** is that the rate of growth has been declining with the exception of the decade from 1970 to 1980.

Figure 1 Cape Cod Population Change Rate



Land development studies from each of the three towns that form the Tri-Town septage district have been completed at various times. From these studies the following amount of land is available for development within each town:

- Orleans – 605 acres (6.7%) based on 2003 land use study (given the age of the study, the amount will have decreased);
- Eastham – 293 acres (2.7%) from 2008 land use study; and
- Brewster – 459 acres from 2013 Open Space and Recreation Plan.

Table 2 shows the number of new home construction permits for Town that has sent septage to Tri-Town in the past. The numbers in the table are for residential new single family home construction. There is a definite declining trend. Some of the decline from 2007 and later may be associated with the downturn in the economy nationwide.

If we look at building permits issued in the communities served by Tri-Town since 2007 (this corresponds to the septage flow data in **Table 1** allowing for three years lag until the first pump out of a system), the average number of permits per year per town has been 20. However, during this same time the septage flows to Tri-Town did not increase. Given the declining population it is likely that many of these permits may have been for reconstruction or significant remodeling of existing homes. Therefore, the permits will not be used to adjust the annual septage flow estimates.

Table 2 New Home Building Permits by Town

Year	Town							
	Orleans	Brewster	Eastham	P-Town	Harwich	Wellfleet	Truro	Dennis
1997	53	105	96	16	155	40	54	99
1998	57	110	113	19	156	47	58	79
1999	69	119	140	9	167	48	58	106
2000	48	95	94	14	118	50	40	89
2001	36	75	52	11	105	48	39	77
2002	44	0	47	12	98	50	40	108
2003	45	51	40	12	66	42	34	59
2004	38	47	37	25	81	54	32	69
2005	27	49	52	25	55	23	30	60
2006	23	38	33	22	52	15	25	50
2007	21	31	52	18	42	16	24	54
2008	41	19	12	14	28	13	10	36
2009	18	13	11	20	50	8	6	18
2010	12	17	14	20	37	14	16	27
2011	15	12	14	14	37	8	14	27
2012	19	14	22	16	40	17	29	26

The final and most significant factor impacting future septage generation is changes to wastewater management practices. Most of the Cape communities have undertaken a Comprehensive Wastewater Master Plan (CWMP). From these CWMPs for the various communities the following changes in wastewater management are planned for the communities served by Tri-Town. Some of these changes will impact the amount of septage generated and some will not:

- Orleans – hybrid sewerage& alternative treatment resulting in septage reductions overtime

- Eastham – Sewerage currently recommended for Rock Harbor, Town Cove and Great Salt Pond water shed resulting in septage reductions over time
- Brewster – Alternative treatment schemes planned for Pleasant Bay watershed with no significant change in septage generation expected
- Wellfleet – Adding oyster beds to reduce the nitrogen levels entering the harbor with no change in septage generation
- Truro – no known change
- P-town – WWTP recently expanded with no known further expansion thus no change from current level expected
- Harwich – The Pleasant Bay water shed will be sewered and the wastewater sent to the Chatham WWTP. A centralized WWTP will be constructed by 2030 with phased sewering of the Herring River watershed.

Below is the current projected time frame for the changes listed above that will impact future septage generation. The percent changes listed below are from the current levels of septage treated at Tri-Town from each Town:

Orleans – Alternative 1 of the proposed hybrid solution

- 17% reduction due to sewering of the downtown area by 2020 (Phase 1)
- Additional 12% reduction by 2025(Phase 2)
- Additional 9% reduction by 2030(Phase 3)
- Additional 9% reduction by 2035 (Phase 4)

Eastham – Sewer Rock Harbor and Town Cove watersheds (dates dependent on Orleans Phase 1)

- 15% reduction for sewering the Town Cove watershed by 2030
- Additional 15% reduction for sewering Rock Harbor watershed by 2035

Harwich – Sewering Pleasant Bay watershed and phases sewering of the Herring River watershed

- 10% reduction for sewering Pleasant Bay watershed by 2025
- Additional 10% reduction for sewering Northeast herring River watershed by 2035.

The following list summarizes the assumptions that are used to estimate the future septage volumes from now to 2040:

- No significant increases in septage due to lack of development and population growth.

- Decreases over time due to wastewater management practices for the various towns served by Tri-Town based on the CWMPs from these towns.

Table 3 lists the estimated septage quantities that could be delivered to Tri-Town based on the current flow and the future reduction discussed above:

Table 3 Projected Average Annual Septage Volumes in Gallons to 2040

Town	2010 thru 2013	2014 thru 2020	2021 thru 2025	2026 thru 2030	2031 thru 2035	2036 thru 2040
Orleans	2,211,043	2,212,000	1,836,000	1,571,000	1,372,000	1,173,000
Brewster	2,119,460	2,120,000	2,120,000	2,120,000	2,120,000	2,120,000
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Dennis	207,908	208,000	208,000	208,000	208,000	208,000
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Total	*9,207,819*	*9,213,000*	*8,837,000*	*8,572,000*	*8,106,000*	*7,787,000*

3.0 CURRENT AND FUTURE FOOD WASTE VOLUMES

In October of 2014 the Massachusetts Department of Environmental Protection (MA DEP) enacted new regulations for the disposal of food waste generated within Massachusetts. The regulation stipulates that any commercial generator of food waste that produces one ton or more in any given week must separate this food from their other waste so it can be recycled if possible.

In 2002 the MA DEP compiled a list of all the commercial institutions in the State that generate one ton or more a week of food waste and the amounts they generate. In 2011 the United States Environmental Protection Agency (US EPA) updated the survey. **Table 4** provides the findings of these surveys for each town on Cape Cod.

Table 4 Food Waste Generated on Cape Cod

Town	Food Waste (tons/yr)	Generators	Relative Contribution	
			Food Waste	Producers
Orleans	889.4	22.00	6.2%	7.2%
Eastham	232.5	6.00	1.6%	2.0%
Brewster	356.5	10.00	2.5%	3.3%
Harwich	1,065.8	19.00	7.4%	6.2%
Chatham	805.2	18.00	5.6%	5.9%
Dennis	742.5	18.00	5.2%	5.9%
Wellfleet	163.5	6.00	1.1%	2.0%
Truro	52.5	1.00	0.4%	0.3%
Provincetown	979.5	28.00	6.8%	9.2%
Yarmouth	2,352.3	49.00	16.4%	16.0%
Barnstable	2,578.4	55.00	18.0%	18.0%
Mashpee	993.4	17.00	6.9%	5.6%
Falmouth	1,618.6	35.00	11.3%	11.4%
Sandwich	1,370.5	22.00	9.6%	7.2%
Bourne	107.8	5.00	0.8%	1.6%
Totals	14,308.4	306.00	100.0%	100.0%

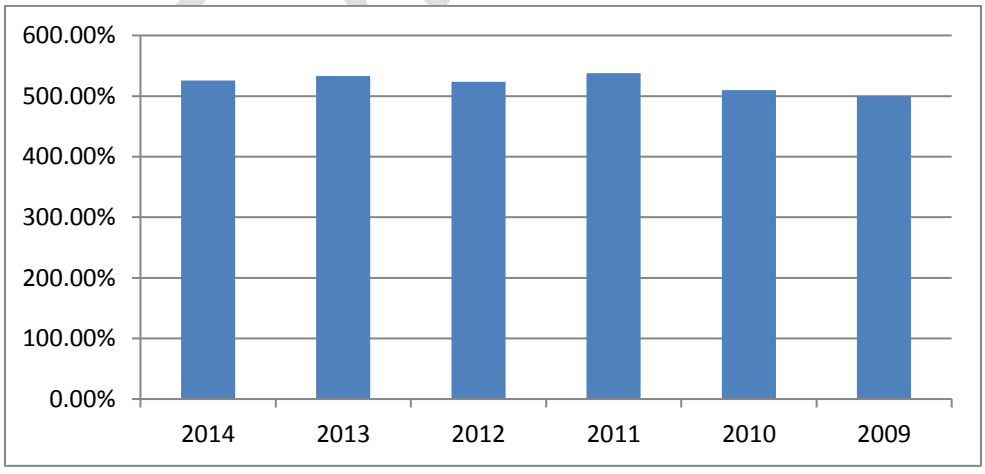
The factors influencing future food waste generation are population and expected changes in tourism. As noted earlier the population trend suggests no significant increases in the food waste volumes.

The Cape Cod Chamber of Commerce (Chamber) performs survey of accommodations and publishes occupancy rates on their website. The Chamber data is shown in **Table 5** and **Figure 2**:

Table 5 Accommodation Occupancy Rates

Month	Year					
	2014	2013	2012	2011	2010	2009
January	31.34%	28.40%	26.57%	22.76%	33.86%	26.41%
February	39.33%	42.87%	43.70%	46.40%	28.52%	46.00%
March	31.20%	30.69%	38.94%	32.70%	28.47%	34.15%
April	40.45%	44.88%	37.60%	44.50%	40.78%	37.24%
May	41.57%	43.80%	46.20%	47.60%	45.60%	45.70%
June	57.80%	62.60%	62.50%	56.86%	59.10%	51.00%
July	74.76%	77.70%	74.30%	83.90%	75.90%	65.08%
August	87.35%	85.37%	85.60%	84.04%	80.01%	81.35%
September	68.19%	66.21%	67.40%	68.04%	66.20%	61.60%
October	53.79%	50.26%	40.90%	50.90%	51.63%	51.50%
November		35.50%	30.46%	30.00%	29.20%	27.92%
December		28.30%	27.65%	29.47%	19.00%	21.97%
Cumulative January thru October	*525.78%*	*532.78%*	*523.71%*	*537.70%*	*510.07%*	*500.03%*

Figure 2 Cumulative Accommodation Occupancy Rate for Cape Cod by Year



From **Table 5** and **Figure 2** it can be seen that there are not significant swings in the occupancy rate. This coupled with the population trends suggests stability in the food waste generation rate for Cape Cod. The estimated generation rate is expected to remain in the range of 14,000 to 15,000 tons per year Cape wide.

4.0 TREATMENT ALTERNATIVES

There are two waste materials being examined; septage and food waste. Of these the septage has existing infrastructure in the form of the Tri-Town facility. In addition the Tri-Town facility faces several challenges that must be addresses now in advance of any infrastructure that could handle food waste from being in place. Therefore septage will be addresses first and separately from the food waste.

4.1 SEPTAGE TREATMENT ALTERNATIVES

Tri-Town is owned cooperatively by the three towns of Orleans, Brewster and Eastham. The agreement between the three towns expires at the end of 2016. In addition, the facility's permit will also expire at the same time. To obtain a new permit, the facility will need to be modified to reduce the nitrogen discharge level. In addition, some equipment, such as the dewatering equipment, will need to be replaced due to its age and condition. In the Stantec report entitled "Tri-Town Septage Treatment Facility Cost Estimate Evaluation Update" dated February, 2014 the needs and cost for these updates were established.

There are two alternatives available for treatment of the septage now handled at Tri-Town

- Continue operation of Tri-Town with upgrades to the facility; and
- Seek treatment from existing treatment facilities in the area.

A survey was made of existing WWTPs both on and off Cape to determine if there is sufficient treatment capacity available to replace Tri-Town. The Tri-Town facility was designed to handle 45,000 gallons per day (11.25 million gallons per year based on 250 days of operation) of septage. There are five other wastewater and septage treatment facilities on the Cape including Barnstable WWTP, Yarmouth Dennis STF, Chatham WWPCF, Provincetown WWTP and the Falmouth WWTF. All were contacted to determine their ability to accept additional septage if there was no facility in Orleans with the exception of Provincetown which could not be reached. Below is a summary of the findings of our inquiries:

- Barnstable will accept out of town septage only if it arrives in a truck that contains some septage from in Town. The facility does not currently have additional capacity but is studying the possibility of accepting more septage.
- Yarmouth Dennis (YD) will accept septage from any town but is at capacity most of the year. From December through April the facility has an additional one million gallons of capacity during the period.
- Chatham will not accept any out of town septage. The town has been in discussion with Harwich to increase their sewered wastewater capacity to accept the Harwich portion of the Pleasant Bay watershed.

- Provincetown does not accept any septage and recently expanded to increase the amount of sewered wastewater it can accept, according to public information on the Town's website..

- Falmouth does not accept any out of town septage

Based upon the information gathered it is clear that there is not sufficient capacity on Cape Cod to replace the Tri-Town facility.

The following off Cape facilities were also contacted:

- Dartmouth WWPC
- Fall River WWTP
- Marion WWTF
- New Bedford WWTP
- Plymouth STP
- Wareham WWTF

Below is a summary of the findings of our inquiries:

- Dartmouth only accepts a very small amount of local septage (8,000 gallons per month).
- Fall River has capacity and is interested in receiving an additional 35,000 gallons per day of septage.
- Marion does not accept septage.
- New Bedford has capacity but the actual amount varies with the wastewater loading. The facility currently handles 150,000 to 200,000 gallons of septage per day.
- Plymouth is currently at or near capacity. They are working on a study of potential upgrades.
- Wareham has the capacity to accept an additional 20,000 to 25,000 gallons per day.

A combination of the facilities at Fall River, New Bedford and Wareham provides enough capacity to replace the Tri-Town operations. **Table 6** lists the tipping fees and distance from Tri-Town for these facilities.

Table 6 Off Cape Options for Septage Treatment

Facility	In Town tipping rate	Out of Town tipping Rate	Round trip distance from Tri-Town
Fall River WWTP	$0.45 per gallon	$0.66 per gallon	160 miles
New Bedford WWTP	$0.05 per gallon	$0.065 per gallon	140 miles
Wareham WWTP	$0.08 per gallon $0.10 per gallon for grease	$0.08 per gallon $0.10 per gallon for grease	100 miles

If septage treatment in Orleans is abandoned, the most significant issue related to this alternative is transportation. Transport can of course be made more economical if large loads are possible thus reducing the number of trips. The Massachusetts and Federal over the road gross truck weight limit is 80,000 pounds. This limits the maximum septage load to 5,000 gallon depending on the specific truck. Septage collection trucks are generally 3,000 gallons but can go up to 5,000 gallons. Under special permits that must be renewed each year it may be possible to increase the gross weight to 99,000 pounds. This would increase the septage load to 7,000 gallons+.

There are two options for using the off Cape facilities to process the septage currently treated by Tri-Town; one is for the Town to completely abandon septage treatment and leave it to the haulers to transport their loads off Cape. The second is for the Town to convert the Tri-Town facility to a septage transfer station and charge a fee to transport the septage. The following are the infrastructure requirements for these alternatives:

For the first option there are no infrastructure needs. For the transfer station option the following would be required:

- Existing equipment repairs;
- Three special permit 7,000 gallon tanker trucks and trailers; and
- 3 full time equivalent (FTE) truck drivers and ½ FTE administrative employees.

Tables 7 and **8** are the relative advantages and disadvantages of these two versions of this alternative:

Table 7 Relative Advantages and Disadvantages of Leaving the Transport to the Haulers

Advantages	Disadvantages
• City has no responsibility or cost for septage	• Significantly higher cost passed on to residents caused by lost productivity of hauler • Potential loss of service from small businesses (one to two trucks) • Potential to reduce non-emergency pumping • Potential revenue loss if a WWTP is constructed for sewed portion of the Town

Table 8 Relative Advantages and Disadvantages of Converting to a Transfer Station

Advantages	Disadvantages
• No treatment or discharge issues from septage treatment • Reuse existing receiving and storage tanks and equipment • Haulers maintain higher productivity so pumping cost less impacted	• Town has two dedicated 7,000 gallon truck trailer combinations • 3.5 full time equivalent employees • Some costs of operation remain as well as tip fee • Potential revenue loss if a WWTP is constructed for sewed portion of the Town

The current septage receiving system at Tri-Town has only minor upgrade needs to continue operation as a transfer facility. It therefore, does not make sense to abandon the operation and leave the local septage haulers to transport septage off Cape on their own. This would create significant cost and productivity losses to the local hauler that could involve large costs increases and potentially abandonment of service to the areas served by Tri-Town during high flow periods. For these reasons, leaving the treatment completely to the private sector will not be further considered.

Therefore the following two septage treatment options are reviewed economically below;

- Upgrading and continuing operations at Tri-Town; and
- Converting the existing septage receiving operation to a transfer facility operated by the Town.

There are some relevant data and assumptions that will be used in the analysis:

- Trucks for transferring the septage will be replaced every seven years and these costs are included under the capital cost in today's dollars.
- The charge for septage treatment at another facility will be on average $0.07 per gallon (note the range is $0.065 to $0.08).

- The fees charged for transfer operations are the same as for current Tri-Town facility operations
- Based on past Town records Tri-Town annual O&M costs and revenue is equal.
- Capital costs for upgrades to Tri-Town are from the Stantec Report dated February 2014.
- Operations are out to 2040 which assumed all upgrades in place (if done) by 2020.
- It is assumed the discount rate is equal to the inflation rate for operations.

Table 9 shows the cost in today's dollars for continuing septage treatment at Tri-Town and converting Tri-Town to a septage transfer station operated by the Town of Orleans (see **Appendix A** for detailed transfers stations costs):

Table 9 Life Cycle Cost Comparison for Septage Treatment in Today's Dollars

Item	Upgrade and operate Tri-Town	Convert Tri-Town to a septage transfer station
Capital Cost	$5,200,000	$2,420,000
Annual O&M and Revenue	$0	$289,000
Years of operation	25	25
Total cost in today's dollars	*$5,200,000*	*$9,645,000*

Given the large differential in cost between the two options, minor changes in the assumptions will not impact the relative standing of each. Therefore it is recommended that the Tri-Town septage facility be upgraded and treatment operations continue into the future.

4.2 SEPTAGE SOLIDS HANDLING

Currently the septage treated at Tri-Town is dewatered to 35% solids. These solids are trucked by the Town to a sludge transfer facility in Yarmouth. A third party transports the sludge to a private facility in Plymouth, Maine for processing and recycling. The material is alkaline stabilized to a Class A biosolids and used on agricultural fields. This is the baseline case for comparing the other options. **Table 10** lists the relative advantages and disadvantages of the current operation:

Table 10 Relative Advantages and Disadvantages of Current Solids Practice

Advantages	Disadvantages
• The Town does not need to market the end product • The existing septage receiving and thickening equipment can be reused	• High cost of third party handling • Risk of dependence on third party • New dewatering equipment Is needed • Solids content from the new dewatering equipment will likely be lower than the current operation, thus increasing overall costs.

Both Yarmouth Dennis and Chatham use the same vendor and transfer facility. Other facilities on the Cape transport sludge that has not been dewatered to the incinerator in Cranston, RI. The alternative to the current third party disposal operation would be to process the septage solids locally to produce a recyclable product.

The most important factor to consider in any local processing alternative is the ability to find an outlet for the end product. End products from septage or sewage solids (biosolids) include the following:

- Energy
- Class A and B biosolids for agricultural land application
- Class A soil amendments suitable for use by the general public

Energy is most commonly derived from anaerobic digestion. In this process low solids sludge is heated and introduced into a sealed vessel with no oxygen. Bacteria known as methanogens convert a portion of the solids to methane gas which is most commonly burned in an engine that drives an electric generator. The heat produced in the engine is reused to warm the biosolids entering the vessel. There are minimum quantities of biosolids that are required for this process to successfully generate electricity. The minimum size electric generating equipment for converting methane to electricity is a 143 kw engine driven generator or 30 kw micro-turbine. The amount of biosolids required each day to meet the capacity of these generators is eight dry tons per day for an engine generator and two dry tons per day for a micro-turbine. Tri-Town currently produces two to three dry tons per day. This could support a micro-turbine but not an engine generator. However, the value of 30kw of electricity is only about $115 per day. For energy production to be viable additional feedstock material in the form of food waste will be required. It must also be understood that solids still remain after anaerobic digestion and these will need to be further treated for recycling.

Class A and B biosolids for agricultural land application are produced in a variety of ways including chemical stabilization of various types, anaerobic digestion and aerobic digestion. Agricultural land application is limited only to a portion of the year and only in dry weather. It requires large storage capacity for the material as well as vast amounts of agricultural land to

accept the material. This does not exist in most of Southern New England. Therefore this end product use is not viable for Orleans.

There are two types of Class A soil amendments that are generally accepted by the public and suitable for use on residential and public lands; the first is compost and the second is dried pellets. Compost has been tried before on the Cape at Orleans and at Yarmouth Dennis. The Orleans facility was an open air facility without odor control. This configuration resulted in adverse odor impacts to the surrounding community and the operation was halted. At the Yarmouth Dennis STF an enclosed composting facility with odor control system was constructed. However, at this site the technology used involved a single piece of equipment that was essential to moving the material through the process. This piece of equipment proved unreliable. This made the process untenable and the operation was halted. However improvements in equipment and odor control have overcome these issues and composting has proven to be a reliable operation for biosolids processing with over 200 facilities operating across the country many of which operate in close proximity to residential areas.

There are several biosolids composting facilities in Massachusetts with the end product being used in New England. There are several types of composting methods but in general the infrastructure needs for successful composting include the following:

- Fully enclosed active aerated composting system with a minimum of 21 days retention time
- Handling equipment for mixing yard waste or other wood waste with the biosolids
- Odor control system for capturing and treating all of the air from the enclosed composting operation
- Post composting screening system for recovering bulking agent
- An aerated low rate curing operation with, at minimum, a roof cover
- Two front end loaders for moving the material through the operation.
- Sufficient land area for storing several months' worth of finished product
- One full time operator.

Alternatively, Yarmouth was contacted to gage their interest in reopening their enclosed facility in cooperation with the Town of Orleans. However, after an internal discussion, Yarmouth decided they were not interested in attempting to reopen the compost facility at this time.

Dried pellets are produced by drying the biosolids to a minimum of 90% solids. The end product is sold for use as a soil amendment. The process requires that the biosolids be stabilized in

advance of drying by either anaerobic or aerobic digestion. Without this stabilization the end product will become too odorous for use when it is rewetted. While pellets are well accepted in many parts of the country they have not caught on in New England. There is a very large biosolids pelletizing plant in Quincy processing biosolids from the Deer Island WWTP for MWRA. Most of the product produced at this facility is shipped by rail to other states for use in agriculture. Based on this experience pellets would likely need to be used on agricultural land. Other than cranberry bogs there is limited agricultural land available in southeastern Massachusetts. Any dried product would need to be shipped long distances. For these reasons drying and pelletizing will not be considered further for Orleans.

Of the various product and technologies reviewed for this alternative only composting has any potential for further consideration. **Table 11** lists the relative advantages and disadvantages of this treatment method.

Table 11 Relative Advantages and Disadvantages of Composting

Advantages	Disadvantages
• Generally accepted soil like product produced and used throughout New England • Process is very adaptable to fluctuations in loading • Has better nitrogen release characteristics than most commercial fertilizers	• Large footprint required for processing and product storage • High energy consumption for aeration and odor control • Poor history in Orleans and likely difficult to gain public acceptance of a facility • Orleans would need to market as well as produce the product

The unit cost for the current third party solids disposal operation is $110 per ton of sludge. The facility generates 1,182 tons of solids per year at 35% solids content (65% water). This equates to 414 tons of dry solids per year. The cost of this is $130,000 per year. In the future the solids content is likely to be lower due to changes in the type of dewatering equipment used. The current plate and frame press equipment is very labor intensive and seldom used for sludge dewatering anymore. Centrifuges or screw presses are more common now because they are highly automated. However they produce a lower solids content sludge than the current equipment. The new solids content will likely be about 25%. The new wet sludge tonnage will be 1,652. The revised cost for solids disposal will be about $183,000 per year.

A cost estimate for a fully enclosed composting facility was generated (see **Appendix B** for detailed costs). The life cycle of the composting facility would be from 2020 to 2040. **Table 12** below compares the cost in today's dollars of constructing and operating a composting facility to continuing the current third party operation. New dewatering equipment would be needed for both options and the capital cost for that equipment is already captured in the upgrades to the Tri-Town facility. The only capital cost required for the current third party option would be the replacement of the truck used to transport the solids to Yarmouth from Orleans. It is assumed that a new truck will be needed every7 years.

Table 12 Life Cycle Cost for Septage Solids Handling

Item	Continued third party operation	New enclosed composting facility at the Tri-Town site
Capital cost	$100,000	$7,726,000
Annual O&M	$183,000	$401,000
Years	20	20
Total in today's dollars	3,760,000	15,746,000

There is significant cost difference in the two alternatives and it is recommended that the current third party operation be continued.

4.3 TRI-TOWN TIPPING FEE

Based on the above analysis the continued operation of Tri-Town or similar facility in Orleans is the most economical approach to septage treatment in the Orleans. The current Tri-Town tip fees are the following:

- $0.10 per gallon for in district septage;
- $0.14 per gallon for septage from outside of Orleans, Brewster and Eastham; and
- $0.15 per gallon for portable toilet discharge.

In the months of January and February, Tri-Town reduces the tip fee for all loads to $0.08 per gallon. The only other facilities on Cape that accept out of Town septage loads are Yarmouth/Dennis and Barnstable. YD charges $0.12 per gallon for all loads other than Fats, Oils and Grease (FOG) and Barnstable charges $0.105 per gallon but part of each load must come from Barnstable.

Several septic pumping companies were contacted and 10 were interviewed. The fee schedules for each vendor varied. Some charged a flat rate for all towns and tank sizes and other varied the rate by tank size and some also varied the rate depending on the Town they were pumping from. All vendors used any of the three available facilities, Tri-Town, YD or Barnstable. The pumping fee ranges are listed below:

- 1,000 gallon tanks - $0.225 to $0.37 per gallon; and
- 1,500 gallon tanks – $0.217 to $0.232 per gallon.

The $0.14/gallon charged by Tri-Town represents between 38% to 65% of the fee vendors collect for pumping a system.

The seasonal nature of the population has significant impact on the septage treatment facilities and the tip fees charged. **Figures 3 and 4** show the average monthly and average daily septage delivered to Tri-Town from 2010 through 2014 respectively. It can be seen that during the months of June through October Tri-Town is at or near its' daily capacity. In November, the flows begin to drop and in December and March the facility receives about half its' capacity. January and February, however see a return to near loading of about 88% of plant capacity. This is due to the reduction in the tipping fee charged. It is during these same months that the YD Facility reported it had extra capacity.

Figure 3 Average Monthly Septage Delivered to Tri-Town from 2010 to 2014 (gallons)

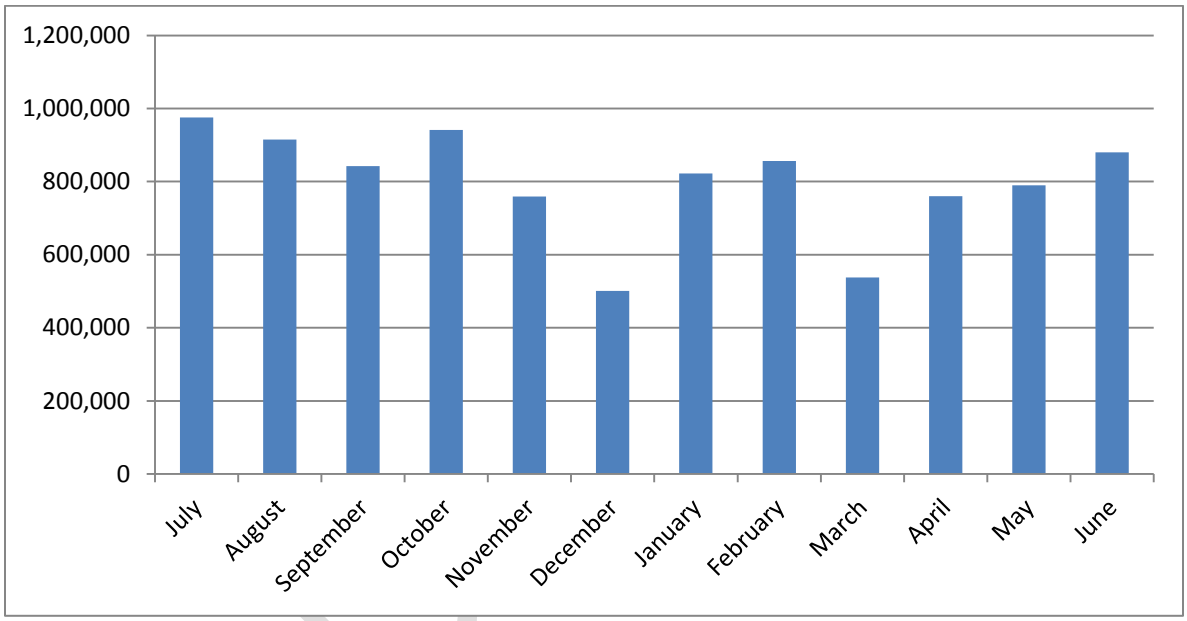
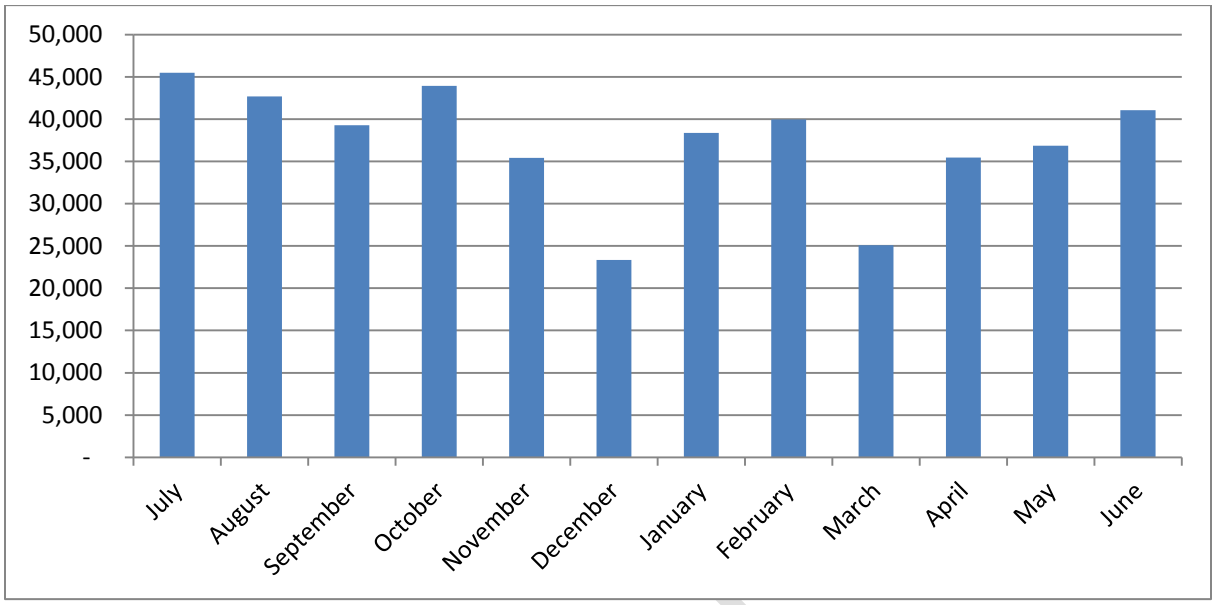


Figure 4 Average Daily Septage Deliveries for Each Month 2010 to 2014 (gallons)



The following can be deduced from the data above:

Tri Town operates at or near capacity for several months while charging the highest fee on the Cape for out of town septage. This testifies to the need for Tri-Town and that during the busy months the haulers will deliver to the closest or the only available facility. The vendors only make money when they are pumping and not when delivering septage and thus it is worthwhile for them to pay the higher tipping cost. Therefore, they will seek the closest available facility.

In the off season, the vendors have more time to seek the lowest cost treatment alternative. The tipping fee represent as much as a 60% deduction from their revenue.

There are two potential changes in tip fee to be examined:

The first is lowering the $0.14 per gallon for out of District septage to $0.10 in the hopes that additional flow would make up the difference. This does not work out. If the out of District fee is lowered to $0.10 per gallon Tri-Town would need to receive an additional 861,600 gallons per year of septage to break even with the current revenue. In the busy months from June to October there is only 323,000 gallons of capacity available. We have already seen that in the less busy months the cost needs to be lowered to $0.08 per gallon to maintain flow. Therefore this is not a viable option.

The second alternative would be to increase the tipping fee during the busy months. If the tip fee was increased by $0.01 per gallon for all loads, and if current deliveries were maintained the additional revenue would be $45,547. However, it is likely the deliveries would drop if the cost was increased. If the deliveries fell below 362,000 per year, the extra revenue would be

eliminated. This is only 3.8% of the annual deliveries and it is likely the facility would see this level or more of decline in months other than July. It is therefore not recommended to change the current fee structure.

4.4 FOOD WASTE PROCESSING ALTERNATIVES

As noted in **Section 3.0** of this TM, approximately 14,000 to 15,000 tons per year of food waste is generated on Cape Cod that will be required to meet the new alternative disposal regulations that went into effect on October 1, 2014. Food waste has more energy than septage biosolids and thus it takes less of it to produce electricity. One wet ton of food waste (approximately 0.3 dry tons) will produce 10.8 kw of electricity. To meet the 143 kw minimum for engine generators about 13.2 wet tons of food waste (four dry tons) is required. To meet this minimum tonnage would require capturing all of the average daily food waste generated from the following towns, Dennis, Harwich, Brewster, Chatham, Orleans, Eastham, Wellfleet, Truro and Provincetown. However, it must be noted that this is on average. In the summer the food waste generation will be high but in the winter it is likely it will not be possible to capture enough food waste to constantly make electricity.

It is important to note that the food waste consists almost entirely of post-consumer food. That is to say, food scraps from meal preparation or plate cleaning and past date or spoiled food. This is important because the form of the food waste dictates the methods available for handling and processing the waste. The most common form of anaerobic digestion is the same as used for biosolids, which is a liquid slurry in a sealed tank. For this type of food waste there are two methods available; the first is to liquefy the food waste and digest it in a similar manner to biosolids. The second is to place the solids in a sealed chamber with a front-end loader and circulate liquid through the solids. The liquid goes to a sealed tank digester similar to biosolids digestion.

In both cases there are residual solids after digestion that must be treated either by composting or pelletizing. In some applications these solids are directly land applied to agricultural land. However, as discussed previously this is not an option for Orleans. In the liquefied process, the solids are extracted from the liquid with dewatering equipment similar to that used for biosolids. In the high solids method the solids are removed from the chamber by front-end loader.

With any food waste, some contamination of the waste with non-food waste will occur such as packaging, forks and spoons etc. With a liquefied process, the contamination must be removed pre-digestion in the liquefying stage. In the high solids process the contaminants are removed through screening at the end of the post digestion composting process. Below is a list of the infrastructure required for anaerobic digestion of food waste at Orleans:

- Food waste receiving building with odor control system
- For liquefied digestion a conveyor with sorting stations, grinder, liquid solid separator

- For high solids chamber digestion the food waste is placed into the chamber by front-end loader
- Liquid digestion tank with pumps, mixing and heating system
- Post digestion dewatering equipment (liquid to go to wastewater treatment plant)
- Solids composting system similar to that described for septage solids composting
    - Fully enclosed active aerated composting system with a minimum of 21 days retention time
    - Handling equipment for mixing yard waste or other wood waste with the digested solids
    - Odor control system for capturing and treating all of the air from the enclosed composting operation
    - Post composting screening system for removing contaminants and recovering bulking agent
    - An aerated low rate curing operation with at minimum a roof cover
    - Sufficient land area for storing several months' worth of finished product
- Three to five full time employees would be needed to oversee the pre-digestion digestion and composting operations. The number of employees would depend on the type of digestion used.
- Either system will require a minimum of three front end loaders.

As an alternative, drying and pelletizing may be substituted for composting for final processing of the solids. As noted the most likely use for the pellets would be agricultural which would involve shipping the product off Cape at the least. The marketability of these pellets would need to be studied to make this determination.

Tables 13 list the relative advantages and disadvantages of the liquefied and high solids digestion processes.

Table 13 Relative Advantages and Disadvantages of Food Waste Anaerobic Digestion

Advantages	Disadvantages
• Generally accepted soil like product produced and used throughout New England • Power and heat generation, heat is used in the process	• Very high capital investment and operations cost • Large footprint for digestion and either composting or drying • Truck traffic associated with food waste tipping • Complex pre-processing system (for liquefied system) • Sorting required (for liquefied system)

As noted above the minimum electricity generation from an engine generator would be 143 kw with and associated value of approximately $552 per day. This is based on collecting an average of 13.2 wet tons of food waste per day. This would be relatively simple in the summer but likely would not be attainable in the winter. However if we assume this is attained year round the revenue from electricity would be $201,480 per year. This is less than the O&M cost just to run a composting operation as was shown in **Table 12**. It is noted that a composting operation would be needed post digestion to render the solids recyclable. This would also be less than it would cost to have the third party handle the post digestion solids. Therefore it is not recommended for the Town to pursue processing food waste on it own at the Tri-Town site.

As an alternative to a town operated facility the potential for having a third party develop and operate a facility to process food waste from a larger area is examined below.

There are several companies in the United States that have technology licenses and have developed or are trying to develop organics digestion or composting facilities. With the rise of legislation in New England there is much interest in this region for these developers.

Generally the food waste is processed through an anaerobic digester. The digestion process produces methane gas that is collected, cleaned and burned in an engine generator to produce electricity. After the digestion process is complete there are residual solids that are either dried and pelletized or composted to make a commercial product. In some agricultural area the solids are directly land applied to farm land. However this requires large amounts of agricultural land. This is not available on Cape Cod.

The primary revenue source for these commercial facilities is the tip fee that would be paid by the haulers delivering the waste. Power generated from the digestion process and the finished products are a small fraction of the facility revenue. The base infrastructure for these facilities is expensive and economies of scale are an important part of making them financially viable. In general the minimum economic size appears to be about 100 tons per day with a minimum of 1.0 MW electricity generation for digestion facilities. **Table 14** lists several facilities of this type either in planning or in operation:

Table 14 Listing of a Few Commercial Source Separated Organics Facilities

Facility	Facility type	Energy generation	Waste processed	Facility status
AGreen Energy Rutland, MA	Anaerobic Digestion	0.48 MW[1]	Not Available	Operating
AGreen Energy Hadley, MA	Anaerobic Digestion	2.4 MW	Not Available	Development
Columbia Biogas Portland, OR	Anaerobic Digestion	3.0 MW	300 tons/ day	Development
Harvest Power British Columbia	Composting	N/A	110 tons/day	Operating
Harvest Power London, ON	Anaerobic Digestion	2.7 MW	Not Available	Operating
Harvest Power Orlando, FL	Anaerobic Digestion	5.4 MW	356 tons/day	Operating
Harvest Power Bourne, MA	Anaerobic Digestion	Unknown	Unknown	Development
Long Island Compost Brookhaven, NY	Anaerobic Digestion	Not Available	329 tons/day	Development
Stop & Shop Freetown, MA	Anaerobic Digestion	Approx. 1.0 MW	95 tons/day	Development
Quantum Biopower Southington, CT	Anaerobic Digestion	Approx. 1.0 MW	110 tons/day	Development
WeCare Environmental Marlborough, MA	Composting	N/A	100 to 160 tons/day	Operating

Notes:

1. All of the slurry produced by the digester is used for land application on site. There is no processing or transport required.

Only the AGreen Energy facility in Rutland, MA is below 100 tons per day or 1.0 MW of energy production. The Rutland facility is located on a farm and all of the digestate (slurry coming out of the digesters) is land applied on site. There is no composting or drying of the digestate as there is in all the other anaerobic digestion facilities listed. The list is not comprehensive, but is representative. The available food waste on the entire Cape is only about 15,000 tons per year or about 40 tons per day on average with significant seasonal fluctuations. These quantities are well below the amounts needed for a third party to build and operate a facility at Orleans. To obtain the needed volumes of food waste, the material would need to be trucked in from other areas.

In addition, there are two commercial facilities in planning in Southeastern Massachusetts; the first is a 90 ton per day facility planned in Freetown, MA. This facility is to be located at a Stop & Shop distribution warehouse site and has been permitted but is not yet under construction. The

second is a facility being developed in Bourne, MA by Harvest Power to anaerobically digest food waste and create dried pellets with the solids from the process. This facility is to be located at the Bourne landfill. The Town and Harvest Power are still in negotiations. Either of these two facilities will be closer to additional food waste beyond what is available on the Cape that would be needed to develop a commercial facility.

Because the amount of food waste on the Cape is insufficient to sustain a commercial venture and with two other facilities planned closer to more abundant sources of food waste, it is unlikely a developer will be interested in investing the substantial capital to build and operate a facility in Orleans.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The geography, limited development growth potential and seasonal nature of the economy all helped shape the recommended alternatives. For septage handling, it is recommended that the Tri-Town facility be upgraded and continue operations into the future. Whether Orleans pursues this course on its' own or develops a new district entity is a political decision beyond the scope of this document. However, given the dependence of the Outer Cape communities on the Tri-Town facility, it may be worth exploring expanding the District membership.

It is worth noting that in implementing the Comprehensive Wastewater Management Plan (CWMP) there will likely be a wastewater treatment plant that will process sewage from some portions of the Town. Depending on the implementation schedule for this construction there may be some ability to combine wastewater functions between the septage and sewage treatment facilities. The economic analysis presented in this document did not include these synergies and thus the practice of septage treatment at Tri-Town stands on its own merits.

Two scenarios were examined for altering the pricing for accepting septage loads at Tri-Town; One was to reduce the out of district tip fee from $0.14 to $0.10 per gallon. The intent being that a reduced cost would increase flow. This is already successfully done by Tri-Town during January and February. However, this change would require that Tri-Town receive an additional 861,600 gallons per year of septage be treated at Tri-Town in order to meet a similar revenue amount. At the time of year when additional septage is most available (June through October) Tri-Town only has 323,000 gallons of excess capacity. Thus it is not viable to reduce the cost year round.

The second alternative would be to increase the tipping fee. This could only be done in the busy months since Tri-Town already reduces the tip fee in the winter months. The additional revenue for each $0.01 per gallon increase would be eliminated if Tri-Town lost just 3.8% of gallons tipped. This represents less than one truck load of septage per day. It is likely one truck would go elsewhere for the lower tip fee except during the busiest month of July. Therefore neither of these scenarios are promising and changing the current rate structure Is not recommended.

The location of Orleans in relation to available sources of food waste drove the inability to make such a facility economical. It is recommended that the Town track the progress of the planned facilities in Freetown and Bourne and to see if the Commonwealth will offer subsidies for such facilities in the future to encourage their development.

APPENDIX A

SEPTAGE TRANSFER STATION CAPITAL O&M COST ESTIMATES

Septage Transfer Station Capital Cost

Item	Unit cost	Unit	Quantity	Cost
Upgrades to receiving station				$ 500,000
Rolling Stock				
7000 gallon pumper tanker trucks (2015)	$160,000.00	each	3	$ 480,000
7000 gallon pumper tanker trucks (2022)	$160,000.00	each	3	$ 480,000
7000 gallon pumper tanker trucks (2029)	$160,000.00	each	3	$ 480,000
7000 gallon pumper tanker trucks (2026)	$160,000.00	each	3	$ 480,000
Total				***$ 2,420,000***

Septage Transfer Station O&M Cost

item	Unit cost	Unit	Quantity	Cost
Truck & trailer operation	80.00	$/hr	4,500.00	$ 360,000
Labor				
Pay truck driver	65,000.00	$/FTE	3.00	$195,000
Pay administration	65,000.00	$/FTE	0.50	$32,500
Benefits	50%	$/FTE		$113,750
Tip Fee @ Receiving Facility	0.07	$/gal	9,200,000.00	$644,000
Subtotal				$1,345,250
Revenue				
Tip fee charged to haulers				($1,056,851)
Cost to Operate Facility over Revenue Amount				$288,399

December 23, 2014

APPENDIX B

COMPOSTING FACILITY CAPITAL AND O&M COST ESTIMATES

Composting Facility Capital Cost

Item	Unit cost	Unit	Quantity	Cost
Site Improvements				
Clear & grade	$10,000	acres	2.0	$ 20,000
Paved roads		ft^2	24,000	
Paved storage pad		ft^2	16,900	
Compost building	$150.00	ft^2	19,250	$2,887,500
Compost process				
Aeration floor	$40.00	ft^2	10,000	$400,000
Aeration fans	$5,000.00	each	10	$ 50,000
Odor control (49,000 cfm)				
Biofilter fans	$15,000.00	each	4	$60,000
Biofilter plenum	$ 40.00	ft^2	12,300	$492,000
Biofilter media	$ 50.00	yd^3	1,815	$90,741
Equipment				
Mixer	$250,000.00	each	1	$250,000
Screener	$250,000.00	each	1	$250,000
Electrical & controls				$1,000,000
Subtotal				$5,500,241
Contractor O&P	25%			$1,375,060
Engineering	10%			$550,024
Rolling stock				
Front-end loader	$300,000.00	each	1	$300,000
Total				$7,726,000

Composting O&M

Item	Unit cost	Unit	Quantity	Cost
Labor				
Pay Operator	65,000.00	$/FTE	1.00	$ 65,000
Benefits	50%	$/FTE		$ 32,500
Electricity	$ 0.12	kwh	1,960,488	$ 235,259
Biofilter media	$ 50.00	yd^3	988	$ 49,383
Regulatory reporting				$ 5,000
FEL operations	$ 35.00	hr	1,040	$ 5,000
Screen operation	$ 50.00	hr	416	$ 5,000
Mixer Operations	$ 50.00	hr	416	$ 5,000
System maintenance	5%	of capital		$ 23,000
Revenue	$ 5.00	yd^3	4,800	$ (24,000)
Total				$ 401,141