TETRA TECH

FINAL MEMO

To:	Patty Daley, Michele White, Kari Parcell Barnstable County/Cape Cod Commission
Cc:	----
From:	Debra Darby/Tetra Tech
Date:	November 1, 2021 Revised
Subject:	Barnstable County MSW Diversion Options for Recyclable, Reusable and Hard to Dispose Waste Materials; Task 1 – Quantify and Characterize Cape Cod MSW Components

1.0 INTRODUCTION

At the request of Barnstable County (the County), the Project Team led by Tetra Tech, which also includes members of Gershman, Brickner & Bratton Inc. (GBB) performed analysis of the County's municipal solid waste (MSW) components. Data and reports were collected collaboratively with the County. It is our understanding that the County is interested in identifying diversion opportunities and evaluate alternative methods to control costs and provide flexibility to the Cape Cod Municipalities and Islands of Martha's Vineyard and Nantucket.

Due to limited disposal capacity in Massachusetts and in the region, and with only one MSW landfill in Massachusetts anticipated to remain open by 2030, the projected net MSW export is expected to increase to 2.4 million tons annually. As the disposal options continue to decrease, municipalities will have a more difficult time transporting trash for disposal, and solid waste management costs will likely continue to rise. Reducing the amount of waste for disposal will help municipalities achieve a more robust, diverse, and cost-effective materials management system.

The MassDEP has prioritized additional diversion potential on a tonnage basis focused on opportunities to reduce waste by phasing out use of single use products and disposable packaging, increase recycling, reuse and donation, and existing underutilized capacity, or opportunities for local market development potential. The 2030 Massachusetts Draft Solid Waste Master Plan (SWMP) indicates materials with high priority diversion include food waste, textiles, bulky materials, untreated wood, and cardboard, while looking to develop local markets for these materials. The SWMP also sites increasing capacity of managing waste material through rail transportation, construction, and demolition (C&D) processing, and anaerobic digestion for managing food waste.

Tetra Tech is working with the County to align as closely as possible with the MA SWMP for reuse, recycling, and waste diversion, and focus on the materials with the greatest diversion potential and be positioned to get ahead of new waste bans and policies by encouraging reuse, recycling, and organics diversion from disposal at a higher rate.

1.1 OBJECTIVES

The Project Team conducted a tonnage/volume analysis to quantify and characterize Cape Cod's MSW components for further considerations and management, and various options for disposal and transportation.

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This task was conducted as a desktop review of Cape Cod and Islands. These communities include:

- Upper Cape towns of Bourne, Sandwich, Falmouth, Mashpee
- Mid Cape towns of Barnstable, Dennis, Yarmouth
- Lower Cape towns of Brewster, Harwich, Chatham, Orleans
- Outer Cape towns of Eastham, Wellfleet, Truro, and Provincetown
- Nantucket and Martha's Vineyard towns of Aquinnah, Chilmark, Oak Bluffs, Tisbury, West Tisbury, Edgartown.

2.0 BACKGROUND

The Project Team conducted an analysis of 17 MSW components and based on how the data was reported from the town transfer stations. These components are grouped into the following categories:

1. Recyclables (plastics, glass, recyclable mixed fibers, and metals)
2. Organics (food waste and yard waste)
3. Asphalt, brick, and concrete (ABC), and construction and demolition (C&D)
4. Textiles/Rugs and Carpets
5. Mattresses
6. Bulky Items/Furniture
7. Other Bulky Items (white goods)
8. Tires
9. Propane Tanks and Fire Extinguishers
10. Electronics/E-Waste
11. Household Hazardous Waste (HHW) (antifreeze, oils, and liquids)
12. Batteries/Universal Waste

Mixed paper, chipboard, newspaper, and cardboard are included in the recyclable mixed fibers as noted above in category 1. The MSW data quantified and analyzed are the reported monthly tonnages from the municipal transfer stations that responded to our Request for Information (RFI) on February 19, 2021. Municipalities responses were received between March 5-19, 2021. The MSW data is over four years looking back to 2017. Our findings are summarized in the following sections.

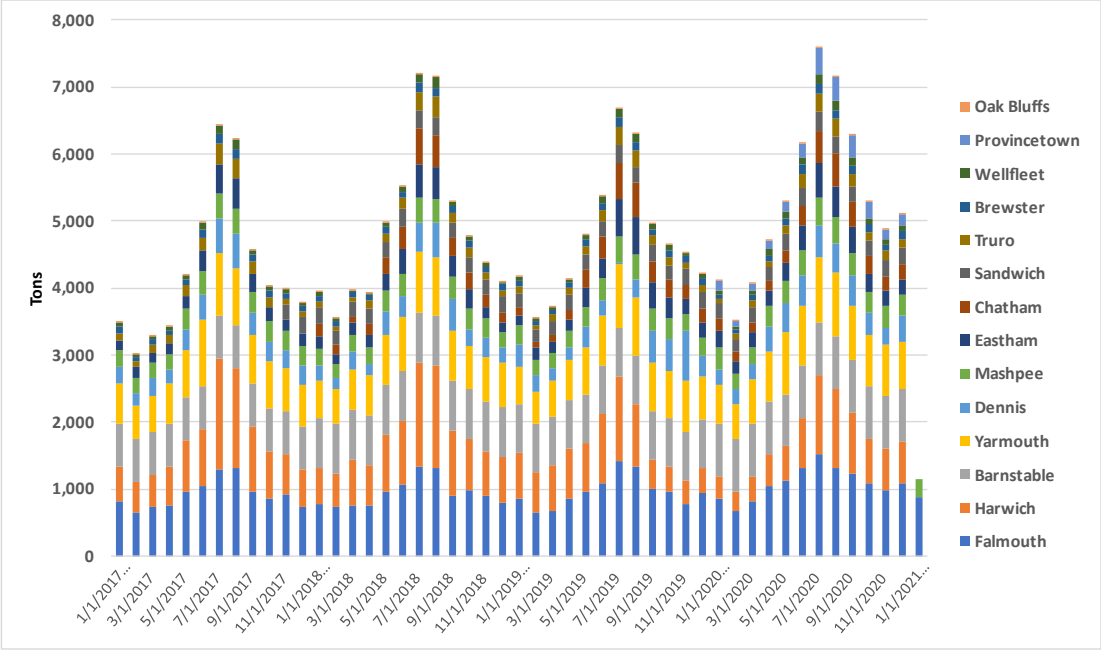
2.1 WASTE GENERATIONS PER MONTH

From 2017 to 2020, the year-round population on Cape Cod increased by 1.02% from 214,107 in 2017 to 216,294 in 2020 *(2020 Cape Cod Commission).* With influx of summer residents and tourists, the population density increases to more than 500,000 during the summer months. To get a sense of the seasonal variations in the waste stream, monthly tonnage data was requested from the transfer stations within Barnstable County and included two towns on Martha's Vineyard *(Oak Bluffs and Tisbury)* in Dukes County. Some, but not all the municipalities provided data. Nantucket also responded to an email request for outbound MSW, and the annual data from the Island appears in **Table 14** in the Appendix.

Several municipalities included data for not only MSW but other materials such as bulky items and construction and demolition (C&D) material. The reported tonnages were consolidated by month and by material. The results for the largest material streams were graphed to help show the fluctuations between the seasons. Four years of data starting in 2017 were used for these comparisons.

The most reported material stream was for MSW, with 13 of the 15 Barnstable County town transfer stations reporting monthly data. **Figure 1-1** shows the results for the MSW monthly tonnages from municipal programs with the obvious seasonal fluctuations between the summer and winter seasons. In most cases, the waste stream doubles in tonnage between May through September. Even with two transfer stations missing from the data *(Bourne and Orleans),* the trend would likely be the same, it indicates the total monthly tonnage for all of Barnstable County is likely slightly larger than shown. This helps illustrate that using yearly averages for capacity may not fully account for the surge of material over the summer months. In addition, the summer MSW tonnages are increasing year to year, from 2017 to 2020.

Figure 1-1: MSW Generation Per Month (in Tons)[1]



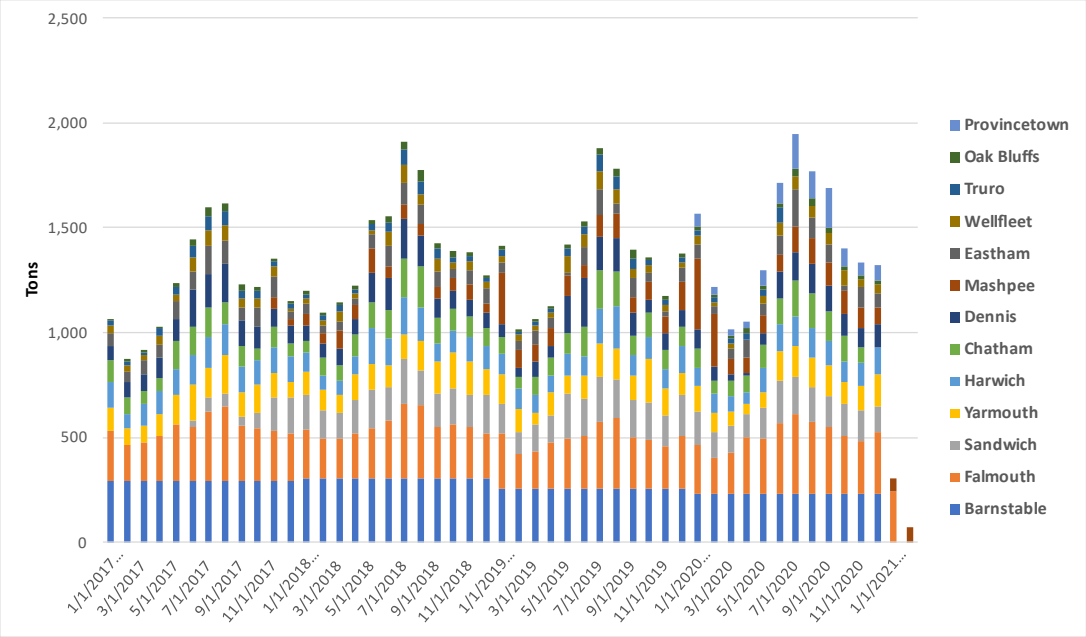
1) *Does not include private waste hauler subscription service pick up at the curb.*

2.2 RECYCLABLES

Recyclable materials were also well reported with 11 of the Cape Cod transfer stations reporting monthly tonnages as well as data from the Oak Bluffs transfer station. Some municipalities reported information as a yearly tonnage. When this occurred, the tons were evenly distributed over the year so the data could be included, even though it is much likelier that the tons were greater in the summer and much smaller during the winter months. Recyclables include all commodity recovered materials at the transfer stations including glass bottles, plastics, cardboard and other fibers, and all metals. The results are similar to the MSW results with a distinct seasonal variation. Key trends to notice are the summer tonnages increase with distinct seasonal variation with

the recycling rate peaking during July to September in each year. In addition, the summer tonnages are increasing year to year, from 2017 to 2020. **Figure 2-1** shows results for the recycling monthly tonnages reported by the municipal transfer stations.

Figure 2-1: Recycling Generation Per Month (in Tons)



2.3 ORGANICS

Residential food waste collection at Cape Cod and Islands Town Transfer Stations is relatively new with nine municipalities providing a drop-off location for collection within Barnstable County. These towns are Barnstable, Brewster, Chatham, Dennis, Falmouth, Mashpee, Truro, Wellfleet and Yarmouth.

2.3.1 Martha's Vineyard

Like Barnstable County, Martha's Vineyard (Dukes County) also has a significant seasonal fluctuation. Martha's Vineyard has 16,000 year-round residents and the population increases to over 200,000 during the summer months. Martha's Vineyard Refuse Disposal and Resource Recovery District (MVRRRD) represents the towns of Aquinnah, Chilmark, Edgartown, and West Tisbury. On Martha's Vineyard, the Island Grown Initiative (IGI) operates a farm and an in-vessel composting system. IGI collaborates with Island hauler Bruno's Rolloff on the collection of commercial food waste from nearby restaurants, caterers, schools, and camps. IGI reported that municipal residential curbside collection is conducted in a small area of Tisbury and Oak Bluffs downtown.

The curbside collection is a premium service handled primarily by one private hauling company, Bruno's Rolloff. In 2019, IGI collected 360 tons of food waste from 40 organizations from the six towns of Aquinnah, Chilmark, Edgartown, Oak Bluffs, Tisbury, and West Tisbury. In 2020, the total amount of food waste collected was 208.79 tons. The decrease in the tonnage was most likely due to COVID-19 pandemic.

Residential food waste is collected at five of the six town Transfer Stations including Chilmark, Edgartown, Oaks Bluff, Tisbury, and West Tisbury. IGI provides toters for residents to bring their food waste to these town Transfer

Stations, and at two drop-off locations (the IGI farm gate or on Chappaquiddick). **Table 2-1** below shows the annual food waste collection at the five Town Transfer Stations. About 40 cubic yards of leaf and yard waste is collected from five of the six MVRRRD towns, and this material is also delivered to IGI for composting. Other inbound feedstocks for composting include yard debris from commercial landscapers, and cardboard. Stumps are not accepted but IGI does accept woodchips. IGI does not track the volumes of the yard waste material or wood chips delivered to the compost facility.

Table 2-1: 2020 Martha's Vineyard Towns Food Waste Tonnage Delivered to IGI

Marth's Vineyard Towns	Food Waste (Tons)
Chilmark	3.74
Oak Bluffs	6.10
Edgartown	12.45
Tisbury	5.46
West Tisbury	8.25
Total	**36.74**

2.3.2 Nantucket

Nantucket operates an in-vessel composting operation in which co-mingled MSW, food waste and other compostable materials are screened and processed into a composted material. The composting system is a Bedminster Bioconversion Technology Process operated by a private company, Waste Options Nantucket LLC (Waste Options), and is located at the Town-owned site at 188 Madaket Road. The material in the MSW/Compost category goes through the Composter along with animal manure, invasive plants, and dewatered biosolids. The materials are composted, screened, then cured for at least 6 months, and is eventually mixed with leaf and yard waste in traditional composting windrows to create a finished compost product for the community. The contamination, which is primarily plastics, is screened out before proceeding to the Aeration Floor. Historically, this contamination (estimated to be 30-35% by weight) has been the only material landfilled on Nantucket.

With the emerging concerns with PFAS in Massachusetts, the Town and Waste Options preemptively stopped offering the Composter Compost with biosolids to the public in August 2019. The compost made with biosolids is currently used as daily landfill cover. With MassDEP's permission, the Town plans to remove the biosolids portion from the composting process and will mostly likely send the biosolids to the landfill as an interim method of disposal.

2.3.3 Cape Cod

There was less information available on the organics data from both food waste and yard waste collection at the Cape Cod Transfer Stations. There were also some differences in how the transfer stations recorded this data in units so there were some assumptions made in consolidating the reported tonnages. It was also unknown if some data had the food and yard waste combined into a singular tonnage as the general term of compost was used for collection reporting. Christmas trees were not counted in the waste as the weight was unknown. The results were not as seasonally variable as the MSW and the Recycling results. There were several spikes in both the food waste and yard waste data from the Chatham transfer station. The reasoning for this could not be determined

based on the available information. **Figure 2-2** shows results for the Food Waste Recycling monthly tonnages reported by the municipal transfer stations from both Martha's Vineyard towns and Cape Cod towns. **Figure 2-3** shows results for Yard Waste (Compost) monthly tonnages reported by the Cape Cod municipal transfer stations.

Figure 2-2: Food Waste Generation Per Month (in Tons)

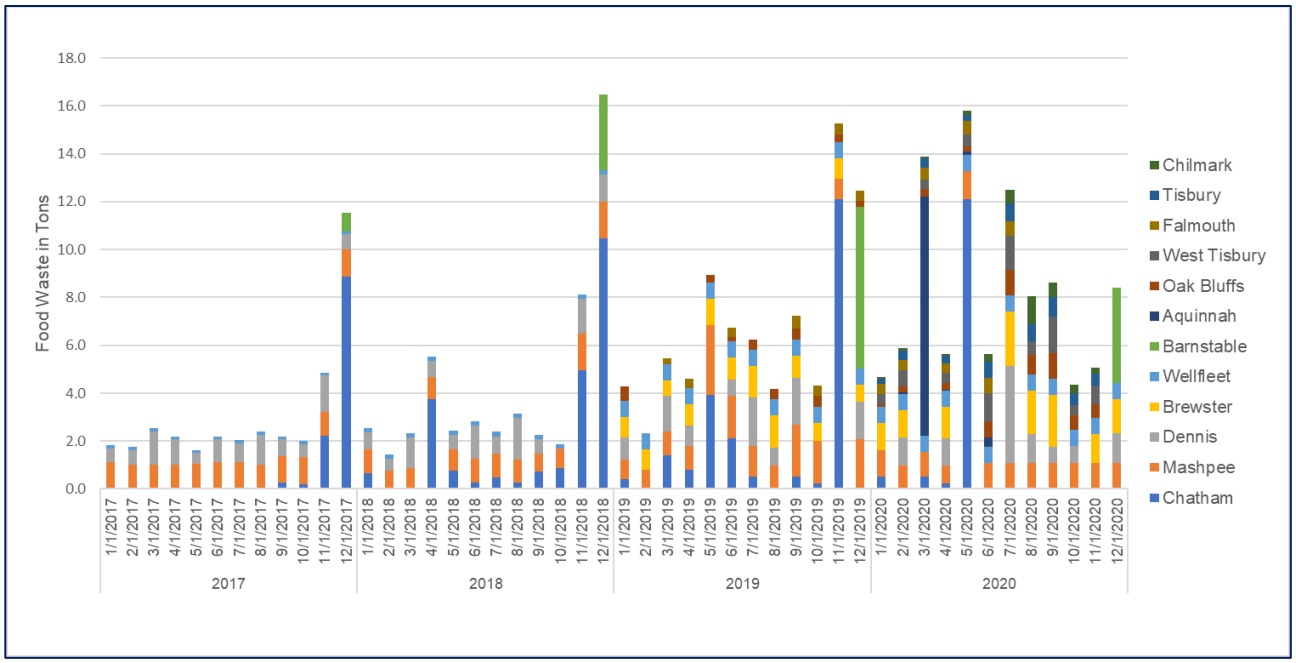
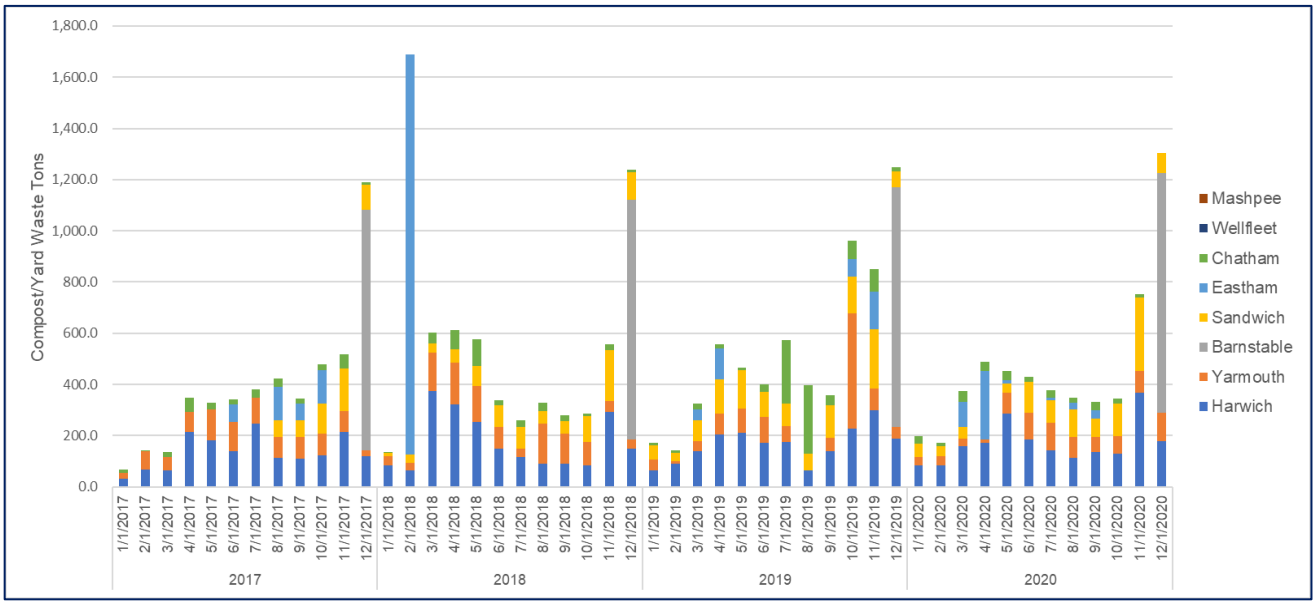


Figure 2-3: Compost/Yard Waste Generation Per Month (in Tons)

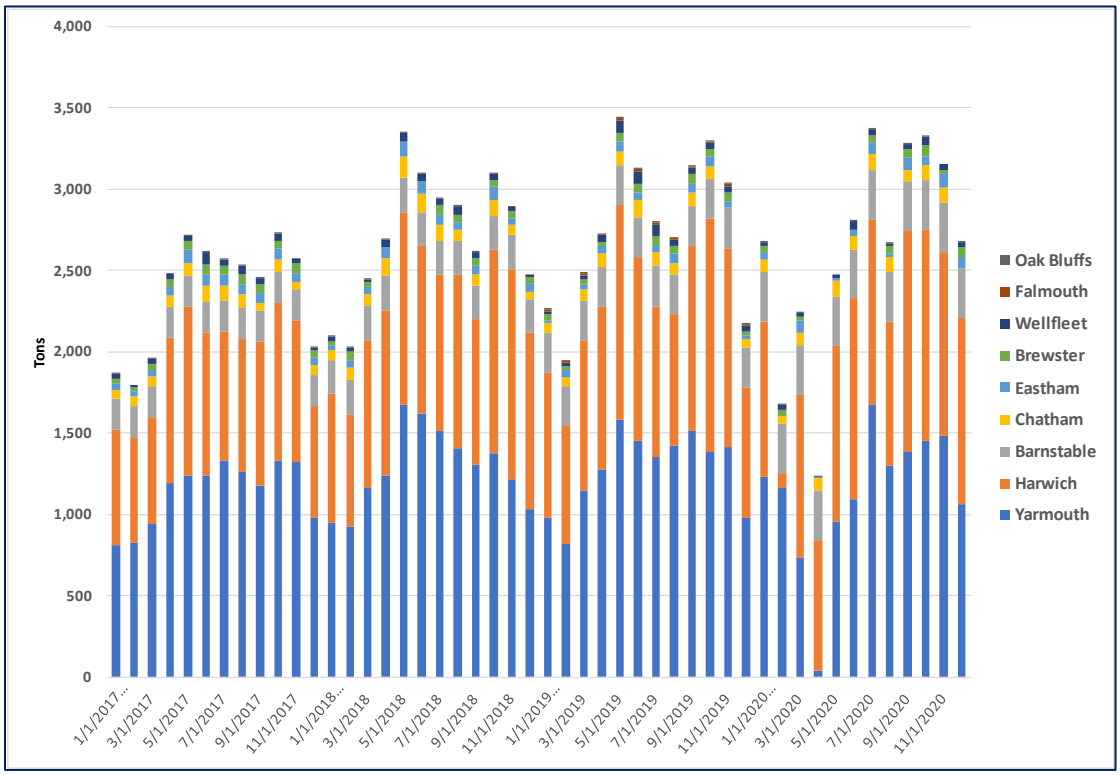


For compost *(yard waste),* it does appear that most of the material is cured and stored near the transfer stations and is assumed to mostly be utilized in the region by residents. Many towns will pay for an annual screening of the yard waste material to create a consistent finished soil amendment product that is more appealing for residents to take and use for at home applications. Screening the composted material removes the large fragments to create a more consistent compost product. As one example, the Town of Barnstable does not accept brush and stumps, only leaves and grass for their static pile composting operation at the transfer station. The compost piles are moved to the back end of the yard waste area and material is left to aerobically breakdown into compost for 5-7 years, after which it is screened to 3/8-inch particle size for consistency and offered free to town sticker holders. Barnstable screens an average of 4,000 cubic yards of compost per year. Due to budget cuts in this current year the town did not screen and is requesting to restore screening funding for fiscal year 2022.

2.4 CONSTRUCTION & DEMOLITION

The final major waste stream is for construction and demolition (C&D) materials. Six of the Barnstable County transfer stations, and the Oak Bluffs transfer station reported monthly tonnage data. However, the tonnages were dominated by two municipalities, Harwich, and Yarmouth. It could be likely these locations accept most of the C&D from the Cape, but this has not been confirmed based on the information available to the Project Team at this time. The Yarmouth Transfer Station also takes commercial C&D material from private haulers for a fee that might account for the higher tonnage at that Transfer Station. The generation was less variable than for MSW over the seasons, with the exception of a drastic drop in April of 2020 which correlates to the onset of restrictions due to the COVID-19 pandemic. Overall, the C&D disposal rate increased during the month of May 2018 and May 2019 and peaked during the months of July and September in 2020 as shown in **Figure 2-4**.

Figure 2-4: C&D Generation Per Month (in Tons)



3.0 ESTIMATING TOTAL MATERIAL GENERATION

This study focused on the MSW and recycling materials coming through the town Transfer Stations whether by drop-off or curbside service by a private hauler. This study does not include residential MSW and recycling picked up by a private hauler subscription service, business disposal or commercial generated tonnage unless those private haulers pay a tip fee at the Transfer Stations. Some Transfer Stations do allow for private haulers to tip for a fee. This analysis is based on the information provided by the Transfer Stations.

All of the Cape and Islands towns have access to municipal trash and recycling programs. With the exception of Bourne, Falmouth and Provincetown, not only are residents able to purchase an annual sticker, but these three towns also offer curbside service in addition to the transfer stations.

As only the yearly data for MSW generation was provided from all of the transfer stations through the MassDEP Re-TRAC reporting system portal, the monthly data from several towns can be utilized to estimate the generation from the other municipalities. This can be accomplished by creating a per-household generation rate for each of the waste materials in question. Then the housing numbers for towns that do not have data can be used to estimate the generation from that location. One assumption is that most waste is taken by the residents to their individual town transfer station, and not to another location.

Since there was overall MSW data known for 2019, this year was selected to calculate the other material generation. The tonnage generation for the following material streams were consolidated from the transfer station information that includes MSW, C&D, Recycling, Compost (Yard Waste), Food Waste, Textiles, Tires, and Batteries. The reported results are shown in **Table 3-1**.

Table 3-1: 2019 Consolidated Tonnages Per Year Reported from Barnstable County Transfer Stations

Municipality	MSW (tons)	C&D (tons)	Recycling (tons)	Compost/Yard Waste (tons)	Food Waste (tons)	Textiles (tons)	Tires (tons)	Batteries (tons)
Barnstable	-	-	3,077	938	6.7	-	13.5	-
Bourne	-	-	-	-	-	-	-	-
Brewster	1,131	516	-	-	-	-	-	-
Chatham	3,091	802	1,280	837	22.1	16.9	4.0	15.6
Dennis	3,769	-	1,308	-	-	-	5.1	-
Eastham	3,513	545	708	-	-	33.1	0.6	-
Falmouth	11,510	148	2,899	-	2.9	-	4.5	-
Harwich	8,184	2,561	1,344	1,974	-	66.8	7.8	-
Mashpee	3,556	-	1,240	-	17.4	19.6	9.2	1.7
Orleans	-	-	-	-	-	-	-	-
Provincetown	0	-	0	-	-	-	-	-
Sandwich	2,783	-	1,988	1,266	-	0.0	3.0	3.6
Truro	1,624	-	418	-	-	-	-	-

Wellfleet	835	515	534	-	8.1	-	5.5	-
Yarmouth	8,308	3,187	1,472	1,062	-	81.4	47.6	5.6

In the results above if no data was given then a hyphen is shown. A zero (0) indicates that some data were given for that material from that particular town transfer station, but no tons were reported for that year. Compost generally indicates yard waste but may have contained food waste when not separately reported. Batteries include automobile batteries as well as other collected batteries such as Ni-Cad and Lithium-Ion rechargeable types. When reported in units, the tonnage was estimated by an average unit weight for the batteries.

As a method to calculate overall County generation with a known data set, the sticker holder household numbers were utilized to estimate the overall generation. Other household numbers can be utilized. (*As an example, for comparisons to other counties, the total number of households estimated from the US Census are utilized for commonality.)* For Barnstable County generation it was deemed to be of interest to look at the total average generation from the sticker holder household numbers. These numbers do not indicate the generation by sticker households alone.

The known quantities from the above in **Table 3-1** were used to calculate the pounds generated per sticker holder household for each of the waste types. These results are shown in **Table 3-2**.

Table 3-2: 2019 Total Waste Generation Pounds Per Year by Sticker Holder Household (HH) Numbers

Municipality	Sticker Holder (HH)	MSW	C&D	Recyclables	Compost
Barnstable	8,600	-	-	716	218
Bourne	8,135	-	-	-	-
Brewster	3,509	644	294	-	-
Chatham	3,160	1,956	508	810	530
Dennis	7,031	1,072	-	372	-
Eastham	3,759	1,869	290	377	-
Falmouth	21,000	1,096	14	276	-
Harwich	5,541	2,954	4,444	485	713
Mashpee	4,464	1,593	-	555	-
Orleans	3,825	-	-	-	-
Provincetown	2,348	0	-	0	-
Sandwich	5,020	1,109	-	792	504
Truro	3,348	970	-	250	-
Wellfleet	3,309	505	311	323	-
Yarmouth	9,434	1,761	3,248	312	225
Average lbs. per Sticker HH		**1,412**	**1,301**	**479**	**438**

Municipality	Sticker Holder (HH)	Food Waste	Textiles	Tires	Batteries
Barnstable	8,600	1.6	-	3.2	-
Bourne	8,135	-	-	-	-
Brewster	3,509	-	-	-	-
Chatham	3,160	14.0	10.7	2.6	9.9
Dennis	7,031	-	-	1.5	-
Eastham	3,759	-	17.6	0.3	-
Falmouth	21,000	0.3	-	0.4	-
Harwich	5,541	-	24.1	2.8	-
Mashpee	4,464	7.8	8.8	4.1	0.8
Orleans	3,825	-	-	-	-
Provincetown	2,348	-	-	-	-
Sandwich	5,020	-	0.0	1.2	1.4
Truro	3,348	-	-	-	-
Wellfleet	3,309	4.9	-	3.3	-
Yarmouth	9,434	-	17.3	10.1	1.2
Average lbs. per Sticker HH		**5.7**	**15.7**	**2.9**	**3.3**

The average generation from all of the reporting transfer stations are used to calculate the average generation, shown in the final row in **Table 3-2** on the previous page.

The results show that 1,412 lbs. of MSW and 479 lbs. of recyclables were generated per sticker holder household numbers in Barnstable County. The result of 3.2 lbs. of tires is remarkable, as most automobile tires weigh about 23 lbs. each, but this can be explained by the fact that most households do not throw away tires every year, so this represents an overall average. Batteries include the combined tonnages of automobile batteries as well as lithium-ion and other collected batteries.

The generation of C&D per sticker household numbers is an estimate of all C&D generation in the County, as commercial C&D is also collected at the Yarmouth and Harwich locations and it is difficult to separate from individual household generation.

To estimate the generation from the non-reporting towns, the County generation total average lbs. per sticker holder households is multiplied by the total number of sticker holder households in that town. The results are shown in **Table 3-3** with the green boxes indicating reported tonnages and the orange boxes indicating estimated (calculated) tonnage generation.

Table 3-3: 2019 Estimated Total Generation Tons Per Year for Multiple Waste Streams

Municipality	Sticker Holders	MSW	C&D[1]	Recycling	Compost	Food Waste	Textiles	Tires	Batteries
Barnstable	8,600	6,071		3,077	938	7	67	14	14
Bourne	8,135	5,743		1,948	1,781	23	64	13	13
Brewster	3,509	1,131	516	840	768	10	28	6	6
Chatham	3,160	3,091	802	1,280	837	22	17	4	16
Dennis	7,031	3,769		1,308	1,540	20	55	5	12
Eastham	3,759	3,513	545	708	823	11	33	1	6
Falmouth	21,000	11,510	148	2,899	4,599	3	165	5	35
Harwich	5,541	8,184	12,311	1,344	1,974	16	67	8	9
Mashpee	4,464	3,556		1,240	978	17	20	9	2
Orleans	3,825	2,700		916	838	11	30	6	6
Provincetown	2,348	1,658		562	514	7	18	4	4
Sandwich	5,020	2,783		1,988	1,266	14	39	3	4
Truro	3,348	1,624		418	733	10	26	5	6
Wellfleet	3,309	835	515	534	725	8	26	6	5
Yarmouth	9,434	8,308	15,321	1,472	1,062	27	81	48	6
Total Estimated Tons		**64,476**	**30,158**	**20,534**	**19,376**	**205**	**736**	**132**	**143**
Total Measured Tons		**66,010**							

Key:

Reported tonnages

Estimated (calculated) generation tonnages

(1) C&D tons assumed to be accounted for in 6 reporting locations. Yarmouth and Harwich likely get most commercial C&D tons. We assumed that most of the Cape's C&D is going to these two larger transfer stations, therefore we don't estimate tonnages for each town.

To check the estimate, the calculated MSW tonnage was compared to the MassDEP Re-TRAC 2019 reported MSW tonnage from the 15 transfer stations. The 2019 reported total tonnage was 66,010 tons while the calculated tonnage was 64,476, which is very close. It is likely closer in actuality as some of the yearly reported tonnages also included bulky materials, while these figures were estimated separately.

In addition to the above generated tonnages, the number of units per household were calculated for hard to dispose of materials including Electronics (TV's, microwaves, computers, and air conditioners), White Goods (appliances), Mattresses and Box Springs, and other Bulky items such as toilets, chairs, and sofas.

Household Hazardous Waste (HHW) liquids such as antifreeze, auto oil and paint were recorded by the gallon and combined for the total of liquids received at the reporting transfer stations. Propane canisters of all sizes were recorded by the number of units and combined in the results below. The same methodology as for the tonnage estimates described above was utilized to estimate the number of units per sticker holder households.

Table 3-4 shows the average number of individual items collected at the transfer stations. **Table 3-5** on the next page shows the number of individual items collected (from all generators) per 20 households of sticker holders. Representing the number of items collected in this way allows for easier reporting of whole number units (i.e., non-fractions of an item). For example, 1,711 electronics items collected in Chatham would be equal to 0.33 items per household, compared to 7 items per 20 sticker holder households [0.33*20=6.66]. The HHW liquids is in gallons per 20 households as sticker holders.

Table 3-4: 2019 Consolidated Units Received from Barnstable County Transfer Stations

Municipality	Sticker Holders	Electronics in units	White Goods in units	Other Bulky in units	Mattresses in units	HHW-Liquids in gallons	Propane Containers in units
Barnstable	8,675	-	1,959	-	3,204	-	470
Bourne	5,675	-	-	-	-	-	-
Brewster	1,131	-	-	-	-	-	-
Chatham	5,140	1,711	1,212	716	899	4,435	1,414
Dennis	3,769	-	-	-	2,101	-	546
Eastham	3,570	450	262	-	244	-	79
Falmouth	11,510	756	231	-	375	4,850	-
Harwich	4,490	-	742	-	2,663	-	-
Mashpee	3,517	842	775	-	1,340	1,754	638
Orleans	2,476	-	-	-	-	-	-
Provincetown	3,025	-	-	-	-	-	-
Sandwich	2,783	4,492	193	-	838	2,850	179
Truro	1,048	-	-	-	-	-	-
Wellfleet	774	600	435	846	562	-	91
Yarmouth	8,428	1,911	-	-	667	-	-
Total in Units		**10,762**	**5,809**	**1,562**	**12,893**	**13,889 (Gal.)**	**3,417**

Table 3-5: 2019 Units per 20 Households as Sticker Holders Per Year

Municipality	Sticker Holders	Electronics in units	White Goods in units	Other Bulky in units	Mattresses in units	HHW-Liquids in gallons	Propane Containers in units
Barnstable	8,675	-	5	-	7	-	1
Bourne	5,675	-	-	-	-	-	-
Brewster	1,131	-	-	-	-	-	-
Chatham	5,140	7	5	3	3	17	6
Dennis	3,769	-	-	-	11	-	3
Eastham	3,570	3	1	-	1	-	0
Falmouth	11,510	1	0	-	1	8	-
Harwich	4,490	-	3	-	12	-	-
Mashpee	3,517	5	4	-	8	10	4
Orleans	2,476	-	-	-	-	-	-
Provincetown	3,025	-	-	-	-	-	-
Sandwich	2,783	32	1	-	6	20	1
Truro	1,048	-	-	-	-	-	-
Wellfleet	774	16	11	22	15	-	2
Yarmouth	8,428	5	-	-	2	-	-
Total Average Units per 20 Households with stickers		**10**	**4**	**12**	**7**	**14**	**2**

The average units per household is utilized to estimate the overall generation of bulky waste from throughout Barnstable County as shown in **Table 3-6**. The green boxes indicate the reported units for 2019 and the orange boxes indicate the estimated units from the average calculated from **Table 3-5** above. Units are frequently a better indication of the amounts of this type of material than tonnages, with the exception of HHW liquids which is in gallons.

Table 3-6: 2019 Estimated* Generation Units for Bulky Materials

Municipality	Sticker Holders	Electronics (units)	White Goods (units)	Other Bulky (units)	Mattresses (units)	HHW-Liquids (gallons)	Propane Containers (units)
Barnstable	8,675	4,189	1,959	5,346	3,204	6,088	470
Bourne	5,675	2,740	1,115	3,497	1,863	3,982	697
Brewster	1,131	546	222	697	371	793	139
Chatham	5,140	1,711	1,212	716	899	4,435	1,414
Dennis	3,769	1,820	741	2,323	2,101	2,645	546
Eastham	3,570	450	262	2,200	244	2,506	79
Falmouth	11,510	756	231	7,093	375	4,850	1,413

Harwich	4,490	2,168	742	2,767	2,663	3,151	551
Mashpee	3,517	842	775	2,167	1,340	1,754	638
Orleans	2,476	1,196	487	1,526	813	1,738	304
Provincetown	3,025	1,461	594	1,864	993	2,123	371
Sandwich	2,783	4,492	193	1,715	838	2,850	179
Truro	1,048	506	206	646	344	735	129
Wellfleet	774	600	435	846	562	543	91
Yarmouth	8,428	1,911	1,656	5,194	667	5,915	1,035
Total Estimated Units	**33,097**	**25,388**	**10,830**	**38,597**	**17,277**	**44,107 (Gal.)**	**8,057**

Key

Reported tonnages

Estimated (calculated) generation tonnages

**The above estimates assume that bulky and HHW items are evenly brought to each transfer station location.*

There was also some limited information reported on Fire Extinguishers, Chlorofluorocarbons (CFCs or aerosols), and Fluorescent tubing recovered at a few transfer stations, but not enough to compare or estimate collections from all the sites. This limited information is included in the Appendix.

4.0 COMPARISONS TO OTHER LOCATIONS

To assess how Barnstable compares to other locations, GBB used data from previous work to compare the household generation of Residential MSW and Recycling.

2.5 4.1 KITSAP COUNTY, WASHINGTON AND SOUTHERN COUNTIES OF MARYLAND

Kitsap County in Washington State is a peninsula in Puget Sound and the Southern Counties of Maryland (Charles, Calvert, and St. Mary's Counties) is a peninsula between the tidal Potomac and Chesapeake Bay. Both are somewhat rural but are near population centers, both have military bases, and both are somewhat limited in transportation options due to their location. Kitsap utilizes waste-by-rail to transport waste while the Southern Counties mostly utilize transfer stations with travel trailers. (Charles has a landfill with decreasing capacity, so they are looking at building a transfer station).

While both locations have some seasonal tourism, neither location has the amount seen by Barnstable County. The Southern Counties have a mix of curbside MSW collection and convenience centers similar to Barnstable County's smaller municipal transfer stations. Kitsap has extensive curbside collections for both MSW and single stream recyclables. To make the comparisons even, the total households per county from the US Census data was utilized. The results for Barnstable County are shown in **Table 4-1**.

Most of the tonnage data is from the monthly reports, but when not given the data from the yearly total report is substituted. The non-bulky estimated residential MSW tonnage for Barnstable County is calculated at 64,461 tons from a total of 163,557 US Census households, which is 788 lbs. of MSW generated per household per year. The average recycling generated per household is 253 lbs. per year

Table 4-1: Barnstable County Per Household MSW and Recycling Generation Per Year

2019 Monthly Data		From 2019 Yearly Data			
Municipality	HH Total (Census 2019 est.)	MSW Total 2019 (Tons)	MSW lbs. per HH	Recycling Total 2019 (Tons)	Recycling lbs. per HH
Barnstable	26,395	8,675	657	3,077	233
Bourne	11,605	5,675	978	-	-
Brewster	7,961	1,131	284	-	-
Chatham	7,468	3,091	828	1,280	343
Dennis	16,001	3,769	471	1,308	164
Eastham	6,289	3,513	1,117	708	225
Falmouth	21,713	11,510	1,060	2,899	267
Harwich	10,585	4,490	848	1,344	254
Mashpee	10,273	3,556	692	1,240	241
Orleans	5,714	2,476	867	-	-
Provincetown	4,680	3,025	1,293	0	0
Sandwich	9,962	2,783	559	1,988	399
Truro	3,255	1,624	998	418	257
Wellfleet	4,701	835	355	534	227
Yarmouth	16,955	8,308	980	1,472	174
Total	**163,557**	**64,461**	**788**	**16,268**	**199**
	Average Lbs. per Total HH		**799**		**253**

The average for the MSW is slightly different than the calculated result from the total as there is no weighting of tonnages to the average calculation. The average for the recycling is more accurate as it does not include the null results where there was no reporting, while the total just looks at the total tons reported and the total households.

How does Barnstable County Massachusetts compare to Kitsap County, Washington, and the Southern Counties of Maryland? The data for both Kitsap and Southern Counties are older (2014) so there may be some changes in the waste streams since that time, however the comparisons are still helpful to make.

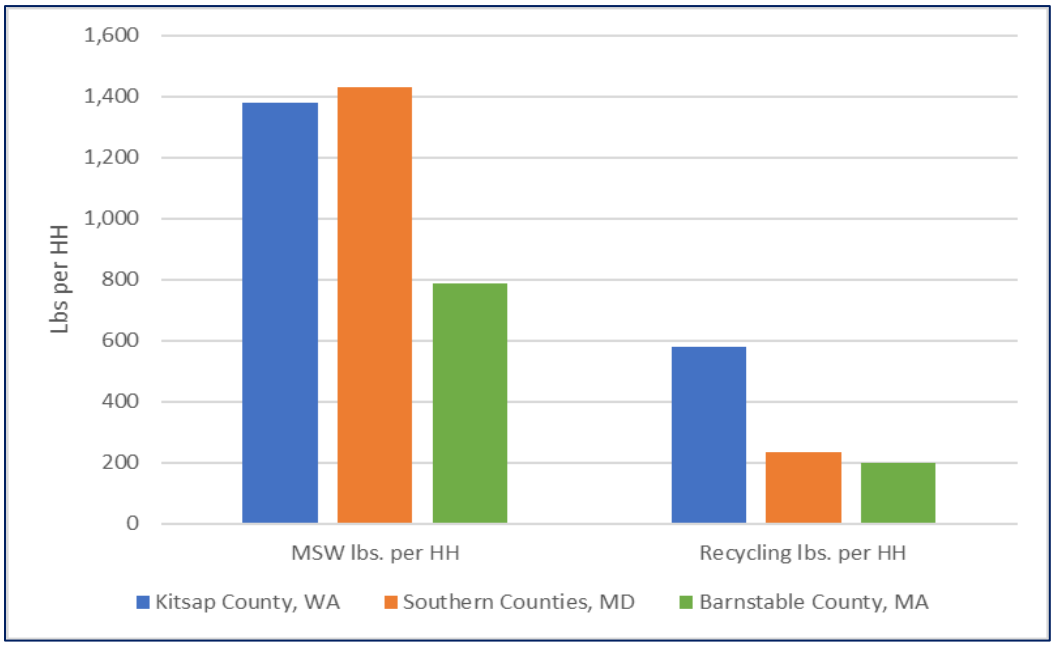
As with Barnstable County, the total US Census (2020) households were used to estimate the per household generation. The results are shown in **Table 4-2** and in **Figure 4-1** on the next page.

Table 4-2: Comparison of Waste and Recycling Generation from Counties in Washington and Maryland

Location	Total Households	Residential MSW Total (Tons)	MSW lbs. per HH	Recycling Total (Tons)	Recycling lbs. per HH[2]
Kitsap County, WA	97,622	67,295	1,379	28,208	578
Southern Counties, MD[1]	119,759	85,736	1,432	13,898	232
Barnstable County, MA	163,557	64,461	788	16,268	199

1) *Includes the Maryland counties of Charles, Calvert, and St. Mary's.*
2) *Not all of Barnstable County's towns reported recycling. The average per HH recycling is 253 lbs. when not including the missing data in the average.*

Figure 4-1: County Comparisons for Residential Recycling Generation per Household



The Barnstable County recycling generation per household is very close to the Southern Counties Maryland but is considerably less than for Kitsap. This seems reasonable as the Maryland counties mostly have citizen drop-off locations for the recycling similar to most of Barnstable County, while Kitsap has extensive curbside cart collections for single stream recyclables. The generation of MSW in Barnstable County is lower than the other two locations, which may indicate the larger seasonality of Barnstable County to Kitsap County and the Southern counties in Maryland. It is helpful to see that there are no glaring anomalies in this data for Barnstable County and the results seem to make sense.

5.0 ASSUMPTIONS

- Monthly data was received from the Towns that responded to the Request for Information (RFI). The Town of Orleans transfer station did not respond to the Request for Information (RFI). The Town of Bourne was not included in the RFI request for monthly data, however the annual data in Re-TRAC submitted by the Town of Bourne is included in this analysis.

  The Town of Bourne did respond to an email request for monthly data, and some of the Bourne Transfer Station MSW and recycling data appears in **Table 8** in the Appendix. Nantucket also responded to an email request for outbound MSW, and annual data from the Island appears in Table 14 in the Appendix.
- Most waste is taken by residents to their town transfer stations, and not to another location. Towns do not allow non-residents to use their transfer stations. The towns do have systems in place for seasonal and second-home populations, in which case there is pay-per-visit or pay-per-bag program is used. In some cases, the transfer station gatehouse attendant will ask for proof that second home or rental unit is in that town. This also exclude households that subscribe to a commercial waste service.
- The number of residents (households) who participated in the food waste recycling drop-off programs at the town transfer stations is unknown.
- There was less information available on the organics data from both food waste and yard waste collection at the transfer stations. There were also some differences in how the transfer stations recorded this data in units so there were some assumptions made in consolidating the reported tonnages for yard waste, compost, and brush. Additional towns did respond to a second request for monthly data on food waste and compost/yard waste tonnages. These data sets were included in **Figure 2.2 and Figure 2.3.**
- There was also some limited information reported on Fire Extinguishers, Chlorofluorocarbons (CFCs or aerosols), and Fluorescent tubing recovered at a few transfer stations, but not enough to compare or estimate collections from all of the sites. These components were not included in the report but are included in the Appendix. See **Tables 5, 6 and 7.**
- Nantucket also responded to an email request for outbound MSW, and annual data from the Island appears in **Table 9** in the Appendix.
- There are several Cape Cod municipalities that are designated to be communities with Environmental Justice (EJ) populations *(Source: Massdep.gov environmental justice population US Census 2010*). https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts#interactive-map.

Assumptions for Report Conversions

- MSW Lbs. per Cubic Yard (Yd^3) - 225 lbs./yd^3 *(Source: USEPA)*
- C&D - 416 lbs./Yd^3 *(Source: Cascadia Consulting)*
- Recyclables - 260 lbs./Yd^3 *(Source: USEPA)*

Compost/Organics

- Yard Waste – 250 lbs./Yd^3 *(USEPA)*
- Food Waste – 396 lbs./Yd^3 *(USEPA)*

- Food Waste – 125 lbs./Bin *(GBB estimate)*

Other Materials

- Cathode Ray Tubes (CRT) – 80 lbs./Unit *(Calculation from reported information)*
- CRT (small) – 41 lbs./Unit *(USEPA)*
- Electronics (general large, which refers to microwaves or larger electronics) – 125 Units per Ton
- Tires (general) – 30 lbs./Unit *(GBB estimate)*
- Tires (Truck) – 120 lbs./Unit *(USEPA)*
- Tires (Auto) – 23 lbs./Unit
- Mattress (General) – 100 lbs./Unit *(GBB estimate from internet reports; assumes dry mattress)*
- Box Spring (General) – 22 lbs./Unit *(GBB estimate)*
- Batteries (box) – 60 lbs./Box *(GBB estimate*)
- Batteries (mixed) – 250 Units/Ton *(GBB estimate; assumes average weight of 8 lbs. per unit from a combo if Ni-Cad, Li-Ion and Auto batteries)*
- Batteries (Auto) – 41 lbs./Unit *(powerstream.com)*

REFERENCES

- Massachusetts Draft Solid Waste Master Plan 2030
- Massachusetts Materials Management Capacity Study Final Report February 11, 2019
- MassDEP Re-TRAC Portal Data: Cape and Islands MSW Tonnage Report 2011-2020, and Cape and Islands Recycling Dividends Plan Spending Report 2017-2020
- Massachusetts Municipal Residential Recycling Rates Fiscal Years 1997-2021, and Calendar Years 2002-2008
- 2010 CDM Evaluation of Future Disposal Alternatives for Municipal Solid Waste
- Joint Base Cape Cod 2013 Joint Land Use Study Update and Community – Military Partnerships Final Report, October 30, 2013
- 2018 Cape Cod Regional Policy Plan (RPP)
- Cape Cod Commission Final Revised Municipal Draft Population Forecast April 24, 2017
- Town of Dartmouth Massachusetts Waste Analysis Fiscal Year 2011

APPENDIX

A few fire extinguishers, and fluorescent lights, and chlorofluorocarbons (CFCs or aerosols) were recovered at Mashpee, Wellfleet, and Yarmouth transfer stations. These items are listed in **Tables 5, 6** and **7** below.

Table 5: Mashpee and Wellfleet - Fire Extinguishers Collected in Units

	Mashpee	Wellfleet
January 2017		4
January 2018		11
January 2019		11
January 2020		28
October 2020	18	

Table 6: Mashpee - Fluorescent Light Bulbs in Feet and Units per Year

Mashpee	Fluorescent Light Bulbs (ft.)	Fluorescent Light Bulbs (Other)
January 2017	4,736 ft.	330
January 2018	12,054 ft.	1,933
January 2019	3,376 ft.	1,126
January 2020	6,010 ft.	906

Table 7: Town of Yarmouth - Chlorofluorocarbons (CFCs or Aerosols) in Tons per Year

Yarmouth	CFCs (Tons)
2017	55
2018	85
2019	95

The Town of Bourne did respond to an email request for monthly data, and some of the Bourne Transfer Station MSW and recycling data appears in **Table 8** below and on the next page.

Table 8: Town of Bourne - MSW Materials in Tons

	MSW (Tons)	C&D (Tons)	Recyclables (Tons)	Compostables/ Organics (Tons)	Tires (Tons)	Metals (Tons)	Textiles/ Clothing (Tons)
2017	1,121.00	20,829.00	6,299.00	3,587.00	14.00	1,164.00	25.00
2018	942.00	12,572.00	6,463.00	5,311.00	20.00	938.00	25.00
2019	974.00	14,060.00	6,359.00	3,668.00	18.00	1,031.00	28.00
2020	925.00	15,908.00	12,052.00	3,667.00	15.00	1,009.00	18.00

	Electronics/ Computers (Tons)	Shrink-wrap (Tons)	ABC (Tons)	Batteries (Tons)	Mattresses (Tons)
2017	83.00	20.00	500.00	7.00	120.00
2018	83.00	55.00	747.00	5.00	127.00
2019	81.00	1.00	478.00	6.00	137.00
2020	70.00	6.00	576.00	6.00	81.00

Nantucket also responded to an email request for outbound MSW, and annual data from the Island appears in **Table 9** below.

Table 9: Nantucket – Outbound Materials in Tons

	Tires	Mattresses	Electronics
2016	41.63	98.34	59.54
2017	43.41	66.74	44.08
2018	14.74	71.80	42.31
2019	93.95	63.15	36.07
2020	42.37	100.19	23.48