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MEMORANDUM

To: Mr. Paul Vlasich and Ms. Jennifer Perry, Town of Exeter

From: Renee L. Bourdeau, Project Manager, Horsley Witten Group

Date: November 27, 2017, Revised July 17, 2018

Re: Nitrogen Control Plan – Preliminary Nitrogen Reduction Alternatives

cc: Ed Leonard, Wright-Pierce

1.0 Purpose

The purpose of this memorandum is to summarize the methodology and results for developing planning-level cost estimates and rate of implementation for three nitrogen reduction alternatives. These alternatives include:

1) to meet minimum MS4 requirements;
2) meet minimum MS4 requirements with an additional annual investment of $100,000;
3) implement controls to the maximum on Town property; and
4) reduce nitrogen non-point sources to a level equivalent to the removal if the wastewater treatment facility (WWTF) were upgraded to achieve a 3-mg/L effluent concentration at current flows (10,400 pounds of nitrogen).

This memorandum builds on a previous Baseline Nitrogen Modeling Methodology and Results memorandum prepared by the Horsley Witten Group (HW), dated June 15, 2017, revised July 18, 2017 (HW, 2017[1]), which describes the baseline nitrogen loads from the Town.

2.0 Non-Point Source Load Reduction Strategies

There are a variety of feasible non-point source load reduction strategies that Exeter can consider to reduce the Town's baseline nitrogen load to receiving waters. These strategies are described below, including the level of nitrogen load reduction expected from implementation of each strategy and the 20-year life-cycle cost to implement each strategy. The level of implementation for each of the strategies and the total cost to the Town for each of the alternatives is described in Section 3 of this memorandum. Baseline nitrogen loading from the Town and definitions can be found in the prior HW memorandum (HW, 2017).

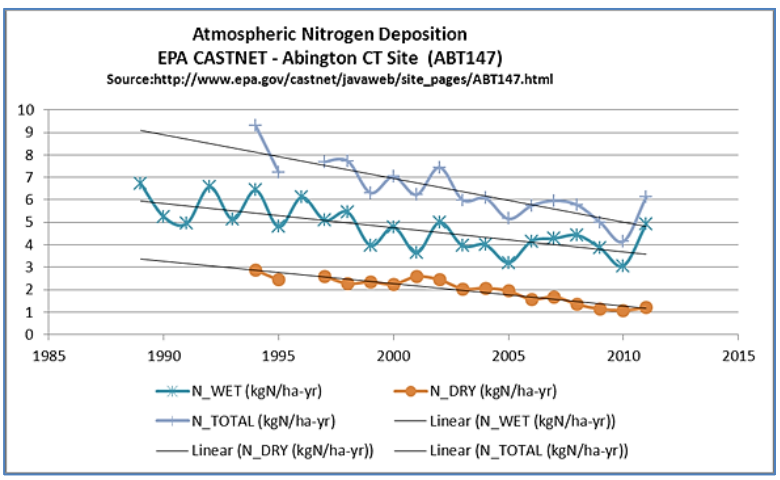
1 https://www.exeternh.gov/sites/default/files/fileattachments/public_works/page/38361/nitrogen_control_plan_memo_ph_1_task_1_7.18.17.pdf

2.1 Non-Structural Load Reduction Strategies

2.1.1 Atmospheric Deposition

Atmospheric sources of nitrogen are a non-negligible portion of the total nitrogen load and has historically been treated as a static value based on published values representative of the late 1990s; however, there is a growing body of data which indicates that atmospheric nitrogen deposition is decreasing, especially since the late 1990s when the Clean Air Act and Clean Air Act Amendments were promulgated (Wright-Pierce, 2017). In particular:

- The Long Island Sound TMDL Report (CTDEP, 2000) included an 18% reduction in atmospheric nitrogen deposition as a part of the required reductions. The CTDEP Long Island Sound Study Work Group is currently re-evaluating the TMDL and expects that atmospheric nitrogen deposition has been reduced more than the 18% value.
- A paper entitled "Historical Changes in Atmospheric Deposition to Cape Cod", (Bowen, Valiela, 2001) analyzed atmospheric nitrogen deposition trends for the 20th century. The conclusions presented in the paper indicate that there was an upward trend through the 20th century; that the data was very variable; and that the upward trend through the 20th century seems to slow down or even reverse in the last decade.
- The NHDES "Great Bay Non-Point Source Study" (Trowbridge, et.al., 2014) summarizes the basis for the NHDES nitrogen loading model for the Great Bay Estuary. Appendix A of the report summarizes data regarding wet deposition rates, dry deposition rates, NOx emissions estimates and NOx emissions projections through 2020. Referencing EPA estimates, NHDES cites that NOx emissions are expected to decrease by 65% from 2001 to 2020.
- The EPA CASTNET (Clean Air Status and Trends Network) program is a long-term environmental monitoring program. Data collected from selected sites around the country are posted on their website (www.epa.gov/castnet). Data for wet deposition, dry deposition and total deposition for their site in Abington, CT (which is the closest site) indicate clear trends towards reduced atmospheric nitrogen deposition (see inset figure). Reductions in total deposition from the late 1990s to 2012 at this site are approximately 20%.



By documenting the reductions in atmospheric sources of nitrogen over the planning period, the scope and cost of implementing non-point source controls will be reduced. For planning purposes, we have assumed an expected 18% reduction in the nitrogen load from atmospheric deposition, which is applied to all land uses in the Town. To verify these observations, the Town could request that the a local agency (i.e., UNH, PREP) establish a local atmospheric deposition monitoring station for the benefit of all Great Bay communities. Estimated total nitrogen reductions in atmospheric deposition come at no cost to the Town.

2.1.2 Agriculture Nutrient Management Program

Nitrogen is one of the most important crop inputs; yet, it is also one of the most complex. It is susceptible to environmental losses, and its effectiveness is impacted by soil types and weather. Feasible and widely used agricultural best management practices (BMPs) include the use of slow release fertilizer and the use of cover crops.
UNH Cooperative Extension recommends that at least 15% of the fertilizer be of a reduced water solubility to be considered a slow release fertilizer. This reduced water solubility allows for the gradual release and uptake of nitrogen and phosphorous which in turn reduces excess nutrient wash off.

Cover crops are another valuable management practice available for protecting water quality, especially groundwater quality. Cover crops reduce soil erosion by protecting the soil surface from raindrop impact, increasing water infiltration, trapping and securing crop residues, improving soil aggregate stability and providing a network of roots which protect soil from flowing water (USDA, 2013).

The Chesapeake Bay Program (CBP) established nitrogen removal efficiency credits of up to 40% for farmers that adopt agricultural fertilizer best management practices primarily through enhanced and comprehensive nutrient management plans. The enhanced nutrient management plans involve a number of agronomic practices and land/crop treatment measures. Further, the 2010 Maryland TMDL Plan listed specific nitrogen removal credits for the following agriculture best practices:

- Nutrient Management Plan Compliance: 3 pounds per acre reduction
- Precision Agriculture: 2 pounds per acre reduction
- Cover Crops: 5.8 pounds per acre reduction
- Conservation Tillage: 4.6 pounds per acre reduction
- Streamside Buffer: 17.1 pounds per acre reduction

The proposed measures outlined in the CBP to reduce nitrogen loads in existing agricultural operations consist of:

- Enhancing Nutrient Management Plans (application timing, rate and agronomic utilization)
- Increased Use of Land Treatment Measures (cover crops, conservation tillage, vegetated stream buffers)
- Possible Use of Structural Nutrient Management (structural BMPs for treatment removal, additional storage, anaerobic digesters and/or offsite transport systems)

A potential program for Exeter could focus on the development and implementation of enhanced nutrient management plans including increased use of land treatment measures and possible structural nutrient management measures for agricultural activities in collaboration with United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) and UNH Cooperative Extension. We can assume that implementation of a program such as this could achieve, at a minimum, a potential reduction of 15% from the agricultural load. This is consistent with assumptions made in the Oyster River Watershed Integrated Plan (VHB, 2014), developed for Durham, NH.

According to the Town only one (1) farm is regulated under NRCS within the Town boundaries and therefore a program like this may not be worth the staff and financial investment. If the Town decided in the future to implement such a program, it would require an estimated additional 0.1 full time staff (FTE) to assist in the program management and administration, oversight of any regulation changes, and consultation with farmers and NRCS staff (Table 1). The cost per farm to develop a management plan is estimated to be approximately $5,000. The total cost for implementation of a nutrient reduction management plan for an average farm in the Northeast was estimated at $9,307 per year, based on data provided in NRCS, 2003. This is equivalent to $12,100 per year per farm in 2017 dollars (an assumed additional 30% was added to account for inflation to 2017 dollars).

Table 1. Agriculture Nutrient Management Program Estimated Costs[1]

Program Measure	Estimated Annual Cost	Estimated One Time Capital Cost
Development of Comprehensive Plans		$5,000
Farm Program Implementation	$12,000	
Annual Administration of Program (0.1 FTE)	$9,000	
Total	**$21,000**	**$5,000**
20-Year Life-cycle Cost[2]		**$469,000**

1. Estimated cost are rounded to the nearest $1,000
2. Life-cycle Cost calculated assuming 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation

2.1.3 Residential Fertilizer Program

The Town of Exeter under their Zoning Ordinances (2016) with the oversight of the Healthy Lawns Clean Water committee prohibits the use of fertilizer within wetland buffers, shoreland protection and aquifer protection districts on any land use. The Ordinance prohibits the use of fertilizer, except lime or wood ash, based on the following criteria:

- Within the following wetland buffers:
    - 40’ for very poorly drained soils (hydric A) soils;
    - 50’ poorly drained soils (PD)
    - 100’ Prime Wetlands; and

- 75' Vernal Pools.

- Within the shoreland buffers as described in Table 2.
- Aquifer Protection District in its entirety.

Table 2. Shoreland Buffer Distances

Watershed	River Segment Type	Buffer Distance
Exeter River	Major tributary	300 feet
	Perennial brooks and streams	150 feet
Fresh River	Major tributary	300 feet
	Perennial brooks and streams	150 feet
Squamscott River	Major tributary	300 feet
	Perennial brooks and streams	150 feet
	Upland extent of any tidal marsh	150 feet

The Town and the Healthy Lawns Clean Water committee are working to develop a proposed amendment that may allow for the use of organic products in the shoreland and aquifer protection districts with an annual maximum of 1-2 lbs of Nitrogen per 1,000 square feet of lawn. Since the current ordinance does not capture all residential lawns within the Town, we explored the potential additional pollutant load that could be removed if a Town wide residential lawn fertilizer program were implemented.

The Chesapeake Bay Program developed an Urban Nutrient Management Program targeted at reducing pollutant loads from residential lawns (Schueler and Lane, 2014). The program estimates that it could achieve a nitrogen removal efficiency ranging from 6% for low risk lawns to 20% for high risk lawns and a blended efficiency of 9%. High risk lawns have one or more of the following characteristics:

- Owners are currently over-fertilizing beyond state or Cooperative Extension recommendations
- Soils are phosphorus-saturated soils as determined by soil analysis
- Newly established turf
- Steep slopes (greater than 15%)
- 5% or more of the soil is exposed soil for managed turf, or more than 15% of the soil is exposed for unmanaged turf
- Water table within 3 feet of soil surface
- Over-irrigated lawns
- Soils are shallow, compacted or have low water holding capacity
- High use areas
- Sandy soils, or soils with infiltration rates greater than 2 inches per hour
- Within 300 feet of a stream, river, or Bay
- Located on karst terrain

- Active construction sites

The overall effectiveness of the program is dependent on the number and extent of core elements promoted and adopted by homeowners and lawn care professionals as a result of a comprehensive and multi-faceted Public Education and Outreach Program. The core elements of CBP's Urban Nutrient Management Program include the following:

- Maintain dense vegetative cover to reduce runoff, prevent erosion, and retain nutrients.
- Choose not to fertilize, or adopt a reduce rate/monitor approach or a small fertilizer dose approach.
- Retain clippings and mulched leaves on yard and keep them out of streets & storm drains.
- Do not apply fertilizers before spring green up or after grass becomes dormant.
- Maximize use of slow-release N fertilizer during the active growing season.
- Set mower height at 3 inches or taller.
- Immediately sweep off any fertilizer that falls on a paved surface.
- Restrict fertilizer usage within 25 feet of a water feature and require this zone as meadow, grass buffer, or a forested buffer.
- Employ lawn practices to increase soil porosity and infiltration capability, especially along portions of the lawn that convey or treat stormwater runoff.

For the Town, an assumed load reduction of 9% is being applied, which represents a blend of low and high risk lawns. Since a lawn fertilizer program is already underway in Exeter for wetland buffers and shoreland and aquifer protection districts, it is anticipated that participation would be high as the residents are generally well-engaged and aware of the environmental issues.

Implementation of a successful program would require additional staff time of approximately 0.5 FTE to assist in the program management and administration, oversight of any regulation changes, consultation with residents and landscapers, and assistance with the promotion and tracking of certification trainings, outreach and participation levels. Coordination with homeowner associations in key neighborhoods will also be important. Staffing needs for this program could potentially be met through a new staff position that could also provide 0.5 FTE for administering and managing other components of a Non-Point Source Program.

Full implementation of this program is anticipated to take several years and perhaps as much as five years to fully implement. Depending on the results after the fifth year, additional measures may need to be considered. The level of effort required to sustain the program beyond the five years will depend on the initial resident response and the level of involvement / interaction with other program partners.

The estimated program costs, including one-time capital costs, staff time and other annual costs, are outlined in Table 3.

Table 3. Residential Fertilizer Program Estimated Costs[1]

Program Measure	Estimated Annual Cost	Estimated One Time Capital Cost
Develop Outreach Plan and Materials		$25,000
Staff (0.5 FTE)	$45,000	
Personnel Training/Certification	$5,000	
Assessment Survey		$25,000
Total	**$50,000**	**$50,000**
20-Year Life-cycle Cost[2]		**$1,165,000**

1. Estimated cost are rounded to the nearest $1,000
2. Life-cycle Cost calculated assuming 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation

2.1.4 Enhanced Street/ Pavement Cleaning Program

In accordance with the final 2017 NH Municipal Separate Storm Sewer System (MS4) permit, the Town is required to develop and implement an Enhanced Street/Pavement Cleaning Program. As part of this program, the Town is required to clean all curbed impervious cover (i.e., directly connected impervious cover) two times per year (spring and fall). The final permit provides expected nitrogen load reduction factors based on the type of sweeper technology. We assume that a high-efficiency regenerative air-vacuum sweeper will be used by the Town to complete sweeping twice per year, which would result in a 2% reduction in initial load from directly connected impervious surfaces.

The Town currently conducts street sweeping and pavement cleaning more than twice per year, therefore meeting the minimum requirements under the MS4 permit. The estimated program costs are outlined in Table 4. These costs include a one-time investment to develop the program, an estimated cost to replace an existing high-efficiency regenerative air-vacuum sweeper every five-years, and the annual cost to maintain the program. Maintenance of the program includes staff time to operate the sweeper and equipment operation and maintenance including fuel and sweeper brushes. The costs also include a subcontractor to implement weekly sweeping from September 1 through December 1 to meet the requirements under Section 2.1.6. These costs are based on local data provided by the Town.

Table 4. Enhanced Street/ Pavement Cleaning Program Estimated Cost[1]

Program Measure	Estimated Annual Cost	Estimated One-Time Capital Cost
Develop Program		$5,000
Regenerative Sweeper (replaced every 5 years)		$880,000[3]
Sweeper Maintenance	$13,000	
Sweeper Operation (1 FTE)	$95,000	
Subcontractor	$78,000	
Total	**$186,000**	**$885,000**
20-Year Life-cycle Cost[2]		**$3,330,000**

1. Estimated cost are rounded to the nearest $1,000
2. Life-cycle Cost calculated assuming 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation
3. Represents the cost to purchase four (4) regenerative sweeper

2.1.5 Infrastructure Operations and Maintenance Program

In accordance with the final 2017 NH MS4 permit, the Town is required to develop and implement an Infrastructure Operations and Maintenance Program detailing the activities and procedures the Town will implement to maintain the MS4 infrastructure in a timely manner. The program shall include routine inspections, cleaning and maintenance of catch basins to maintain 50% free-storage capacity in the catch basin sump. Through implementation of this program, the Town would achieve a 6% (NH MS4 Permit, 2017) reduction in the initial nitrogen load from all directly connected impervious cover.

Currently the Town subcontracts catch basin cleaning services and cleans about 50 percent per year. The estimated program costs are outlined in Table 5. These costs include a one-time investment to develop the program and the annual cost to implement the program. These costs are based on data from the Town.

Table 5. Infrastructure Operation and Maintenance Program Estimated Cost[1]

Program Measure	Estimated Annual Cost	Estimated One Time Capital Cost
Develop Program		$5,000
Implementation of the Program (Subcontractor)	$25,000	
Total	**$25,000**	**$5,000**
20-Year Life-cycle Cost[2]		**$557,000**

1. Estimated cost are rounded to the nearest $1,000
2. Life-cycle Cost calculated assuming 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation

2.1.6 Enhanced Organic Waste and Leaf Litter Collection Program

In accordance with the final 2017 NH MS4 permit, the Town can receive nitrogen reduction credits by performing regular gathering, removal and proper disposal of landscaping wastes, organic debris, and leaf litter from impervious surfaces. In order to receive this credit, the Town must gather and remove all landscaping wastes, organic debris, and leaf litter from impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year. The gathering and removal shall occur immediately following any landscaping activities and at additional times when necessary to achieve a weekly cleaning frequency. The Town must also ensure that the disposal of these materials will not contribute pollutants to any surface water discharges. The Town may use an enhanced sweeping program at a weekly frequency provided that the sweeping is effective at removing leaf litter and organic materials (such as a regenerative sweeper). Through implementation of this program, the Town would receive a 5% reduction in the initial nitrogen load from all directly connected impervious cover. The cost to implement this program would be covered under the Town's current efforts for enhanced street sweeping, as described in Section 2.1.4 and Table 4.

2.2 Structural Load Reduction Strategies

2.2.1 Advanced Onsite Septic Systems

Traditional septic systems do not remove nitrogen from wastewater. Advanced systems are similar to traditional septic systems, but have an added component that reduces nitrogen concentrations from the effluent before it is discharged to the ground. They are installed at an individual home or cluster of homes, and usually cost more to operate and maintain than a traditional septic system. The increased O&M costs are due to power needs for the system (e.g., pumps, aerators), required water quality sampling, and other elements that are not needed for a traditional onsite system.

An advanced treatment system refers to a system that includes a septic tank, an aeration system, and a recirculation system in the septic tank. Some systems may also have an additional component for advanced denitrification. Alternative treatment components can be added to a conventional system, often between the septic tank and the drainfield, to provide advanced treatment of nitrogen (Figure 1).

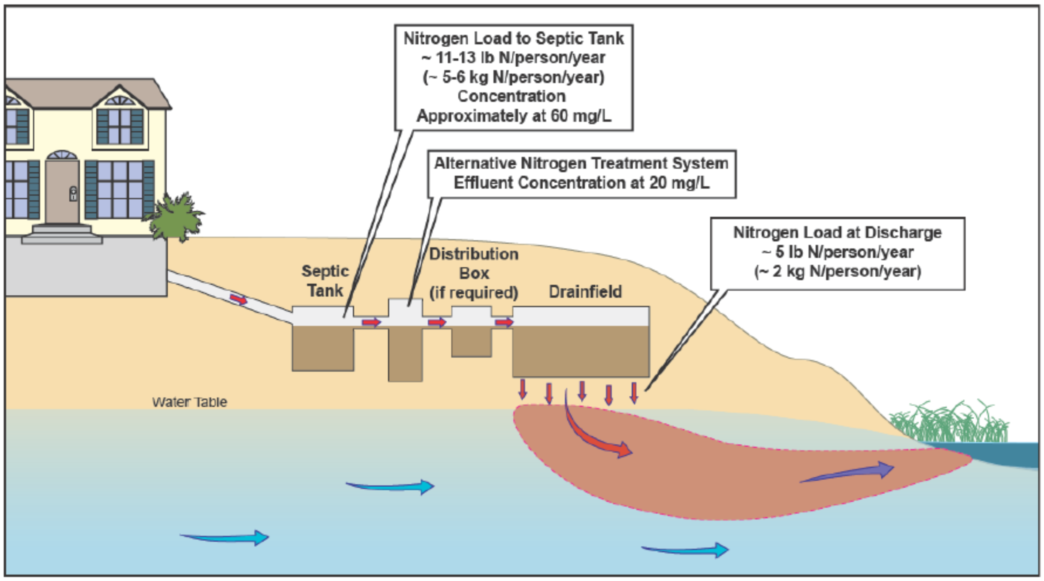


Figure 1. Advanced Onsite System with Nitrogen Treatment (Source: EPA, 2013)

A typical human contributes approximately 10.6 pounds of nitrogen in wastewater to the drain field each year (Trowbridge, et. al., 2014). According to the 2010 US Census, an average household in New Hampshire is made up of approximately 2.4 persons, which would result in approximately 25.4 pounds of nitrogen per year entering an average septic system drain field. The nitrogen load delivered to a receiving waterbody from a septic system drain field (the 'delivered load') depends on the distance of the system to that receiving waterbody. According to Trowbridge, et. al. (2014), a septic system drain field within 200 meters of a receiving waterbody would deliver approximately 60% of the initial load, whereas a septic system drain field outside 200 meters would deliver approximately 26% of the initial load.

Implementation of an advanced onsite system removes approximately 7 pounds of nitrogen per person per year to the drain field (66% reduction in initial load) (EPA, 2013). Therefore, approximately 8.6 pounds of nitrogen per year would enter an advanced onsite treatment drain field. Table 6 presents the estimated initial and delivered load for both traditional and advanced onsite treatment systems in Exeter.

Table 6. Initial and Delivered Load by Onsite System Type

System Distance from Waterbody	No. of Systems	Traditional System		Advanced System	
		Initial Load (lbs N/yr)	Delivered Load (lbs N/yr)	Initial Load (lbs N/yr)	Delivered Load (lbs N/yr)
Within 200 meters	19	25.4	15.2	8.6	5.2
Greater than 200 meters	1,318	25.4	6.5	8.6	2.2

The average capital cost per household to install a traditional septic system is estimated to be between $5,000 and $6,000 (EPA, 2013); to be conservative, we have used a value of $10,000 in this analysis. The average advanced onsite treatment system, which includes a septic tank, an aeration system, and an anoxic environment separate from the septic tank, is approximately $10,000 to $15,000. In our analysis, we used the difference between a traditional system and an advanced system, or an estimate of $15,000 per system for installation, with an annual operation and maintenance cost of $1,000 per system. These costs assume a new system is being installed and represents an average system with ideal subsurface conditions to treat onsite wastewater. The 20-year life-cycle cost for an advanced septic system is approximately $41,000.

2.2.2 Sewer Extensions

The Exeter Wastewater Facilities Plan (Wright-Pierce, 2015) explored locations in Town that are currently serviced by septic systems that could be served by the wastewater treatment plant through sewer extensions. Sewer extensions would result in the wastewater load being diverted from a non-point source (groundwater) to a point source (wastewater treatment plant) discharge. The conversion of an on-site septic system to a sewer connection for an average residence in Exeter would result in an estimated average 34% reduction in delivered load to the receiving water (6.7 lbs N/yr delivered from a traditional septic system compared to 4.25 lbs N/yr delivered from the wastewater treatment facility). The cost to connect a single home to sewer was assumed to be $40,000 per household (Wright-Pierce, 2015). The annual operation and maintenance is assumed to be equivalent to an estimated annual sewer bill which is estimated to be 90 units per household (or 67,230 gallons) at a rate of $7.39 per 1,000 gallons plus a quarterly fee of $40. This results in an average annual sewer bill of approximately $660. The 20-year life-cycle cost per household for a sewer extension is approximately $65,000.

2.2.3 Stormwater Best Management Practices

In accordance with the final 2017 NH MS4 permit, the Town must implement and enforce regulations which require the use of structural stormwater BMPs optimized for the reduction of nitrogen in both new development and redevelopment. To reduce the baseline nitrogen load from stormwater runoff, the Town will need to make efforts to retrofit existing impervious areas (including both publicly and privately owned) with structural stormwater BMPs. The final 2017 NH MS4 permit lists a range of structural stormwater BMPs that provide varying degrees of nitrogen load reduction based on the practice type, the underlying soil type (i.e., rate of soil infiltration) and the capture depth of the BMP (i.e., the size of the practice compared to the drainage capture area). These practices and the range of cumulative nitrogen load reduction are presented in Table 7 below. Infiltration practices (i.e., trenches, basins, rain gardens and bioretention) are suitable for soils capable of infiltrating a minimum of 0.17 inches per hour which is characteristic of soils with a hydrologic soil group (HSG) of A or B. Therefore, in areas of Town with underlying soils in HSG A and B, infiltration BMPs will be most suitable when optimizing for nitrogen. For areas of Town with underlying soils in HSG C and D, gravel wetlands or enhanced biofiltration systems with internal storage reservoirs will be most suitable when optimizing for nitrogen removal.

Table 7. Range of Cumulative Nitrogen Load Reduction for Structural Stormwater BMPs (Source: 2017 NH MS4 Permit)

Stormwater Structural BMP Practice	Range of Cumulative Nitrogen Load Reduction*
Infiltration Trench	56% - 100%
Surface Infiltration Practices (i.e., basins, rain gardens and bioretention)	52% - 100%
Bio-filtration Practice	9% - 40%
Gravel Wetland System	22% - 79%
Enhanced Bio-filtration with Internal Storage Reservoir (ISR)	22% - 79%
Sand Filter	9% - 40%
Porous Pavement;	76% - 79%
Wet Pond or wet detention basin;	9% - 40%
Dry Pond or detention basin; and	1% - 23%
Dry Water Quality Grass Swale with Detention.	1% - 23%

**Range based on underlying soil infiltration rate and/or BMP capacity*

Using a literature review together with best professional engineering judgment estimates for the cost to implement structural stormwater BMPs in Exeter are provided in Table 8. These costs include both construction and pre-construction costs (i.e., design and permitting) (which typically range from 10 to 40 percent of the BMP construction cost) by impervious acre treated. Since structural BMPs will be selected based on their nitrogen load reduction capability (Table 7), the average cost per impervious acre treated for infiltration practices and wetland/enhanced biofiltration were averaged. The capital costs are presented in Table 8. Operation and maintenance cost was assumed to be approximately 3 percent of the capital cost per BMP.

Since a portion of the developed load that could be treated by structural stormwater practices may come from pervious area, a cost per pervious acre treated needs to be estimated. Pervious areas when compared to impervious areas, produce a reduced volume of runoff and pollutant load, therefore, the cost per pervious acre treated is expected to be less than and impervious acre. To determine the cost reduction of a pervious acre compared to an impervious acre, the ratio of pervious load (68%) from the Town to the impervious load (32%) was compared. Based on this ratio, the cost per impervious acre was discounted by 70% to derive a pervious cost per acre, which is approximately $17,000 for infiltration practices and $16,000 for enhanced biofiltration practices.

The structural stormwater BMPs, nitrogen load reduction capability and cost will be used in a range of alternatives to determine the level of reduction the Town could achieve through implementation of these controls.

Table 8. Planning Level Unit Cost for Structural Stormwater Best Management Practices[1] (UMCES, 2011)

ROW ID	Structural Stormwater BMP	Initial Capital Costs Per Impervious Acre Treated		
		Pre-Construction Capital Costs[2]	Construction Capital Costs[3]	Total Initial Capital Costs
A	Wet Ponds	$ 21,333	$ 42,665	$ 63,998
B	Dry Extended Detention Ponds	$ 22,500	$ 45,000	$ 67,500
C	Infiltration Practices w/o Sand, Veg.	$ 16,700	$ 41,750	$ 58,450
D	Infiltration Practices w/ Sand, Veg.	$ 17,500	$ 43,750	$ 61,250
E	Filtering Practices (above ground)	$ 14,000	$ 35,000	$ 49,000
F	Filtering Practices (below ground)	$ 16,000	$ 40,000	$ 56,000
G	Bioretention	$ 9,375	$ 37,500	$ 46,875
H	Vegetated Open Channels	$ 4,000	$ 20,000	$ 24,000
I	Bioswale	$ 12,000	$ 30,000	$ 42,000
	Average Cost – Infiltration Practices (Rows C, D, and G)	**$14,525**	**$41,000**	**$56,000**
	Average Cost –Enhanced Bio (Rows E and F)	**$15,000**	**$37,500**	**$53,000**

Notes:

1. *All costs are expressed per acre of impervious area treated, not per acre of BMP. Initial costs are assumed to take place in year T=0; annual costs are incurred from year T= 1 through year T= 20.*
2. *Includes cost of site discovery, surveying, design, planning, permitting, etc. which, for various BMPs tend to range from 10% to 40% of BMP construction costs.*
3. *Includes capital, labor, material and overhead costs, but not land costs, and associated implementation.*

3.0 NUTRIENT REDUCTION ALTERNATIVES

With guidance from the Town, HW evaluated a range of alternatives with varying nutrient reduction goals. For each strategy, we also evaluated the level of implementation and developed a planning-level cost to implement the strategy. For each strategy the following load reduction metrics were evaluated:

- Available acreage – estimated as the total available land area in the Town for the management strategy to be implemented
- 2010 Baseline initial load – the estimated 2010 baseline initial (unattenuated) load from the available acreage and associated land use category as calculated in the Baseline Nitrogen Modeling Methodology and Results Memorandum (HW, 2017)
- Estimated nitrogen reduction from strategy – the estimated nitrogen reduction as a percentage of existing load for each of the strategies as described in Section 2 above
- 2010 Baseline initial load removed – calculated as the 2010 baseline initial load multiplied by the estimated nitrogen reduction from each strategy

- 2010 Baseline initial load remaining – calculated as the 2010 baseline initial load minus the baseline initial load removed
- 2010 Baseline delivered load – calculated as the 2010 baseline initial load multiplied by the delivery factor which is based on the target transport pathway (i.e., stormwater, groundwater) as described in the Baseline Nitrogen Modeling Methodology and Results Memorandum (HW, 2017)
- Delivered load remaining – calculated as the 2010 baseline initial load remaining multiplied by the delivery factor which is based on the target transport pathway (i.e., stormwater, groundwater) as described in the Baseline Nitrogen Modeling Methodology and Results Memorandum (HW, 2017)
- Delivered load removed – calculated as the 2010 baseline delivered load minus the delivered load remaining

Costs were broken down into the following categories:

- One-time capital cost – represents the cost that would occur one time over the course of implementing the strategy
- Annual operation and maintenance cost – the annual operation and maintenance cost to implement the strategy
- Total 20-year life-cycle cost – the cost if financed over a 20-year loan term with 2.5% annual interest rate, and 1% annual O&M inflation
- Equivalent annual cost – calculated as the total 20-year life-cycle cost divided by 20-years
- Estimated annual cost per pounds of nitrogen removed – calculated as the equivalent annual cost divided by the delivered load removed minus the atmospheric deposition load

Each of the metrics and the cost items described above are presented in Tables 13, 14, 16 and 18. The alternatives and results are described in the following three sections.

3.1 Alternative 1: Nitrogen Load Reduction Target of 10,400 Lbs N/ Year

Alternative 1 is the implementation of a combination of nitrogen non-point source mitigation strategies to achieve a nitrogen reduction of 10,400 pounds of nitrogen per year, which the equivalent amount of nitrogen that would be removed by upgrading the Exeter wastewater treatment facility (WWTF) from 5-mg/L to achieve a 3-mg/L effluent concentration. The level of implementation strategy and planning-level cost to implement these strategies to meet the 10,400 pounds is presented in Table 13 below. The most cost-effective strategies, based on dollars per pound of nitrogen removed, were selected first.

For Alternative 1, we assumed that the Town would implement all non-structural programmatic strategies as described in Section 2, above. Implementation of the non-structural strategies achieves a reduction of 3,505 pounds of nitrogen per year, which alone will not achieve the 10,400 pound load reduction; therefore, structural reduction strategies (i.e., advanced septic systems, sewer extensions and stormwater structural BMPs) also need to be implemented.

The level of implementation of structural strategies was determined simply based on what is necessary to meet the load reduction target of 10,400 pounds. We assumed that the Town would implement a combination of advanced septic systems and structural stormwater BMPs to achieve this load reduction target. Sewer extensions were not considered, as the Town has not identified locations where extending sewer is necessary or feasible. Based on these assumptions, approximately 40% of the total septic systems in town (535 systems) would be replaced with advanced onsite treatment system.

Table 9 provides supporting calculations of the expected load reduction from septic systems. The delivered load values were calculated using the average pounds per year per system as described in Sections 2.7. Through implementation of advanced septic systems in Town, an additional 2,430 pounds of nitrogen would be removed.

Table 9. Estimated Initial and Delivered Load Removed through Septic System Retrofit

Type of Treatment System	2010 Baseline Condition			Alternative 1		
	No. of Systems	Estimated Initial Load (lbs N/yr)	Estimated Delivered Load (lbs N/yr)	No. of Systems	Estimated Initial Load (lbs N/yr)	Estimated Delivered Load (lbs N/yr)
Traditional (in 200m)	19	483	290	0	0	0
Traditional (out 200m)	1,318	33,477	8,604	802	20,376	5,237
Advanced (in 200m)	0	0	0	19	163	98
Advanced (out 200m)	0	0	0	516	4,436	1,140
TOTAL	**1,337**	**33,960**	**8,894**	**1,337**	**24,975**	**6,475**
				REMOVED	**8,985**	**2,419**

The implementation of non-structural and septic system retrofit strategies (Table 9) results in a total load reduction of 5,924 pounds of delivered nitrogen load per year, which leaves another 4,476 pounds of delivered nitrogen to be removed in order to meet the 10,400 pound target. To provide this additional load reduction, structural stormwater BMPs optimized for nitrogen removal were evaluated.

Since the 2017 NH MS4 Permit presents a range of cumulative nitrogen load reductions (Table 7) based on the underlying soil type and capture depth of the BMP, assumptions need to be made on capture depth of the BMPs assumed to install for this analysis. It was assumed that BMPs sized to capture 0.5 inches of runoff would be used for both infiltration and enhanced biofiltration practices, with an understanding that BMPs with a smaller or larger capture depth may be used once projects are identified. The average cumulative nitrogen load reduction for both infiltration and enhanced biofiltration are presented in Table 10.

Table 10. Average Nitrogen Load Reduction for Infiltration and Enhanced Biofiltration BMPs

Structural Stormwater BMP Practice	Assumed BMP Capture Depth (in)	Assumed Infiltration Rate, B Soils (in/hr)	Cumulative Nitrogen Load Reduction	Assumed Infiltration Rate, A Soils (in/hr)	Cumulative Nitrogen Load Reduction
Infiltration Trench	0.5	0.27	91.0%	0.52	92.5%
Surface Infiltration Practices (i.e., basins, rain gardens and bio-retention)		0.27	90.0%	0.52	91.5%
Average Infiltration Practices			**91%**		**92%**
Gravel Wetland System	0.5	NA	53%	NA	53%
Enhanced Bio-filtration with Internal Storage Reservoir (ISR)					
Average Enhanced Biofiltration Practices			**53%**		**53%**

The available developed land for treatment in the Town is presented by cover type (pervious vs. directly connected impervious area (DCIA)) and HSG in Table 11. For each of the developed land types the initial baseline pollutant load is estimated along with an average pollutant load export rate (PLER). The average pollutant load export rate was estimated using an average area weight value equivalent to the initial pollutant load divided by the land area. Table 11 also presents the BMP removal efficiency and BMP cost associated with the land type if it were optimized for nitrogen reduction based on the 2017 NH MS4 permit. These values will be used to calculate the expected load reduction from structural stormwater BMPs for all alternatives evaluated. Operation and maintenance cost associated with the structural stormwater BMPs is assumed to be 3 percent of the capital costs.

Table 11. Available Developed Land Area by Cover Type for Treatment

Developed Land Type	Developed Land Area (acres)	Initial Pollutant Load (lbs N / Year)	Average PLER (lbs N/ ac/ yr)[1]	BMP Type Optimized for N Removal	BMP N Removal Efficiency[2]	BMP Capital Cost ($/ac)
Pervious HSG A	362	108	0.30	Infiltration	92%	$ 17,000
DCIA HSG A	20	234	11.70	Infiltration	92%	$ 56,000
Pervious HSG B	1,309	1,568	1.20	Infiltration	91%	$ 17,000
DCIA HSG B	85	1,083	12.74	Infiltration	91%	$ 56,000
Pervious HSG C	38	92	2.42	Enhanced Bio	53%	$ 16,000
DCIA HSG C	2	25	12.50	Enhanced Bio	53%	$ 53,000
Pervious HSG D	2,198	7,919	3.60	Enhanced Bio	53%	$ 16,000
DCIA HSG D	241	3,133	13.00	Enhanced Bio	53%	$ 53,000
TOTAL	**4,255**	**14,162**				

NOTES:
1. Calculated as initial pollutant load divided by the land area.
2. BMP Removal Efficiency optimized for nitrogen, per MS4 permit

To achieve the additional reduction of 4,476 pounds of delivered nitrogen load, approximately 1,560 acres of developed land would need to be retrofit within the Town with structural stormwater BMPs (Table 12). This represents approximately 37% of the total developed land area within the Town. Of the 1,560 acres, 100% or 348 acres of the directly connected impervious area (DCIA) would need to be treated, which would be a difficult task for the Town. To treat 37% of the Town's developable land, the 20-year life-cycle cost to the City would be approximately $73.35 Million. The life-cycle cost includes a 20-year loan term with an interest rate of 2.5 percent and a 1 percent inflation rate on the operation and maintenance cost for each strategy.

Table 12. Alternative 1: Structural Stormwater BMP Estimated Acres Treated and Cost

Developed Land Cover	Treated Town Area (acres)	2010 Baseline Initial Load (lbs N/ Year)[1]	BMP Load Removal (%)	BMP Initial Load Removed (lbs N/ Year)[2]	2010 Baseline Initial Load Remaining (lbs N/ Year)[3]	2010 Delivered Load Removed (lbs N/ Year)[4]	2010 Delivered Load Remaining (lbs N/ Year)[5]	% Total Town Developed Area[6]	One Time Capital Cost[7]	Annual O&M Cost[8]	20-Year Life-Cycle Cost[9]
DCIA LAND											
HSG A	20	234	92%	215	19	187	16	100%	$ 1,120,000	$ 33,600	
HSG B	85	1,083	91%	980	103	853	90	100%	$ 4,760,000	$ 142,800	
HSG C	2	25	53%	13	12	11	10	100%	$ 106,000	$ 3,180	
HSG D	241	3,133	53%	1645	1488	1431	1295	100%	$ 12,773,000	$ 383,190	
Total DCIA	**348**	**4,475**		**2,853**	**1,622**	**2,482**	**1,411**	**100%**	**$ 18,759,000**	**$ 562,770**	
PERVIOUS LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	0	0	91%	0	0	0	0	0%	$ -	$ -	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	1,212	4,365	53%	2,292	2,073	1,994	1,804	55%	$ 19,384,000	$ 581,520	
Total Pervious	**1,212**	**4,365**		**2,292**	**2,073**	**1,994**	**1,804**	**31%**	**$ 19,384,000**	**$ 581,520**	
TOTAL	**1,560**	**8,840**		**5,145**	**3,695**	**4,476**	**3,215**	**37%**	**$ 38,143,000**	**$ 1,144,290**	**$ 73,352,000**

NOTES:

1. *Baseline Initial Load = Town Developed Area for Treatment (acres) x Average PLER (Table 11)*
2. *BMP Initial Load Removed = Baseline Initial Load x BMP N Load Removal*
3. *Baseline Initial Load Remaining = Baseline Initial Load – BMP Initial Load Removed*
4. *Delivered Load Removed = BMP Initial Load Removed x 0.87 (Stormwater Delivery Factor)*
5. *Delivered Load Remaining = Baseline Initial Load Remaining x 0.87*
6. *% Total Town Developed Area = Town Developed Area for Treatment ÷ Developed Land Area (Table 11)*
7. *One Time Capital Cost = Town Developed Area for Treatment x BMP Capital Cost*
8. *BMP O&M Cost = 3% of Capital Cost*
9. *20-year Life-cycle Cost = 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation*

Implementation of all of the strategies for Alternative 1 will result in an estimated annual nitrogen load reduction of 10,400 pounds. To achieve this load reduction, the 20-year life-cycle cost would be approximately $102 Million (Table 13), with an equivalent annual cost of $5.1 Million or $680 per pound of nitrogen removed[1] to implement Alternative 1. The most cost effective strategy for reducing nitrogen is taking credit for changes in rates of nitrogen deposition on the land surface. The next most cost effective strategy for the Town is implementation of a residential lawn fertilizer program ($140/lb N removed), followed by infrastructure maintenance ($300/lb N removed), followed by advanced septic systems ($450/lb N removed). Structural stormwater BMPs are approximately $800 per pound of nitrogen removed and street sweeping and catch basin cleaning the most costly at $2,500 per pound removed. On average the cost to implement non-structural strategies to reduce nitrogen are $550 per pound of nitrogen removed; whereas, structural strategies are approximately $690 per pound of nitrogen removed on average.

[1] Cost per pound of nitrogen removed excludes the load associated with atmospheric deposition because this removal is not associated with a cost to the Town.

Table 13. Alternative 1: Nitrogen Load Reduction Target of 10,400 Lbs N/ Year

NPS Non-Structural Reduction Strategies	Primary Target Pathway	A Available Acreage	B Baseline Initial Load (LBS N/ YR)[1]	C Estimated N Reduction from Strategy[2]	D Baseline Initial Load Removed (LBS N/ YR)	E Baseline Initial Load Remaining (LBS N/ YR)	F Baseline Delivered Load (LBS N/ YR)[3]	G Delivered Load Remaining (LBS N/ YR)[4]	H Delivered Load Removed (LBS N/ YR)	I One-Time Capital Cost	J Annual O&M Cost	K Total 20-Year Life-Cycle Cost	L Equivalent Annual Cost	M Estimated Annual $/LBS N Removed
Calculation					**(B x C)**	**(B - D)**	**(B x 0.87)**	**(E x 0.87)**	**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Atmospheric Deposition	Stormwater	12,812	18,423	18%	3,316	15,107	16,028	13,143	2,885	$ -	$ -	$ -	$ -	$ -
Residential Fertilizer Program	Stormwater	2,363	5,559	9%	500	5,059	4,836	4,401	435	$ 50,000	$ 50,000	$ 1,165,000	$ 59,000	$ 140
Infrastructure Maintenance Program	Stormwater	350	1,634	6%	98	1,536	1,422	1,336	85	$ 5,000	$ 25,000	$ 557,000	$ 28,000	$ 300
Organic Waste and Leaf Litter Collection Program	Stormwater	350	1,634	5%	82	1,552	1,422	1,351	71	$ 885,000	$ 186,000	$ 5,047,000	$ 253,000	$ 2,500
Enhanced Street/ Pavement Cleaning Program	Stormwater	350	1,634	2%	33	1,601	1,422	1,393	28					
Non-Structural TOTAL					**4,029**				**3,505**	**$ 940,000**	**$ 261,000**	**$ 6,769,000**	**$ 340,000**	**$ 550**

NPS Structural Reduction Strategies	Primary Target Pathway	A Available Acreage	B Baseline Initial Load (LBS N/ YR)[1]	C Estimated N Reduction from Strategy[2]	D Baseline Initial Load Removed (LBS N/ YR)	E Baseline Initial Load Remaining (LBS N/ YR)	F Baseline Delivered Load (LBS N/ YR)[3]	G Delivered Load Remaining (LBS N/ YR)[4]	H Delivered Load Removed (LBS N/ YR)	I One-Time Capital Cost	J Annual O&M Cost	K Total 20-Year Life-Cycle Cost	L Equivalent Annual Cost	M Estimated Annual $/LBS N Removed
Calculation						**(B - D)**			**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Stormwater Structural BMPs	Stormwater	4,255	14,165	36%	5,145	9,020	12,324	7,848	4,476	$ 38,143,000	$ 1,145,000	$ 73,352,000	$ 3,668,000	$ 800
Advanced septic systems	Groundwater	N/A	33,960	27%	8,985	24,975	8,894	6,475	2,419	$ 8,025,000	$ 535,000	$ 21,912,000	$ 1,096,000	$ 450
Structural TOTAL					**14,130**				**6,895**	**$ 46,168,000**	**$ 1,680,000**	**$ 95,264,000**	**$ 4,764,000**	**$ 690**
TOTAL (Non-Structural + Structural)					**18,159**				**10,400**	**$ 47,108,000**	**$ 1,941,000**	**$ 102,033,000**	**$ 5,104,000**	**$ 680**

3.2 Alternative 2: Nitrogen Load Reduction Expected to Meet MS4 Requirements

Alternative 2 represents the level of nitrogen non-point source strategy implementation required to meet the minimum control measures in the 2017 Final NH MS4 permit (effective July 1, 2018). The requirements have been extrapolated out for 20-years, for comparison purposes to the other alternatives, with the assumption that the requirements would not become more stringent over time. Based on the current permit requirements, the Town would be responsible for developing and implementing an organic waste and leaf litter collection program, infrastructure maintenance program and an enhanced street/pavement cleaning program. Beginning with the fifth annual report and in each subsequent annual report, the Town would report on Town owned properties and infrastructure that have been retrofitted with BMPs to mitigate impervious area. Since the permit does not specify the number of BMPs required per year or the amount of impervious cover treated, we assume that 1 acre of impervious cover would be treated per permit year to meet this requirement. This alternative also assumes that there would be reductions in atmospheric deposition over the 20-year implementation period.

This alternative could serve as the anticipated minimum estimated cost to the Town for implementation of strategies to provide nitrogen reduction. The level of implementation by NPS strategy, estimated nitrogen load reduction and a planning-level cost to implement this alternative are presented in Table 14 below.

To calculate the cost from retrofitting 1 acre of impervious area with structural stormwater BMPs for permit years 5 through 20, the same methodology used in Alternative 1 was applied to Alternative 2. Table 15 presents the anticipated load reduction and cost to retrofit 16 acres of directly connected impervious cover. Implementation of structural stormwater BMPs at this level would cost the Town approximately $1.72 Million (20-year life-cycle cost) with an expected delivered load reduction of approximately 161 pounds of nitrogen per year.

For Alternative 2, the strategies required under the 2017 Final NH MS4 permit that achieve nitrogen removal would provide a reduction of 3,230 pounds of delivered nitrogen per year, which is 8 percent reduction in the delivered total non-point source load (40,485 pounds per year) or a 20 percent reduction in the delivered stormwater load (16,028 pounds per year). The 20-year life-cycle cost including would be approximately $7.3 Million, with an average annual cost of $386,000, and an average of $1,070 per pound of nitrogen removed to implement Alternative 2[1].

[1] Cost per pound of nitrogen removed excludes the load associated with atmospheric deposition because this removal is not associated with a cost to the Town.

Table 14. Alternative 2: Nitrogen Load Reduction Expected to Meet MS4 Requirements

		A	B	C	D	E	F	G	H	I	J	K	L	M
NPS Non-Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Baseline Initial Load Removed (LBS N/ YR)**	**Baseline Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation					**(B x C)**	**(B - D)**	**(B x 0.87)**	**(E x 0.87)**	**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Atmospheric Deposition	Stormwater	12,812	18,423	18%	3,316	15,107	16,028	13,143	2,885	$ -	$ -	$ -	$ -	$ -
Infrastructure Maintenance Program	Stormwater	350	1,634	6%	98	1,536	1,422	1,336	85	$ 5,000	$ 25,000	$ 557,000	$ 28,000	$ 300
Organic Waste and Leaf Litter Collection Program	Stormwater	350	1,634	5%	82	1,552	1,422	1,351	71	$ 885,000	$ 186,000	$ 5,047,000	$ 253,000	$ 2,500
Enhanced Street/ Pavement Cleaning Program	Stormwater	350	1,634	2%	33	1,601	1,422	1,393	28					
Non-Structural TOTAL					**3,529**				**3,070**	**$ 890,000**	**$ 211,000**	**$ 5,604,000**	**$ 281,000**	**$ 1,521**

		A	B	C	D	E	F	G	H	I	J	K	L	M
NPS Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Baseline Initial Load Removed (LBS N/ YR)**	**Baseline Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation						**(B - D)**			**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Stormwater Structural BMPs	Stormwater	4,255	14,165	1.3%	184	13,981	12,324	12,163	161	$ 896,000	$ 26,880	$ 1,724,000	$ 87,000	$ 600
Structural TOTAL					**184**				**161**	**$ 896,000**	**$ 26,880**	**$ 1,724,000**	**$ 87,000**	**$ 500**
TOTAL (Non-Structural + Structural)					**3,713**				**3,230**	**$ 1,786,000**	**$ 237,880**	**$ 7,328,000**	**$ 368,000**	**$ 1,070**

Table 15. Alternative 2: Structural Stormwater BMP Estimated Acres Treated and Cost

Developed Land Cover	Treated Town Area (acres)	Baseline Initial Load (lbs N/ Year)[1]	BMP Load Removal (%)	BMP Initial Load Removed (lbs N/ Year)[2]	Baseline Initial Load Remaining (lbs N/ Year)[3]	Delivered Load Removed (lbs N/ Year)[4]	Delivered Load Remaining (lbs N/ Year)[5]	% Total Town Developed Area[6]	One Time Capital Cost[7]	Annual O&M Cost[8]	20-Year Life-Cycle Cost[9]
DCIA LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	16	204	91%	184	19	161	17	19%	$ 896,000	$ 26,880	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	0	0	53%	0	0	0	0	0%	$ -	$ -	
Total DCIA	**16**	**204**		**184**	**19**	**161**	**17**		**$ 896,000**	**$ 26,880**	
PERVIOUS LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	0	0	91%	0	0	0	0	0%	$ -	$ -	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	0	0	53%	0	0	0	0	0%	$ -	$ -	
Total Pervious	**0**	**0**		**0**	**0**	**0**	**0**		**$ -**	**$ -**	
TOTAL	**16**	**204**		**184**	**19**	**161**	**17**	**0.4%**	**$ 896,000**	**$ 26,880**	**$ 1,724,000**

NOTES:

1. *Baseline Initial Load = Town Developed Area for Treatment (acres) x Average PLER (Table 11)*
2. *BMP Initial Load Removed = Baseline Initial Load x BMP N Load Removal*
3. *Baseline Initial Load Remaining = Baseline Initial Load – BMP Initial Load Removed*
4. *Delivered Load Removed = BMP Initial Load Removed x 0.87 (Stormwater Delivery Factor)*
5. *Delivered Load Remaining = Baseline Initial Load Remaining x 0.87*
6. *% Total Town Developed Area = Town Developed Area for Treatment ÷ Developed Land Area (Table 11)*
7. *One Time Capital Cost = Town Developed Area for Treatment x BMP Capital Cost*
8. *BMP O&M Cost = 3% of Capital Cost*
9. *20-year Life-cycle Cost = 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation*

3.3 Alternative 3: Nitrogen Load Reduction Expected to Meet MS4 Requirements plus an Additional Annual Investment of $100,000

Alternative 3 represents the level of nitrogen non-point source strategy implementation required to meet the minimum control measures in the MS4 permit (Alternative 2) plus an additional annual investment of $100,000, or a total annual investment of $382,000 for Alternative 3. The level of implementation by strategy, estimated nitrogen load reduction and a planning-level cost to implement this alternative is presented in Table 16 below.

For Alternative 3, we assumed that the Town would implement all non-structural programmatic strategies as described in Alternative 2 with the addition of the residential lawn fertilizer program. To fully implement and maintain these programs for 20-years would require an annual investment of $340,000 ($59,000 more than Alternative 2) and a load reduction of 3,505 pounds of nitrogen per year. Using the remaining $41,000 per year, structural stormwater BMPs would be implemented on 23.5 acres and account of an additional 236 pounds of nitrogen per year (Table 17).

Implementation of Alternative 3, including both non-structural and structural strategies described above, will result in an estimated annual delivered nitrogen load reduction of 3,741 pounds, 23 percent of the stormwater load (16,028 pounds per year) or 9 percent of the total delivered non-point source load (40,485 pounds per year). The 20-year life-cycle cost would be approximately $9.3 Million, an average annual cost of $467,000 or $550 per pound of nitrogen removed[1] to implement Alternative 3.

[1] Cost per pound of nitrogen removed excludes the load associated with atmospheric deposition because this removal is not associated with a cost to the Town.

Table 16. Alternative 3: Nitrogen Load Reduction Expected to Meet MS4 Requirements plus an Additional Annual Investment of $100,000

		A	B	C	D	E	F	G	H	I	J	K	L	M
NPS Non-Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Baseline Initial Load Removed (LBS N/ YR)**	**Baseline Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation					**(B x C)**	**(B - D)**	**(B x 0.87)**	**(E x 0.87)**	**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Atmospheric Deposition	Stormwater	12,812	18,423	18%	3,316	15,107	16,028	13,143	2,885	$ -	$ -	$ -	$ -	$ -
Residential Fertilizer Program	Stormwater	2,363	5,559	9%	500	5,059	4,836	4,401	435	$ 50,000	$ 50,000	$ 1,165,000	$ 59,000	$ 140
Infrastructure Maintenance Program	Stormwater	350	1,634	6%	98	1,536	1,422	1,336	85	$ 5,000	$ 25,000	$ 557,000	$ 28,000	$ 300
Organic Waste and Leaf Litter Collection Program	Stormwater	350	1,634	5%	82	1,552	1,422	1,351	71	$ 885,000	$ 186,000	$ 5,047,000	$ 253,000	$ 2,500
Enhanced Street/ Pavement Cleaning Program	Stormwater	350	1,634	2%	33	1,601	1,422	1,393	28					
Non-Structural TOTAL					**4,029**				**3,505**	**$ 940,000**	**$ 261,000**	**$ 6,769,000**	**$ 340,000**	**$ 550**
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
NPS Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Baseline Initial Load Removed (LBS N/ YR)**	**Baseline Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation						**(B - D)**			**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Stormwater Structural BMPs	Stormwater	4,255	14,165	1.9%	271	13,894	12,324	12,088	236	$ 1,316,000	$ 40,000	$ 2,531,000	$ 127,000	$ 600
Structural TOTAL					**271**				**236**	**$ 1,316,000**	**$ 40,000**	**$ 2,531,000**	**$ 127,000**	$ 600
TOTAL (Non-Structural + Structural)					**4,300**				**3,741**	**$ 2,256,000**	**$ 301,000**	**$ 9,300,000**	**$ 467,000**	**$ 550**

Table 17. Alternative 3: Structural Stormwater BMP Estimated Acres Treated and Cost

Developed Land Cover	Treated Town Area (acres)	Baseline Initial Load (lbs N/ Year)[1]	BMP Load Removal (%)	BMP Initial Load Removed (lbs N/ Year)[2]	Baseline Initial Load Remaining (lbs N/ Year)[3]	Delivered Load Removed (lbs N/ Year)[4]	Delivered Load Remaining (lbs N/ Year)[5]	% Total Town Developed Area[6]	One Time Capital Cost[7]	Annual O&M Cost[8]	20-Year Life-Cycle Cost[9]
DCIA LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	23.5	299	91%	271	28	236	25	28%	$ 1,316,000	$ 39,480	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	0	0	53%	0	0	0	0	0%	$ -	$ -	
Total DCIA	**23.5**	**299**		**271**	**28**	**236**	**25**		**$ 1,316,000**	**$ 39,480**	
PERVIOUS LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	0	0	91%	0	0	0	0	0%	$ -	$ -	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	0	0	53%	0	0	0	0	0%	$ -	$ -	
Total Pervious	**0**	**0**		**0**	**0**	**0**	**0**		**$ -**	**$ -**	
TOTAL	**23.5**	**299**		271	**28**	**236**	**25**	**0.6%**	**$ 1,316,000**	**$ 39,480**	**$ 2,530,760**

NOTES:

1. *Baseline Initial Load = Town Developed Area for Treatment (acres) x Average PLER (Table 11)*
2. *BMP Initial Load Removed = Baseline Initial Load x BMP N Load Removal*
3. *Baseline Initial Load Remaining = Baseline Initial Load – BMP Initial Load Removed*
4. *Delivered Load Removed = BMP Initial Load Removed x 0.87 (Stormwater Delivery Factor)*
5. *Delivered Load Remaining = Baseline Initial Load Remaining x 0.87*
6. *% Total Town Developed Area = Town Developed Area for Treatment ÷ Developed Land Area (Table 11)*
7. *One Time Capital Cost = Town Developed Area for Treatment x BMP Capital Cost*
8. *BMP O&M Cost = 3% of Capital Cost*
9. *20-year Life-cycle Cost = 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation*

3.4 Alternative 4: Nitrogen Load Reduction for Implementation to the Maximum on Town Property

Alternative 4 represents the level of nitrogen non-point source strategies when implemented on Town property. This level of implementation includes the following strategies:

- Required under the MS4 permit (i.e., Alternative 2)
- Residential Lawn Fertilizer Program since the Town is already in progress with this effort
- Upgrades of septic systems within 200 meters of a receiving water body
- Implementation of structural stormwater BMPs on city owned parcels and within the right-of-way to treat directly connected impervious area (DCIA).

While the Town has redevelopment standards in place which would require management of stormwater from existing impervious cover on private parcels, the timing of the redevelopment cycle of these parcels is outside of the Town's control and therefore was not considered in this alternative. The level of implementation by strategy, estimated nitrogen load reduction and a planning-level cost to implement this alternative is presented in Table 18 below.

For Alternative 4, we assumed that the Town would implement all non-structural programmatic strategies as described in Alternative 3. To fully implement and maintain these programs for 20-years would require an annual investment of $340,000 and a load reduction of 3,505 pounds of nitrogen per year. To upgrade all septic systems within 200 meters of a water body (approximately 19 systems), would result in a load reduction of 192 pounds of nitrogen per year at a cost of $35,000 annually.

By implementing stormwater structural BMPs on Town owned properties and within the right-of-way, the Town would treat approximately 323 acres of directly connected impervious area (DCIA) (92% of total DCIA). Implementation at this level would result in a load reduction of 2,278 pounds of nitrogen per year at 20-year life-cycle cost of $33.4 Million or $1.7 Million annually (Table 19).

Implementation of Alternative 4, including both non-structural and structural strategies described above, will result in an estimated annual delivered nitrogen load reduction of 5,974 pounds, 15 percent of the total delivered non-point source load (40,485 pounds per year). The 20-year life-cycle cost would be approximately $40.9 Million, an average annual cost of $2.0 Million or $710 per pound of nitrogen removed[1] to implement Alternative 4.

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[1] Cost per pound of nitrogen removed excludes the load associated with atmospheric deposition because this removal is not associated with a cost to the Town.

Table 18. Alternative 4: Maximum Extent Practical Nitrogen Load Reduction

		A	B	C	D	E	F	G	H	I	J	K	L	M
NPS Non-Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Baseline Initial Load Removed (LBS N/ YR)**	**Baseline Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation					**(B x C)**	**(B - D)**	**(B x 0.87)**	**(E x 0.87)**	**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Atmospheric Deposition	Stormwater	12,812	18,423	18%	3,316	15,107	16,028	13,143	2,885	$ -	$ -	$ -	$ -	$ -
Residential Fertilizer Program	Stormwater	2,363	5,559	9%	500	5,059	4,836	4,401	435	$ 50,000	$ 50,000	$ 1,165,000	$ 59,000	$ 140
Infrastructure Maintenance Program	Stormwater	350	1,634	6%	98	1,536	1,422	1,336	85	$ 5,000	$ 25,000	$ 557,000	$ 28,000	$ 300
Organic Waste and Leaf Litter Collection Program	Stormwater	350	1,634	5%	82	1,552	1,422	1,351	71	$ 885,000	$ 186,000	$ 5,047,000	$ 253,000	$ 2,500
Enhanced Street/ Pavement Cleaning Program	Stormwater	350	1,634	2%	33	1,601	1,422	1,393	28					
Non-Structural TOTAL					**4,029**				**3,505**	**$ 940,000**	**$ 261,000**	**$ 6,769,000**	**$ 340,000**	**$ 550**

		A	B	C	D	E	F	G	H	I	J	K	L	M
NPS Structural Reduction Strategies	**Primary Target Pathway**	**Available Acreage**	**Baseline Initial Load (LBS N/ YR)[1]**	**Estimated N Reduction from Strategy[2]**	**Initial Load Removed (LBS N/ YR)**	**Initial Load Remaining (LBS N/ YR)**	**Baseline Delivered Load (LBS N/ YR)[3]**	**Delivered Load Remaining (LBS N/ YR)[4]**	**Delivered Load Removed (LBS N/ YR)**	**One-Time Capital Cost**	**Annual O&M Cost**	**Total 20-Year Life-Cycle Cost**	**Equivalent Annual Cost**	**Estimated Annual $/LBS N Removed**
Calculation						**(B - D)**			**(F - G)**				**(K ÷ 20 YRS)**	**(L ÷ H)**
Advanced Septic Systems	Groundwater	NA	33,960	2.2%	319	33,641	8,893	8,702	192	$ 380,000	$ 9,500	$ 689,000	$ 35,000	$ 200
Stormwater Structural BMPs	Stormwater	4,255	14,165	18.5%	2,618	11,547	12,324	10,046	2,278	$ 17,386,000	$ 521,580	$ 33,435,000	$ 1,672,000	$ 800
Structural TOTAL					**2,618**				**2,469**	**$ 17,766,000**	**$ 531,080**	**$ 34,124,000**	**$ 1,707,000**	$ 700
TOTAL (Non-Structural + Structural)					**6,647**				**5,974**	**$ 18,706,000**	**$ 792,080**	**$ 40,893,000**	**$ 2,047,000**	**$ 710**

Table 19. Alternative 4: Structural Stormwater BMP Estimated Acres Treated and Cost

Developed Land Cover	Treated Town Area (acres)	Baseline Initial Load (lbs N/ Year)[1]	BMP Load Removal (%)	BMP Initial Load Removed (lbs N/ Year)[2]	Baseline Initial Load Remaining (lbs N/ Year)[3]	Delivered Load Removed (lbs N/ Year)[4]	Delivered Load Remaining (lbs N/ Year)[5]	% Total Town Developed Area[6]	One Time Capital Cost[7]	Annual O&M Cost[8]	20-Year Life-Cycle Cost[9]
DCIA LAND											
HSG A	16	196	92%	180	16	156	14	80%	$ 896,000	$ 26,880	
HSG B	73	933	91%	844	89	735	77	86%	$ 4,088,000	$ 122,640	
HSG C	2	17	53%	9	8	8	7	100%	$ 106,000	$ 3,180	
HSG D	232	3,019	53%	1585	1,434	1,379	1,248	96%	$ 12,296,000	$ 368,880	
Total DCIA	**323**	**4,164**		**2,618**	**1,546**	**2,278**	**1,345**		**$ 17,386,000**	**$ 521,580**	
PERVIOUS LAND											
HSG A	0	0	92%	0	0	0	0	0%	$ -	$ -	
HSG B	0	0	91%	0	0	0	0	0%	$ -	$ -	
HSG C	0	0	53%	0	0	0	0	0%	$ -	$ -	
HSG D	0	0	53%	0	0	0	0	0%	$ -	$ -	
Total Pervious	**0**	**0**		**0**	**0**	**0**	**0**			**$ -**	
TOTAL	**323**	**4,164**		**2,618**	**1,546**	**2,278**	**1,345**	**7.6%**	**$ 17,386,000**	**$ 521,580**	**$33,435,000**

NOTES:

1. *Baseline Initial Load = Town Developed Area for Treatment (acres) x Average PLER (Table 11)*
2. *BMP Initial Load Removed = Baseline Initial Load x BMP N Load Removal*
3. *Baseline Initial Load Remaining = Baseline Initial Load – BMP Initial Load Removed*
4. *Delivered Load Removed = BMP Initial Load Removed x 0.87 (Stormwater Delivery Factor)*
5. *Delivered Load Remaining = Baseline Initial Load Remaining x 0.87*
6. *% Total Town Developed Area = Town Developed Area for Treatment ÷ Developed Land Area (Table 11)*
7. *One Time Capital Cost = Town Developed Area for Treatment x BMP Capital Cost*
8. *BMP O&M Cost = 3% of Capital Cost*
9. *20-year Life-cycle Cost = 20-year loan term, 2.5% annual interest rate, and 1% annual O&M inflation*

3.5 Alternative Comparison

Table 20 presents the cost and load reduction for each of the four alternatives described above. Alternative 3 represents the most cost-effective alternative to implement with regards to the "estimated annual dollars per pound of nitrogen removed" metric ($550) with Alternative 2 being the least cost effective based on an $1,050 per pound of nitrogen removed. Of the four alternatives, Alternative 1 would be the most expensive and most difficult for the Town to achieve as this would require implementing structural stormwater controls on all of the directly connected impervious cover in Town as well as on 45 percent of the pervious area. Alternatives 1 and 4 would require the Town to implement new regulations to the upgrade of certain septic systems to advanced treatment systems. Currently, neither the State nor the Town has regulations in place mandating the use of advanced treatment systems.

Table 20. Cost and Load Reduction by Alternative

Alternative	Total 20-Year Life-Cycle Cost	Equivalent Annual Cost	2010 Delivered Load Removed (lbs N/year)	Percent of Total NPS Delivered Load Removed[1]	Estimated Annual $ / lbs N Removed[2]
1 – 10,400 lbs	$ 102,033,000	$ 5,104,000	10,400	26%	$ 680
2 – MS4	$ 7,328,000	$ 368,000	3,230	8%	$ 1,070
3 – MS4 Plus	$ 9,300,000	$ 467,000	3,741	9%	$ 550
4 – Town Property	$40,893,000	$2,047,000	5,974	15%	$ 710

1. *Includes both stormwater and groundwater load (40,485 pounds N per year)*
2. *Does not include load removed from atmospheric deposition.*

4.0 CONCLUSIONS AND RECOMMENDATIONS

- Since the 2012 NPDES permit required the Exeter WWTF to achieve an effluent TN of 3-mg/l, one premise of this analysis is that the required TN removals could be achieved by upgrading the WWTF again or by removing non-point source (NPS) nitrogen.
- "NPS Alternative 1" consists of achieving 10,400 lbs per year via NPS removals within 20-years. This results in a reduction in delivered total non-point source loadings of 26%. This report estimates these costs with a 20-year life cycle cost of $102M, and an equivalent annual cost of $680 per pound N removed.
- "NPS Alternative 2" consists of meeting the minimum requirements of the MS4 program. This results in a reduction in delivered total non-point source loadings of 8%. This report

estimates these costs at a 20-year life cycle cost of $7.3M. This would remove 3,230 pounds N per year at an equivalent annual cost of $1,070 per pound N removed.

- "NPS Alternative 3" consists of meeting the minimum requirements of the MS4 program plus spending an additional $100,000 per year. This results in a reduction in delivered total non-point source loadings of 9%. This report estimates these costs at a 20-year life cycle cost of $9.3M. This would remove 3,741 pounds N per year at an equivalent annual cost of $550 per pound N removed.
- "NPS Alternative 4" consists of meeting the minimum requirements of the MS4 program and implementing other strategies to the maximum extent practicable. This results in a reduction in delivered total non-point source loadings of 15%. This report estimates these costs at a 20-year life cycle cost of $40.9M. This would remove 5,974 pounds N per year at an equivalent annual cost of $710 per pound N removed.
- When optimizing structural stormwater BMPs for nitrogen removal, infiltration practices (i.e., trenches, basins, rain gardens and bioretention) should be used in areas with underlying hydrologic soil groups A and B; whereas, gravel wetlands and enhanced biofiltration practices with internal storage reservoirs should be used in areas with underlying hydrologic soil groups C and D.
- The on-going Exeter WWTF Upgrade is targeting an effluent TN concentration of 5-mg/l. Based on information from Wright-Pierce, this on-going upgrade has a capital cost of approximately $53M for all phases (including some elements that are not nitrogen-related) and is expected to be substantially completed in 2019.
- A separate analysis by Wright-Pierce determine the estimated cost to implement an additional WWTF Upgrade to achieve 3-mg/l for 1.7-mgd at a capital cost of $6.4M (with no debt service) with a 20-year life cycle cost of $11.6M (including 20 years of operations and maintenance with no annual inflation). This would remove 10,400 pounds N per year at an equivalent annual cost of $56 per pound N removed.

5.0 NEXT STEPS

HW and Wright-Pierce will review this memorandum and alternative results with the Town in order to determine a path forward for the Town to develop a Nitrogen Control Plan in accordance with the Administrative Order on Consent.

6.0 REFERENCES

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Town of Exeter
Nitrogen Control Plan

Presented by: Edward Leonard, PE
Renee Bourdeau, PE
July 23, 2018

WRIGHT-PIERCE
Engineering a Better Environment

Horsley Witten Group

Agenda

- Why the Nitrogen Control Plan is Needed
- Watershed Loads & Load Reduction Goals
- Nitrogen Control Measures
- Alternatives Analysis
- What will be in the Nitrogen Control Plan
- Next Steps and Key Decisions with Select Board

2

Why is the Nitrogen Control Plan Needed?

- NPDES Permit - 2012
  - Achieve <3 mg/l TN
- Administrative Order on Consent (AOC) - 2013
  - Achieve 'interim limit' of <8mg/l TN by 2019
  - Begin tracking all activities affect TN in town-wide
  - Coordinate with NHDES for 'tracking and accounting for total nitrogen'
  - Coordinate with NHDES for 'nitrogen allocation'
  - Develop a Nitrogen Control Plan (2018)
  - Develop an Engineering Evaluation (2023)

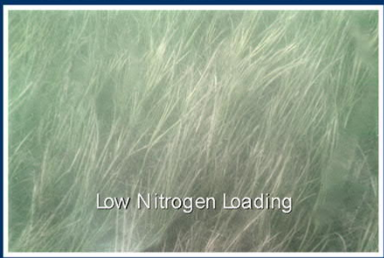
3

What will the Nitrogen Control Plan Do?

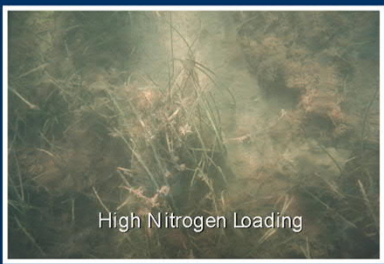
- Document baseline loadings (2010) and load reduction goals
- Take credit for actions already taken by the Town
  - Fertilizer regulation revisions implemented
  - Site Plan regulation revisions implemented
  - WWTF Upgrade underway
  - PTAPP tracking and accounting underway
- Develop a 5-year implementation plan leading up to the Engineering Evaluation due in 2023
  - Approach to make progress towards goals
  - Approach to monitoring

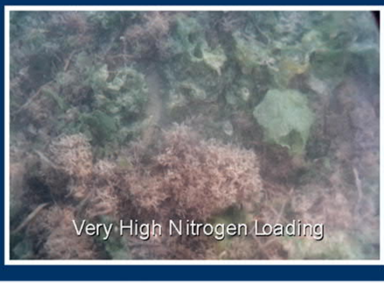
4

Why is the AOC Focused on Nitrogen



Excess Nitrogen contributes to:
- Increased algae
- Reduced water clarity
- Reduced light penetration
- Reduced dissolved oxygen
- Loss of habitat





5

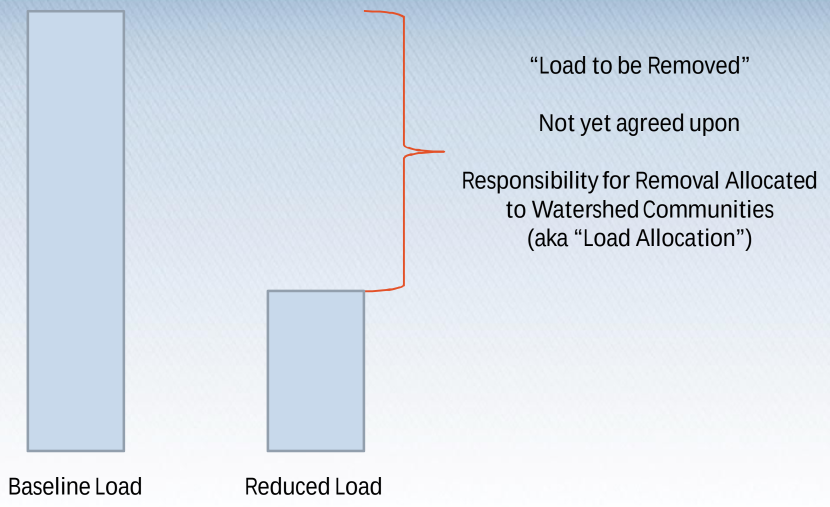
Nitrogen Inputs, Delivery and Attenuation Mechanisms

Input Load → Delivery Method → Attenuation Mechanism → Delivered Load

Input Load	Delivery Method	Attenuation Mechanism
• Wastewater	• WWTFs	• Storage in soils & plants
• Fertilizers	• Groundwater	• Removal in crops & woods
• Stormwater	• Precipitation	• Microbial action in soils
• Leaf litter	• Stormwater	• Aeration in surface water
• Atmospheric Sources		• Treatment
		• BMPs

6

Load Reduction Goals: Simplified Terminology



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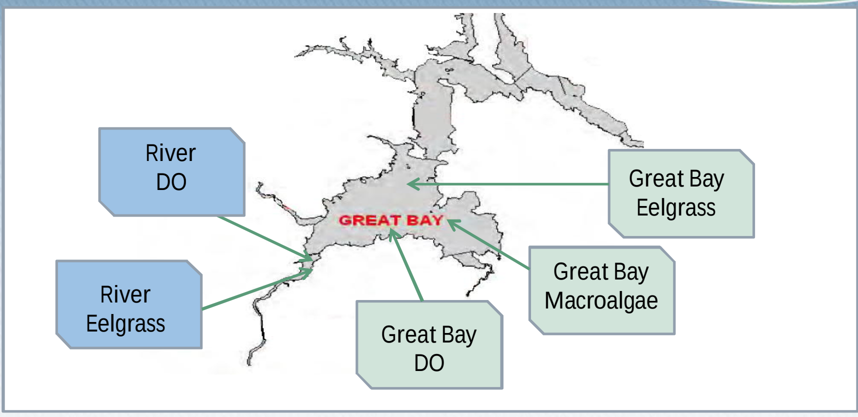
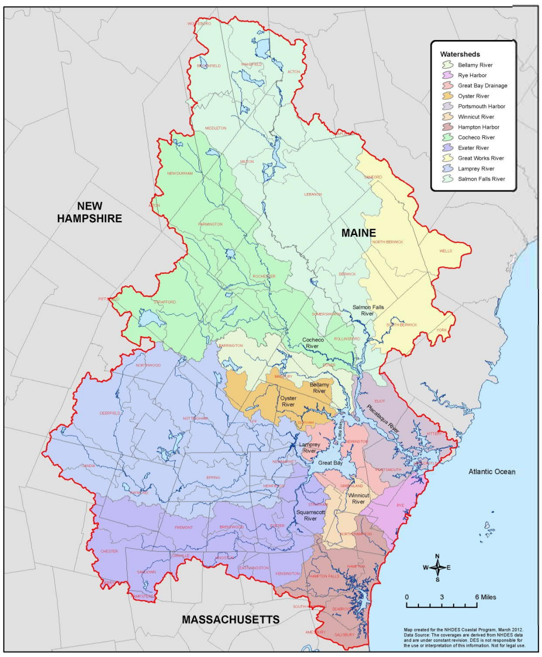
How Much N Reduction Needed?

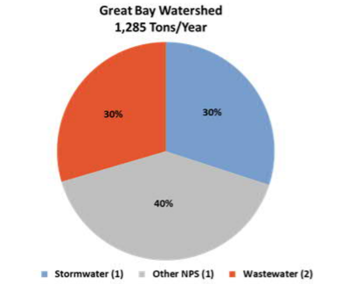


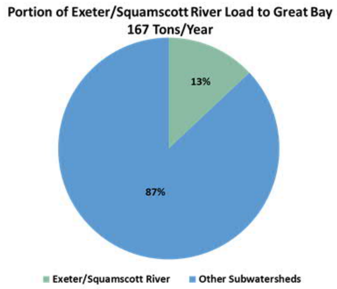
<u>Based on NHDES Work</u>:
Goal 1 = 161.7 tons/year for Great Bay Eelgrass
Goal 2 = 140 tons/year for River DO
Goal 3 = 88 tons/year for River Eelgrass

8

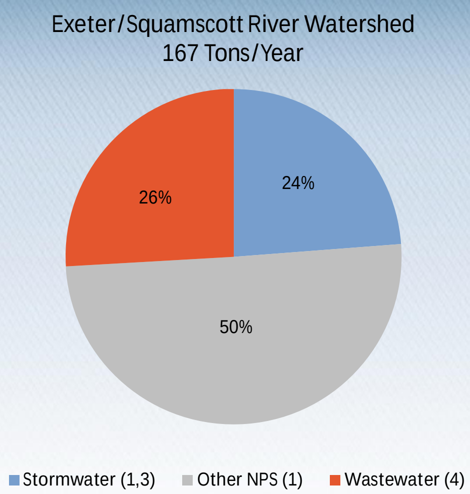
Coastal Watershed







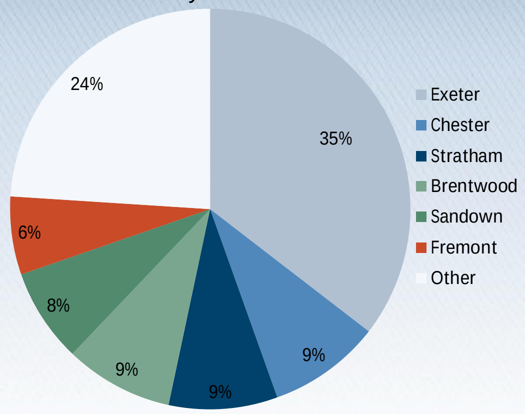
Watershed Loads



Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010
3. HW Baseline Memorandum, 2017
4. Wastewater Facilities Plan for Exeter, W-P, 2015

Watershed Loads

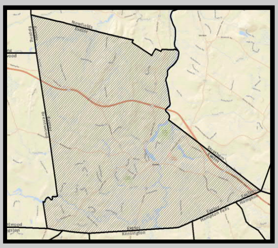
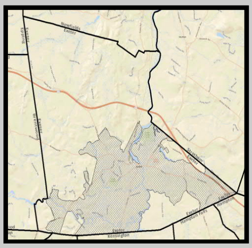
Exeter/Squamscott River Watershed
Load by Town



Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010

11

Watershed Loads

AOC & NCP	MS4	Exeter/Squamscott River Only
		

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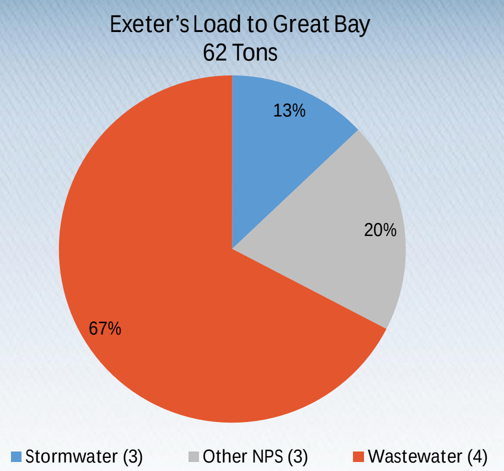
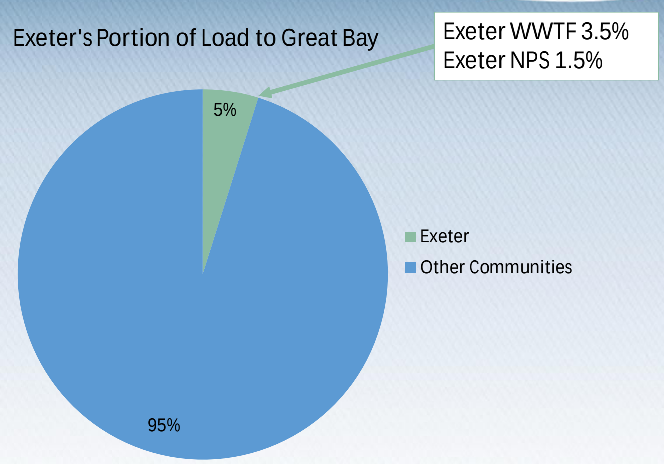
Watershed Loads - NCP



Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010
3. HW Baseline Memorandum, 2017
4. Wastewater Facilities Plan for Exeter, W-P, 2015

Watershed Loads – NCP



Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010

Nitrogen Management Measures

- Point Source Strategies >> WWTF Upgrade
  - Existing Conditions – Lagoons for 1.7-mgd at 20-mg/l
  - On-Going Upgrade – Enhanced Treatment for 2.2-mgd to 5-mg/l
  - Future Expansion – Enhanced Treatment for 3.0-mgd to 5-mg/l
  - Future Upgrade – Advanced Treatment for 3.0-mgd to 3-mg/l

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Nitrogen Management Measures

- Non-Point Source Strategies
  - Atmospheric Deposition
  - Agricultural Nutrient Management
  - Residential Fertilizer Management[Δ]
  - Enhanced Street/Pavement Cleaning Program*
  - Enhanced Organic Waste & Leaf Litter Collection*
  - Stormwater Infrastructure O&M Program*
  - Advanced On-Site Septic Systems
  - Limited Sewer Extensions
  - Stormwater Best Management Practices

[Δ] Under MS4 permit, this is only required on municipally owned properties
* Required under the 2017 Final MS4 Permit

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Cost-Effectiveness of Nitrogen Management Measures

Strategy	Est. 20 Year Cost Per Pound TN Removed
Atmospheric Deposition Reductions from Clean Air Act	$ 0
WWTF Upgrade (20-mg/l to 5-mg/l)	$ 50
WWTF Upgrade (from 5-mg/l to 3-mg/l)	$ 60
Residential Fertilizer Program	$ 140
Agricultural Program	$ 200
Septic System (within 200m of Waterbody)	$ 210
Infrastructure Maintenance Program	$ 330
Septic System (outside 200m of Waterbody)	$ 470
Stormwater Infiltration BMP	$ 520 - $1,170
Stormwater Enhanced Biofiltration BMP	$ 850 - $1,910
Sewer Extensions	$1,350
Enhanced Street/Pavement Cleaning Program, Leaf Litter Collection Program	$2,530

NPS Alternatives

- Each alternative assumes that the Exeter WWTF is upgraded to 5-mg/l effluent TN
- NPS Alternative 1
  - Remove the equivalent NPS load as upgrading the Exeter WWTF to 3-mg/l effluent TN (i.e., equals 10,400 lbs/year by NPS measures in 20 years)
- NPS Alternative 2
  - Meet the requirements of the MS4 program
- NPS Alternative 3
  - Meet MS4 requirements plus an additional $100,000/year
- NPS Alternative 4
  - Alternative 3 plus requiring select on-site denitrification systems plus stormwater BMPs on public properties and rights-of-way

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NPS Alternatives

Alternative	NPS Delivered Load Removed (lbsN/year)	Percent Reduction of NPS Delivered Load	Total 20 Year Life Cycle Cost	Est Cost per NPS Delivered Load Removed ($/lbN/year)
1 – 10,400 Lbs Reduction	10,400	26%	$102.0M	$680
2 – MS4 Requirements	3,230	8%	$7.3M	$1,070
3 – MS4 Plus	3,740	9%	$9.3M	$550
4 – Town Property	5,970	15%	$40.9M	$710
Comparison WWTF Upgrade "from 5 to 3" mg/l	10,400	-	$11.6M	$60

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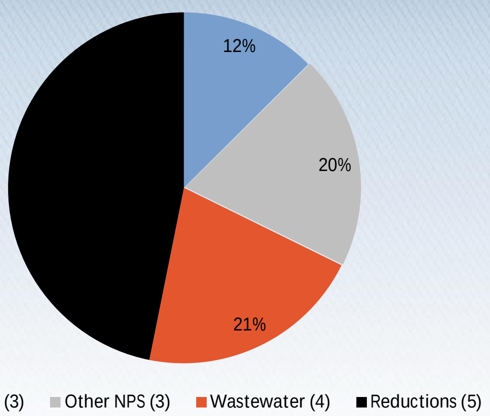
Watershed Loads - NCP

Town of Exeter's Load to Great Bay
After WWTF Upgrade & Residential Fertilizer Ordinance

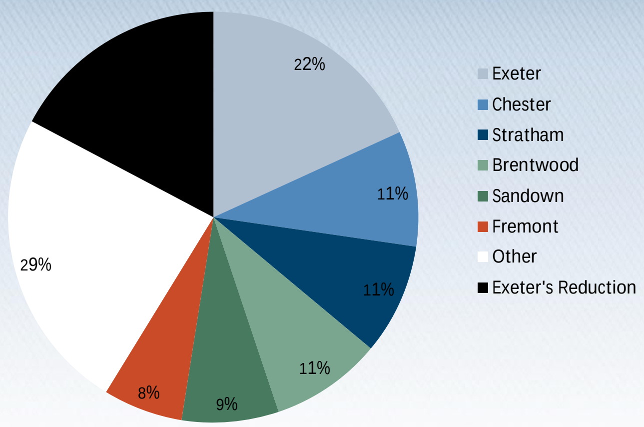


Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010
3. HW Baseline Memorandum, 2017
4. Wastewater Facilities Plan for Exeter, W-P, 2015
5. HW Alternatives Memorandum, 2018

20

Watershed Loads - NCP

Exeter/Squamscott River Watershed Load by Town after
Exeter WWTF Upgrade & Residential Fertilizer Ordinance



Source:
1. DES GBNNPS Study, 2014
2. DES Draft GB NLA, 2010

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Next Steps

- Obtain input from the Select Board on the NPS Alternative Selection shown in the NCP (7/23)
- Brief River Advisory Committee (8/23)
- Develop Draft NCP for Town staff input
- Submit Draft NCP for Select Board input (9/7)
- Present Draft NCP to Select Board (9/10)
- Receive comments from Town (9/18)
- Update and submit NCP to EPA (9/28)

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Questions / Discussion

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EXETER PUBLIC WORKS DEPARTMENT
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MEMO

DATE: July 20, 2108

TO: Russell Dean, Town Manager

FROM: Jennifer R. Perry, P.E., Public Works Director

RE: Municipal Solid Waste Program Fee Increases

The costs for collection and disposal of Exeter's municipal solid waste (MSW) continue to rise. There was a significant cost increase with the end of Northside Carting's 9 years of service (5 year contract and 4 year extension) in May 2017. Waste Management's 5 year contract (through May 2022) increases fees 3% per year, includes a provision for biannual diesel fuel surcharges and reflects the changing value of recycling commodities (which has been decreasing in value).

The Public Works Department has reviewed fees that support the MSW program and proposes several modifications to offset the costs of the program. The April 25, 2018 draft report "Solid Waste Program Review" prepared by intern Chris Robillard provides a thorough review of the MSW program and supports the following recommendations.

1. Increase the price of pay-as-you-throw blue bags from $2.00 to $2.50 for large bags and $1.00 to $1.25 for small bags.
   a. Blue bag prices were last adjusted in 2009.
   b. Increases would yield additional $121,000 annually if bag sales remain constant.
   c. The proposed prices are comparable to other PAYT communities:

	Large Bag	Small Bag
Concord	$2.50	$1.25
Raymond	$2.35	$1.80
Newmarket	$2.25	$1.15
Dover	$2.15	$1.45
Kensington	$2.00	--
Somersworth	$1.85	$1.30

2. Increase the price of freon containing appliance sticker from $7.00 to $10.
   a. Exeter's current disposal cost is lower than surrounding communities.
   b. Increase would yield additional $1,200 annually.

3. Require all users of the transfer station to obtain a $10 annual permit. Currently residents may dispose of leaf bags and Christmas trees without a permit.

4. No longer allow commercial vendors or entities to dump brush and leaves. Most surrounding towns accept brush for free from residents, but do not accept from commercial vendors. Exeter is receiving excessive volumes of brush and some may be coming from beyond Exeter. An alternative could be to establish a fee schedule for commercial vendors, such as what Stratham charges residents:
   6-foot pickup load............$25
   8-foot pickup load............$30
   single axle dump..............$50
   tandem axle dump..........$100

4/25/2018

Solid Waste Program Review

Exeter, New Hampshire

Chris Robillard

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Abstract

The town of Exeter, New Hampshire operates a complex, multi-faceted solid waste program consisting of curbside trash and recycling collection, hazardous materials disposal, specialty waste disposal, and a transfer station. Economic forces and new contracts have led to increased costs in operating the program in recent years. This report looks at all aspects of the Exeter solid waste program, analyzing the past five years in an effort to project future costs. The report concludes with several recommendations to town officials and employees that seek to address the budgetary shortfall in the program.

Abbreviations

EIA .... Energy Information Administration

EPA .... Environmental Protection Agency

DOE .... Department of Energy

HHW .... Household Hazardous Waste

NHDES .... New Hampshire Department of Environmental Services

RFP .... Request for Proposal

STEO .... Short Term Energy Outlook

DPW .... Department of Public Works

PAYT .... Pay As You Throw

Scope and Methods

This report represents a review of the solid waste program in Exeter, NH. All aspects of current solid waste financial concerns were explored to include solid waste collection, recycling, specialty waste programs, and the town transfer station. Financial implications related to the Cross Road landfill were not explored, since its continual monitoring is mandated, and therefore its cost is not subject to budgetary concerns.

The bulk of the financial data within this report comes from past years' budgets. Town budgets serve as baseline for spending and revenues and are used to develop projections. Other financial data comes from Finance Department reports as well as sales data from Waste Zero, the blue bag distributor. Projection data as it applies to waste tonnage costs, haul fees, etc. comes from analysis of invoices from both Northside Carting, Inc. and Waste Management for the period of 2013-2017. The town's website also provides invaluable information related to the various programs as well as access to the Northside Carting Inc. and Waste Management contracts. Finally, fuel price information comes from the Energy Information Administration (EIA) as outlined in the Waste Management contract.

Background

Exeter, New Hampshire is a historic town in Rockingham County situated upon the Exeter and Squamscott rivers. Located approximately 34 miles southeast of the state capital and 43 miles north of Boston, Exeter consists of 20.1 square miles of land and inland water area (NH Employment Security, 2017). Exeter is a varied town in that it consists of a walkable historic downtown and busy commercial areas surrounded by rural housing and conservation lands. The town is just a few miles from Interstate-95 while also being bisected by NH Route 101, the highway connecting many of New Hampshire's largest communities in the southern portion of the state.

The estimated town population was 14,845 in 2016, an increase of just under 800 since the 2000 census (NH Office of Strategic Initiatives, 2017). Within the population, the age distribution has changed dramatically. The percentage of residents older than 45 has increased by 17% since 2000 with the largest increase being in the percentage of residents aged 60-74%. There were approximately 6,257 households in 2015, of which 3,766 were family households. The average household size was 2.25 with a median household income of $73,519.

In 1993, the town implemented the pay-as-you-throw program that currently exists. This occurred once the town's Cross Road Landfill was no longer operational. Throughout the 2000s, Exeter has maintained curbside collection service through trash removal companies. While the service has remained relatively consistent, the contractor has varied. There have been two contracts through Waste Management, the current contractor, interposed by a contract with

Northside Carting from 2008-2017. While the town has had experience with Waste Management, that previous contract expired a decade ago.

Current Contract/MSW

In 2008, the town entered into a five-year contract with Northside Carting for the collection and disposal of solid waste and recycling. The contract was for a five year term, ending on May 31, 2013. In 2012, the contract was modified and extended through May 2017. The contract with Northside was fairly simple in that Northside charged the town an annual sum for all aspects of solid waste collection. After several service-related concerns, the town issued a Request for Proposal (RFP) for a new solid waste collection contract. After reviewing a few proposals, the town awarded the contract to Waste Management. Compared to the Northside Carting contract, the Waste Management contract is much more detailed with charges broken down by service.

The Waste Management contract term is from June 1, 2017 through May 31, 2022; with a three year extension provision provided there is mutual agreement between the parties. Solid waste collection services remain the same under the new contract. Table 1 outlines the contract charges. In addition to the charges below, there is a biannual fuel surcharge adjustment. Waste Management set a fixed quantity of 1,599 gallons of diesel fuel per month at a baseline rate of $2.50 per gallon. As prices rise or fall, according to EIA data, monthly fuel surcharges will be added to the monthly charges.

Table 1. Waste Mangement Contract Provisions

Curbside MSW & Recycling Collection/Disposal	$45,370.67 per month
MSW Disposal Per Ton	$70.00 per ton
Recycling Processing	Varied
Curbside Yard Waste Pickup	$7,200.00 bi-annually
Construction Debris (roll off container at Transfer Station)	$190.00 per haul & $70.00 per ton
Cardboard (roll off container at Transfer Station)	$190.00 per haul
Performance Bond	Year 1: $6729.23 Subsequent Years: $7402.15
Startup Costs	$1,666.67/month

Recycling

Recyclable materials are picked up curbside in the same manner as solid waste that goes in blue bags. Recyclables must be in approved recycling bins that are sold at the Department of Public Works. Under the Northside Carting contract, Northside Carting retained the proceeds from the processing of recyclable materials. Under the current Waste Management contract, the means of collection have not changed, but the handling of proceeds has. All recyclable materials must be processed at the materials recovery processing facility at the Turnkey Landfill in Rochester, NH. Acceptable materials include ferrous cans, plastic containers, paper, glass, etc. The recycling program is single-stream, meaning that all recyclables can be placed in the same bin for ease of collection. At the material recovery facility, the single-stream materials are sorted by a variety of mechanical processes.

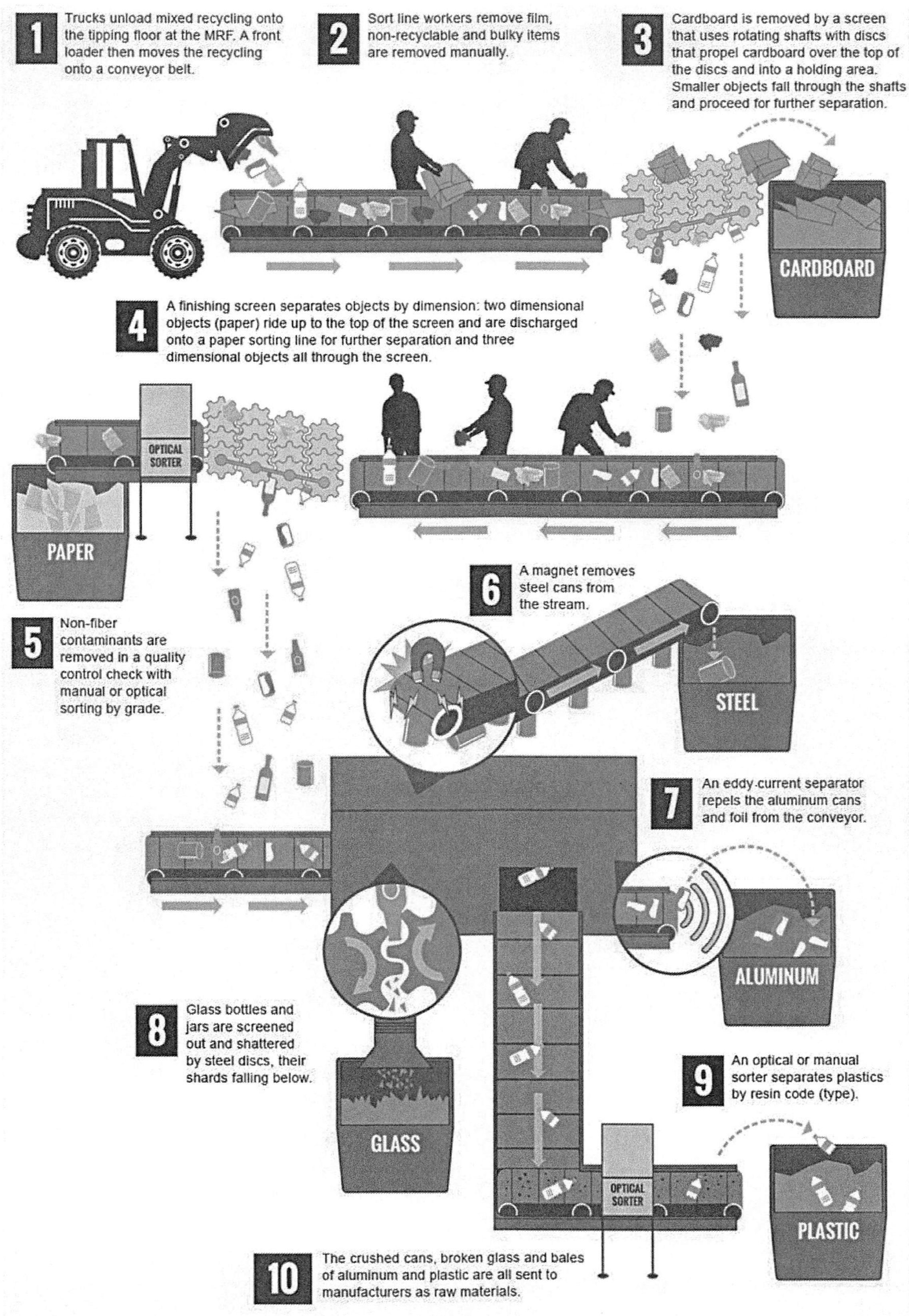

Figure 1. Single Stream Recycling Process; (Advanced Disposal Services, Inc., 2018)

At the processing facility, the composition of the town's recyclables is calculated. Percentages of each type of material give the facility a means for calculating the value of the materials. The percentage of each material is then applied to prevailing market values for each type. This determines the blended value of the materials. Subtracted from this blended value are the processing and transportation fees, which are $78.00/ton and $40.00/ton, respectively. Both are subject to the three percent annual increase per the terms of the contract. If the resulting value is positive, the town retains 50% of that value per ton. If the result is negative, the town is charged a the per ton fee.

In the example below, Exhibit D in the Waste Management contract, recyclable commodities are listed in the first column, followed by the index used for pricing in the second column. Column three shows an example of what a typical single stream recycling load may look like, with percentages listed for each type of material. After applying the market value in column four, the per-ton values are determined in the final column. At the bottom of this table, the total blended value of the recyclables is listed, $88.40/ton in this example. When the processing and transportation fees are applied, the result is a negative $29.60/ton. This means that the town, in this hypothetical example, is billed $29.60 for each ton of recyclables. While one may not expect the town to have to pay for recycling, this is far cheaper than the $70/ton rate for solid waste, not to mention the environmental benefits that are not accounted for here.

Exhibit D

Revenue Share Calculation - Single Stream

Commodity	Index *	Current Composition %	Market Value/Ton	Values
OCC (Cardboard)	PPI OCC #11	19.11%	$ 160.00	$ 30.57
ONP (Newspapers, magazines and inserts)	PPI Sorted Residential Paper #56	38.21%	$ 85.00	$ 32.48
Mixed Paper (All other paper)	PPI Mixed Paper #54	1.64%	$ 65.00	$ 1.06
Aluminum Beverage Cans	SMP for Aluminum Cans (Sorted, Baled cents/lb. delivered minus $.08 per pound)	1.14%	$ 1,220.00	$ 13.89
Steel/Tin Cans	SMP for Steel Cans (Sorted, densified, $/ton and delivered)	2.40%	$ 40.00	$ 0.96
PET (Plastic #1)	SMP for PET (baled, cents/lb. picked up)	3.08%	$ 260.00	$ 8.02
Natural HDPE (Plastic #2)	SMP for Natural HDPE (baled, cents/lb. picked up)	0.94%	$ 710.00	$ 6.65
Colored HPDE (Plastic #2)	SMP for Colored HDPE (baled, cents/lb. picked up)	0.94%	$ 490.00	$ 4.59
Mixed Plastics (Plastic #3-7)	SMP for Commingled ((baled, ¢/lb. picked up)	3.41%	$ 60.00	$ 2.04
Glass	Actual Value	19.15%	$ (28.00)	$ (5.36)
Residue	Fixed Rate	10.00%	$ (65.00)	$ (6.50)
	Total/Blended Value	100.00%		$ 88.40
	MRF Processing Fee	$ 78.00		
	Transportation Fee	$ 40.00		$ (29.60)
	50% share above Fees ($118)			

Blended Value is Calculated Monthly.

- PPI means the higher of the prices issues by RISI Pulp & Paper Index for the New England Region, Domestic Price, 1st issue of the month retroactive to the first of the month.
- SMP means the higher of the price published at www.SecondaryMaterialsPricing.com for the New York Region, first dated price each month, retroactove to the first of the month.
- Actual Value means the average price paid to or charged to the processing facility during the month of delivery, less any freight or other charges paid to third parties.

Figure 2. Waste Management Recycling Charges Example: (Waste Management, 2017)

On average, Exeter's net cost when combining the blended value of the recyclables and the fees is negative $39.78/ton. This means that Exeter was charged, on average, $39.78 for each ton of recyclables during the period from July to December 2017. This is considerably cheaper than the $70.00 that the town is charged for solid waste. When multiplied by the total weight of the recyclables, the total recycling charges end up being an average of $4,981.84 per month.

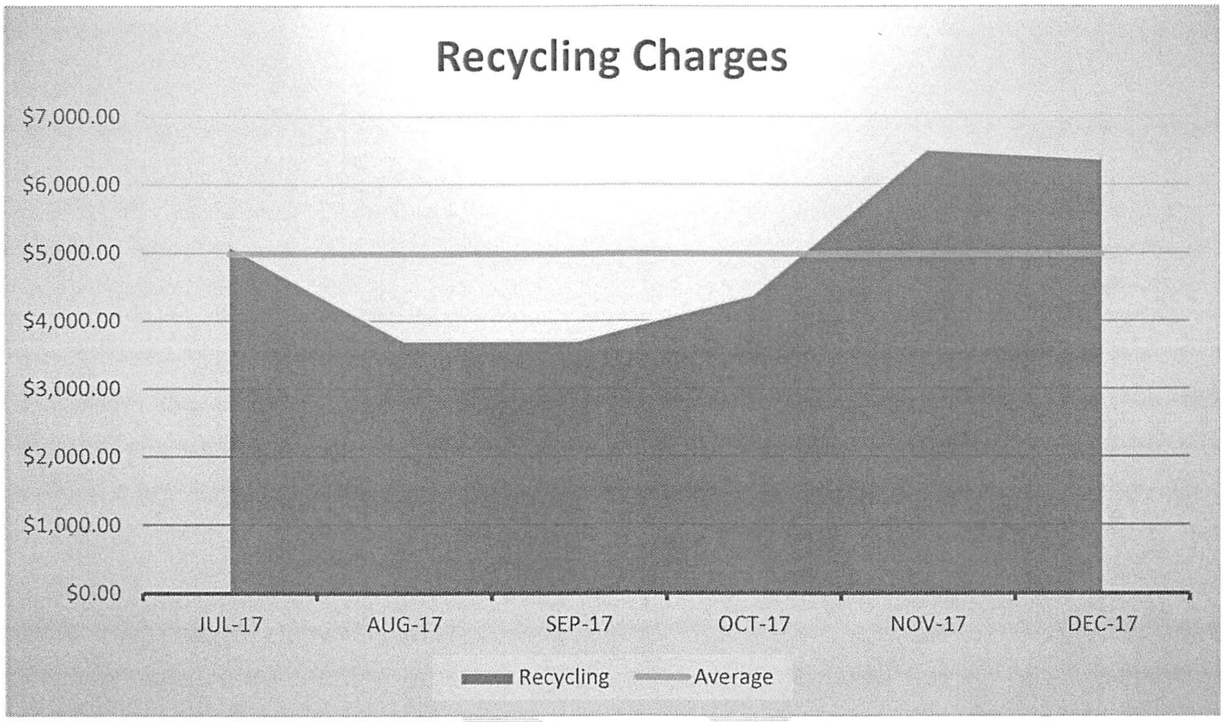

Figure 3. Recycling Charges by Month

Fuel Adjustment

Municipal solid waste collection utilizes large quantities of fuel in the collection, haul, and disposal of waste. The cost of operating a solid waste collection program can be highly variable based on prevailing fuel prices. Since it can be hard to predict operating costs in the later years of a waste collection contract, contractors may include a fuel adjustment provision. The contract with Waste Management contains a bi-annual fuel adjustment, occurring on December 1st and June 1st of each year. The contract establishes a fixed quantity of diesel fuel, 1599 gallons per month, and a baseline fuel cost of $2.50 per gallon. It is from this per gallon rate that the fuel surcharge is calculated. Diesel fuel prices from the six month period prior to the adjustment are subtracted from the baseline rate to determine the per gallon adjustment. To determine the total fuel surcharge, this per gallon adjustment is multiplied by the fixed quantity. The average diesel fuel price is determined by the Energy Information Administration (EIA), using data for the Northeast region. The Northeast region includes Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island. The EIA is part of the US Department of Energy (DOE), although it is independent from the DOE in matters related to data collection and reporting.

In December 2017, the first fuel adjustment occurred. The average retail diesel price for the New England region from June through November was \$2.69333. This represents a \$.19333 per gallon increase over the baseline. When multiplied by the fixed quantity, the resulting fuel surcharge is \$309.14 per month. This monthly charge continues from December 2017 through May 2018, at which point a new surcharge will be calculated using average prices from December 2017 through May 2018. That newly calculated rate will go into effect June 1st.

$$\$2.69333 - \$2.50 = \$.19333/\text{gal} \qquad \$.19333 * 1599\text{gal} = \$309.14$$

Looking forward through the life of the contract, EIA projections provide a means of calculating a reasonable cost of the fuel adjustment over the life of the contract. Each month, the EIA releases an updated Short Term Energy Outlook (STEO), which projects energy prices through the next calendar year using data, trends, and statistical modeling. Current projections show diesel fuel prices exceeding \$3.00/gal at the beginning of 2018 and then dipping down to around \$2.80 before creeping above \$2.90 by the end of 2019 (Figure 1). To project the latter half of the contract, the EIA's long-term projection is used, which projects the price of energy through 2050. Current projections show that by the end of the current solid waste contract, fuel prices will likely be well over \$3.00/gal (Figure 2). As a point of reference, every \$.10 increase in diesel prices above the threshold will result in just under \$2,000 of additional cost to the town per year.

$$\$.10 * 1599\text{gal} = \$159.90/\text{mo.} * 12 = \$1918.8/\text{yr}$$

If diesel prices are \$3.30/gal in 2022, as currently projected, the fuel surcharge at the end of the contract will be \$1,279.20/month, or \$7,675.20 for the last six months of the contract. Using a conservative \$.30 surcharge over the remaining life of the contract, this provision could increase the total cost of the contract by over \$30,000.

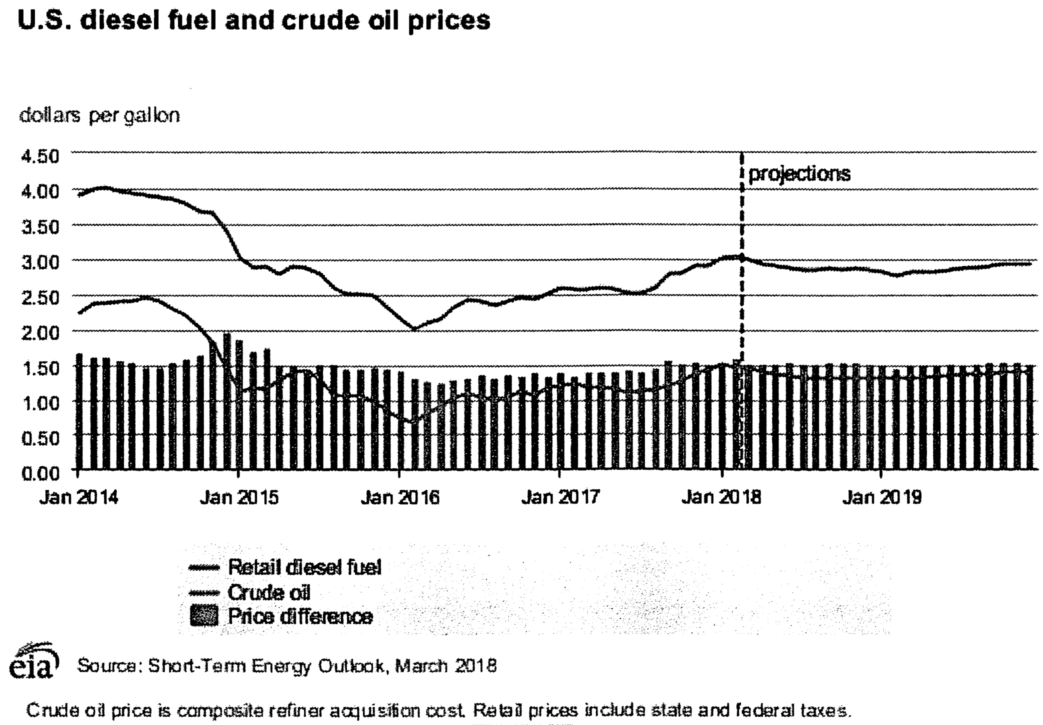

Figure 4. Short-Term Diesel Fuel Price Outlook

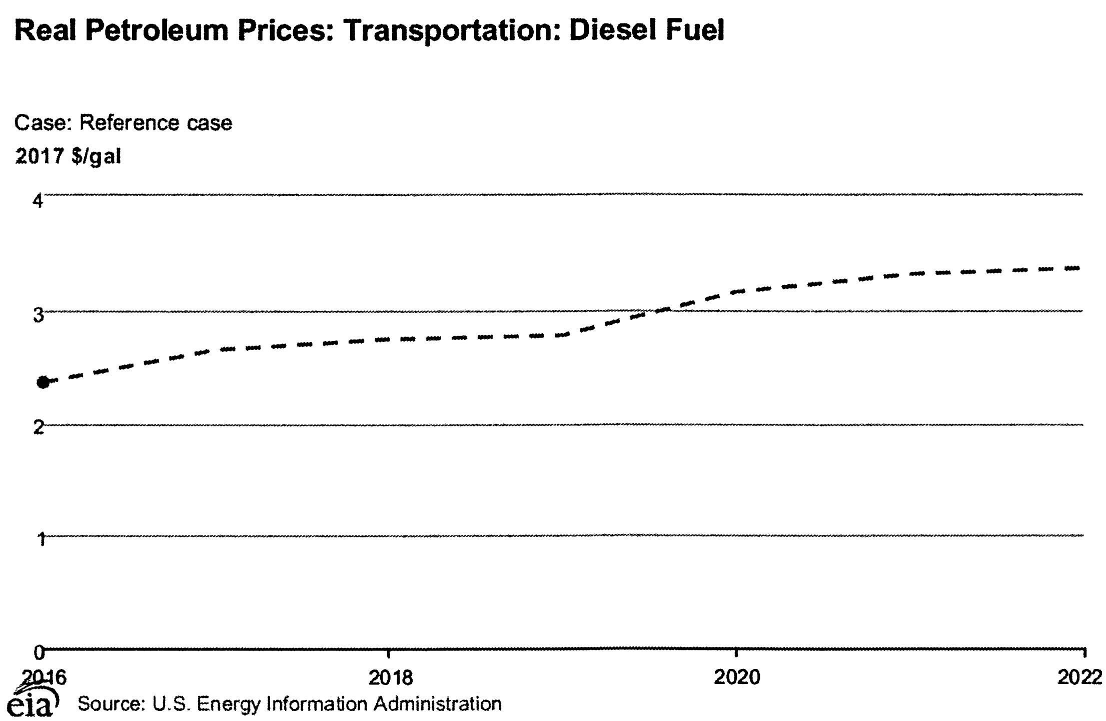

Figure 5. Diesel Fuel Price Projections Through 2022

Solid Waste Disposal

The solid waste program is listed in the town's budget as a part of the General Fund. Many of the programs in solid waste have fees that seek to cover the cost of operating that program. For example, transfer station permits are sold to cover the cost of operating the transfer station, electronic waste stickers are sold to offset the cost of disposal, etc. Solid waste collection and disposal is no different. The town collects funds through the sale of blue bags and bulky waste stickers. These funds then cover the cost of operating a curbside collection service.

Over the five-year period from 2013-2017, the cost of solid waste collection and disposal rose in accordance with the provisions of the contract extension through Northside Carting. The average percent increase in cost year to year was 2.49%. This represents an increase of $66,848.00 in the solid waste disposal budget in 2017 over 2013. Solid waste revenues from bags and stickers increased an average of 2.33% over the same period for an increase of $44,133.50 in 2017 over 2013. Thus, while the percent change of each are similar, the gap between the cost and revenue continues to widen. Figure 6 shows the trend of both revenue and spending. While the gap is fairly consistent, there is a pronounced widening that occurs in 2017 as the Waste Management contract takes effect. Figure 7 displays the net operating deficit of the solid waste collection when combining the cost of the collection and disposal with the revenues generated from blue bag and bulky sticker sales. The deficit is over $200,000.00 annually, and it will continue to grow with the more expensive Waste Management contract and its annual price increases.

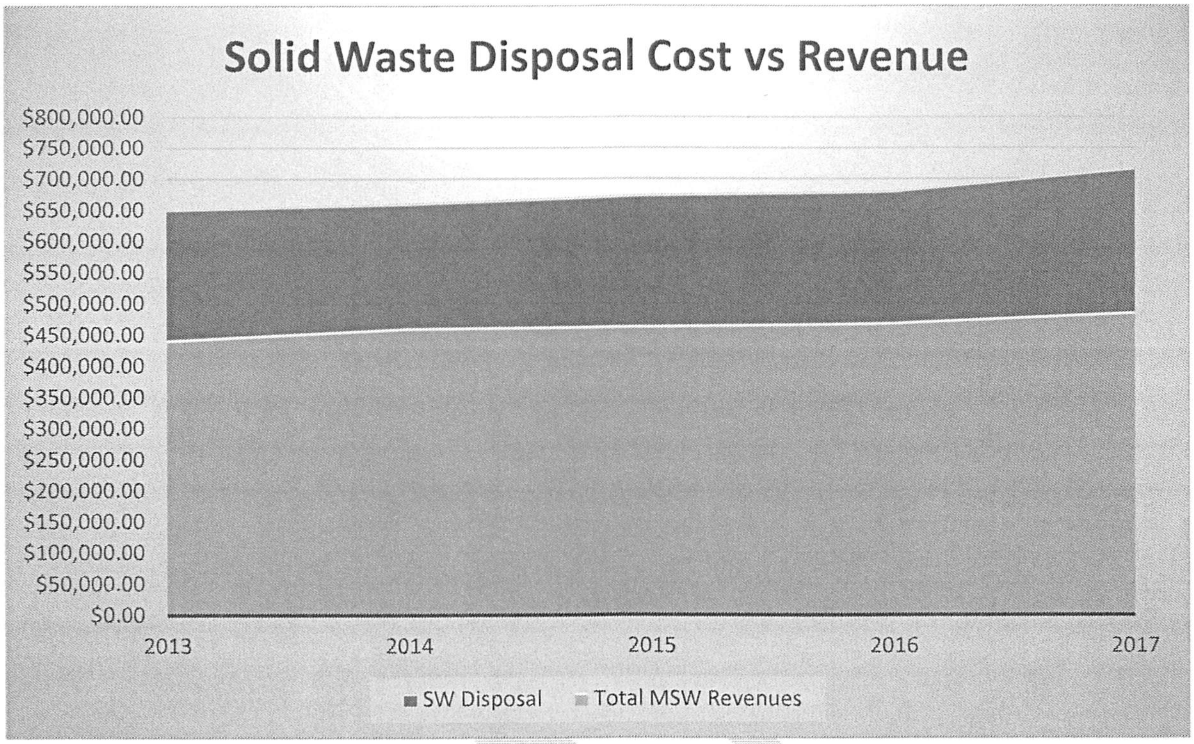

Figure 6. Solid Waste Revenues & Outlays

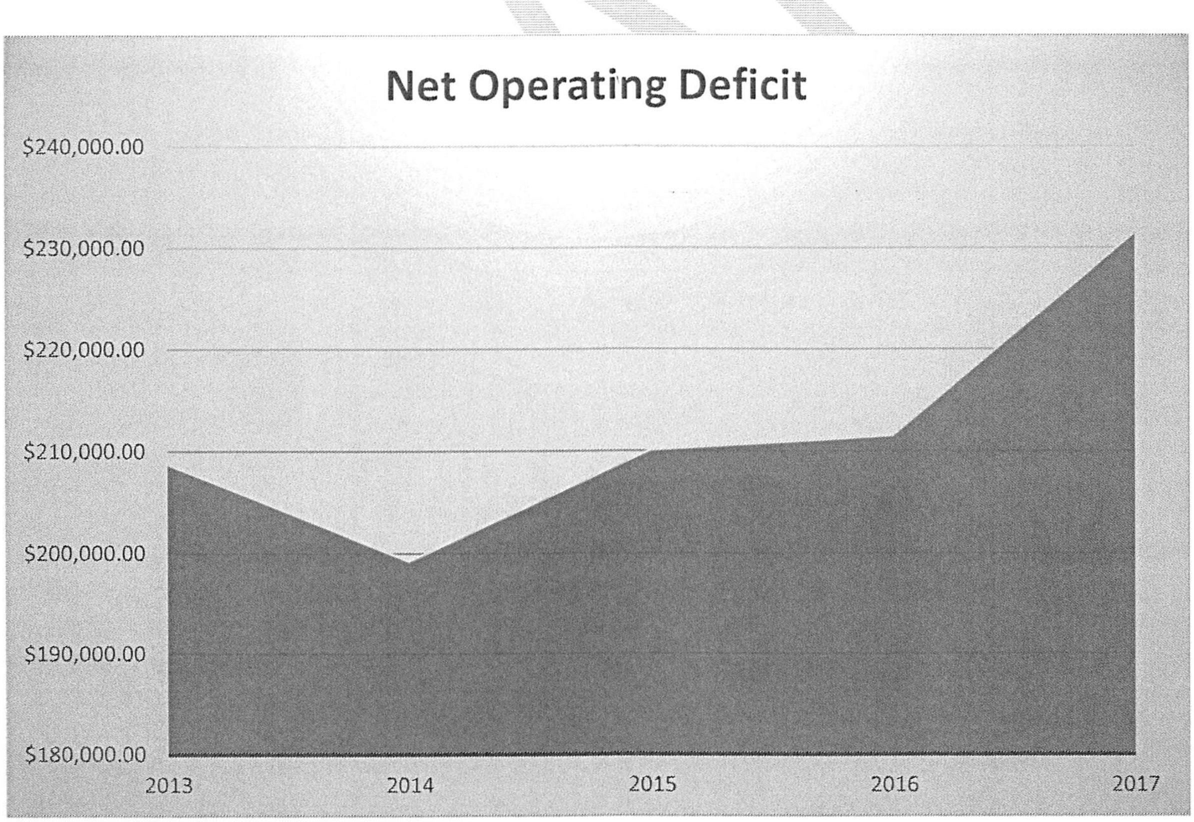

Figure 7. Net Operating Deficit, Solid Waste Collection

Blue Bags/Bulky Stickers

The largest portion of the town's solid waste program is the curbside municipal waste pickup by Waste Management. This service represents both the largest budget line item in the solid waste program and the most visible aspect of the program. To offset the cost of this aspect of the program, Exeter utilizes a Pay-As-You-Throw (PAYT) program. In such a program, residents directly pay for the trash they produce. Not only does this reward recycling and discourage excess disposal, it creates a link between the service provided by the town and the residents using the service.

Exeter has two primary means by which user fees are implemented to cover the cost of municipal waste collection: town designated trash bags and bulky items stickers. PAYT systems come in many forms. Some municipalities use bins of varying size and cost, some charge by weight of the trash, and others use specialty bags that residents purchase. Each of these programs fall within the category of trash-metering, and Exeter employs the third type of program. If an Exeter resident wishes to dispose of trash, it must be in specialty marked trash bags emblazoned with the town seal. Waste Management does not pick up trash that is not in a blue bag. The second means by which Exeter implements user fees is by selling bulky waste stickers. Bulky Waste stickers are used for household goods that are too large to fit into the bags. Items such as mattresses, tables, couches, etc. are all considered bulky items. Appliances and hazardous materials are not permitted to be disposed of as bulky waste items.

Blue bags are sold at a variety of retailers in the town including Arjay's Ace Hardware, Convenient Grocer, Deep Meadow Variety, Extra Mart, Gerry's Variety, Hannaford, Market Basket, Shaw's, and Walgreen's. The town offers small bags (15 gallon) which sell for $1.00 and large bags (33 gallon) which sell for $2.00. Bags are generally sold in rolls of ten bags. The town uses a contractor, WasteZero, who sells the bags to the town and facilitates delivery to the various stores. This eliminates the need for warehousing large quantities of bags, which represent thousands of dollars in retail value, as well as having a town employee deliver and maintain stock at the stores. Currently, when a store needs more bags, they contact WasteZero directly to order another shipment. Most stores sell the bags simply due to the increased traffic they receive. Since all residents need to purchase the bags, being one of the several locations that sells them is lucrative enough to make it worth the stores' while. As an added incentive, stores are authorized to charge an extra $.05 per bag to offset the cost involved with participating in the program. Some stores take advantage of this opportunity while others do not.

Bulky stickers are sold at the town offices, the public works department office, and Arjay's Ace Hardware. For $5.00, residents may place a bulky item at the curb with their trash bags. Residents are limited to one bulky item per week. The bulky item must not be a "white good" such as a washer or dryer, a Freon item such an air conditioner or refrigerator, or an electronic item. All of these items must be properly disposed of or recycled through the programs at the town transfer station.

Combined, the blue bag revenue and the bulky sticker revenue provide the primary means for offsetting the cost of municipal waste collection. Over the five-year period, revenue from the bulky waste stickers increased by approximately 65% while revenue from the blue bags increased by just under 9%. Over the same period, solid waste disposal costs rose approximately 10%. Since bulky waste stickers represent a very small portion of the solid waste revenues, the large percentage increase over the five-year period does little to impact the net cost of the program (Figure 3).

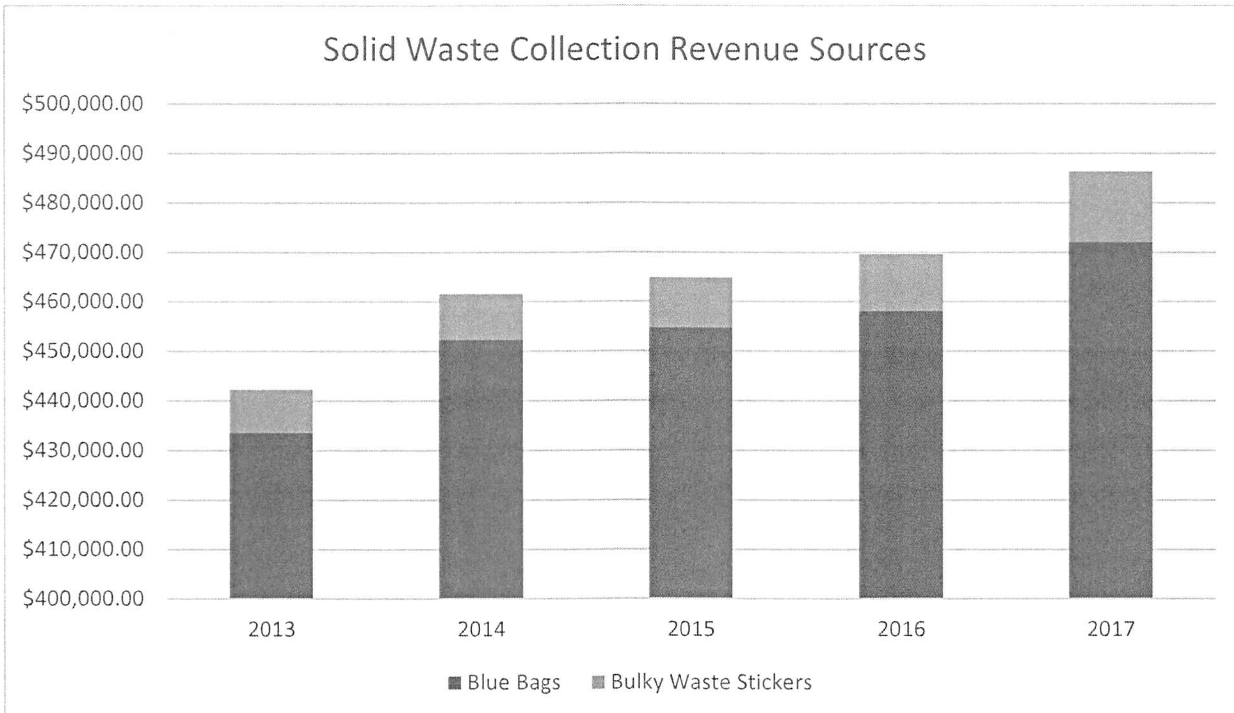

Figure 8. Solid Waste Revenues

Transfer Station

The town operates a transfer station on Cross Road, which allows residents to dispose of certain materials. The transfer station is generally open for 14 hours per week, with an additional four hours when winter hours are in effect. To use the transfer station, residents generally need to purchase a permit. Permits can be purchased at the Town Clerk's office or the Public Works office and are available in two options. An annual permit is $10, and a 5-day permit is $5. Used oil, leaves, Christmas trees, books, CDs, DVDs, clothes, shoes, cell phones, and calculators can all be dropped off at the transfer station at no cost to residents. Metal, non-refrigerant appliances, wood, propane tanks, recyclables, trash (in blue bags), batteries, and mercury-containing items can all be dropped off with a valid transfer station permit. Other specialty items (electronics, refrigerant-containing items, and construction debris) require a valid permit as well as specialty stickers of varying cost. In addition to providing a means of disposing of unwanted goods, the transfer station offers compost and wood chips for free to residents, subject to their availability.

Operation of the transfer station requires several expenses. These costs include the wages and training of employees at the station, operations maintenance at the station, tire disposal (municipal tires only), bulldozer rental to consolidate brush that is dropped off, electricity to run the facility, and various necessary supplies. These costs are offset by permit sales. Transfer station operating costs have varied year to year but have stayed within approximately a $7,000 range. The variability comes from several sources. 2015 and 2016 saw significant decreases in wages due to employee turnover. 2016 wages (including FICA, Medicare, and overtime) were only $5,573.00, while they were $14,588.00 in 2017. Tire disposal in 2016 was $3,305.00 compared to $810.00 in 2015 due to variability in tire replacement. Revenue from permits has been very consistent over the five-year period, holding steady between $15-16,000 with a slight year-to-year increase. Figure 9 shows the budget impact of the transfer station. There is a small, albeit consistent, operating deficit for the transfer station. Deficits range from approximately $4,000.00 to just over $12,000.00.

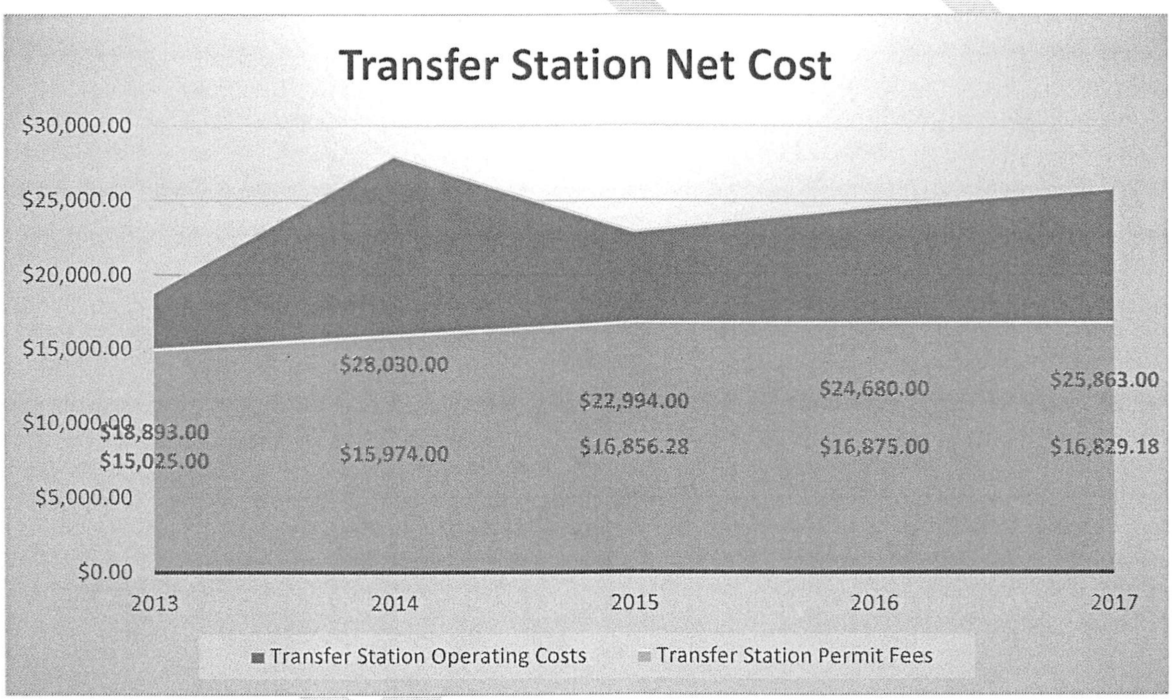

Figure 9. Transfer Station Net Cost

Additionally, the transfer station maintains a roll off container for cardboard and one for construction debris. Valid permit holders can drop off cardboard at the transfer station. When the cardboard bin is full, Waste Management is notified who then hauls off the container for a flat fee of $190.00. The collected materials are added to the town's recyclables. The construction debris roll off operates much the same way except that residents must purchase construction debris stickers or bags in addition to the required permit. Construction bags are used for small items such as drywall pieces, shingles, insulation, etc. The stickers are used for bulky items such as windows, doors, toilets, etc. Stickers and bags both cost $8.00. This revenue helps to offset the cost of the roll off: $190.00 per haul plus $70.00/ton of debris. The cost of the construction debris is tied to the number of hauls needed, which is variable depending on residents' home improvement projects. Table 10 depicts a program that generally runs a few thousand-dollar deficit, with the exception of 2016, which saw a dramatic increase in the number of hauls during the summer months. Typically, there are 1-4 hauls needed every month of the construction debris roll off. June, July, and August of 2016 required 23 hauls of the construction debris roll off, approximately two hauls per week during this time period.

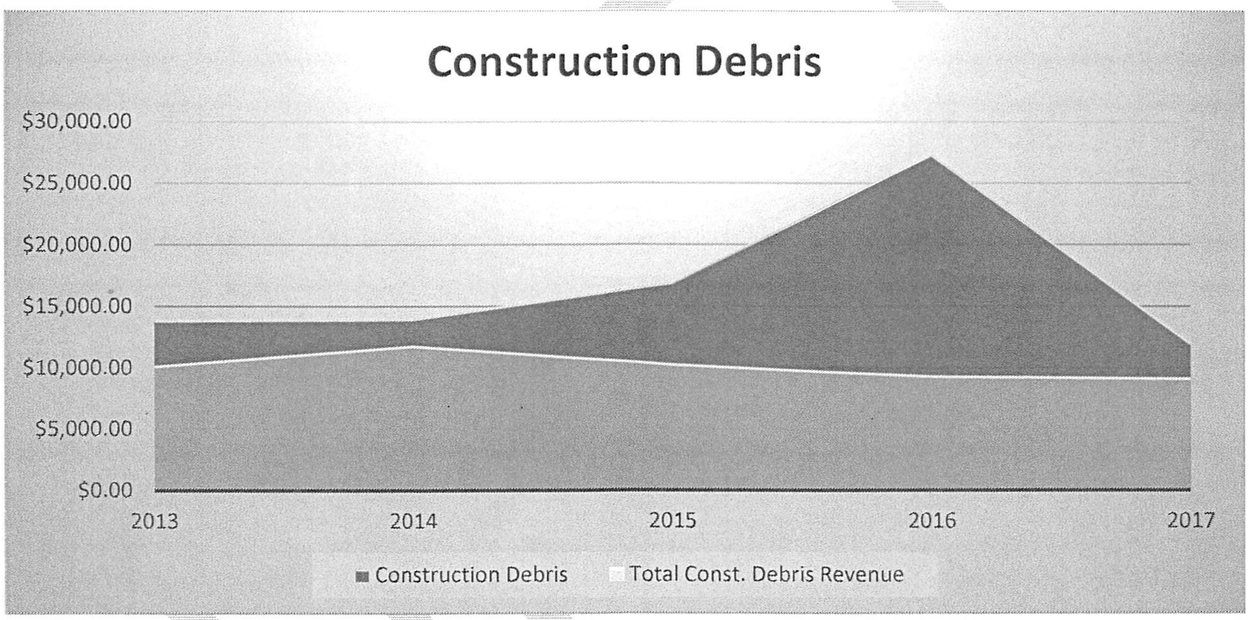

Figure 10. Construction Debris Net Cost

HHW

Since the mid-1980's, the Rockingham Planning Commission has coordinated a regional Household Hazardous Waste (HHW) collection event. The collection event occurs annually, typically on a Saturday in October. The regional program serves East Kingston, Epping, Exeter, Newfields, Seabrook, South Hampton, and Stratham. The Rockingham Planning Commission plans and manages the event, and Exeter hosts the event at the DPW facility while also acting as the fiscal liaison. In such a role, Exeter pays the upfront costs of operating the program and executes the household hazardous waste grant through the New Hampshire Department of Environmental Services (NHDES). This grant provides municipalities with funding at a per capita rate for up to half of the cost of facilitating the program. Costs include not only the disposal and recycling of the materials but also the outreach and education components of the program. To qualify for grant funding, communities need to do much more than advertise the event. The education campaign must "assure the division that it will conduct public educational activities regarding household hazardous waste, including education about its potential dangers and the proper means for its disposal, as well as information about ways to reduce its generation" (NHDES, 2008).

In addition to the grant money and contributions from participating municipalities, the HHW program asks for a $5.00 voluntary donation to help offset the cost of the program. This is a voluntary donation since municipalities would rather have the hazardous materials properly disposed of than worry about collecting a fee. Mandatory fees could suppress participation and lead to illegal dumping or improper disposal, especially among those facing financial hardship. There have been moderate fluctuations in the net costs of the program over the past five years, with 2016 being an outlier compared to the other four. Most years, the cost of the program is within a few thousand dollars of the revenue generated from the donations, town cost sharing, and grant funding. The difference between the overall cost and revenue represents the cost to Exeter.

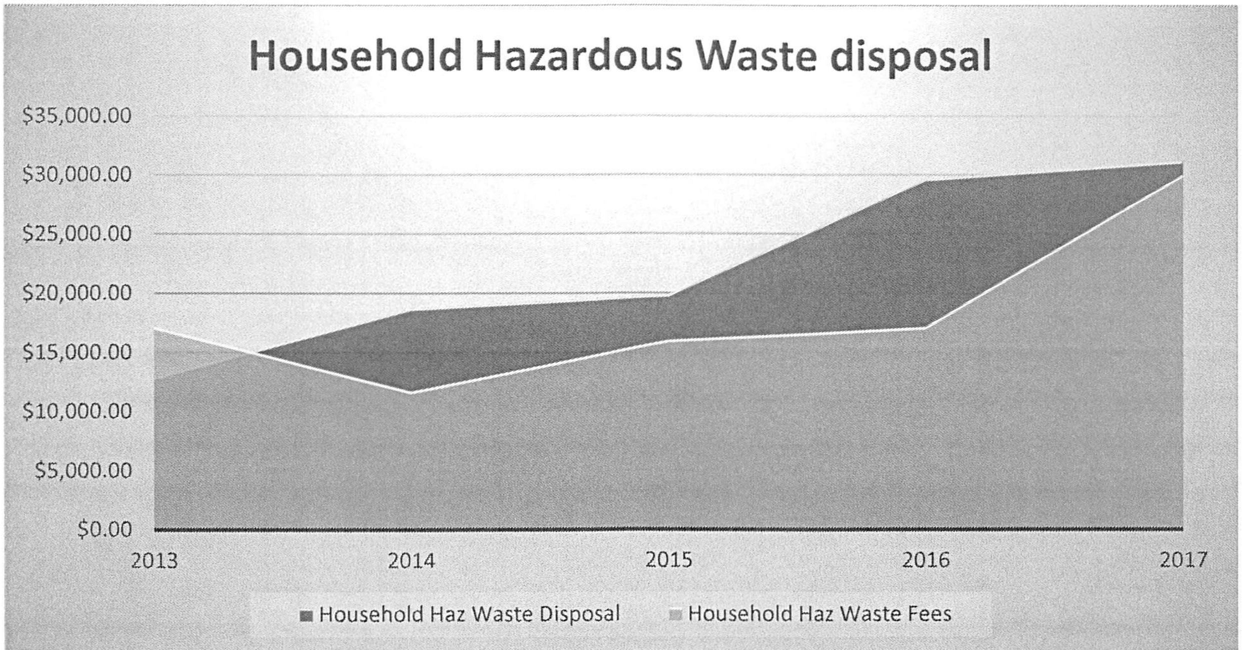

Figure 11. HHW Program Financials

Freon/Refrigerant Program

Exeter operates a Freon disposal program through the transfer station to facilitate the safe and environmentally conscious disposal of Freon or refrigerant containing appliances. All refrigerant-containing appliances (refrigerators, freezers, air conditioners, water coolers, and dehumidifiers) require special disposal. The Environmental Protection Agency (EPA) requires that refrigerant is recovered from a piece of equipment before it is disposed of under the Clean Air Act. Each piece of equipment cited for disposal requires a certification that the refrigerant has been properly recovered. This is why refrigerant equipment cannot be tagged as bulky waste. In Exeter, residents who have a transfer station permit can drop off Freon-containing appliances at the transfer station after purchasing an appliance sticker at Arjay's, the public works office, or the town offices. Stickers cost $7.00, and the revenue goes to offset the cost of disposal.

Due to the varied nature of appliance disposal, net operating costs of this program are highly varied. Some appliances that contain large amounts of metal may have value on the scrap metal market. The copper and refrigerant can both be of value which can reduce or eliminate the cost of disposal for a given year. The number and type of appliances dropped off vary from year to year which also affects the cost of the program. Figure 6 shows program overview for the year 2013-2017. In 2015, the value of the appliances was greater than the cost of disposal, so there was no budgetary impact for Freon disposal that year. The Freon program generally runs a net surplus, although this could change from year to year, based on resident disposal patterns and prevailing market rates for recyclables.

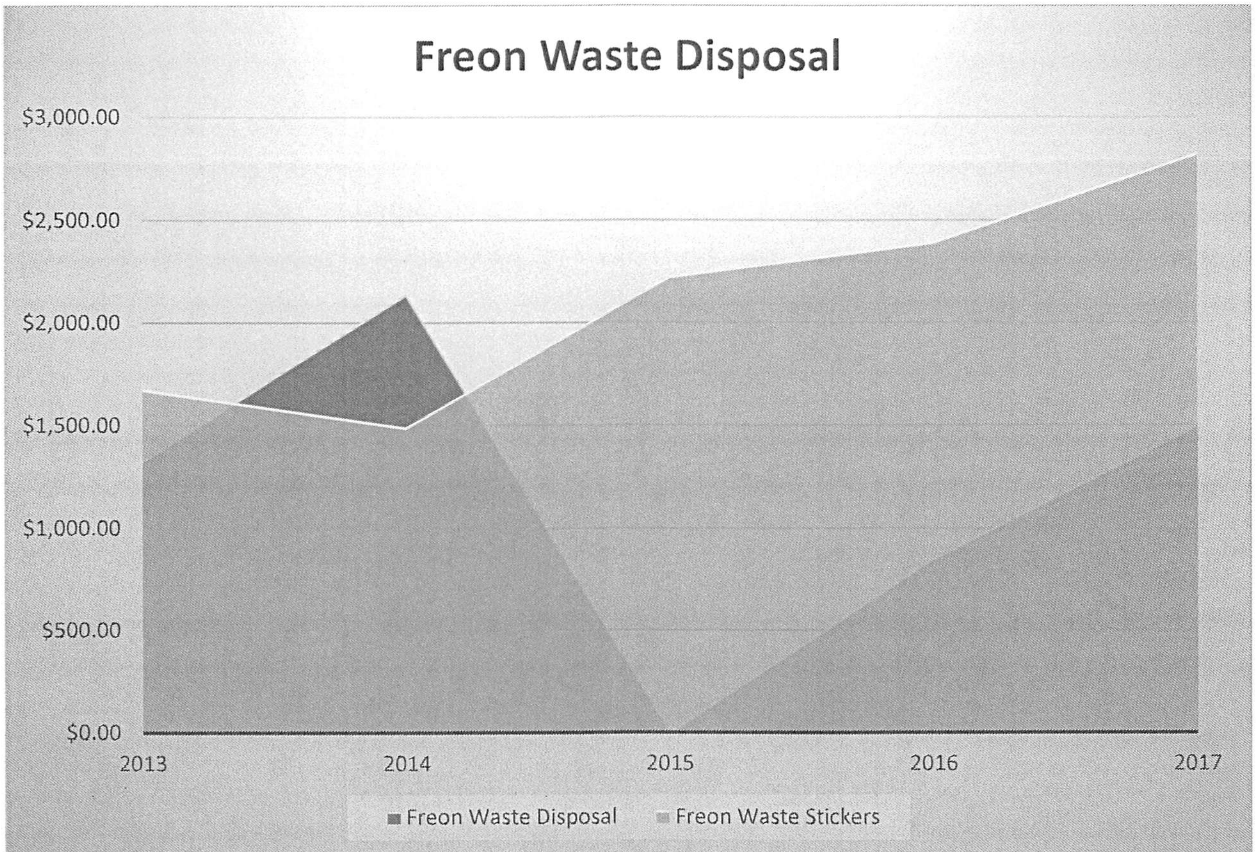

Figure 12. Freon Program Financials

Electronics Disposal

Electronic products that are at or near the end of their useful life are commonly referred to as "e-waste." E-waste is becoming an ever-increasing problem as the number electronic products continues to grow and as the content of the products becomes ever more complex. Toxic heavy metals and harmful chemical compounds are found within the most common electronic products. The environmental and health implications of discarding these goods provides the impetus for enacting strong electronic recycling measures to ensure that they are disposed of properly.

Exeter operates an electronics disposal program through the Transfer Station. After purchasing a Transfer Station permit, residents can purchase a $10 electronics disposal sticker so that they may leave an electronic item at the Transfer Station. Accepted e-waste items include: computers, televisions, scanners, printers, fax machines, microwaves, small kitchen appliances such as toaster ovens or coffee makers, vacuum cleaners, fans, etc. Each item requires a $10 sticker.

Over the past five years, the electronics disposal program has seen large financial changes (Figure 3). In 2013 and 2014, there was a negligible budget surplus in the program with revenue from the fees outweighing disposal costs by roughly $650, on average. In 2015, the trend began to shift, as there was a roughly $700 shortfall. In 2016, disposal costs jumped by roughly $5,000, a 78% increase, while revenues only increased by $1500. 2017 saw a similar discrepancy as disposal costs rose by another $2,000, while revenue increased $1,350, further widening the gap.

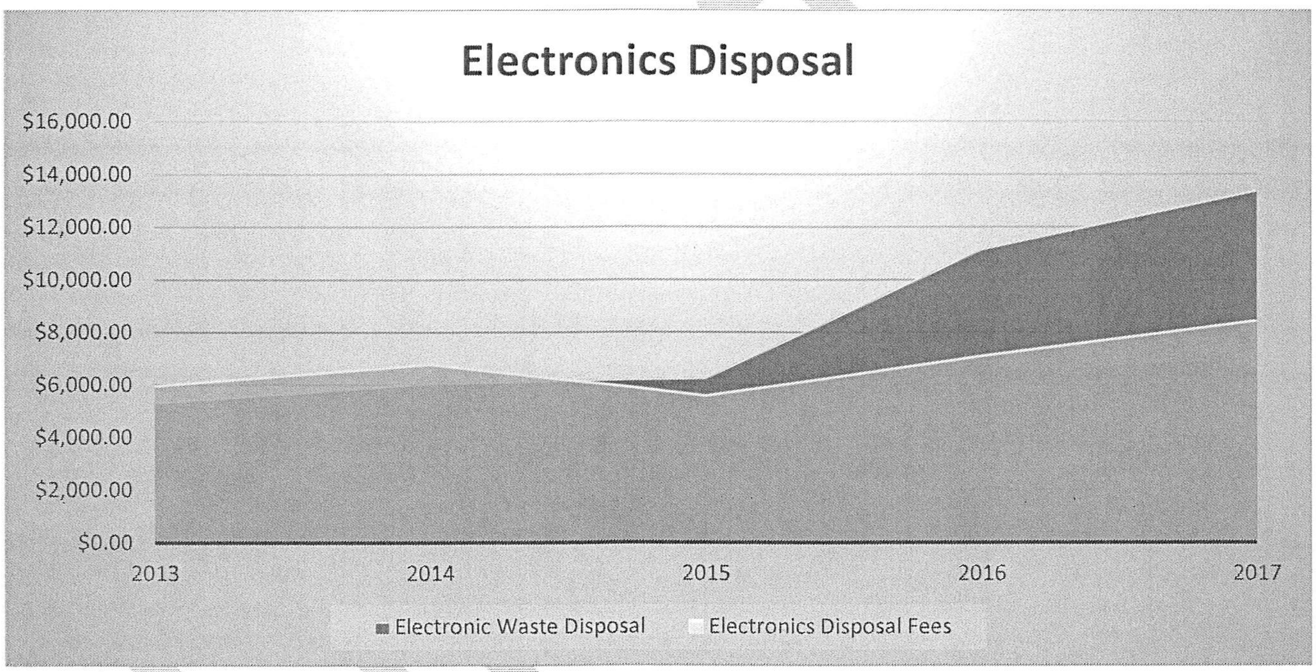

Figure 13. Electronics Disposal Financials

Recycling Bins

Part of the Waste Management contract includes curbside collection of recycling. Collected at the same time as trash, recycling is required to be in town-approved bins. Since the recycling program is single stream, all recyclables go into one bin. The town offers two sizes of bins for recycling, an 18-gallon bin and a 65-gallon tote. Containers, which cost $12 for the bin and $45 for the tote, can be purchased at the Department of Public Works (DPW).

Since 2015, revenue from the sale of the containers has not matched the cost of acquiring the bins from the vendor, although 2017 did see gap narrow quite a bit. In that year, the revenue generated was only $1,400 under the cost of procurement. Over the five-year period from 2013-2015, there was a $6,500 shortfall in the revenue generated as compared to the cost to procure the containers.

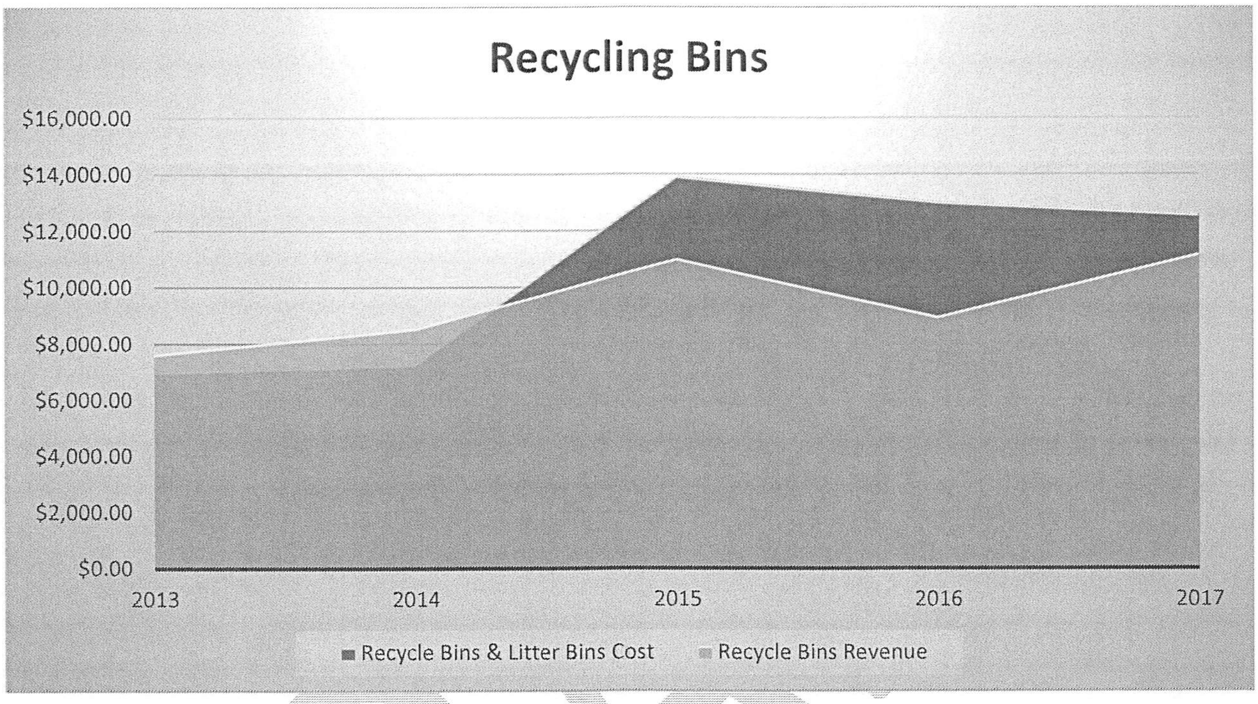

Figure 14. Recycling Bins Financials

Solid Waste Disposal Projections

Based on the 2017 budget line item for solid waste disposal combined with the annual three percent increase, there will be a steady increase in the deficit for the solid waste collection service. The revenue projections assume a continued 2.33% increase each year, as was the trend from 2013 through 2017. In 2013, the gap between revenue and cost was $208,857.00. Based on the assumptions above, by the end of the current Waste Management contract, the gap could be as high as $272,000.00 (Figure 13).

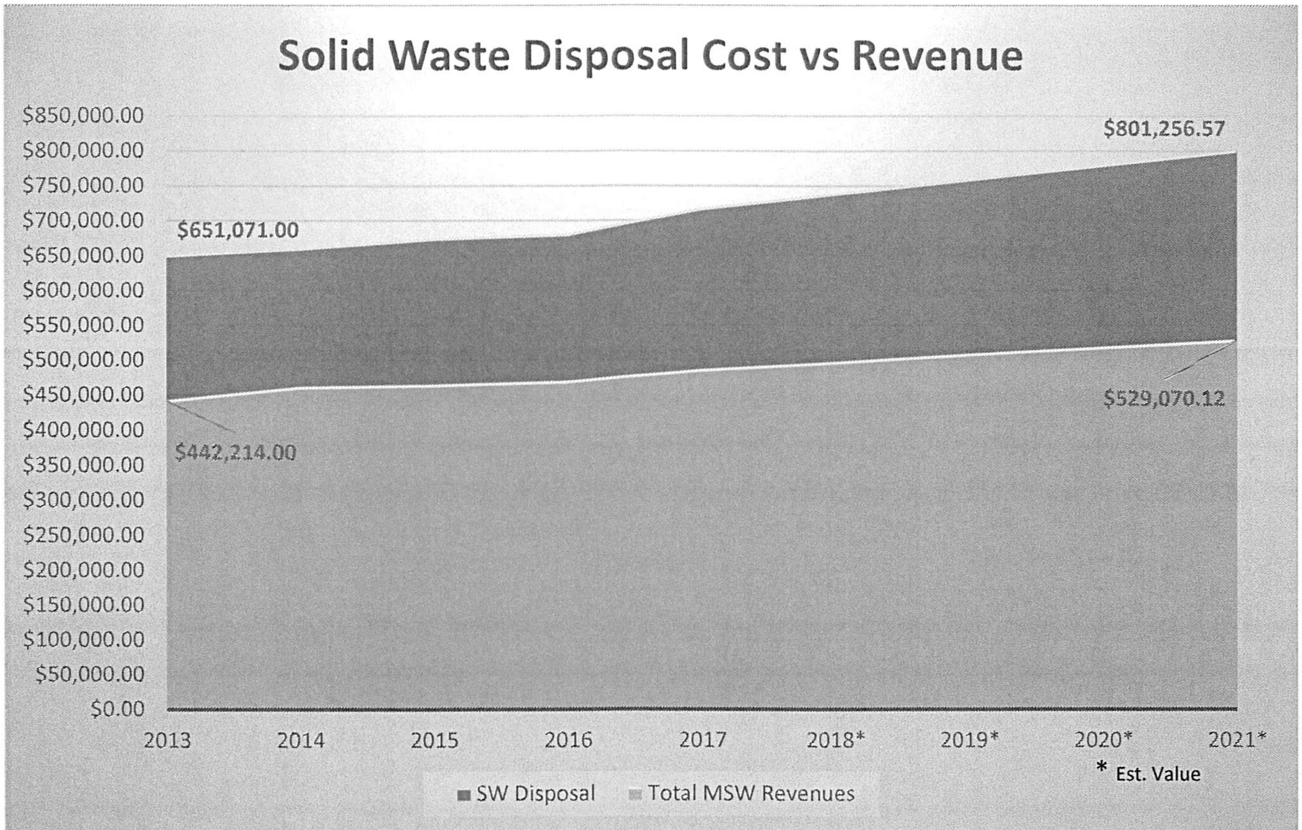

Figure 15. Solid Waste Projections

Solutions/Recommendations

Option 1: Stay the Same

This option is the easiest and most passive option. It acknowledges the rising cost of solid waste disposal and the ever-widening gap between revenues collected and program costs. By choosing this option, the town simply absorbs the cost in the general fund of the budget. The programs are still funded, but resident's tax payments end up subsidizing the areas in which there is a budget shortfall. This may seem attractive since it is the status quo. There will not be any public outcry or backlash since nothing is changed. This option is not the best suited for the town and the solid waste program's long term health. By allowing the general fund to make up the shortfall, the town would be removing the linkage between service and fees. Fees are an important means for ensuring equitable contribution based on program use. This is especially important in a PAYT program, since the goal of such a program is not only to fund the service, but also to give residents a financial incentive to be more environmentally conscious consumers and promote recycling. If the general fund covers the difference, the average taxpayer ends up subsidizing households that produce large amounts of waste. Therefore, while decisions for change may be difficult, they are integral to the underlying theory and spirit of the program.

Option 2: Re-evaluate the Costs of each Program

Recommendation 1: Increase the cost of blue bags

The purpose of a PAYT program is to fund trash disposal costs and tie program use to a fee. Households that produce more trash and do not recycle pay more than more conscientious households. While the cost of solid waste disposal continues to increase each year, the town's fees for blue bags have not. As a result, there is a sizeable gap between revenue collected from blue bags and bulky waste stickers and the cost of solid waste disposal. With the new Waste Management contract, that gap will only continue to grow. Therefore, the town should consider an increase to the price of blue bags. Table 2 shows the price Exeter charges for bags compared to other New Hampshire cities and towns. This table represents the number of New Hampshire towns with populations above 5,000 who have a PAYT bag program in place. This data was derived from each town's website, so the potential exists that the information may not be accurate at the time of this report, especially if a town implemented or changed a program at their 2018 town meeting. It does, however, provide a good reference for where Exeter stands in relation to other New Hampshire municipalities.

The table depicts that Exeter's large bag price is right at the average price for other communities. Its small bags, on the other hand, are $0.37 below the average. The last column of the table lists whether that municipality has curbside collection of trash that is contracted through the town. When considering only these municipalities, Exeter's prices are $0.36 below average for the small bags and $0.17 below average for the large bags. This provides an opportunity for the town to address the price of the bags and adjust them in a manner that closes the gap between the cost of solid waste disposal and revenues generated.

Over the past five years, Exeter has sold over double the number of large bags as small bags. Therefore, given the larger quantity sold and the higher price, changing the price of the large bags would be most impactful. It is unknown how this would impact the sales of each bag. If only large bags are increased, perhaps residents would shift their habits and purchase more small bags. The small bags are half the size, so one could assume that this would result in a doubling of small bag sales for each resident that changes their bag use habit. The large bags have a much higher profit margin, so even if sales of small bags doubled for each large bag that was substituted for, revenue would still take a hit. Therefore, it makes the most sense to adjust the bag prices in tandem.

Raising the price of the bags by 25% appears to be cost-effective solution. The new price would be $1.25 for small bags and $2.50 for large bags. This keeps the bag costs proportional, in that the large bags are still double the size and double the price. It also maintains the price at a more "round" or aesthetically pleasing price rather than an arbitrary number such, as $1.37 per small bag. In 2017, the town sold 93,750 small bags and 195,750 large bags. Using these sales numbers, the price increase would yield an additional $121,313 if bag sales remained constant. Over the past five years sales have actually risen substantially. Small bag sales rose 20,000 from 2013-2017, and large bag sales rose 30,250 over the same period. This demonstrates that sales are expected to continue to rise, generating more revenue each year. This measure alone would cut the current solid waste program deficit in half.

Table 2. Trash Bag Prices, by Town and Size

City/Town	Small Bag Price (Up to 20 Gal.)	Large Bag Price (Up to 33 Gal.)	Curbside Collection Through City/Town?
Barrington	$0.90	$1.30	No
Concord	$1.25	$2.50	Yes
Dover	$1.45	$2.15	Yes
Exeter	**$1.00**	**$2.00**	**Yes**
Farmington	$1.50 (Bag Sticker)	$1.50 (Bag Sticker)	No
Keene	$2.00	$2.00	No
Hopkinton	$0.75	$1.25	No
Littleton	$2.00	$3.00	No
Peterborough	$0.75	$1.50	No
Raymond	$1.80	$2.35	Yes
Somersworth	$1.30	$1.85	Yes

AVERAGE	*$1.37*	*$2.04*	
AVERAGE WITH MSW COLLECTION	*$1.36*	*$2.17*	

Recommendation 2: Continue to Monitor Electronics Disposal Costs

Over the five year period there has only been a substantive shortfall in the past two years: $4,000 in 2016 and $5,000 in 2017. Given the cost of the entire solid waste program, this modest shortfall seems negligible. To maintain the user fee model, the electronics program should ideally pay for itself. If the gap continues to widen in subsequent years, it may be prudent to address the gap through increased electronics disposal fees.

Another option to cut disposal costs is to engage a public awareness campaign regarding disposal of e-waste. Public works, the town office, and the transfer station could all have posters that remind residents of retail stores that offer electronics recycling. Often times this recycling service is free, depending on the product, at many large retailers such as Best Buy, Staples, and Batteries Plus Bulbs. Some items that are still in fair condition may even have value to third-party vendors. Diverting some of this electronic waste can reduce the cost of disposal for the town.

In reviewing municipalities in Rockingham and Strafford counties, it is appears that the $10 electronics sticker is on par with surrounding towns. $10 is the most common price for things like TVs, monitors, and copiers/printers. Many towns charge for e-waste via a fee schedule that lists the item and its associated cost. For example, many towns have several prices for TV disposal based on its size. Often times, these far exceed the $10 that Exeter charges for any item. For example, Milton, NH charges $20 for TVs larger than 46” and Farmington charges $27.50 for TVs over 25 inches. Creating a fee schedule that charged more for larger and more costly items would provide an opportunity to generate additional revenue.

The biggest hindrance to implementing a fee schedule is the loss of simplicity. Currently, there is one sticker for one price which makes the process very simple. Introducing a fee schedule would require additional training of employees and public awareness efforts. It also introduces the concern for how the different permits or prices are collected. One way for this to be implemented would be to introduce a coupon system, such as the one Lee utilizes. Residents purchase coupons that are valued at $2.50, $5, and $10 from a vending machine. They then affix the proper value of coupons to the item and drop it off at the transfer station. This avoids cash handling and can also take sticker sales out of the hands of the town office and PDW. Given that the potential revenue is not substantial and the changes and startup costs associated with the plan, this option can be re-evaluated if the electronics waste budget deficit worsens in subsequent years.

Recommendation 3: Consider Transfer Station Permit Fees

Many surrounding towns operate transfer stations that are either free to residents or charge a small fee for a yearly permit. Epping, Milton, and Stratham all charge $5.00 for permits. No surrounding town appears to charge what Exeter charges for transfer station access. This higher than usual fee does come with unique benefits, however. Most towns operate a fee schedule that charges for virtually everything that comes into the transfer station. Instead, Exeter does not charge for many of these items such as white goods (appliances) small propane tanks and mercury-containing items. The permit fee goes to cover the cost of disposing of these items that cannot be salvaged. Given the comparative cost of a transfer station permit, it may be inadvisable to raise the cost even more.

Recommendation 4: Increase the price of Freon appliance disposal

Given that increasing the cost transfer station permits may not be tenable, Exeter should increase the cost of Freon-containing appliance disposal. In reviewing the transfer station fees for surrounding towns in Rockingham and Strafford counties, it was discovered that Exeter charges much lower than any other town for the disposal of these products. In fact, none of the towns had fees for these products in the single digits. Table 3 shows the fees for surrounding town, which range from $10.00 to $25.00.

In 2017, the town raised $2,827.00 in revenue from the sale of Freon disposal stickers at the current $7.00. Raising the fee to $10.00 would yield roughly an additional $1,200.00 annually and raising it to $15.00 would yield approximately $3,000.00 in additional revenue. The latter option would cut the transfer station's 2017 operating deficit by one-third.

Table 3. Freon Appliance Disposal Fees by Town

Town	Freon appliance disposal fee
Barrington	$17.00
Dover	$10.00
Epping	$10.00
Farmington	$17.00
Hampton	$10.00
Kingston	$25.00
Lee	$10.00
Milton	$10.00
Newmarket	$15.00
Northwood	$15.00
Nottingham	$10.00
Raymond	$20.00
Rye	$15.00
Seabrook	$10.00
Somersworth	A/C: $14.00; Fridge/Freezer: $18.00
Strafford	$20.00
Stratham	$20.00

Option 3: Seek out new sources of revenue

Recommendation 5: Consider the Cost of free brush dumping and commercial utilization

One issue that has been raised regarding the transfer station is the costs associated with brush dumping. Currently, residents with a transfer station permit can dump unlimited amounts of brush and wood at no cost. While there is no additional cost to the resident, the town must rent a bulldozer several times a year to push the brush into a manageable pile at the bank. This allows orderly and continued brush dumping at the transfer station. Renting this equipment costs the town several thousand dollars each year and represents a large portion of the transfer station deficit. Most surrounding towns accept brush for free, so Exeter is not unique in this regard. The town should develop creative means to offset the cost of the equipment rental.

One means of doing so would be to charge commercial vendors a flat fee per load of landscaping debris. The issue has been raised that there is apparent abuse of the landscape materials dumping by commercial vendors. While it is against the town's ordinances to dispose of out-of-town materials at the transfer station, there is no way to determine if a company is bringing in brush from Exeter or across the town line in Kingston. Charging for commercial dumping of brush would allow the town to recoup the cost of renting the bulldozer while also deterring improper disposal. Residents would still face no charges for their disposal of brush; the fee would only apply to businesses. A fee for commercial brush dumping could yield thousands of dollars per year. When combined with other efforts, the gap in the transfer station budget can be effectively eliminated.

Recommendation 6: Consider fees for large metal items and White Goods

As mentioned above, Exeter does not charge for the disposal of bulky metal goods such as washers, dryers, snow blowers, lawn mowers, etc. Residents with a transfer station permit can dispose of these items in the roll off container free of additional charge. The underlying theory behind this method is that these items can be sold as scrap metal and the town can recoup the cost of disposal that way. While this had been the case 5-10 years ago, it is becoming harder and harder to recoup the costs in this manner. First of all, fuel and labor prices continue to rise. This makes hauling the materials much more expensive. Second, today's scrap metal appliances are becoming more and more "contaminated." This refers to the non-metal parts that are attached to the units. The pieces all need to be stripped from the metal, costing more in labor, making the item less valuable. Finally, the price of scrap metal has fallen dramatically. These three factors combine to make what was once a cost-effective program one that puts a strain on the budget. To mitigate this issue, surrounding towns often charge for the disposal of these goods. Kingston, Northwood, and Barrington all charge $5.00 per item. Newmarket, Hampton, Nottingham, and Stratham all charge $10.00 per item. Strafford charges $15.00 per item. Since there is no log for how many of these items are disposed of at the transfer station, it is not possible to accurately predict how much revenue this would generate. It is, however, reasonable to assume that charging even $5 per item could potentially yield hundreds or thousands of dollars per year.

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