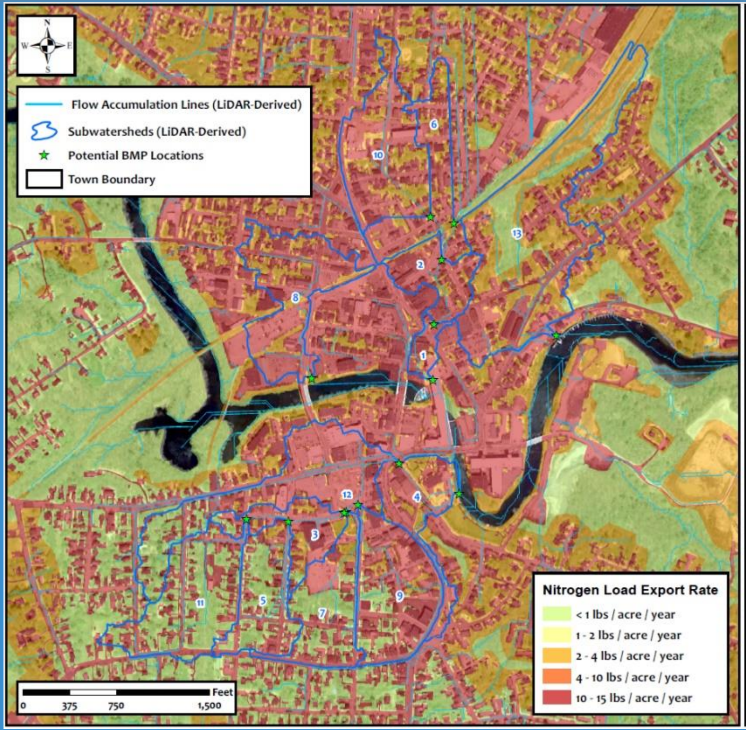


Feasibility Analysis for EPA's Draft Great Bay Total Nitrogen General Permit

in

Dover, Durham, Epping, Exeter, Milton, Newfields, Newington, Newmarket, Portsmouth, Rochester, Rollinsford, Somersworth NH and Berwick, Kittery, North Berwick and South Berwick ME

Prepared for:

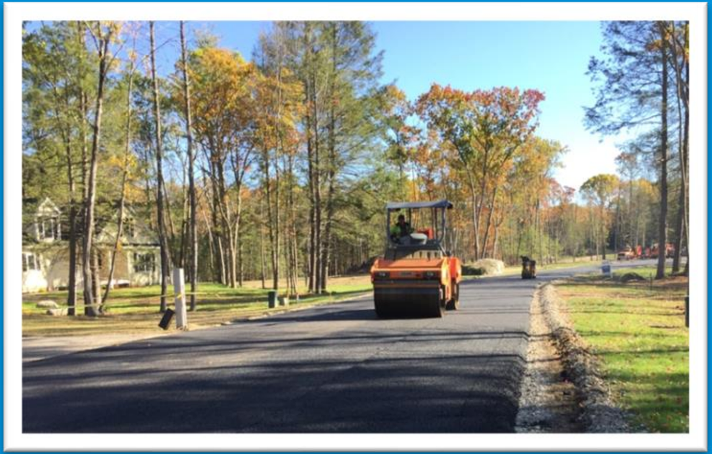
Conservation Law Foundation

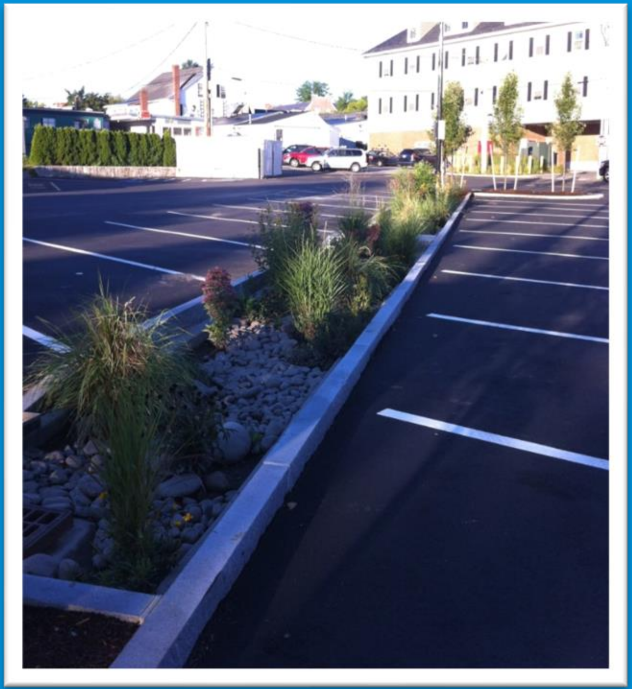
June 16, 2020

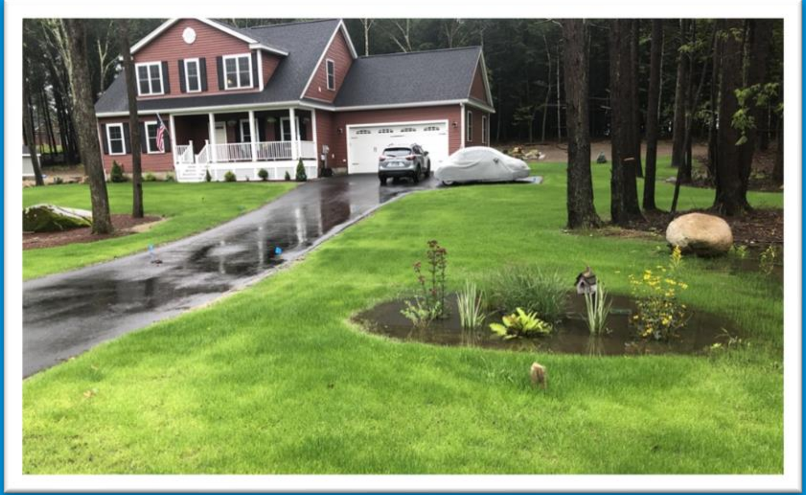
Prepared by:

Robert M. Roseen, Ph.D., P.E., D.W.R.E
Waterstone Engineering

Green Infrastructure Overview AKA Structural BMPS



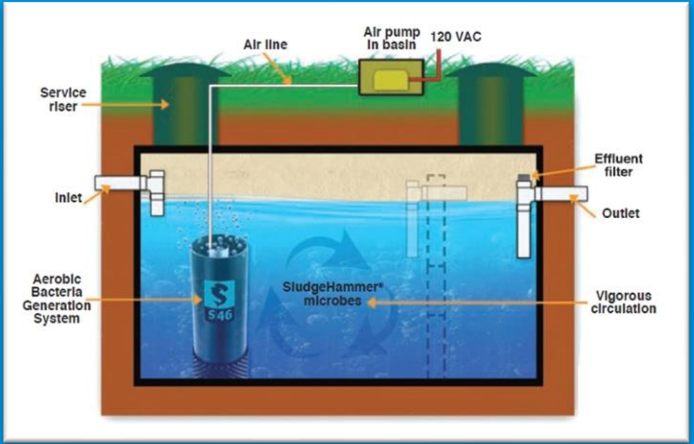




Non-Structural BMPS – Pollution Prevention

STREET SWEEPING

FERTILIZER RESTRICTIONS



SEPTIC SYSTEM RETROFITS

CATCH BASIN CLEANING

LEAF LITTER COLLECTION

GI Reduction of Aquatic Mortality

Source: Spromberg, J. A. et al. (2015). Coho salmon spawner mortality in western U.S. urban watersheds: bioinfiltration prevents lethal stormwater impacts. Journal of Applied Ecology. doi: 10.1111/1365-2664.12534.

A National Marine Fisheries Service study that examined the effects of stormwater on salmon.

- Salmon exposed to undiluted stormwater from a major highway were killed within hours;
- When that same stormwater was pre-filtered through soil, no fish died.
- Previous field assessments in urban stream networks have shown adult coho salmon are dying at high rates (>50%).
- The study provides direct evidence that toxic runoff is killing adult coho salmon in urban watersheds and that inexpensive mitigation measures (e.g., green infrastructure) can improve water quality and promote salmon survival.

Purpose and Summary

- To determine the feasibility and cost to implement the optional 45% reduction of non-point source and stormwater point source nitrogen reduction pathway (Appendix II) with draft Great Bay TNGP
- The TNGP covers nitrogen discharges from 12 New Hampshire communities in the Great Bay watershed with WWTF including Dover, Durham, Epping, Exeter, Milton, Newfields, Newington, Newmarket, Portsmouth (Pease Tradeport and Peirce Island), Rochester, Rollinsford, and Somersworth.
- There are 4 Maine communities within the watershed that are not covered under this permit (Berwick, Kittery, North Berwick and South Berwick) because they are regulated separately by MEDEP.

Table 4.9 – TNGP Nitrogen Control Plan Schedule and Reduc

Plan	Due Date	Reduction Requirement	Start Year
Short-Term Control Plan	1 yr		1
Long-Term Control Plan-1	3 yrs	11%	3
Long-Term Control Plan-2	8 yrs	22%	8
Long-Term Control Plan-3	13 yrs	34%	13
Long-Term Control Plan-4	18 yrs	45%	18

Study Elements

- Feasibility was evaluated for a community’s ability to reduce NPS and stormwater-derived nitrogen by 45% over four 5-year permit periods.
- Included an assessment of methods to implement nitrogen controls and a corresponding cost analysis.
- Optimization by land use determined how to get the most bang for the buck through a variety of stormwater Best Management Practices (BMPs).
- Examined reductions for BMPs to reduce the volume and pollutant load
- Structural BMPs – built infrastructure such as gravel wetlands, dry wells and rain gardens to treat runoff from paved roads, rooftops, parking areas and other hardened surfaces
- Non-structural BMPs that are typically planning- or maintenance-based strategies such as street sweeping, leaf litter control, catch basin cleaning, septic system retrofits, and fertilizer reduction programs.

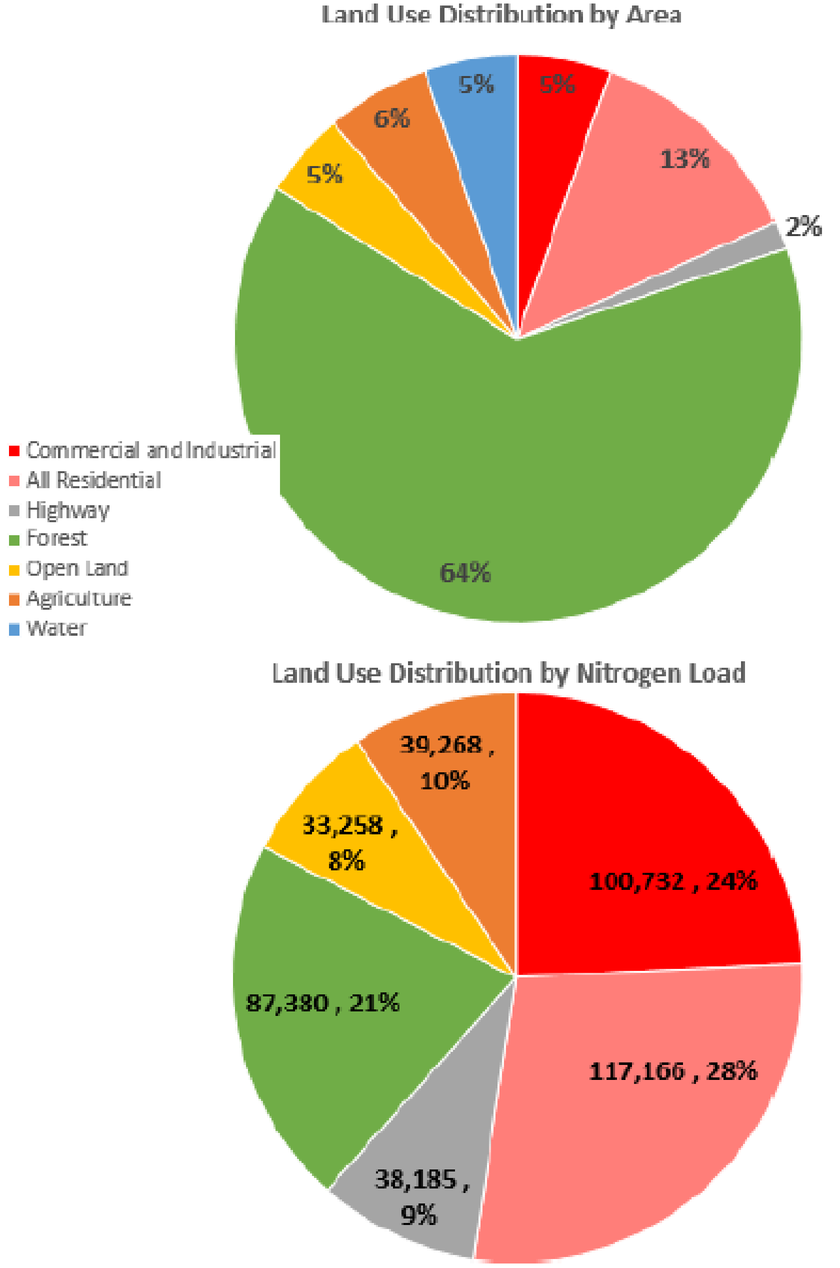


Figure 4.2 - Land Use by Area (%) and Pollutant Load (N Lbs/Yr, %)

Caveats

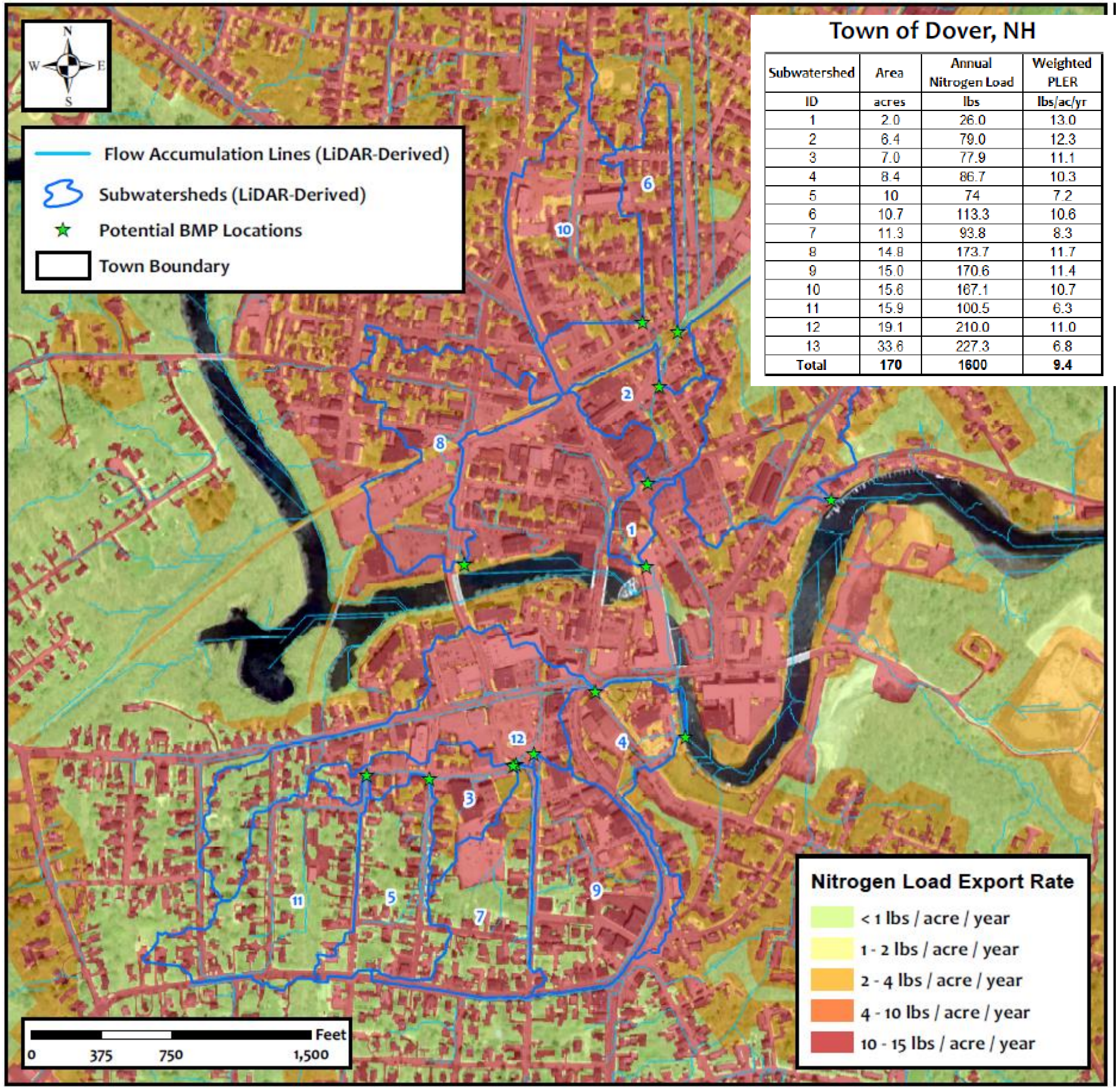
- This study presents a plan, not a prescription, for how to implement the optional pathway of the TNGP.
- This represent one scenario of many possible pathways - each community will need to determine what combination of management approaches is most suitable and achievable.
- EPA's job is not to tell communities how to implement a permit, but rather what the goal is.
- The solution to this wicked problem will need to come from the communities and their consultants working together with EPA.

All Models Are Wrong
Some Models Are Useful

George Edward Pelham Box (1919 –2013)

Methodology

- Land use and land cover were evaluated followed by a pollutant load analysis (PLA) to quantify N sources including atmospheric deposition and septic-derived groundwater loading.
- Methods are consistent with EPA, USGS, and others and generally accepted for water quality permitting purposes.
- Includes new elements of the 2017 MS4 permit including Identification, delineation, and prioritization of potential catchments with high nitrogen loading and identification of potential retrofit opportunities or opportunities for the installation of structural BMPs during redevelopment.



Town of Dover, NH

Subwatershed	Area	Annual Nitrogen Load	Weighted PLER
ID	acres	lbs	lbs/ac/yr
1	2.0	26.0	13.0
2	6.4	79.0	12.3
3	7.0	77.9	11.1
4	8.4	86.7	10.3
5	10	74	7.2
6	10.7	113.3	10.6
7	11.3	93.8	8.3
8	14.8	173.7	11.7
9	15.0	170.6	11.4
10	15.6	167.1	10.7
11	15.9	100.5	6.3
12	19.1	210.0	11.0
13	33.6	227.3	6.8
Total	**170**	**1600**	**9.4**

Table 4.3 –NPS Load by Town for 17 Entities

	Dover	Durham	Epping	Exeter	Milton	Newfields	Newington	Newmarket	Portsmouth	Rochester	Rollinsford	Somersworth	Berwick	Kittery	North Berwick	South Berwick
Area (acres)	18,567	15,852	16,776	12,813	21,931	4,647	6,534	9,080	9,116	29,062	4,841	6,397	24,214	9,510	24,423	18,032
Impervious Area (acres)	2,445	924	933	1,227	695	214	546	579	2,147	2,859	281	1,016	895	1,155	765	704
% Impervious Cover	13%	6%	6%	10%	3%	5%	8%	6%	24%	10%	6%	16%	4%	12%	3%	4%
Surface Water Load (N lbs/year)	50,349	27,664	24,841	26,835	22,446	6,397	11,449	15,213	35,890	63,067	8,841	18,793	30,313	24,251	26,305	21,930
Atm.& SS Load (N lbs/year)	22,654	20,303	18,923	10,412	15,189	4,354	16,992	12,757	8,321	42,974	5,672	9,416	15,643	16,788	10,741	12,398
Total NPS Load (N lbs/year)	73,003	47,967	43,764	37,247	37,635	10,750	28,442	27,970	44,211	106,040	14,513	28,209	45,956	41,038	37,045	34,328
Per-Acre Load (N lbs/acre/year)	3.93	3.03	2.61	2.91	1.72	2.31	4.35	3.08	4.85	3.65	3.00	4.41	1.90	4.32	1.52	1.90
45% Reduction Target (N lbs/year)	32,603	23,553	17,024	14,909	13,307	3,970	12,346	11,000	21,616	42,151	7,142	10,721	23,502	16,361	15,512	16,237

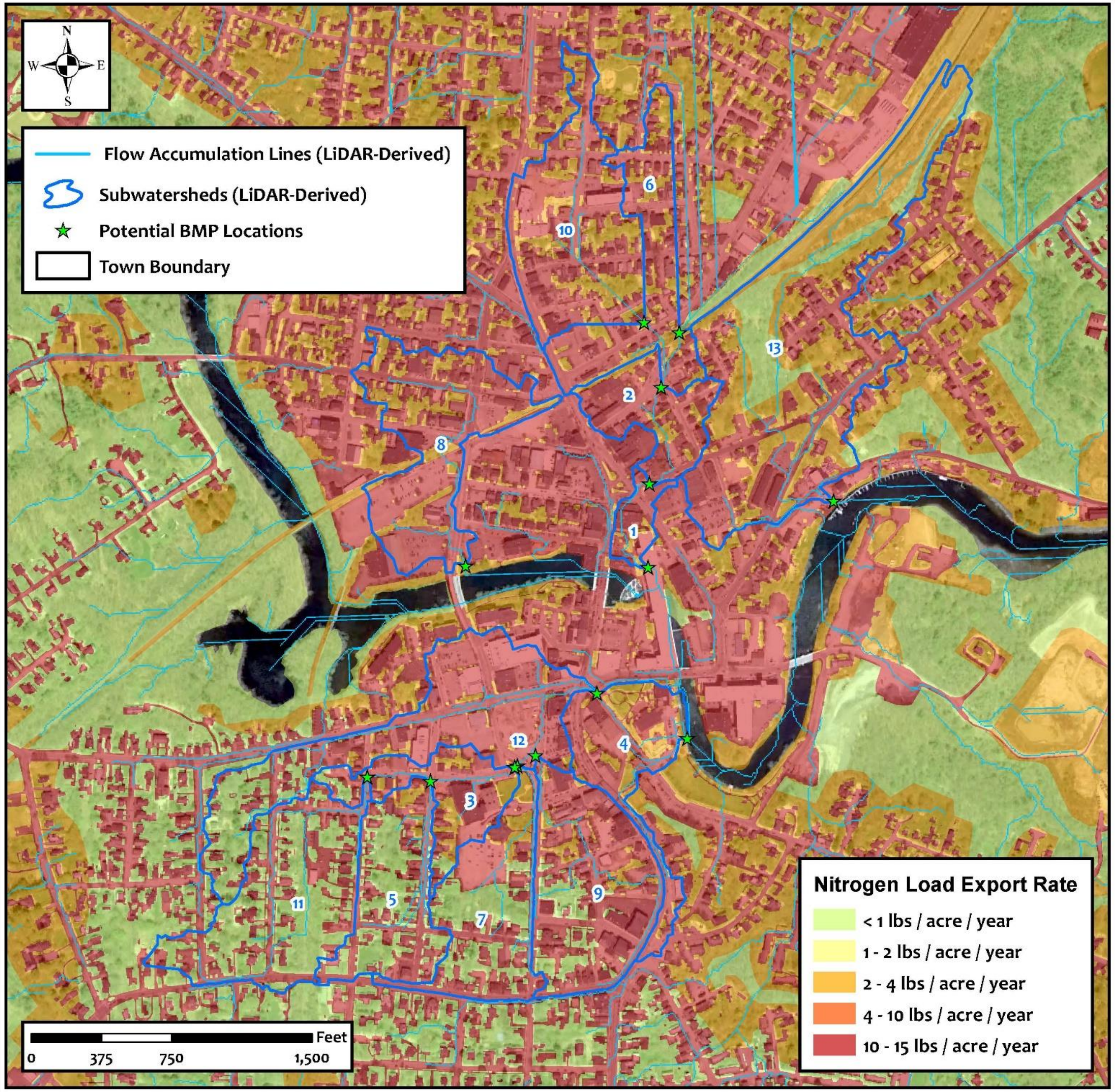
Unit Costs

- A feasibility target of $1000/lb N/yr was chosen because it is less than a typical cost to remove N by WWTP at 8 mg/L or below.
- At costs above $1000/lb N/yr, it could be argued that treatment for nitrogen would be more economically achieved at a WWTP.

Table 4.11 – Unit Costs from Optimization for Structural and Non-Structural BMPs

Land Use, BMP Type, and Capture Depth	Potential Area (Acres)	Unit Cost ($/lb N)
RESIDENTIAL IMPERVIOUS, RAINGARDEN, 0.25	3,635	$633
RESIDENTIAL ROOF, DRY WELL, 0.25	2,526	$396
COMMERCIAL IMPERVIOUS, GRAVEL WETLAND, 0.25	2,226	$491
COMMERCIAL ROOF, DRY WELL, 0.25	556	$337
INSTITUTIONAL I GRAVEL WETLAND, 0.25	838	$498
INSTITUTIONAL ROOF, DRY WELL, 0.25	210	$337
ROAD GRAVEL WETLAND, 0.25	3,613	$746
INDUSTRIAL IMPERVIOUS, GRAVEL WETLAND, 0.25	1,305	$491
INDUSTRIAL R DRY WELL, 0.25	702	$337
OUTDOOR IMPERVIOUS, GRAVEL WETLAND, 0.25	978	$693
SEPTIC RETROFIT*	19,385*	$629
STREET_SWEEPING, RESIDENTIAL	536	$23
STREET_SWEEPING, COMMERCIAL	396	$21
STREET_SWEEPING, INDUSTRIAL	243	$21
STREET_SWEEPING, HWY	3,613	$30
LEAF LITTER, HSG-A	7,936	$733
LEAF LITTER, HSG-B	3,920	$183
LEAF LITTER, HSG-C	3,654	$92
LEAF LITTER, HSG-D	8,580	$61
CATCH_BASIN CLEANING RESIDENTIAL	11,699	$378
URBAN_FERTILIZER_RESIDENTIAL	10,078	$343
URBAN_FERTILIZER_GOLF	642	$343
URBAN_FERTILIZER_SCHOOL	249	$343
URBAN_FERTILIZER_PARK	122	$343

*Septic system retrofits are number of systems, not area treated



Town of Dover, NH

Subwatershed	Area	Annual Nitrogen Load	Weighted PLER
ID	acres	lbs	lbs/ac/yr
1	2.0	26.0	13.0
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4	8.4	86.7	10.3
5	10	74	7.2
6	10.7	113.3	10.6
7	11.3	93.8	8.3
8	14.8	173.7	11.7
9	15.0	170.6	11.4
10	15.6	167.1	10.7
11	15.9	100.5	6.3
12	19.1	210.0	11.0
13	33.6	227.3	6.8
Total	170	1600	9.4

Notes:

1) Subwatershed delineation is conducted at BMP scale to demonstrate a possible implementation plan. The area of analysis is a subset of higher target load areas and does not include the entire municipal area which may require stormwater management to meet nitrogen load reduction targets.

2) Subwatersheds are LiDAR-derived and do not account for sewersheds, which might significantly impact drainage areas.

3) 'Potential BMP Locations' are based on LiDAR-derived stormwater runoff accumulation paths and do not consider any site-specific feasibility assessments.

4) Detailed, site-specific analysis will be required to refine subwatershed boundaries and determine an optimal, feasible BMP implementation strategy.

Data Sources:
-USGS NRCS Maine Lidar, 2013
-LiDAR for the North East, 2011
-NH Granit, Land Use 2015 for Southeastern New Hampshire
-USGS, National Land Cover Database, 2016
-NRCS, Web Soil Survey, 2019
-NH Granit, Impervious Surfaces in the Coastal Watershed of NH and Maine, 2015
-Basemap: Google Earth Imagery, 2019

Table 4.12 – Example BMP Optimization Menu for Dover to achieve 45% NPS Load Reduction

	Potential Area (acres)	Treated Area (acres)	Load Reduction (lbs)	Cost ($)	Unit Cost ($/lb)
Total		9,601.8	32,603.0	$ 17,489,220	$ 536
Structural Controls	**7,552.5**	2,136.6	20,126.1	$ 10,579,206	$ 496
Non-Structural Controls	**9,040.8**	9,040.8	12,476.9	$ 6,910,014	$ 316
Landuse & BMP Type and Depth	**Potential Area (acres)**	**Treated Area (acre**	**Load Reduction (lb**	**Cost ($)**	**Unit Cost ($/lb**
RESIDENTIAL I RAINGARDEN0.25	627.91	627.9	4462.5	$ 2,825,595	$ 633
RESIDENTIAL R DRY WELL0.25	436.34	436.3	4402.9	$ 1,745,360	$ 396
COMMERCIAL I GRAVEL WETLAND0.25	270.43	270.4	3247.9	$ 1,595,537	$ 491
COMMERCIAL R DRY WELL0.25	67.61	67.6	803.3	$ 270,440	$ 337
INSTITUTIONAL I GRAVEL WETLAND0.25	105.63	105.6	1252.4	$ 623,217	$ 498
INSTITUTIONAL R DRY WELL0.25	26.41	26.4	313.8	$ 105,640	$ 337
ROAD I GRAVEL WETLAND0.25	567.35	346.9	2742.7	$ 2,046,939	$ 746
INDUSTRIAL I GRAVEL WETLAND0.25	136.92	136.9	1644.4	$ 807,828	$ 491
INDUSTRIAL R DRY WELL0.25	73.73	73.7	876.0	$ 294,920	$ 337
OUTDOOR I GRAVEL WETLAND0.25	44.7	44.7	380.3	$ 263,730	$ 693
SEPTIC SEPTIC SLUDGEHAMMER	1,575.61	1575.6	10020.9	$ 6,302,440	$ 629
STREET_SWEEPING_HWY STREET_SWEEPING_HWY	567.35	567.4	595.7	$ 18,155	$ 30
LEAF_LITTER_A LEAF_LITTER_A	1,543.08	1543.1	23.1	$ 16,974	$ 733
LEAF_LITTER_B LEAF_LITTER_B	358.31	358.3	21.5	$ 3,941	$ 183
LEAF_LITTER_C LEAF_LITTER_C	305.97	306.0	36.7	$ 3,366	$ 92
LEAF_LITTER_D LEAF_LITTER_D	1654.26	1654.3	297.8	$ 18,197	$ 61
CATCH_BASIN_RES CATCH_BASIN_RES	1310	1310.0	1108.3	$ 419,200	$ 378
URBAN_FERTILIZER_RES URBAN_FERTILIZER_RES	1590.03	1590.0	343.4	$ 117,662	$ 343
URBAN_FERTILIZER_GOLF URBAN_FERTILIZER_GOLF	86.84	86.8	18.8	$ 6,426	$ 343
URBAN_FERTILIZER_SCHOOL URBAN_FERTILIZER_SC	31.4	31.4	6.8	$ 2,324	$ 343
URBAN_FERTILIZER_PARK URBAN_FERTILIZER_PARI	17.96	18.0	3.9	$ 1,329	$ 343

Nutrient Control Plan Summary

Table 4.13 – BMP Optimization Summary Results for Structural and Non-Structural Controls

			Total					Structural Controls				Non-Structural Controls			
Town	Total Existing Load (lbs/yr)	TN Load Reduction Target (lbs/yr)	Treated Area (acres)	Load Reduction (%)	Load Reduction (lbs)	Cost ($)	Unit Cost ($/lb)	Treated Area (acres)	Load Reduction (lbs)	Cost ($)	Unit Cost ($/lb)	Treated Area (acres)	Load Reduction (lbs)	Cost ($)	Unit Cost ($/lb)
Dover	72,451	32,603	9,602	45%	32,603	$17,489,220	$536	2,137	20,126	$10,579,206	$496	9,041	12,477	$6,910,014	$316
Durham	52,341	23,553	4,114	34%	17,796	$11,932,150	$670	1,133	9,298	$7,006,407	$978	4,170	8,498	$4,925,743	$313
Epping	37,831	17,024	2,894	45%	17,024	$9,608,205	$564	501	4,983	$2,401,504	$440	4,146	12,041	$7,206,701	$267
Exeter	33,130	14,909	6,047	45%	14,909	$7,229,884	$485	562	6,375	$2,811,860	$412	6,353	8,533	$4,418,024	$274
Milton	29,570	13,307	2,810	45%	13,307	$7,654,894	$575	459	4,195	$2,174,328	$496	3,695	9,111	$5,480,565	$310
Newfields	8,822	3,970	864	45%	3,970	$2,237,924	$564	105	1,074	$488,678	$440	1,192	2,896	$1,749,246	$257
Newington[1]	27,435	12,346	2,305	45%	12,346	$6,476,901	$525	960	10,239	$5,392,634	$887	1,572	2,107	$1,084,267	$313
Newmarket	24,445	11,000	3,287	45%	11,000	$6,409,285	$583	558	5,058	$3,006,075	$521	3,508	5,942	$3,403,210	$316
Pease	-	-													
Portsmouth[1]	48,035	21,616	7,262	45%	21,616	$9,266,590	$429	1,548	18,029	$8,044,536	$412	5,806	3,586	$1,222,053	$274
Rochester	93,668	42,151	8,946	45%	42,151	$22,309,237	$529	1,343	15,193	$6,595,115	$412	11,306	26,957	$15,714,122	$274
Rollinsford	15,871	7,142	1,271	34%	5,396	$3,108,501	$576	200	1,813	$955,278	$496	1,597	3,583	$2,153,223	$313
Somersworth	23,825	10,721	2,616	45%	10,721	$5,252,508	$490	538	6,137	$2,698,084	$412	2,658	4,585	$2,554,424	$274
Berwick	52,226	23,502	2,548	34%	17,757	$13,412,688	$755	1,090	7,319	$7,136,596	$995	3,010	10,437	$6,276,092	$264
Kittery	36,357	16,361	3,117	45%	16,361	$8,374,193	$512	968	10,248	$5,215,570	$518	2,888	6,113	$3,158,623	$257
North_Berwick	34,472	15,512	1,203	34%	11,720	$6,820,648	$582	395	3,746	$2,026,556	$483	1,986	7,975	$4,794,092	$209
South_Berwick	36,083	16,237	1,546	34%	12,268	$7,276,758	$593	453	4,229	$2,443,448	$518	2,288	8,039	$4,833,310	$270
Total	626,562	281,953	60,430	42%	260,944	$144,859,586		12,951	128,062	$68,975,876		65,216	132,881	$75,883,710	

[1] Costs for Newington and Portsmouth include Pease as per GBNPSS allocation. 46% and 54% of Pease areas are allocated to Newington and Portsmouth respectively.

Key Findings

- It is feasible to reduce nitrogen loads by 45% at costs within national norms while still allowing for growth and development in our communities.
- Costs of BMPs vary by community depending largely on density and development patterns, with an average unit cost of $561/lb N, and a range of $429 - $755 in contrast with WWTP costs between $300-$1,500
- If implemented widely, non-structural BMPs such as street sweeping, catch basin cleaning, and leaf litter collection are the most cost-effective management approaches at an average unit cost of $282/lb N.
- Low-cost structural BMPs such as rain gardens, dry wells and gravel wetlands, with an average annual unit cost of $557/ lb N, can be small-sized and used widely and efficiently in areas with the highest nutrient loads.
- Septic system retrofits offer significant opportunities to reduce nitrogen loads - at an average cost of $630 per pound N, they could reduce nearly 40% of the entire NPS load.

Table 4.10 - Maximum Achievable Nitrogen NPS Load Reduction for

Town	Maximum Achievable Nitrogen Load Reduction
Berwick	36%
Dover	65%
Durham	45%
Epping	65%
Exeter	75%
Kittery	60%
Milton	60%
Newfields	70%
Newington	55%
Newmarket	65%
North Berwick	43%
Portsmouth	75%
Rochester	75%
Rollinsford	45%
Somersworth	75%
South Berwick	43%
Entire Area	65%

Key Findings Cont'd

- Total costs over 20 years range on the low end from $2.2 million for Newfields, $3.1 for Rollinsford and $5.2 for Somersworth, and on the high end to $13.4 million for Berwick, $17.5 for Dover, and $22.3 for Rochester.

- Towns can plan systematically for structural BMPs in highly impacted areas over the 20-year timeframe proposed in the TNGP; smaller municipalities like Newfields, Rollinsford and North Berwick would need to treat 5, 10 and 20 acres per year respectively, while cities of Rochester, Portsmouth and Dover would need structural BMPs to treat 67, 77, and 107 acres per year.

BMP Characteristics		BMP Performance		Costs			
BMP Type	System Size	TP Load Reduced (%)	TN Load Reduced (%)	Bid Cost ($)	Unit Cost ($/lb P)	Unit Cost ($/lb N)	Bid Cost per Acre of DA ($)
Bioswale	0.25" WQV	39%	76%	$15,504	$10,507	$603	$3,424
Tree Planter	0.75" WQV	81%	95%	$20,997	$35,049	$3,717	$12,530
Total	-	-	-	**$36,501**	**$17,594**	**$1,164**	**$5,883**

Stormwater Utility As A Funding Mechanism

- There are significant costs to design, build and maintain municipal stormwater management infrastructure, to prevent flooding and protect water quality.
- A stormwater utility is a common municipal funding mechanism to support a program to design, build and maintain stormwater infrastructure.
- The stormwater user fee is paid by all developed properties within a municipality that generate stormwater runoff, and is analogous to drinking water or wastewater fee for service.
- In 2012 there were 1,500-2,000 communities using stormwater utilities
- The national average stormwater fee for a residential home was $52 per year with a maximum of $268 in Portland Oregon. (EPA 2013).
- This study found that annual fees averaged $91 with a high of $198 (Milton) and a low of $26 (Portsmouth) for a 20-year program.
- The majority of fees were between $52 and $135 per year, well within the national norm and consistent with a 2011 study for Portsmouth (AMEC 2011).

Stormwater Utility Funding Annual Fee

Table 4.17 – Stormwater Utility Funding Annual Fee - Equivalent Residential Unit (ERU) $$/Yr at N-Load Reduction for 15-25 Year Implementation Periods

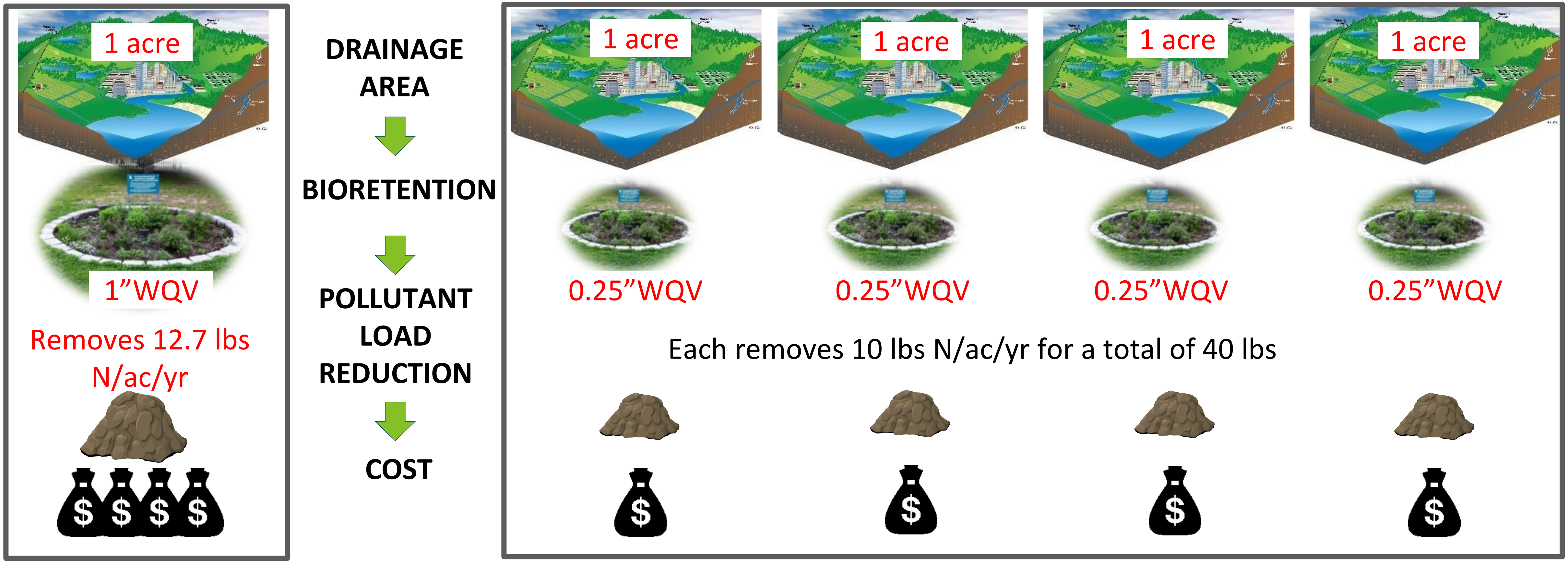
		Dover	Durham	Epping	Exeter	Milton	Newfields	Newing.[1]	Newmark.	Portsmo.[1]	Rochester	Rollinsfo.	Somerswor.	Berwick	Kittery	North Berwick	South Berwick
	Total Cost in $ Millions	$17.49	$11.93	$9.61	$7.23	$7.65	$2.24	$6.48	$6.41	$9.27	$22.31	$8.39	$5.25	$13.41	$8.37	$6.82	$7.28
		Annual Fee - Equivalent Residential Unit (ERU) $$/Yr															
Implementation Period (yrs)	15	$70	$108	$180	$54	$265	$181	$254	$119	$35	$85	$186	$45	$132	$70	$96	$71
	16	$65	$101	$169	$50	$249	$170	$238	$111	$33	$80	$174	$42	$124	$65	$90	$66
	17	$62	$95	$159	$47	$234	$160	$224	$105	$31	$75	$164	$40	$117	$62	$85	$62
	18	$58	$90	$150	$45	$221	$151	$212	$99	$29	$71	$155	$38	$110	$58	$80	$59
	19	$55	$85	$142	$42	$209	$143	$201	$94	$28	$67	$146	$36	$104	$55	$76	$56
	20	$52	$81	$135	$40	$199	$136	$191	$89	$26	$64	$139	$34	$99	$52	$72	$53
	21	$50	$77	$128	$38	$189	$130	$182	$85	$25	$61	$133	$32	$94	$50	$68	$50
	22	$48	$74	$123	$37	$181	$124	$173	$81	$24	$58	$126	$31	$90	$48	$65	$48
	23	$45	$70	$117	$35	$173	$118	$166	$77	$23	$56	$121	$30	$86	$46	$62	$46
	24	$44	$67	$112	$34	$166	$113	$159	$74	$22	$53	$116	$28	$83	$44	$60	$44
	25	$42	$65	$108	$32	$159	$109	$153	$71	$21	$51	$111	$27	$79	$42	$57	$42
Est. # of Households		10,466	4,879	2,137	4,769	1,533	573	263	3,024	7,265	10,266	842	3,922	2,415	3,241	1,525	2,488
% IC Residential		63%	66%	60%	53%	80%	70%	15%	84%	41%	59%	75%	51%	36%	41%	32%	36%
%IC Comm/Ind/Inst		37%	34%	40%	47%	20%	30%	85%	16%	59%	41%	25%	49%	64%	59%	68%	64%

[1] Costs for Newington and Portsmouth include Pease as per GBNPSS allocation. 46% and 54% of Pease areas are allocated to Newington and Portsmouth respectively

Average of $91 with a high of $198 (Milton) and a low of $26 (Portsmouth) for a 20-year program

Assumptions

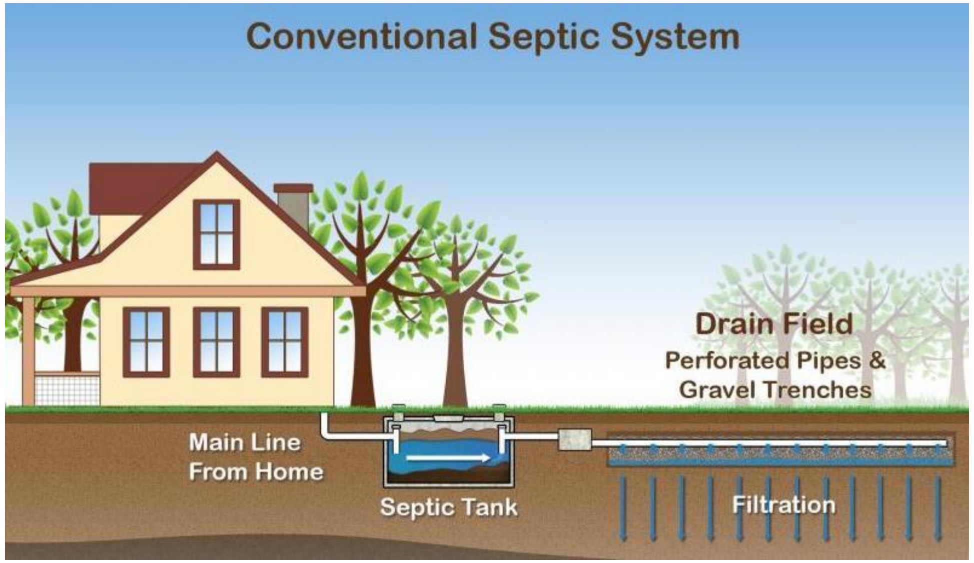
Small Sized BMPs With Optimization



- $40K can build one large system or 4 smaller systems
- An additional 27 lbs of nitrogen per year at nearly equivalent costs, or approx. 315% increase.

Low Maintenance Asset Management

- Most pretreatment approaches are hugely inadequate
- Goal is to use existing staff, equipment for standard catch basin cleaning
- Appropriate for land-use and trash and debris load
- Separate maintenance for aesthetics (frequent) and functionality (infrequent)



Condition Shortly after Install

Condition after Winter

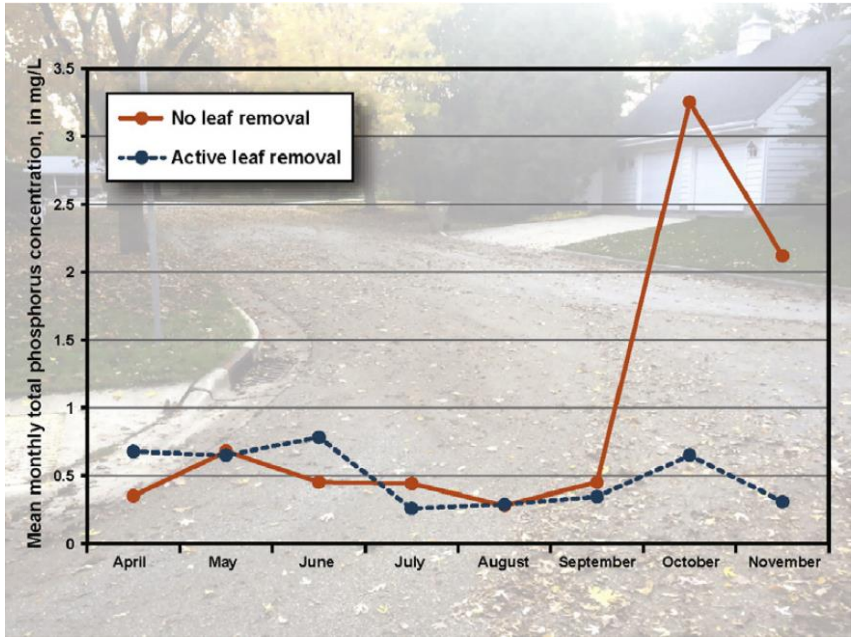
Image Source: NYC Office of Green Infrastructure

Street Sweeping

- Weekly; High-Efficiency Regenerative Air-Vacuum
- NRF = 0.1, 10% RE
- Applicable for all roadways
  - Commercial and Industrial Impervious = 15.0 lbs N/acre/year
  - Residential Impervious = 14.1 lbs N/acre/year
  - Highway Impervious = 10.5 lbs N/acre/year
  - All assumed to be highway because not subdivided by LU type
- [IA] x [NLER] x [NRF] = [14.1 - [0.1*14.1]] = 12.69 lbs N/ac/yr
- Sweeper Cost to operate (sweeper, fuel, maint, operator, benefits) = $112/hr
- Acres swept/day/sweeper = 27.5 acres/day
- Disposal Cost = $6.5/cyd
- Unit Cost Sweeping and Disposal = $31.52/ac
- Material swept per acre = 0.47 cyds/acre
- Unit cost $21-30/lb N

Leaf Litter Collection

- Approx at least 4 times during fall
- Leaves vacuumed, or manually loaded into vehicle, such as a garbage truck or covered dump truck.
- Within 24 hours of leaf collection, remaining leaf litter in the street collected using street sweeping
- NRF = 0.05, 5% RE (0.05 by MS4)
- Applicable for all residential areas excluding ROW
- Leaf Collection Cost to operate 5 vehicles per day (equipment, fuel, maint, operator, benefits) = $309/hr
- Acres per day = 232
- Cost leaf litter pick up $11/acre
- Unit cost weighted average approx. $345/lb N
- [DA] x [NLER] x [NRF] = [3.6 - [0.05*3.6]] = 3.42 lbs N/ac/yr



Catch Basin Cleaning

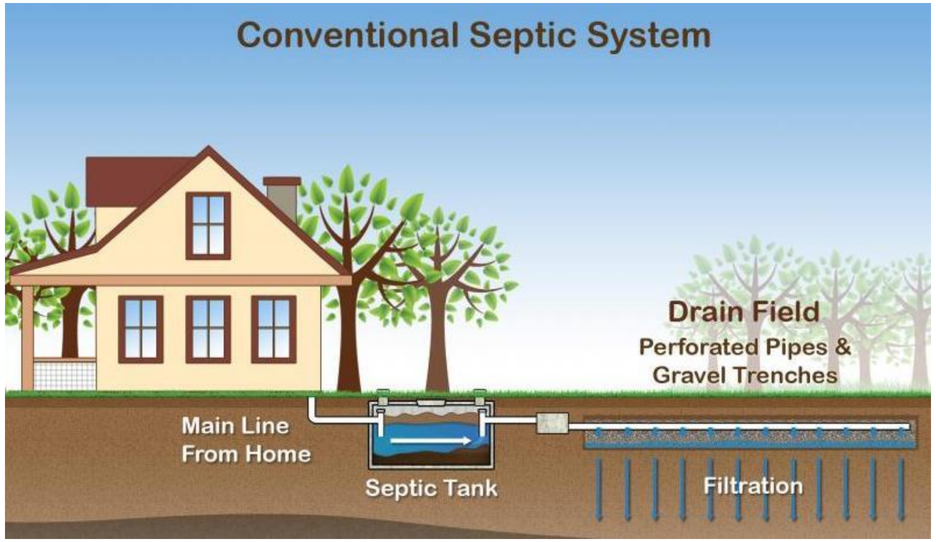
- Applicable for all roadways
  - Commercial and Industrial Impervious = 15.0 lbs N/acre/year
  - Residential Impervious = 14.1 lbs N/acre/year
  - Highway Impervious = 10.5 lbs N/acre/year
  - All assumed to be highway because not subdivided by LU type
- NRF = 0.06 (NH MS4 Permit)
- Catch basins per day per vehicle   5
- Labor and Equip Rate $/HR $100.00
- Cost per catch basin $160.00
- Est CB IC Drainage area   0.501 acres
- Cost per acre $320.00
- Unit cost weighted average approx. $378/lb N
- [DA] x [NLER] x [NRF] = [10.5 - [0.06*10.5]] = 9.87 lbs N/ac/yr

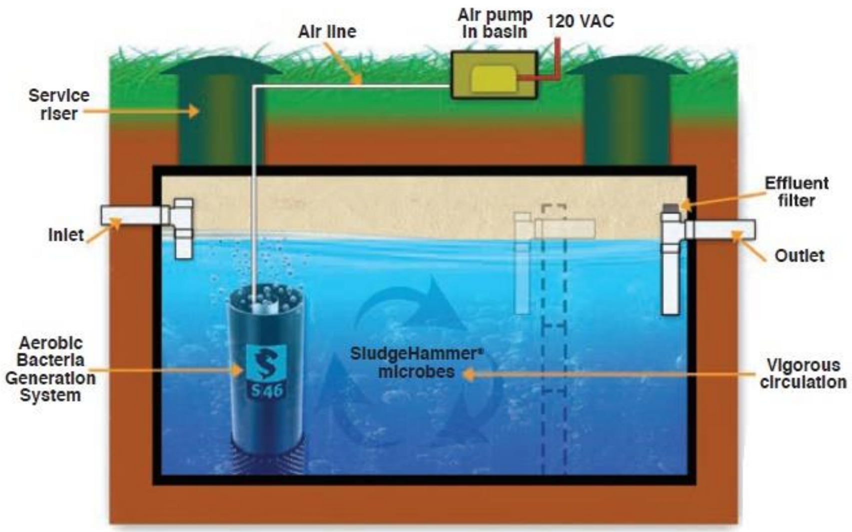
Urban Fertilizer Control

- Based on GBNNPSS Appendix E
- Applicable for residential pervious, golf courses, schools, park
  - 2.4 lbs N/acre/year (HSG-C), ranges 0.3 (HSG-A) - 3.6 (HSG-D)
- NRF = 0.09 (CBP)
  - MS4 permit only specifies a phosphorus reduction credit for this
  - CBP =6% RE for low risk, 20% for high risk lawns, 9% for ‘blended’
- Assumes 45% of residential lawns are fertilized
- Cost per acre $74.00 (from ORIWMP)
- Unit cost weighted average approx. $343/lb N
- [DA] x [NLER] x [NRF] = [2.4 - [0.09*2.4]] = 2.2 lbs N/ac/yr

Septic System Retrofits

- Applicable for residential, over 19,000 septic systems within the regulated communities
- Based on GBNNPSS App G
  - 10.6 lbs N/person/yr
  - # of septic systems per community, population
- NRF = 0.6, 60% RE by MA Septic System Test Center.
- Cost per system $4,000
- Unit cost weighted average approx. $629/lb N
- [# of Systems] x [NLER] x [NRF] = [10.6 - [0.6*10.6]] = 4.2 lbs N/ac/yr
- State supported retrofit programs exist





Retrofit

Future Considerations

Credit Trading

- Nitrogen credit trading has great potential, and a market demand for trading could be developed.
- Upper watershed communities, often unregulated, have tremendous potential for the lowest-cost nutrient controls, such as agricultural BMPs and buffer protection.
- The 12 communities within the TNGP represent 35% of the land area within the Great Bay watershed.

Septic System Retrofit Programs

- This study identified septic system retrofits that could cost effectively reduce nearly 40% of the NPS load
- Would likely require a state coordinated effort similar to other successful examples in FL and NY.
- Incentive program that offsets homeowner costs by providing up to $10,000 in targeted areas .

Conclusions

- Communities have expressed their fear of exorbitant costs and the lack of ability to implement the TNGP.
- Cost estimates to comply with the TNGP could be astronomically high if using conventional strategies.
- To solve this problem with conventional wastewater treatment facilities and stormwater management would be exorbitant. New problems will require new solutions that will be far cheaper.
- The draft TNGP is basically an open door to innovative nutrient control strategies so long as they are defensible and trackable.
- This plan represents one scenario of many possible pathways - each community will need to determine what combination of management approaches is most suitable and achievable.
- The solution to this wicked problem will need to come from the communities and their consultants working together with EPA.

Thank You

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clf conservation law foundation

WATERSTONE ENGINEERING INNOVATIVE STORMWATER MANAGEMENT