Town of Exeter
Wastewater Facilities Plan

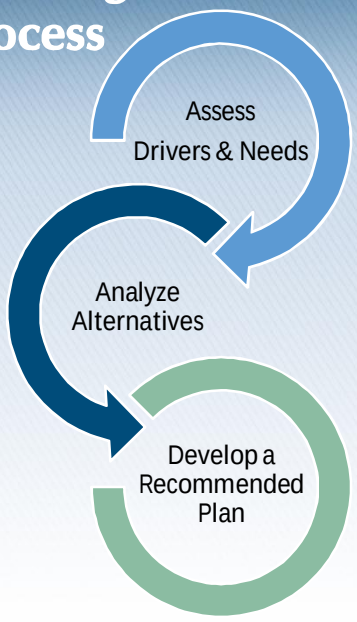
Presented By:
Ed Leonard, PE

Date:
December 3, 2014

WRIGHT-PIERCE
Engineering a Better Environment

TOWN OF EXETER FOUNDED 1638 NEW HAMPSHIRE

Planning Process



- Identify infrastructure needs
- Identify upgrade options
- Identify optimal PS/NPS nitrogen strategy
- Recommend capital improvements
- Identify funding mechanisms and schedule

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Why is this Plan Needed?

- Declining water quality in the Squamscott River and in Great Bay

Photo: National Estuarine Research Reserve System website

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Why is this Plan Needed?

- NPDES Permit
  - Issued in 2012 by EPA
  - Achieve <3 mg/l TN
- AOC (Administrative Order on Consent)
  - Legal agreement with the EPA in 2013
  - Achieve 'interim limit' of <8mg/l TN

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Additional AOC Requirements

- Begin "Tracking & Accounting" for TN
- Implement baseline river monitoring
- Coordinate with NHDES & municipalities
- Develop a Nitrogen Control Plan (2018)
- Implement the Nitrogen Control Plan
- Evaluate effectiveness of NCP (2023)

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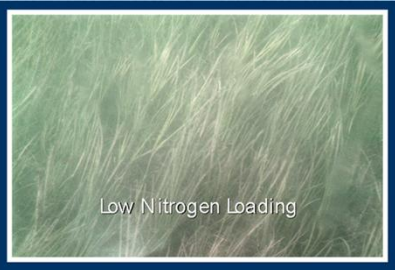
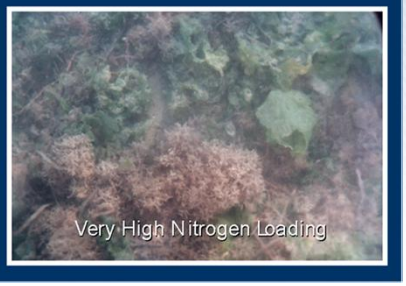
Why is the AOC Focused on Nitrogen



As nitrogen loading increases, healthy eelgrass and diverse animal communities decline as algae replace eelgrass and smother animal communities; eelgrass disappears and fisheries decline.



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What are the Nitrogen Sources and Delivery Mechanisms?

Inputs	Delivery Method	Attenuation Mechanism*
• Food (i.e., wastewater) • Fertilizers • Atmospheric N • N-fixing crops	• WWTFs • Groundwater • Precipitation • Stormwater	• Storage in soil & plants • Removal in crops & woods • Microbial action • Aeration in surface water

* Natural attenuation results in 74% nitrogen removal

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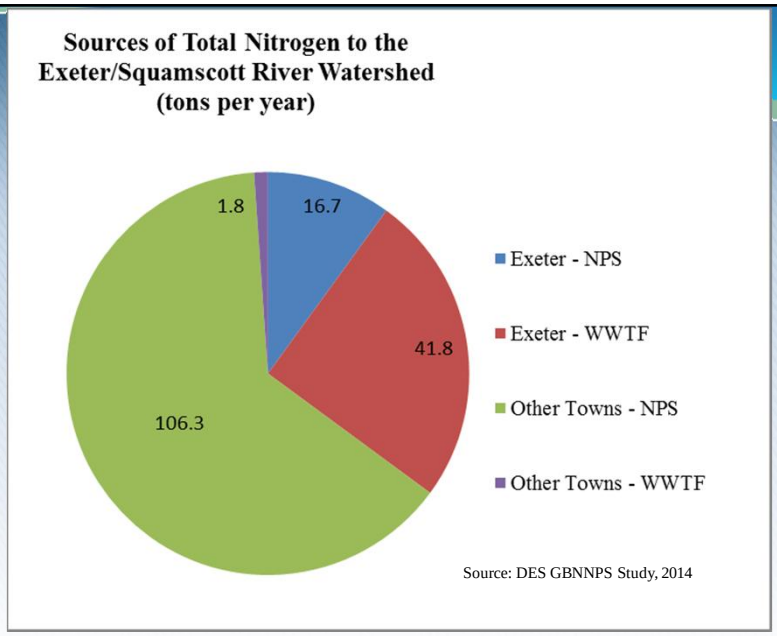

Nitrogen control will require cooperation from other towns

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How Much N Reduction Required?

- There is debate on this
- NHDES:
  - Put Great Bay and Squamscott River on the 303(d) list
  - Established Numeric Nutrient Criteria based on "weight of evidence" approach in June 2009.
  - Issued Great Bay Nitrogen Loading Analysis in December 2010 with "threshold" values

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How Much N Reduction Required?

- Great Bay Municipal Coalition sued NHDES
  - GBMC & NHDES agreed to a Peer Review
  - Joint Report of Peer Review Panel - Feb 2014
  - Settlement Agreement - Apr 2014
- Currently there are no "firm" criteria
  - WQ driver is still present
  - Validates the adaptive approach in the AOC
  - Emphasizes need for water quality monitoring
  - Coalition communities are upgrading WWTFs

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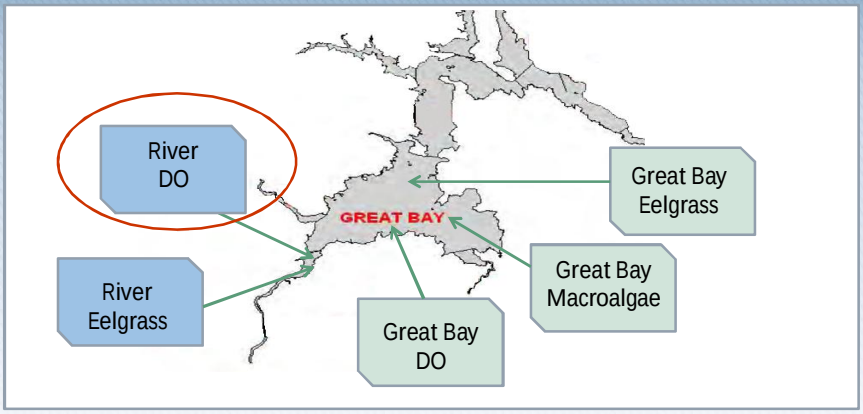
How Much N Reduction Required?



For Planning, we are using 140 tons/yr as the "Estimated Threshold"

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Needs Assessment for Wastewater Treatment Facility (WWTF) and Main Pump Station

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Wastewater Infrastructure

- Collection System
  - 51.8 miles of sewers
  - 2 combined sewer overflow (CSO) locations
  - Main Pump Station
- WWTF
  - Originally constructed in 1964 (lagoons)
  - Upgraded in 1988 (lagoons) and 2002 (outfall)
  - Effluent to Squamscott River

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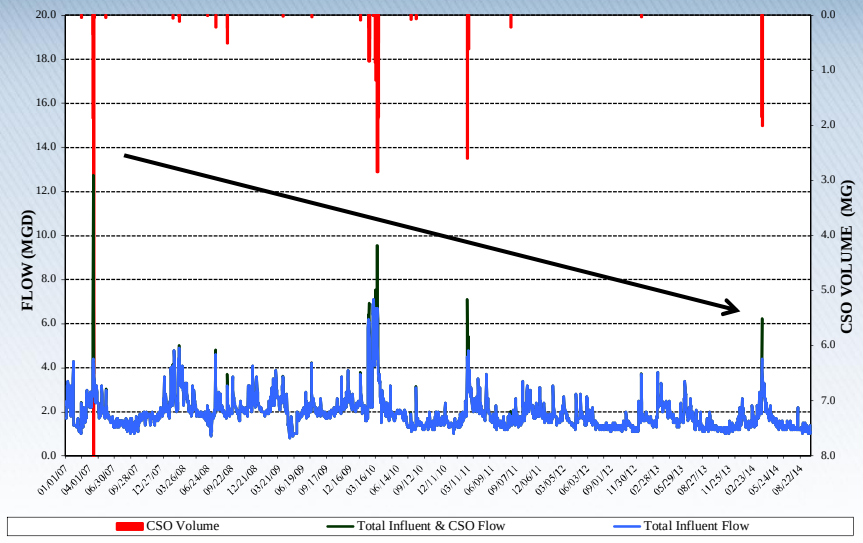
WWTF and CSO Flows



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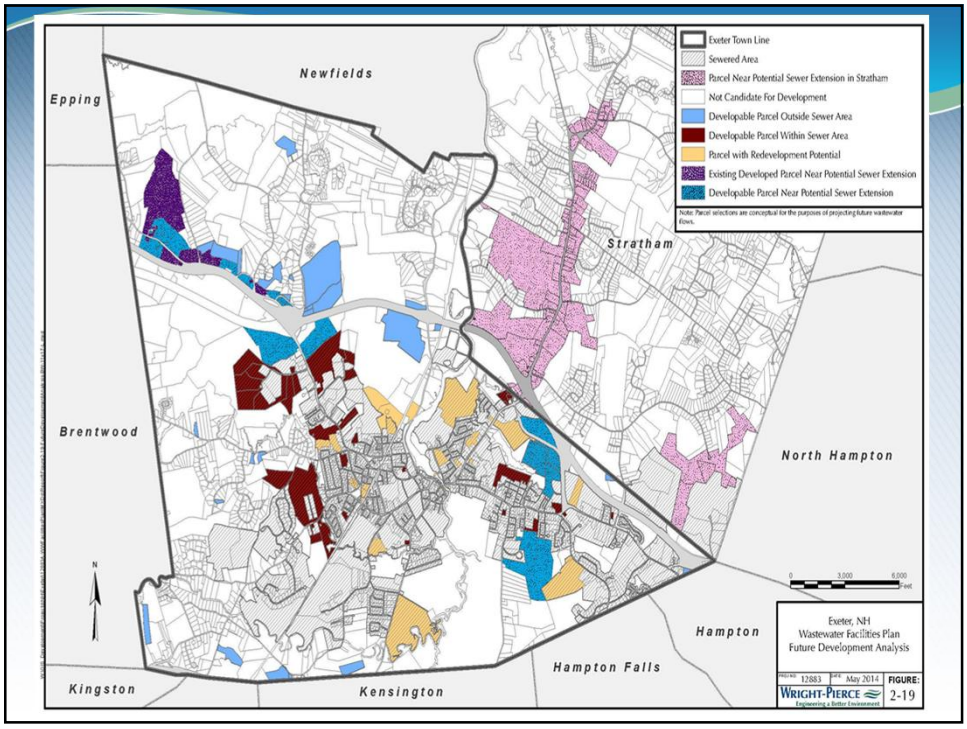
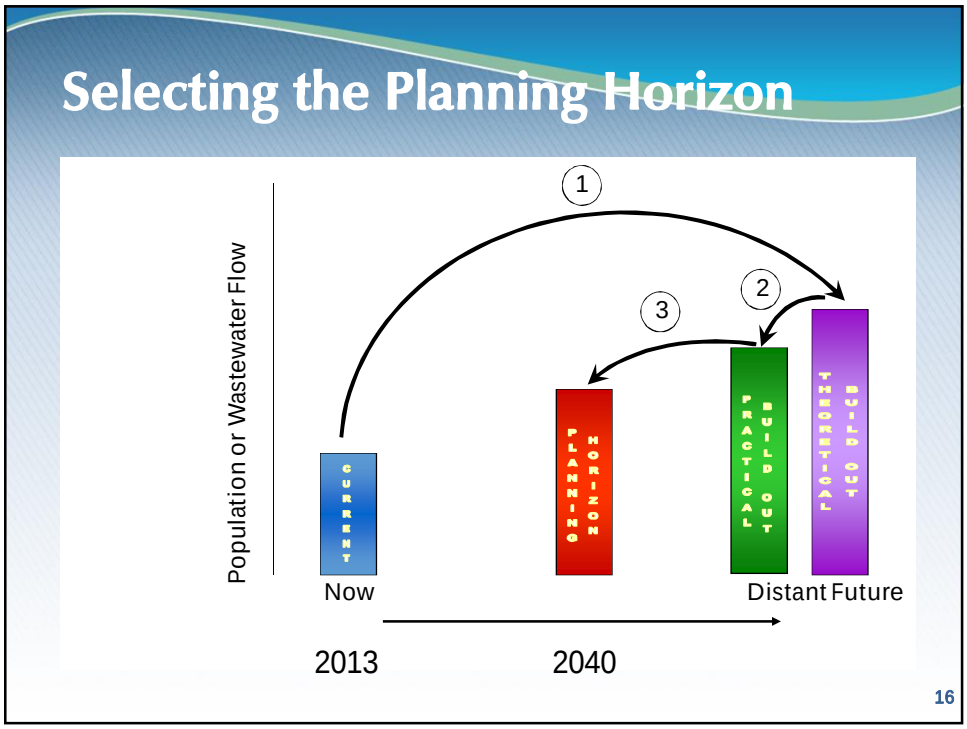

Exeter Town Line
Sewered Area
Parcel Near Potential Sewer Extension in Stratham
Not Candidate For Development
Developable Parcel Outside Sewer Area
Developable Parcel Within Sewer Area
Parcel with Redevelopment Potential
Existing Developed Parcel Near Potential Sewer Extension
Developable Parcel Near Potential Sewer Extension
Note: Parcel selections are conceptual for the purposes of projecting future wastewater flows.
Newfields
Epping
Stratham
Brentwood
North Hampton
Hampton
Hampton Falls
Kingston
Kensington
N
0
3,000
6,000
Feet
Exeter, NH
Wastewater Facilities Plan
Future Development Analysis
PROJ NO. 12883
DATE May 2014
FIGURE: 2-19
WRIGHT-PIERCE
Engineering a Better Environment


Selecting the Planning Horizon
Population or Wastewater Flow
1
2
3
CURRENT
PLANNING HORIZON
BUILD OUT PRACTICAL
BUILD OUT THEORETICAL
Now
Distant Future
2013
2040
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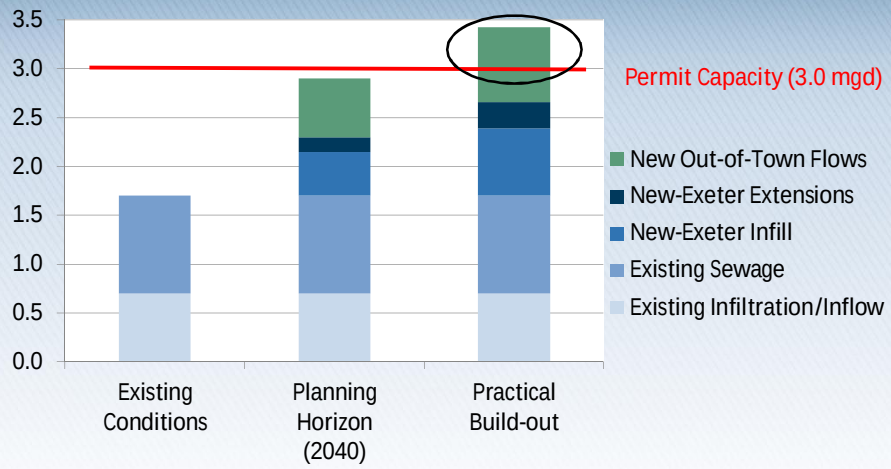
WWTF – Flow Capacity



May need to limit new out-of-town flows, and/or reduce I/I flows, and/or negotiate a higher permit limit

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WWTF – Process

Conventional WWTF

Exeter WWTF

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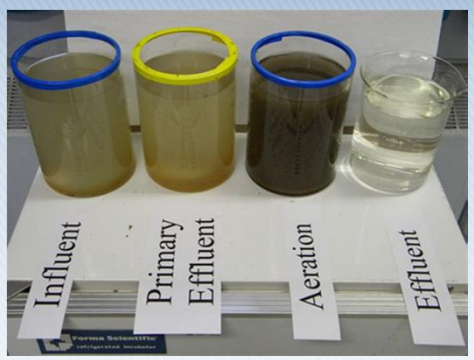
WWTF – Effluent Quality

Exeter WWTF



Conventional WWTF

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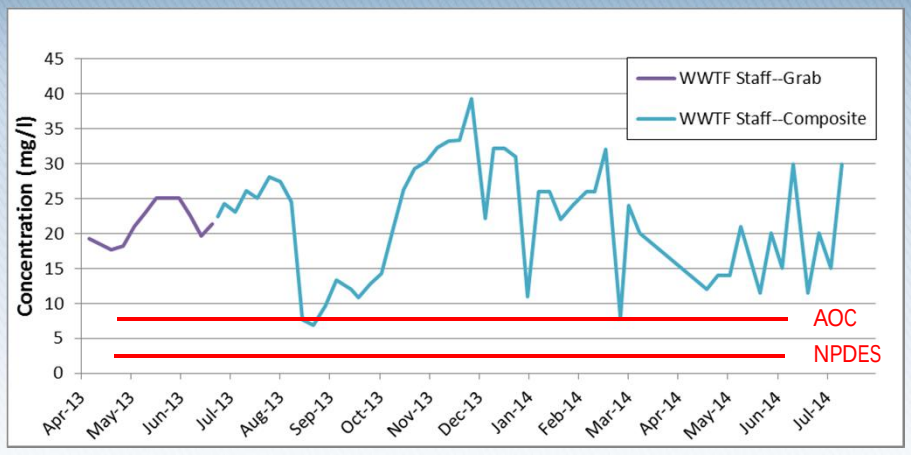
WWTF – Effluent Nitrogen



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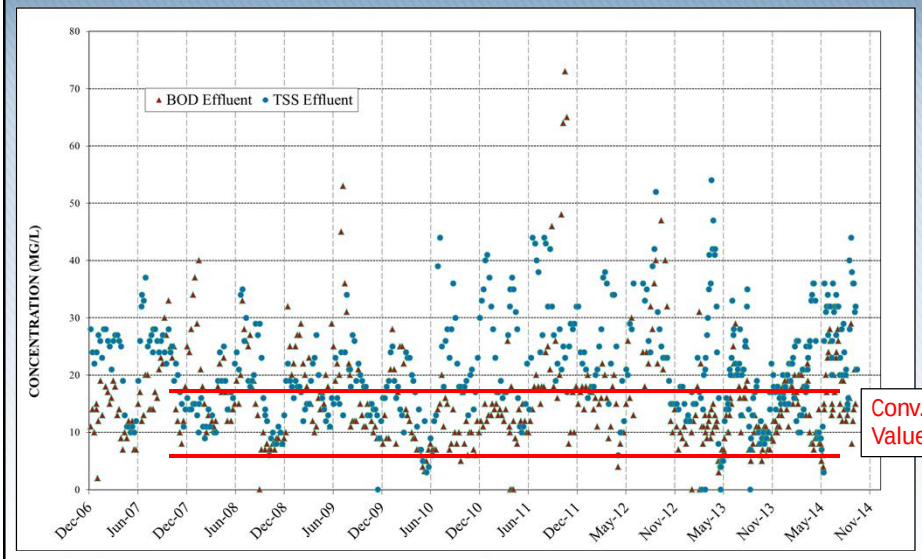
WWTF – Effluent BOD and TSS



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WWTF & MPS - Conclusions

- Main Pump Station needs upgrades to reduce CSOs
- Outdated WWTF can't meet NPDES
- Most of the treatment equipment has exceeded useful life
- Comprehensive upgrade required to a conventional plant

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Prioritizing Nitrogen Management Approaches

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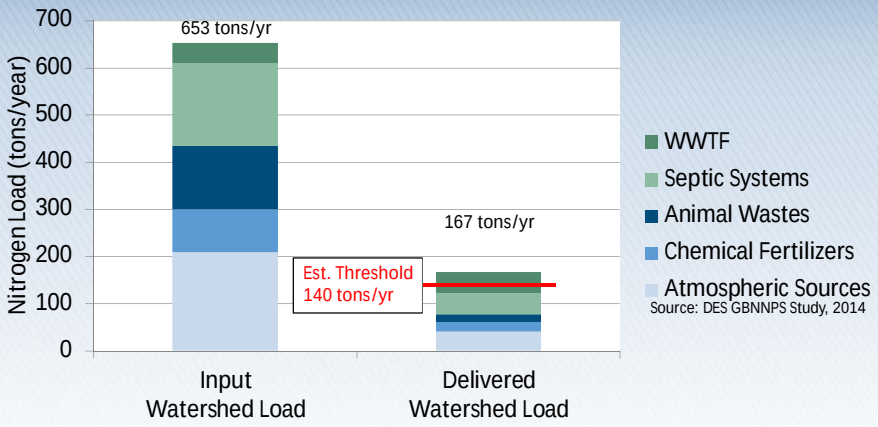
Current* NPS Nitrogen Loads to Exeter/Squamscott Watershed



* Excludes future TN loads due to growth in the watershed.

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Exeter River Watershed
NPS Nitrogen Reductions Required

WWTF Effluent TN	Current Conditions [1, 2]	Planning Horizon [1, 3, 4]
8-mg/l	3%	16%
5-mg/l	-3%	5%
3-mg/l	-8%	-3%
"0-mg/l" (Pease WWTF)	-12%	-10%

1. Based on estimate of threshold load for River DO criteria of 140 tons/year
2. Based on WWTF flow of 1.7 mgd
3. Based on WWTF flow of 3.0 mgd
4. Assumes future growth is near 'nitrogen neutral'
5. Pease Option assumes 8mg/l effluent with 10% of load flowing to Great Bay
6. Negative values indicate amount below the estimated threshold

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Exeter River Watershed
NPS Nitrogen Reductions Possible

	Fraction of NPS Load	Estimated Reduction	Net Reduction
Septic	24%	0% [1]	0%
Animal/Agricultural	17%	10% [2]	1.7%
Chemical Fertilizer	24%	20% [2]	4.8%
Atmospheric Deposition	35%	30% [3]	10.5%
Total Net Reduction			17.0%

1. Set a near nitrogen-neutral policy for new growth
2. Best management practices
3. Clean Air Act mandates result in long-term atmospheric reductions at no cost

Up to 17% NPS load reduction at low cost
Up to 10% NPS load reduction at 'no cost'

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Important to Focus NPS Efforts on Most Effective TN Removal Methods

Management Approach	Assumed Input Load	Resultant Delivered Load	Effective Removal
Secondary WWTF	1	0.67	33%
Standard Septic System, <200m	1	0.60	40%
Denitrifying Septic System, <200m	1	0.30	70%
WWTF with TN Removal to 8 mg/l	1	0.27	73% ★
Standard Septic System, >200m	1	0.26	74% ★
WWTF with TN Removal to 5 mg/l	1	0.17	83%
Denitrifying Septic System, >200m	1	0.13	87%
WWTF with TN Removal to 3 mg/l	1	0.10	90%

1) Effective removals based on methodology used in DES GBNNPS, 2014

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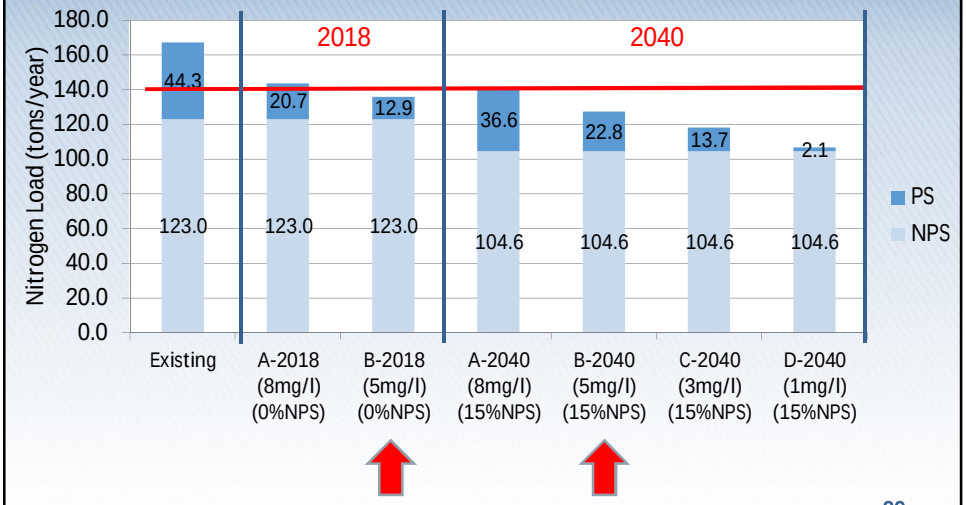
Important to Focus Efforts on Most Economical TN Removal Methods

Annualized Cost per Pound of Nitrogen Removed	Rank	PW $$ per lbTN removed
Atmospheric Deposition Reductions	1	$0
Chemical Fertilizer Reduction Program	2	$30
Agricultural BMPs	3	$50
WWTF Upgrade to 5-mg/l (1)	4	$290
WWTF Upgrade 3-mg/l (1)	5	$300
WWTF Upgrade to 8-mg/l (1)	6	$330
Sewer Extension, <200m to Shore (2,3)	7	$3,000
On-Site Denit. Septic Systems, <200m to Shore (3)	8	$5,000
Rain Gardens, Street Sweeping, Bioretention, Pervious Pavement	9	$500 - $8,000
Sewer Extension, >200m to Shore (2,3)	10	$9,000
On-Site Denit. Septic Systems, >200m to Shore (2,3)	11	$17,000

(1) WWTF at 3.0 mgd; (2) Conveyed to WWTF at 5-mg/l; (3) Includes impacts of natural attenuation

Nitrogen Management Strategies



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WWTF Alternatives Analysis

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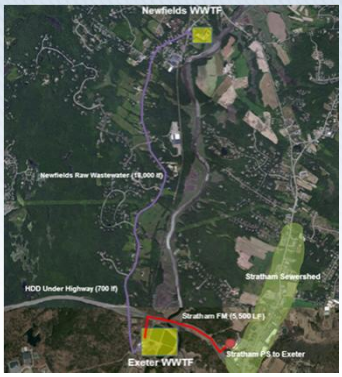
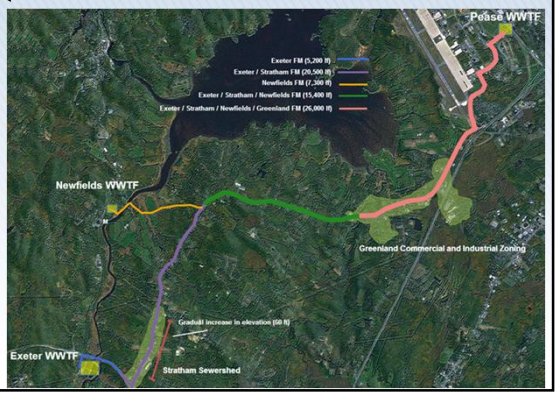
WWTF Alternatives

Alternative 1
(On-Site)

Alternative 2
(Hampton)

Alternative 3
(Pease)





WWTF Alternatives Analysis (April 2014)

	Alternative 1 On-Site	Alternative 2 Hampton	Alternative 3 Pease
Total Capital	Low	Mid	High
Total Annual O&M	Low	Mid	High
50-Yr Present Worth	Low	Mid	High
Exeter Share of 50-Yr PW *	Low	High	Mid
Effluent TN Concentration	3-mg/l	8-mg/l	8-mg/l
Effluent TN Conc. to Great Bay	3-mg/l	0-mg/l	<1-mg/l
Permitting	Certain	Uncertain	Uncertain
AOC Timeframe	Certain	Uncertain	Uncertain
Recommendation	Pursue	Drop	Pursue

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On-Site WWTF Nitrogen Removal Alternatives

Identified:

More Common	Less Common
Modified Ludzack-Ettinger (MLE)	Moving Bed Bioreactor (MBBR)
Four-Stage Bardenpho	Biolac
Sequencing Batch Reactor (SBR)	BioMag
Oxidation Ditch	Rotating Biological Contactors (Aerobic/Anoxic)
Schreiber Cyclic Aeration	De-ammonification
Integrated Fixed Film Activated Sludge (IFAS)	Trickling Filters
Membrane Bioreactors (MBR)	Breakpoint Chlorination
Denitrification Filters	Air Stripping

Short-Listed:

- MLE plus Denitrification Filter
- Bardenpho plus Traditional Filter
- SBR plus Denitrification Filter
- Biolac plus Denitrification Filter

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On-Site WWTF Nitrogen Removal Alternatives

- Process configuration for 8/5/3-mg/l
- Modeling and tank sizing
- Phasing considerations
- Planning-level site layouts
- Planning-level cost estimates
- Evaluative criteria

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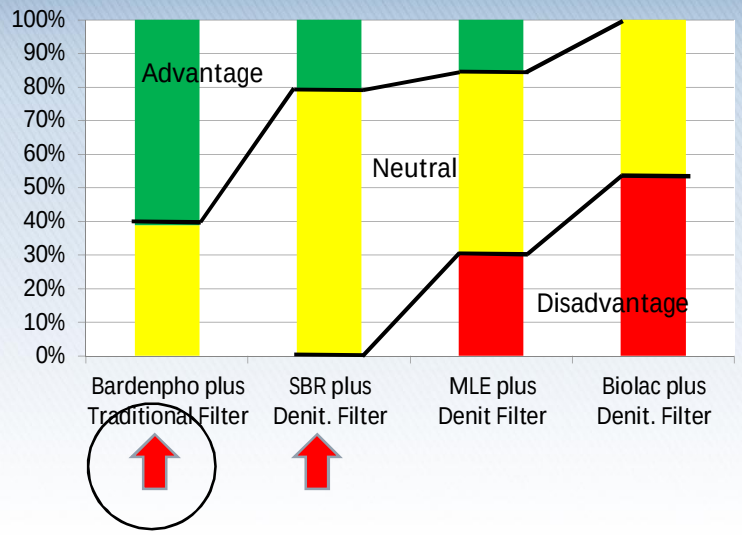
Selected Nitrogen Removal Alternative



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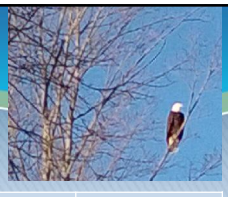
Lagoon Decommissioning



	Reclaim Land	Restore Wetlands	Fill with Water
Cost for Decommissioning	$5M	$5M	$5M
Cost for Finishing the Site	$10M	$1M	$0M
Grants Available?		✓	
Increase Flood Storage in River?		✓	
Potential Recreational Uses:			
Athletic Fields	✓		
Birding/Walking Trails		✓	✓
Boat Launch	✓	✓	✓

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WWTF "Sketch" - Existing

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WWTF "Sketch" – Restore Wetlands

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Recommended Plan for On-Site WWTF

- Point Sources of Nitrogen
  - Upgrade WWTF to TN 5-mg/l $40M
  - Upgrade Main Pump Station (CSO) $ 5M
  - Decommission Lagoons $ 6M
- Non-Point Sources of Nitrogen $tbd
  - Meet AOC requirements (T/A, NCP, AMP)
  - Fund river monitoring program
  - Update ordinances to address “future” TN
  - Encourage State to foster watershed cooperation

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WWTF Alternatives Analysis (Updated November 2014)

	Alternative 1 On-Site	Alternative 3 Pease
Total Capital	$45.9M	$67 to $76M
Total Annual O&M for Treatment & Disposal	$1.85M	$3.7 to $4.7M
50-Yr Present Worth	$104M	$183 to $223M
Exeter Share of 50-Yr Present Worth	$104M	$119 to $155M
Effluent TN Concentration	3-mg/l	8-mg/l
Effluent TN Concentration to Great Bay	3-mg/l	<1-mg/l
Permitting & AOC Timeframe	Certain	Uncertain
50-Yr PW of Exeter Cost for 15% NPS Reduction	$3 to $6M	$0M
Total 50-Yr PW of Exeter PS/NPS Costs	$107 to $110M	$119 to $155M

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Funding and Next Steps

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Program Funding

- Loans
  - DES CWSRF, 20-year loan at 3.4%; or
  - NH Municipal Bond Bank, 20-years at 4.5%
- Grants
  - None secured at this time
  - Targeting US Economic Development Admin
  - Targeting DES State Aid Grant (30% grant)
    - Need vocal town support to the NH Legislature

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Costs for Typical Residential User

- Existing Sewer Fund plus costs resulting from the Recommended Plan
- Sewer User Rates for Single Family Household
  - Current rate for 90ccf per yr - $410/yr
  - Increase rate to $890/yr with SAG (1.3% MHI)
  - Increase rate to $1,090/yr without SAG (1.6% MHI)
- Taxation
  - Assumes no contribution from taxation

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Affordability Strategies

- Update user charge system and connection fees
- Consider regional host fees
- Optimize other expenditures
- Consider phasing project implementation
- Evaluate watershed fees

	LbTN/capita/yr	$$/capita/yr
Exeter - Status Quo	8.4	$0
Rest of Watershed – Status Quo	7.4	$0
Exeter – 2018 (NPDES/AOC)	4.4	$450

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Near-Term Schedule

- WWTF and Facilities Planning
  - Decisions – Winter 2015
  - Start Design – Winter 2015
  - Bidding – April to May 2016
  - Initiate Construction – June 2016 (AOC)
  - Complete Construction – June 2018 (AOC)

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Closing Comments

1. TN management will require effort for next 10+yrs.
2. Watershed-wide NPS TN management is warranted. An estimated 17% reduction in NPS TN is feasible at relatively low cost.
3. A WWTF upgrade is needed. AOC requires TN 8-mg/l, however TN 5-mg/l is more cost effective.
4. Best available information suggests that Town may be able to avoid WWTF TN 3-mg/l and that on-site WWTF will be most cost effective.

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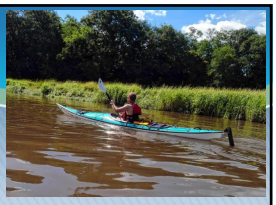
Closing Comments



5. Capital costs can be reduced through phasing.
6. User rates can be reduced through partnering with Stratham and/or Newfields. Capacity is available through the Planning Horizon.
7. State leadership is needed for inter-municipal collaboration and affordability.

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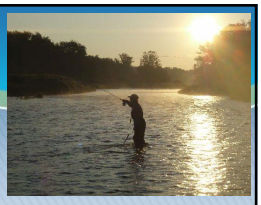
Next Steps



- Address comments from Exeter
- Conclude 'on-site' or 'off-site' approach
- Decide on Stratham/Newfields connections
- Update Facility Plan
- Submit plan to EPA and DES
- Initiate Design activities and WQ monitoring
- Continue with AOC tasks and I/I efforts

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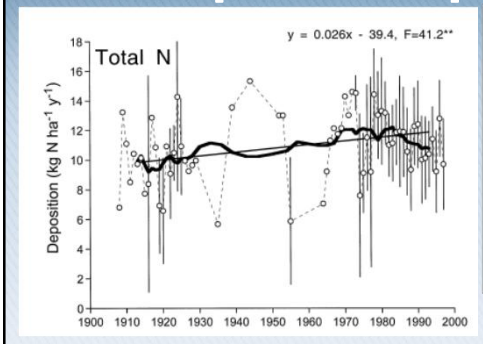
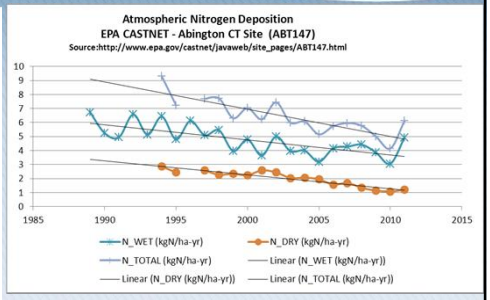
Questions & Discussion

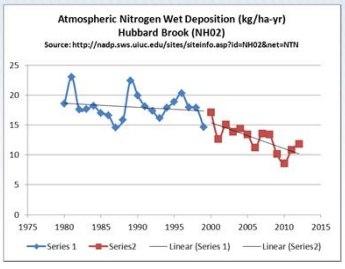
Atmospheric Deposition



Source: "Historical Changes in Atmospheric Deposition to Cape Cod", Bowen, Valiela, 2001, Fig. 5



Data Source: www.epa.gov/castnet



Data Source: http://nadp.sws.uiuc.edu

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WWTF Alternatives Analysis (April 2014)

	Alternative 1 On-Site	Alternative 2 Hampton	Alternative 3 Pease
Capital *	$48.4M	$51.8M	$81.6M
Annual O&M for Total Sewer Budget	$3.4M	$3.8M	$5.8M
50-Yr Present Worth *	$121.9M	$132.6M	$206.8M
Exeter Share of 50-Yr Present Worth *	$121.9M	$119.3M	$144.6M
Effluent TN Concentration	3-mg/l	20-mg/l	8-mg/l
Exeter Share of 50-Yr Present Worth * for Effluent TN at 8-mg/l	n/a	$150M	n/a
Effluent TN Concentration to Great Bay	3-mg/l	0-mg/l	<1-mg/l
Permitting	Certain	Uncertain	Uncertain
AOC Timeframe	Certain	Uncertain	Uncertain

* Includes treatment and disposal costs for Stratham and Newfields; Includes collection system costs.

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