A Cooperative Effort Between

Engineer and Operator in Achieving Nitrogen Removal to the Limit of Technology

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Overview

- Background
- Nitrogen TMDLs and CWMP
- Costs and funding
- Overview of WPCF
- Questions/discussions

Background

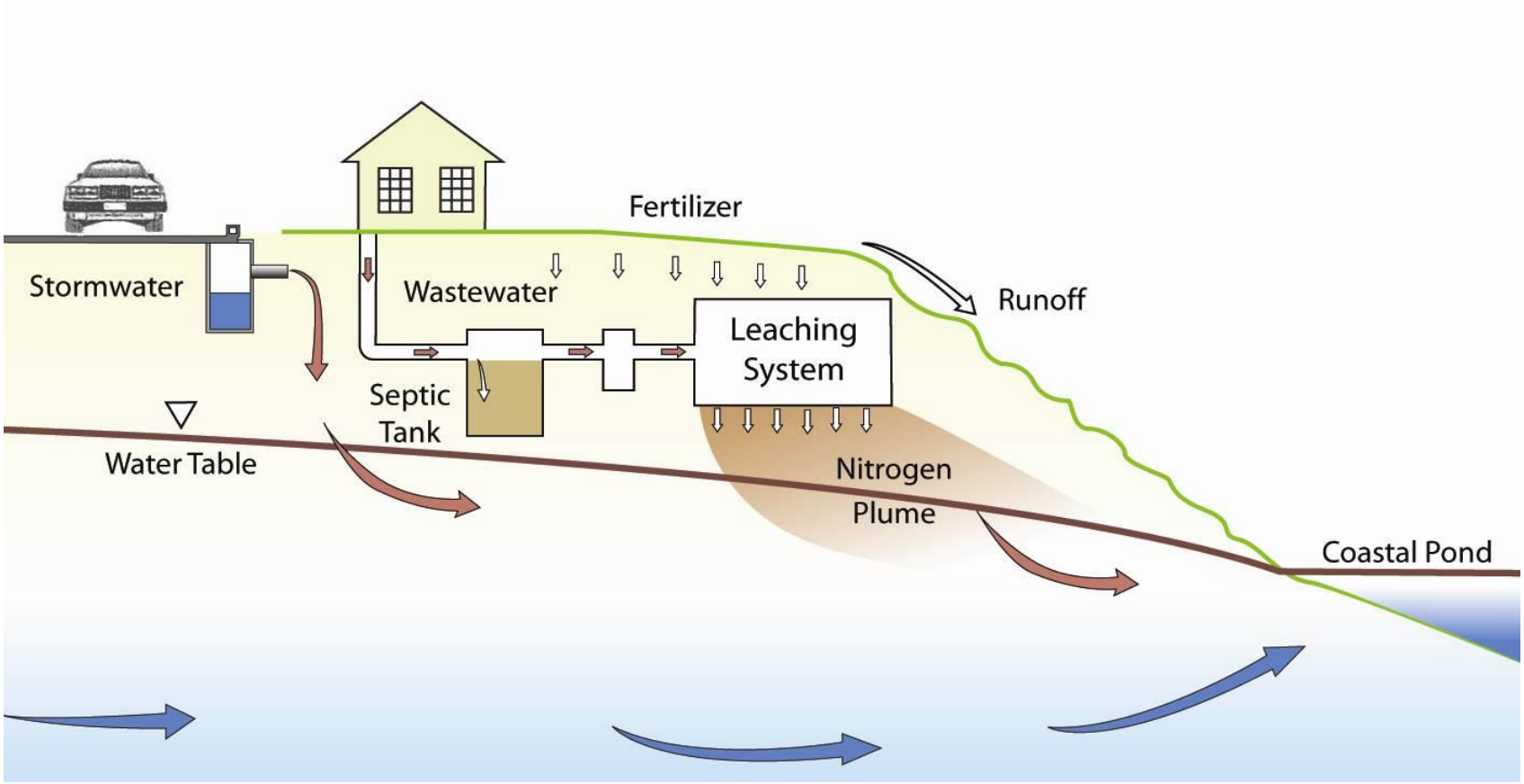
Town of Chatham

- Small residential community
- Year-round population of 6,125 (2010 Census)
- Summer population is 3x year-round
- Over 5,000 developed properties
- Year-round fishing industry and heritage

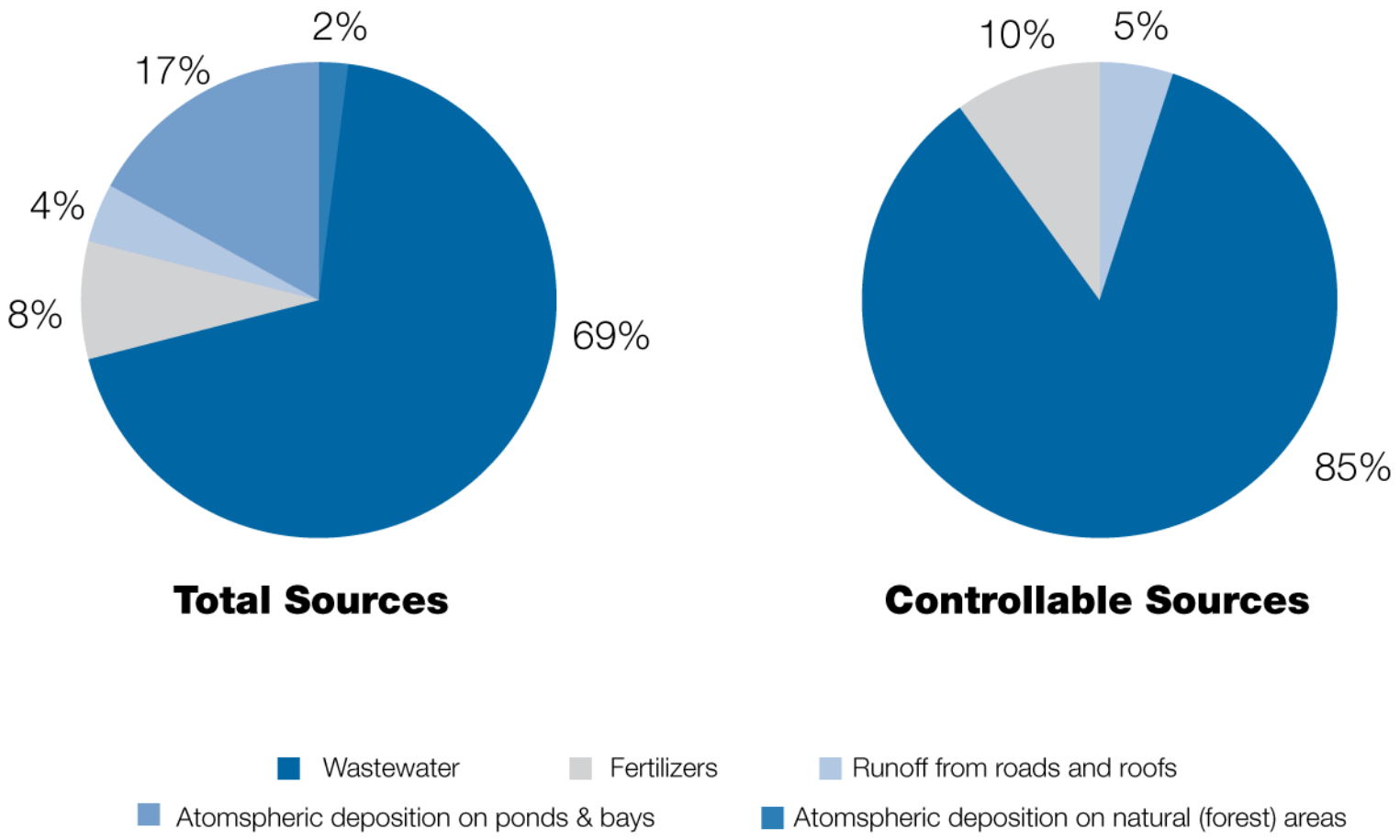
Main issues and challenges

- Extensive use of septic systems in Chatham
- Nitrogen and phosphorus are causing eutrophication of the coastal estuaries and inland ponds
- Water supplies are becoming impacted

Main issues and challenges



Typical nitrogen sources and contribution percentage



Nitrogen TMDLs and CWMP

CWMP in Chatham

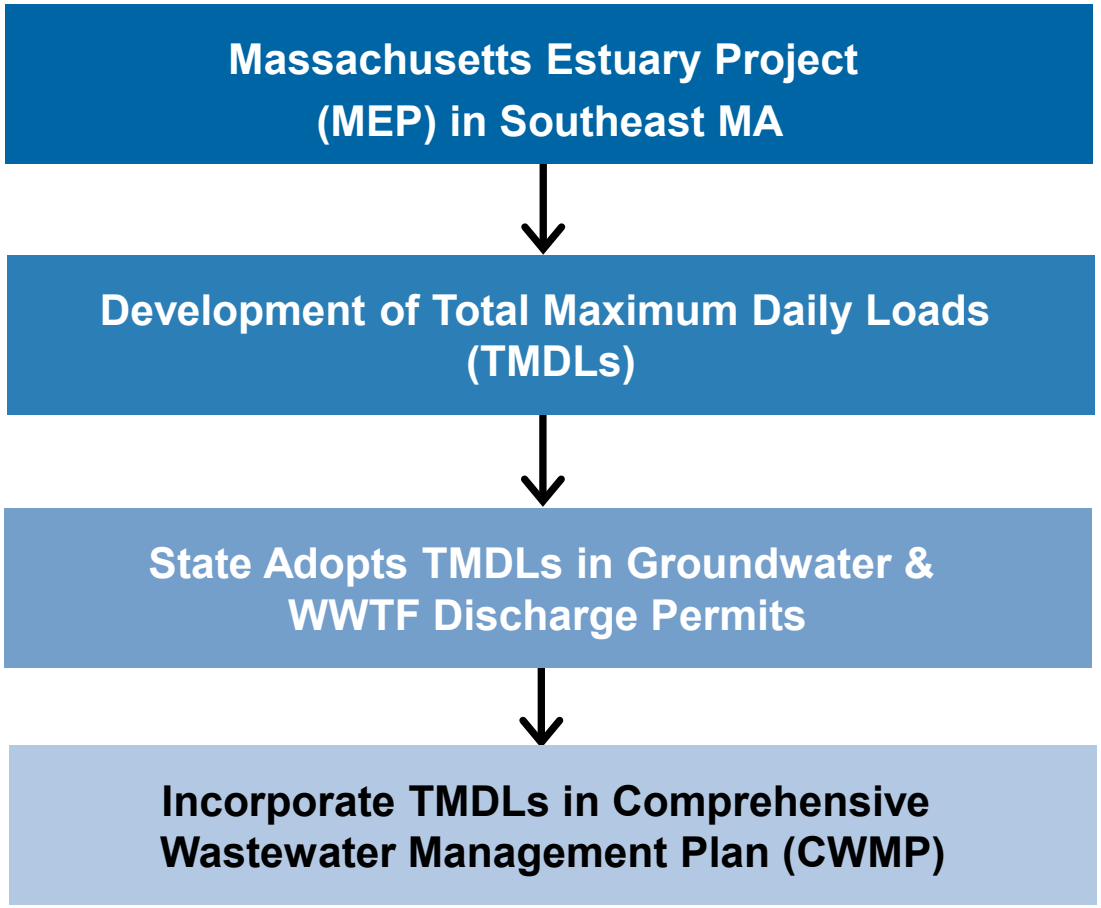
Wastewater facilities plan completed in 1982

- Due to concerns about uncontrolled growth, it did not move forward
- Consent order in 1987 (by MADEP) to complete the CWMP

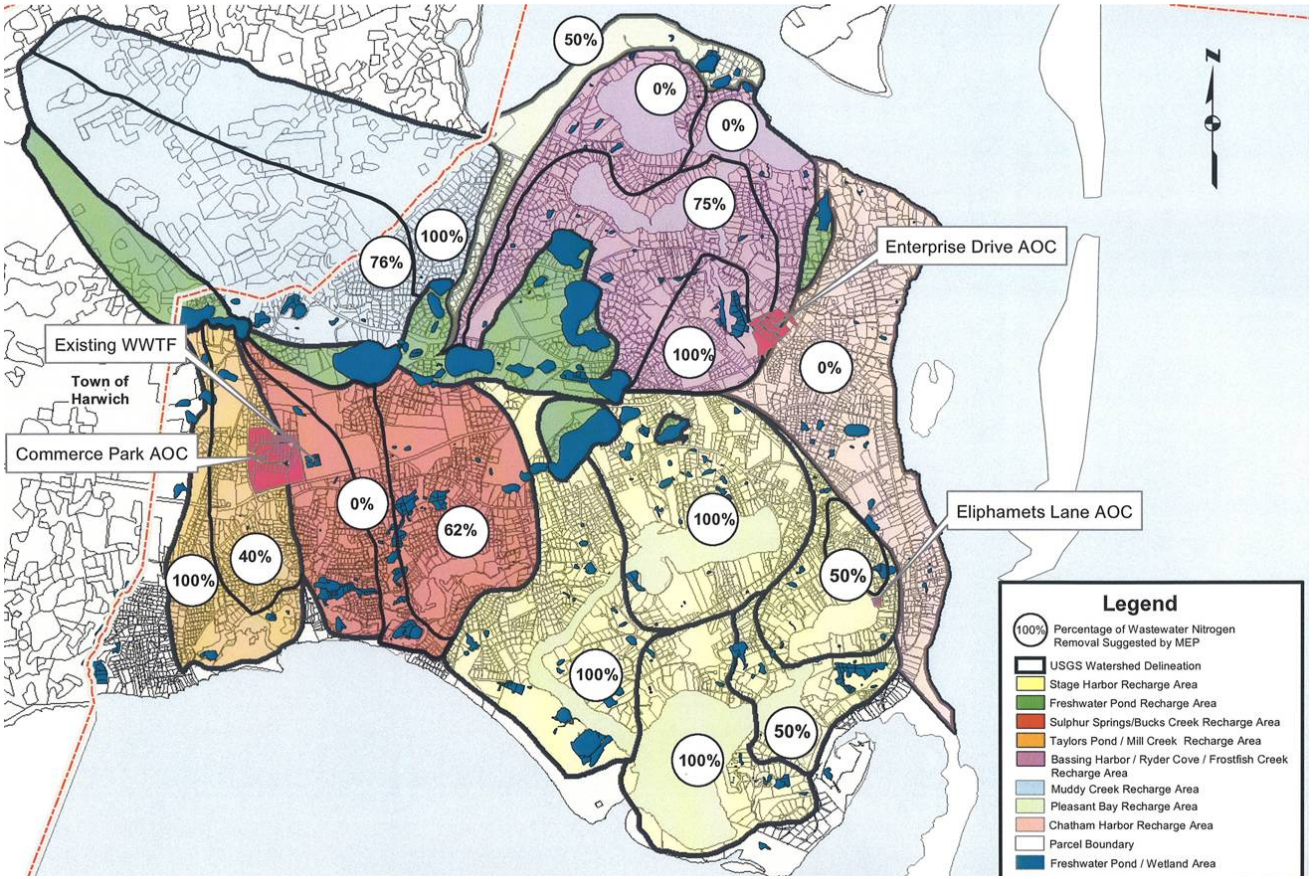
Comprehensive Wastewater Management Plan (CWMP)

- Started in 1997
- Final CWMP approved in July 2009
- Took more than 10 years to complete (waiting for TMDLs)
- 20-year planning period from 2010 to 2030

History of planning process



Wastewater nitrogen that requires removal to meet the nitrogen TMDLs



Wastewater nitrogen alternatives evaluation

Summary of typical nitrogen removals for the wastewater management options		
Technology	**Typical nitrogen concentration in the effluent**	**Typical percent removal**
Title 5 septic system	20 to 40 mg/l	23%
Individual nitrogen removal septic system	15 to 25 mg/l	50%
Community/cluster system	5 to 15 mg/l	75%
Upgraded Chatham WWTF	3 mg/l	93%




Design considerations and phase approach

In order to meet TMDLs in all watersheds

- Required sewering 2/3 of the Town
- Improve WPCF performance
- 3 mg/L total nitrogen discharge limit

Phase 1 (to meet TMDLs)

- Sewer 2/3 of the Town
- 61 sewer sheds
- WPCF upgrade (expand on existing site)

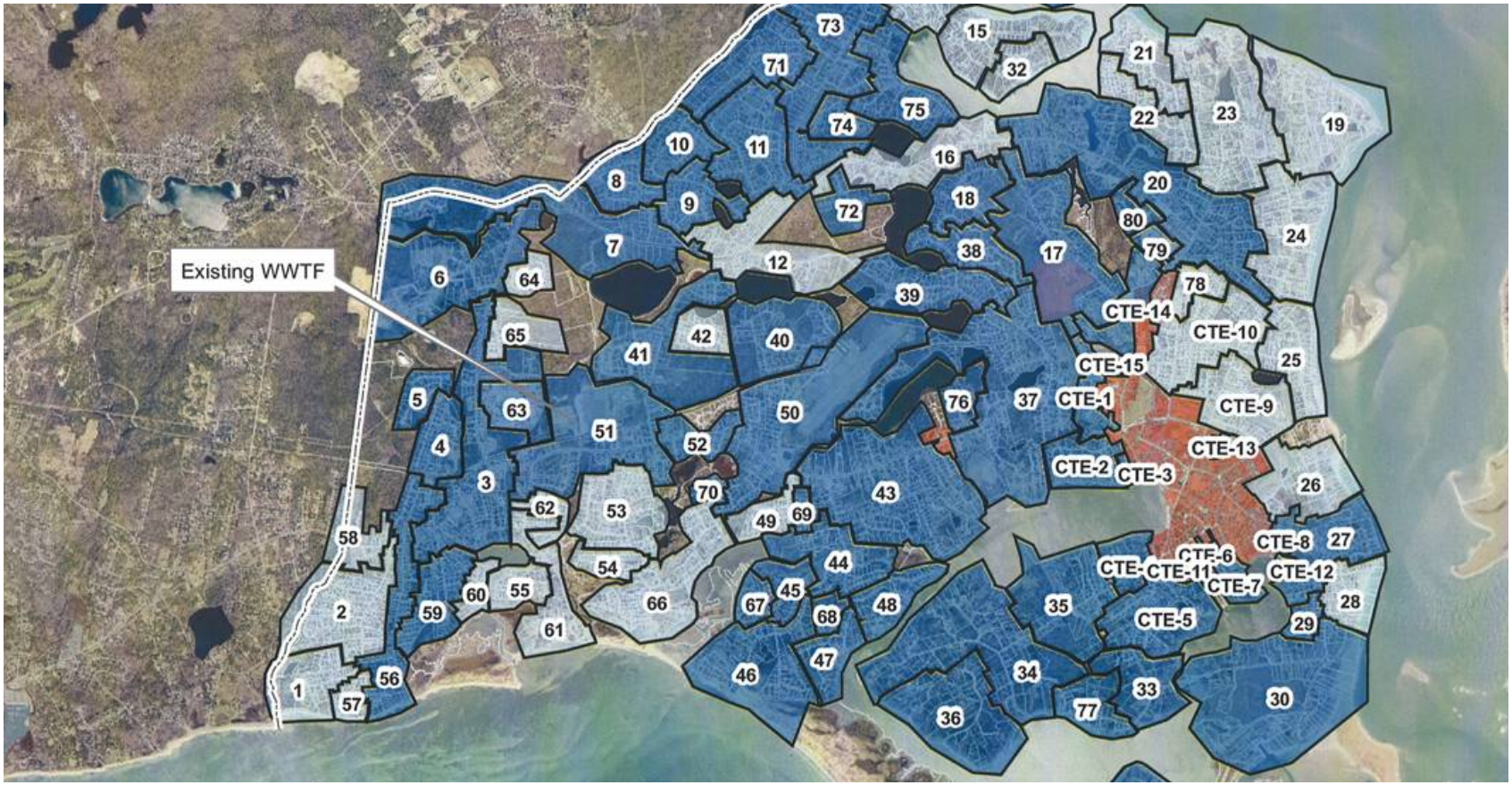
Phase 2

- Sewer the rest of the Town (a fiscally fair approach)
- Expect 33 additional sewer sheds
- Expand WPCF

Project findings and town guidance

- The CWMP needs to be “growth neutral”
- Decentralized wastewater management is appealing; but not feasible for all parts of Town
- Phase 1 of the plan should allow for sewer extension to meet the TMDLs in first 20 years
- Phase 2 should allow for sewer extension to the rest of the Town in the following 10 years

Phase 1 and 2 sewer expansion



Costs and funding

Estimated project costs

Phase	Collection System	WPCF
Phase 1 • Initial Implementation • Remaining phase 1	$20 M $150 M	$40 M -
Phase 2	$80 M	$10 M
Total	$250 M	$50 M

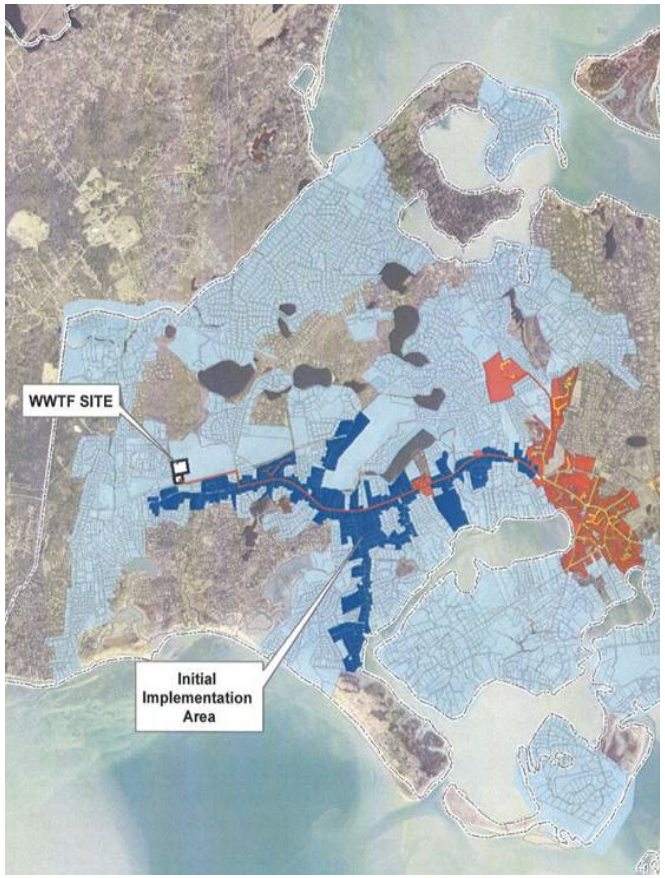
Note: 2010 Dollars

Financing plan

- Stabilize debt and use debt drop-off to help fund implementation of planning project (75%)
- Sewer users would eventually pay for 25% of debt (sewer and collection)

CWMP initial implementation plan

- $60 million appropriation in 2009
- Initial implementation of Phase 1 collection system and pump station expansion and upgrade
  - Construct backbone of collection system
- Phase 1 WPCF improvements
- Water quality improvements projects
  - Stormwater remediation projects
- Alum treatment of 2 freshwater ponds



Funding

- Pay for capital costs with property taxes and the general fund (no betterments)
  - Most affordable way to fund the projects
- American Recovery and Reinvestment Act (ARRA) of 2009
- Evaluated funding options
  - State Revolving Fund (SRF) – 0%
  - United States Department of Agriculture (USDA) Rural Development Funding Options

Elected to use

- SRF Funding for collection system and pumping stations
- USDA Funding for WPCF
- Chatham meets the small community threshold
- Received 45% construction grant of almost $18 million and $1.2 million for design (WPCF)
- Low interest loans

Project costs – initial implementation (2009-2013)

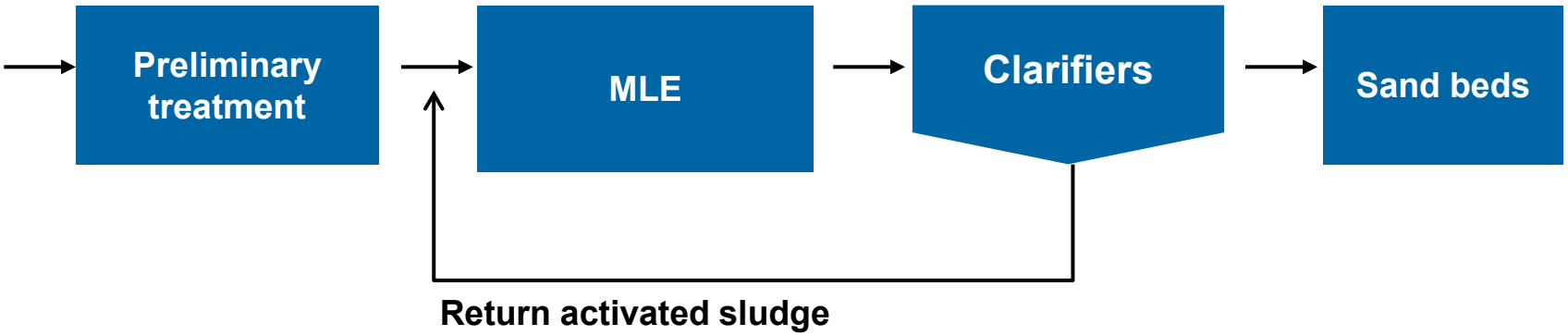
Phase	Total cost
WPCF – Contract 1	**$40M**
Pumping Stations – Contract 2	**$3M**
Collection System – Contracts 3 & 4	**$10M**

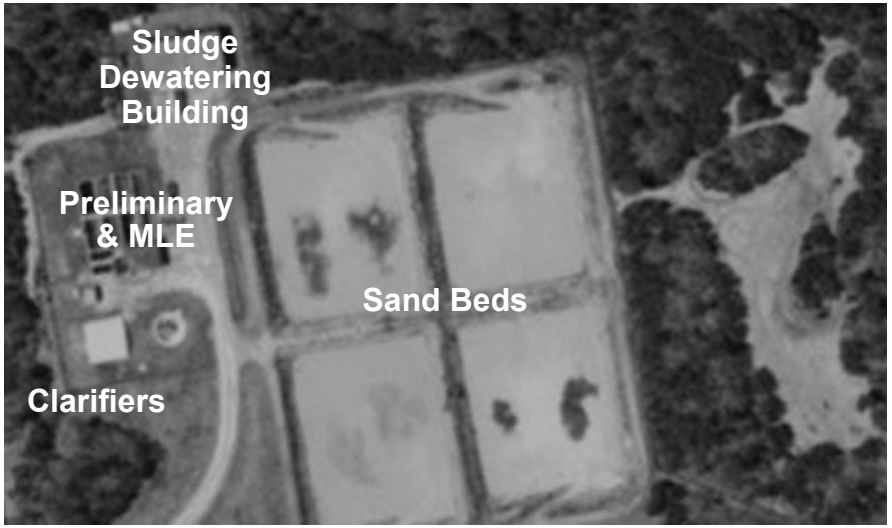
Project costs – Subsequent Phases

- Sewer extensions continue
- Minor upgrades to WPCF will be required over time
- Chatham is about to become the first regional WPCF on Cape Cod
  - Town of Harwich – east side – will tie in by June

Overview WPCF

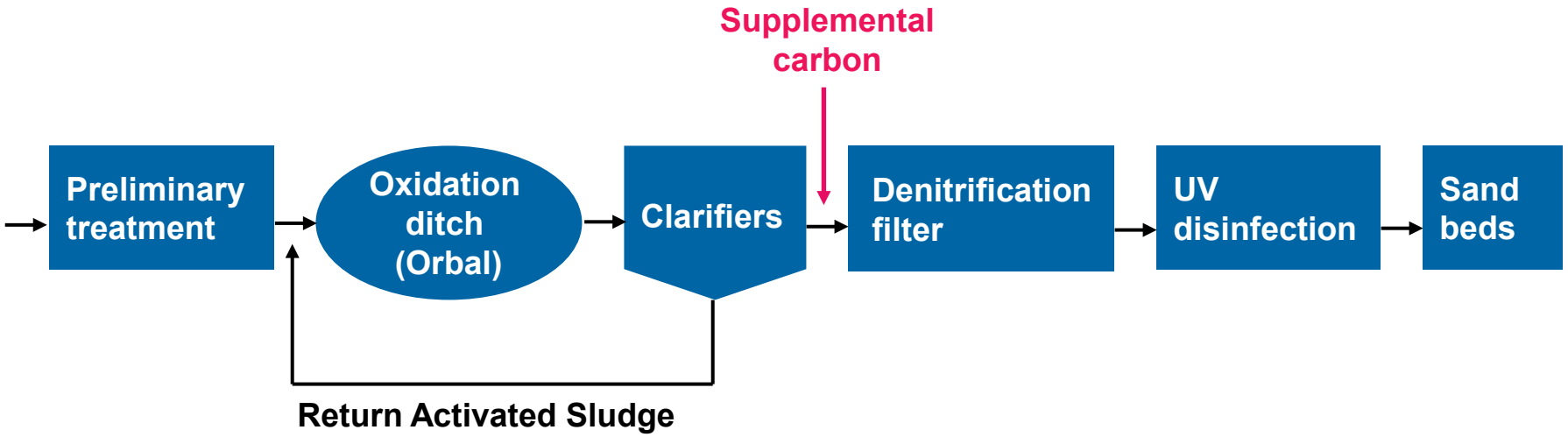
WPCF schematics (liquid stream) before upgrade





WPCF upgrade – Phase 1

- WPCF schematics (liquid stream)



WPCF final aerial photo

WPCF upgrade design challenges

- Wide range of flow (0.08 – 5.6 mgd) and load
- Very low winter wastewater temperatures – 7^{o}C
- Low effluent nutrient limit (3 mg/L TN)
- Applied LEED principles in the design of the facility
- Compressed design phase to get funding

WPCF upgrade design and construction timelines

Task	Date
Official design start of final design	July 6, 2009
Advertise	November 18, 2009
General contractor's bid opening	December 22, 2009
Construction start (notice to proceed)	March 1, 2010
Substantial completion (liquid stream)	April, 2012
Substantial completion (entire project)	June, 2012

Discharge permit

Groundwater discharge permit issued by MADEP in December 2009

- Total nitrogen discharge limit
  - 3 mg/L (limit of technology) at design average annual flow
  - 10 mg/L maximum daily

WPCF upgrade design flows and loads

- Flow ratio (peak hour/startup min) = 70
- Load ratio (BOD and ammonia) = 50

Design conditions (Phase 1)	Flow (mgd)	BOD (lbs/day)	TSS (lbs/day)	NH3-N (lbs/day)
Start-up minimum	0.08	100	160	10
Summer average	2.1	3,200	3,500	370
Maximum month	2.5	5,200	5,000	480
Peak hour	3.9			
Peak hour (Phase 2)	5.6			

WPCF upgrade flow and load variations

- Town goal – achieve TN < 3 mg/L at all times while collection system grows by:
  - Flushing - dual piping and flushing systems
  - Return activated sludge pumping system
    - Designed for 10 years of use
  - Changing operating conditions of oxidation ditch and denitrification filters
  - Future ring for Orbal® oxidation ditch
  - Flexibility for future upgrades
    - Space allowed for additional clarifier, phosphorus removal, process equipment, etc.

- Tools are helpful, but in the care of a careful and diligent operations crew …..

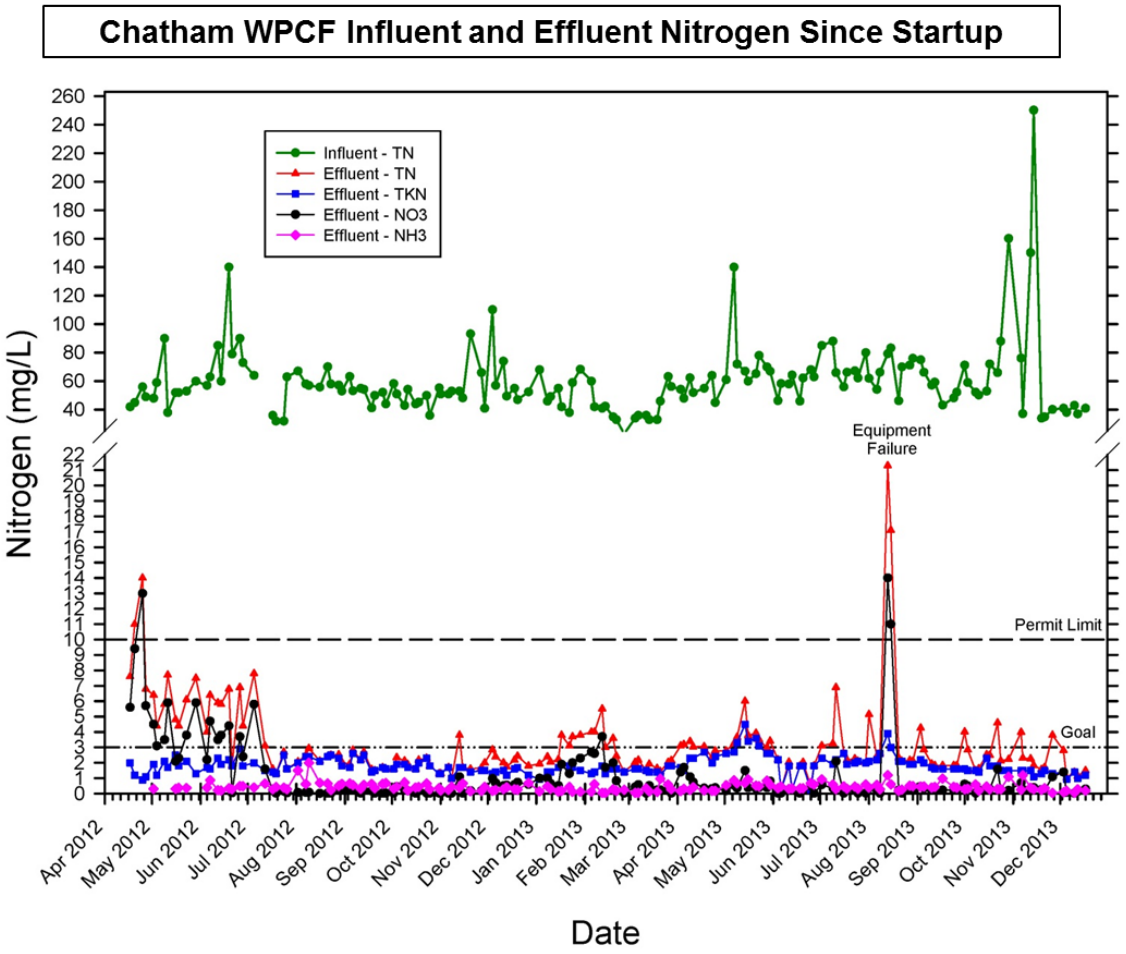
Operation to near perfection

Challenges

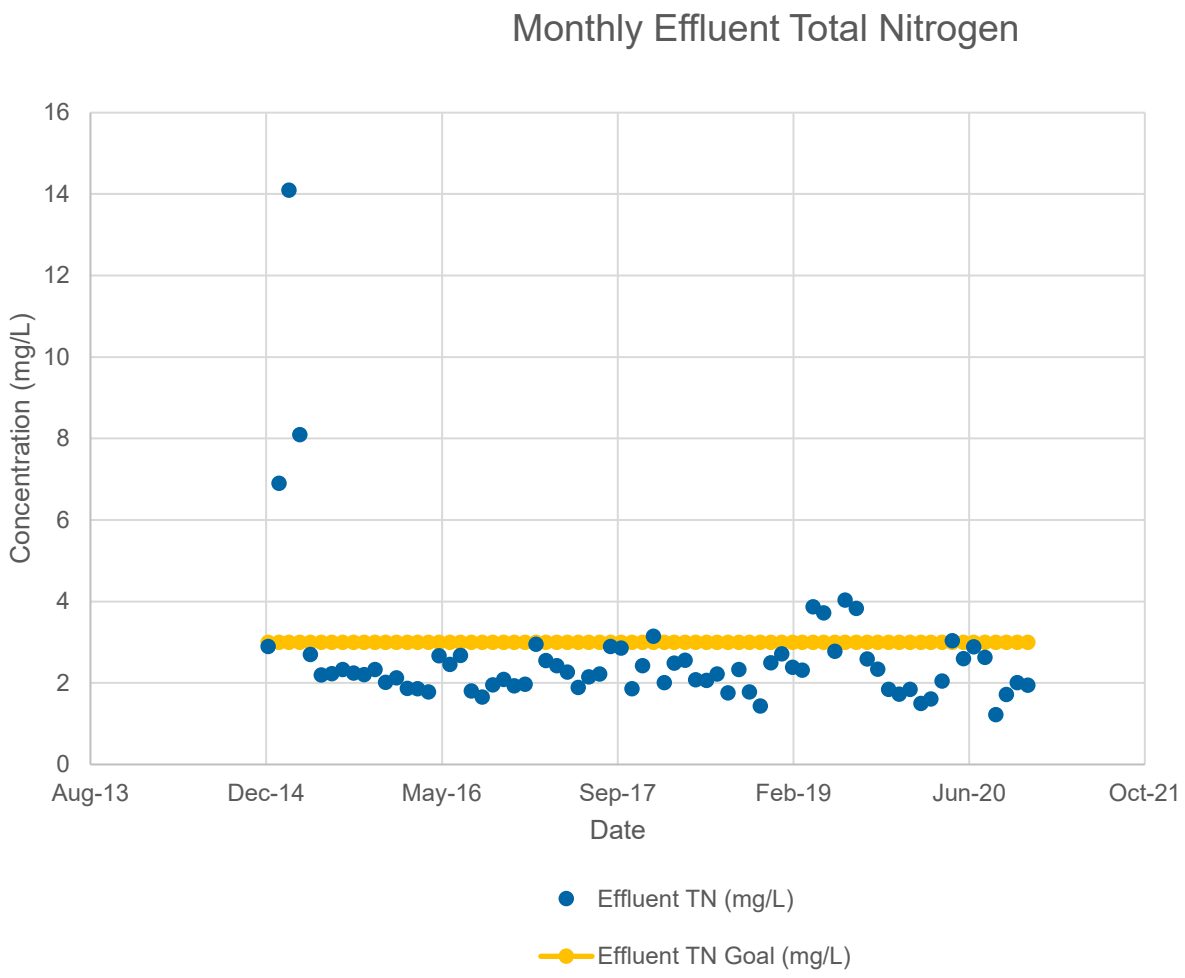
- Target low nitrate
- Equipment failures

Performances

- TN at or below 3 mg/L



Operation to near perfection - continued



Operation to near perfection - continued

- WPCF has a load limit based on 3 mg/L at 1 mgd
- 2015-2020 average effluent TN concentration has been 2.63 mg/L
- Consistently superior Nitrogen removal helped the average effluent nitrogen load stay at 14% of the limit while flow was near 20%

Adaptive management

- Program intended to monitor success of the implementation of the CWMP
- Intended to monitor program over life of the plan (20 years)

Acknowledgement

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- Dr. Robert Duncanson
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- Michael Keller, William Smith
  Former and Current Chief Wastewater Operators of Chatham WPCF

Thank you for your contributions!

Questions

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