THE MASSACHUSETTS ESTUARY PROJECT

Presentation to
21st ANNUAL NONPOINT SOURCE POLLUTION CONFERENCE

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What Is It?

- A watershed based approach for nitrogen management for embayments and estuaries in southeastern Massachusetts.
- A scientific method to develop nitrogen loading limits specific to individual estuarine systems.

Why Is It Needed?

We are observing declining habitat quality within coastal embayments due to increasing nitrogen loading resulting from changes in watershed land uses.

Why Is It Needed?

1. "Grass Roots" genesis
   - Community groups see impacts
   - Want to protect their natural assets
2. Communities are asking for help!
   - Nutrient loads are degrading water quality
   - Impacting natural resources
   - Impacting economic resources

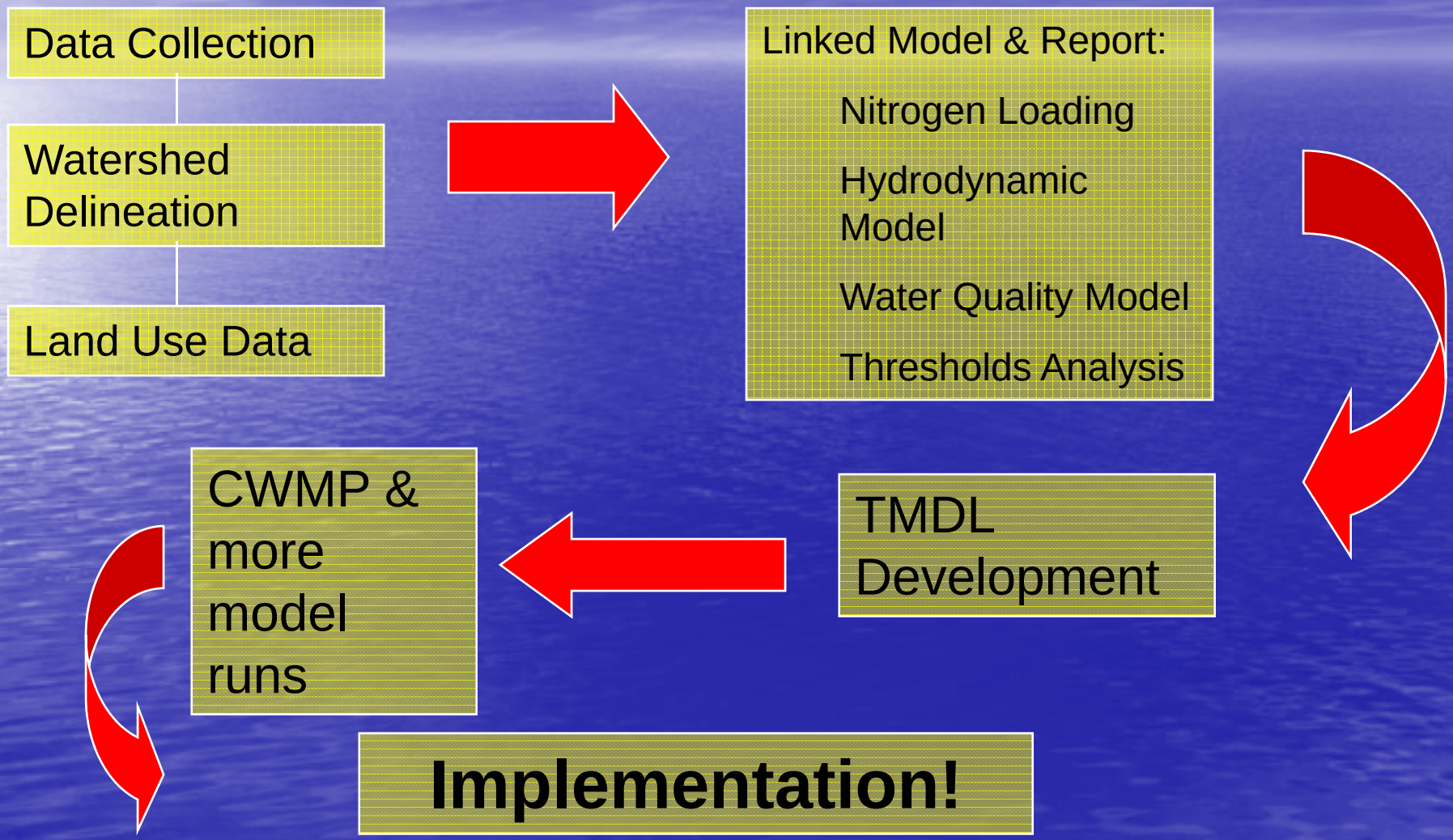
Why Is It Needed?

3. Watershed Approach
   - Need to look at whole watersheds
   - Develop the concept of Comprehensive Water Resources Management Planning
   - Looking at all sources of nitrogen – not just wastewater

Why Is It Needed?

4. Comprehensive Water Resources Planning
   - Nitrogen thresholds set acceptable loading
   - Provides scientific basis for nitrogen management
   - Is the core of nitrogen and bacterial TMDL's
   - Helps define load allocations
   - Helps identify wastewater management options
   - Helps identify water resource priorities

MEP Process


Data Collection
Watershed Delineation
Land Use Data
Linked Model & Report:
Nitrogen Loading
Hydrodynamic Model
Water Quality Model
Thresholds Analysis
TMDL Development
CWMP & more model runs
Implementation!

What It Can Do

- Evaluate a variety of options
  - Conventional approaches
  - Non-traditional approaches
    - Improved flushing
    - Natural attenuation

General Findings to Date

- Most embayment systems are experiencing stress or demonstrating severe water quality impacts

Major loss of eelgrass	Low dissolved oxygen
Elevated levels of chloro a	Algal blooms
Poor benthic organism diversity	Increases in Macroalgae
High nitrogen concentrations	Periodic fish kills

- Elevated levels of nitrogen attributed primarily to wastewater loads, with on-site systems being the leading contributor

- Chatham: 50% - 90% reduction needed in wastewater load from on-site systems

General Findings to Date

- Level of nitrogen reduction needed to restore estuaries are 1-2 orders of magnitude lower than current standards would require.
- Title 5 440 gpda standard is not adequate
- Watershed-wide solutions are needed

Case Study

Chatham, MA

Chatham Ground Watershed Delineations

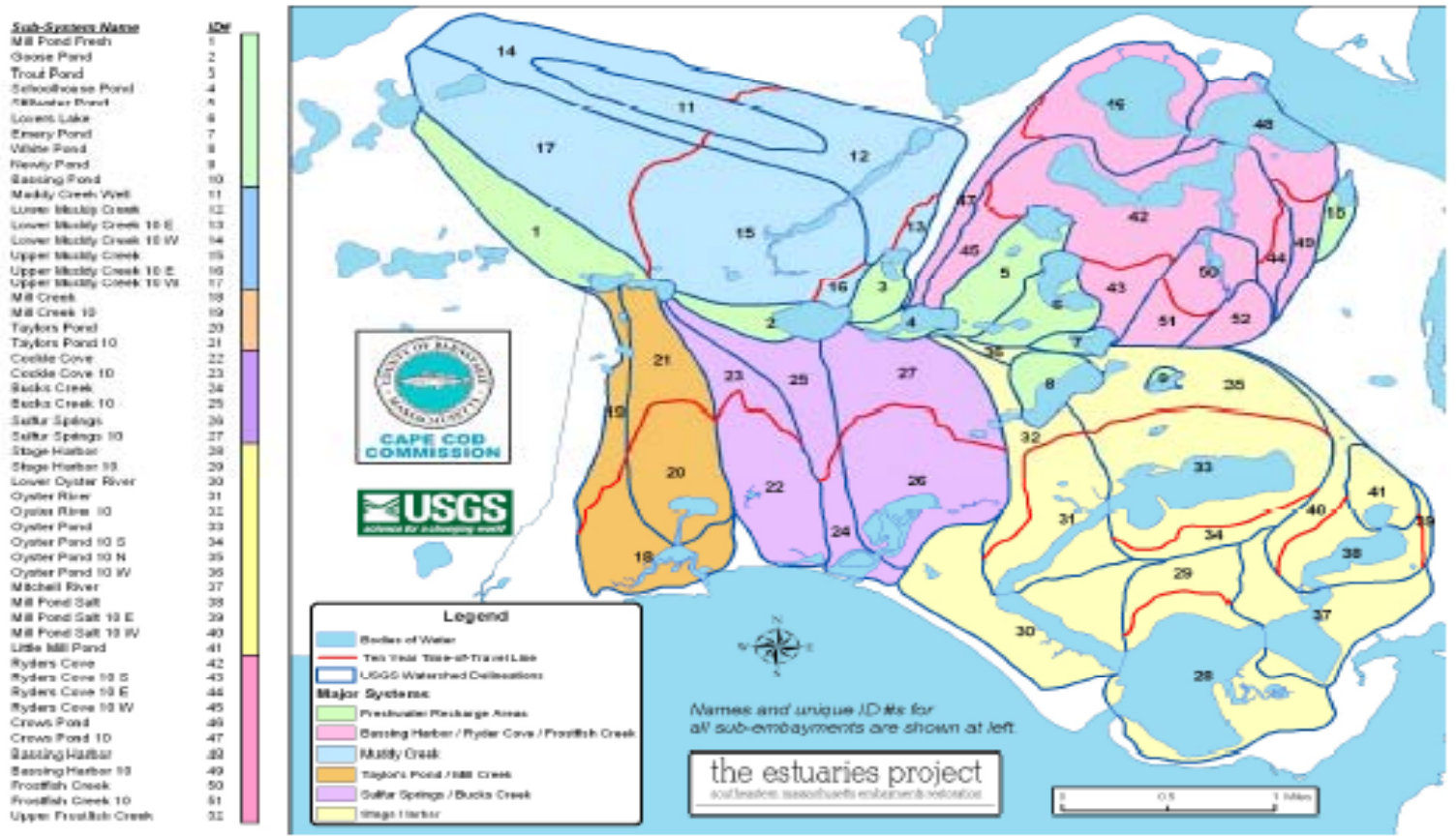


Figure III-2. Watershed and sub-watershed delineations for each of the five major embayment systems within the Town of Chatham, MA. Approximate ten year time-of-travel delineations were produced for quality assurance purposes and are designated with a "10" in the figure legend (left). Sub-watersheds to embayments were selected based upon the functional estuarine sub-units in the water quality model (see section VI).

Chatham Sub-embayment Delineations

Sub-Embayment	ID#
Mill Pond (Fresh)	1
Goose Pond	2
Trout Pond	3
Schoolhouse Pond	4
Stillwater Pond	5
Lovers Lake	6
Emery Pond	7
White Pond	8
Newty Pond	9
Beesing Pond	10
Lower Muddy Creek	11
Upper Muddy Creek	12
Mill Creek	13
Taylors Pond	14
Cockle Cove	15
Bucks Creek	16
Sulfur Springs	17
Stage Harbor	18
Lower Oyster River	19
Oyster River	20
Oyster Pond	21
Mitchell River	22
Mill Pond	23
Little Mill Pond	24
Ryders Cove	25
Crows Pond	26
Beesing Harbor	27
Frostfish Creek	28
Upper Frostfish Creek	29

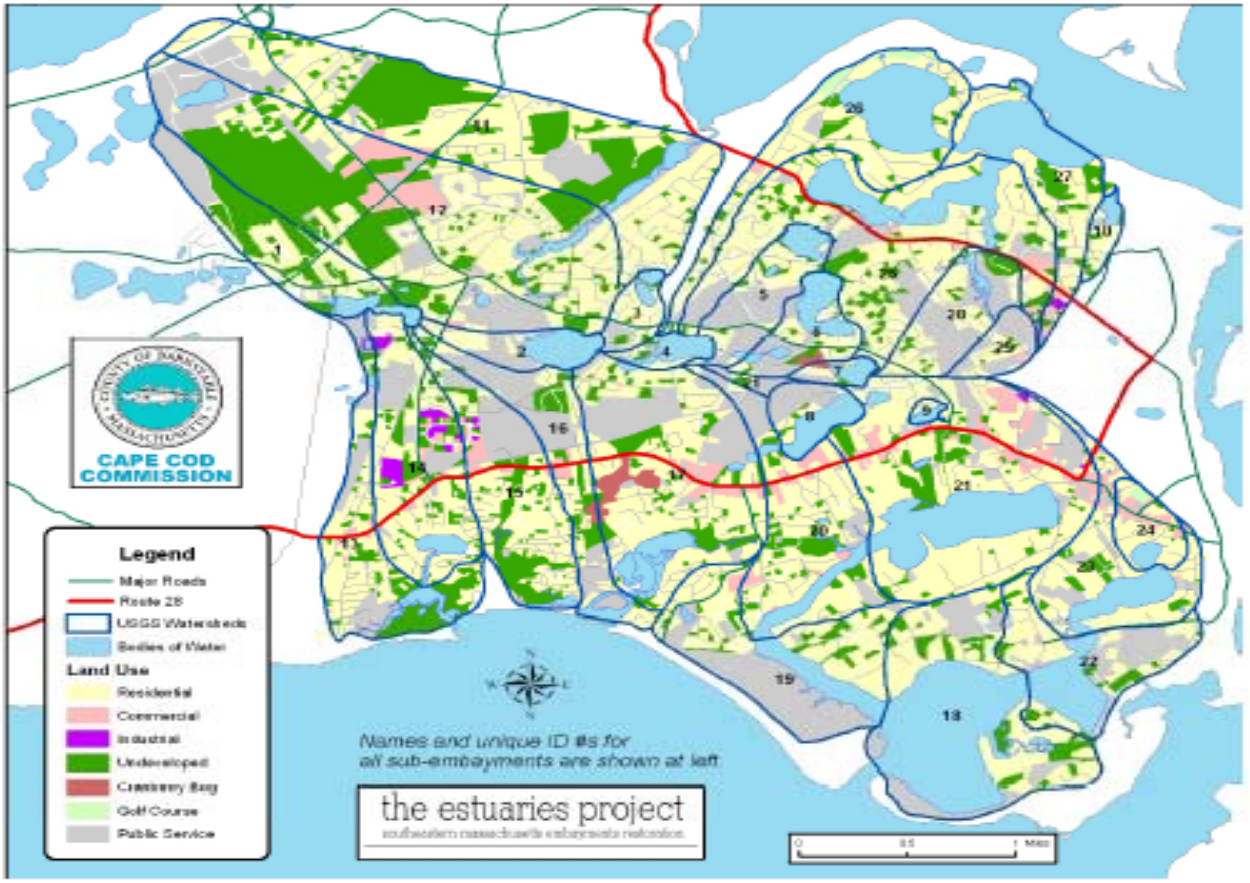


Figure IV-1. Land-use by parcel for the 5 embayment systems. Watershed data encompasses parts of the Towns of Chatham and Harwich, MA.

Parcel Information Based on Zoning

Sub-Embayment	ID#
Mill Pond (Fresh)	1
Goose Pond	2
Trout Pond	3
Schoolhouse Pond	4
Stillwater Pond	5
Lovers Lake	6
Emery Pond	7
White Pond	8
Newfy Pond	9
Bassing Pond	10
Lower Muddy Creek	11
Upper Muddy Creek	12
Mill Creek	13
Taylors Pond	14
Cockle Cove	15
Bucks Creek	16
Sulfur Springs	17
Stage Harbor	18
Lower Oyster River	19
Oyster River	20
Oyster Pond	21
Mitchell River	22
Mill Pond	23
Little Mill Pond	24
Ryders Cove	25
Crows Pond	26
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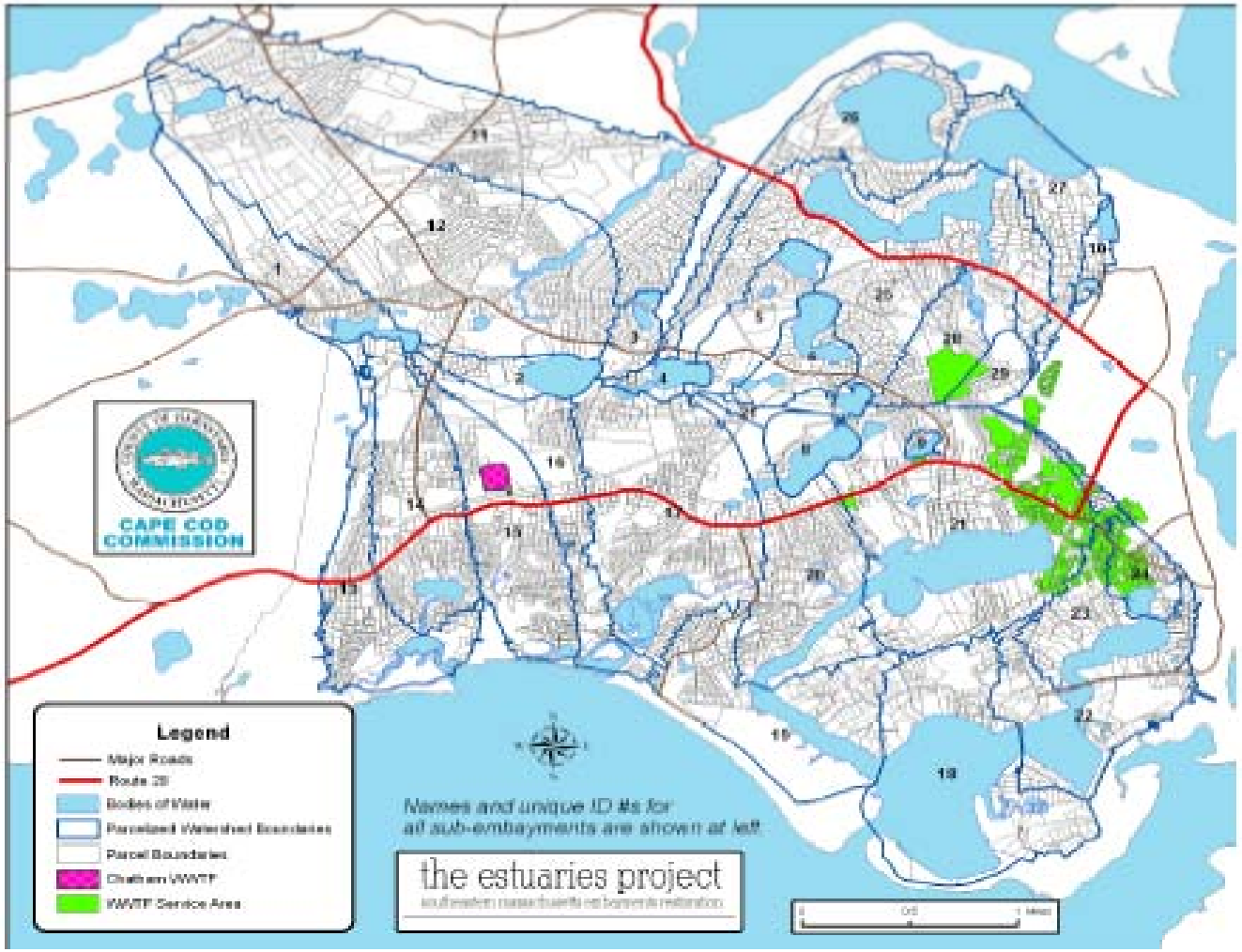


Figure IV-6. Parcel distribution within the watersheds to the 5 embayment systems.

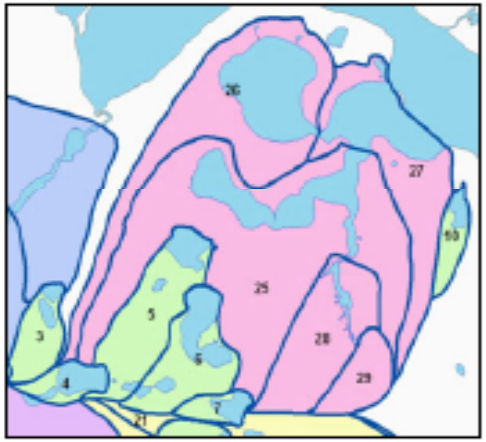
Detailed Nitrogen Loading by Type of Source

Table IV-3 e. Ryder Cove/Bassing Harbor System Nitrogen Loads.

*All values in kilograms/year		Chatham N Loads by Input**:						% of Pond Outflow	Present N Loads			Buildout N	
Name	Watershed ID#	Wastewater	Lawn Fertilizers	Impervious Surfaces	Water Body Surface Area	"Natural" Surfaces	Buildout		UnAtten N Load	Atten %	Atten N Loads	UnAtten N Load	Atten %
Ryders Cove/Bassing	4, 5, 6, 7, 10, 25, 26, 27, 28, 29	8137	465	477	1868	235	1109		11183		10330	12292	
Crows Pond	4, 26	1871	111	89	512	40	94		2622		2618	2716	
Crows Pond	26	1866	111	88	507	40	93		2612		2612	2705	
Schoolhouse Pond	4	95	9	4	112	3	12	5%	11	40%	6	11	40%
Ryders Cove	4, 5, 6, 7, 25, 28, 29	5384	341	341	957	166	811		7190		6357	8000	
Ryder Cove GW	4, 7, 25	3844	201	209	542	92	587		4888		4340	4975	
Ryders Cove	25	3802	197	207	474	89	584		4269		4269	4852	
Schoolhouse Pond	4	95	9	4	112	3	12	26%	58	40%	35	61	40%
Emery Pond	7	28	3	2	63	3	0	62%	62	40%	37	62	40%
Stillwater Pond	4, 5, 6	680	36	39	380	38	96	100%	1218	14%	717	893	14%
Stillwater Pond	5	264	24	29	105	22	23		444			468	
Lovers Lake	6	356	25	26	197	13	64	100%	618	52%	296	682	52%
Schoolhouse Pond	4	95	9	4	112	3	12	69%	156	40%	93	164	40%
Frostfish Creek	28, 29	1353	84	74	35	37	128		1584	18%	1299	1712	18%
Bassing Harbor	10, 27	883	13	47	399	29	204		1371		1355	1575	
Bassing Harbor	27	853	11	46	393	28	202		1332		1332	1533	
Bassing Pond	10	183	11	7	41	5	17	16%	39	40%	24	42	40%

** sums of unattenuated loads adjusted for pond shore percentages

Note that the N Loads by input show the total nitrogen input to each sub-watershed. However, the fresh ponds sub-watersheds typically contribute to more than 1 sub-embayment and therefore their sub-watershed contribution if apportioned based upon the proportion of shoreline. The total nitrogen load to each fresh pond (e.g. # 4, 5, 6, 7, 10) are adjusted to their contribution to the receiving sub-embayment in both the "roll-ups" for each sub-embayment and in the present and build-out Nitrogen Loading (right sections of table)



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Typical Nitrogen Loading

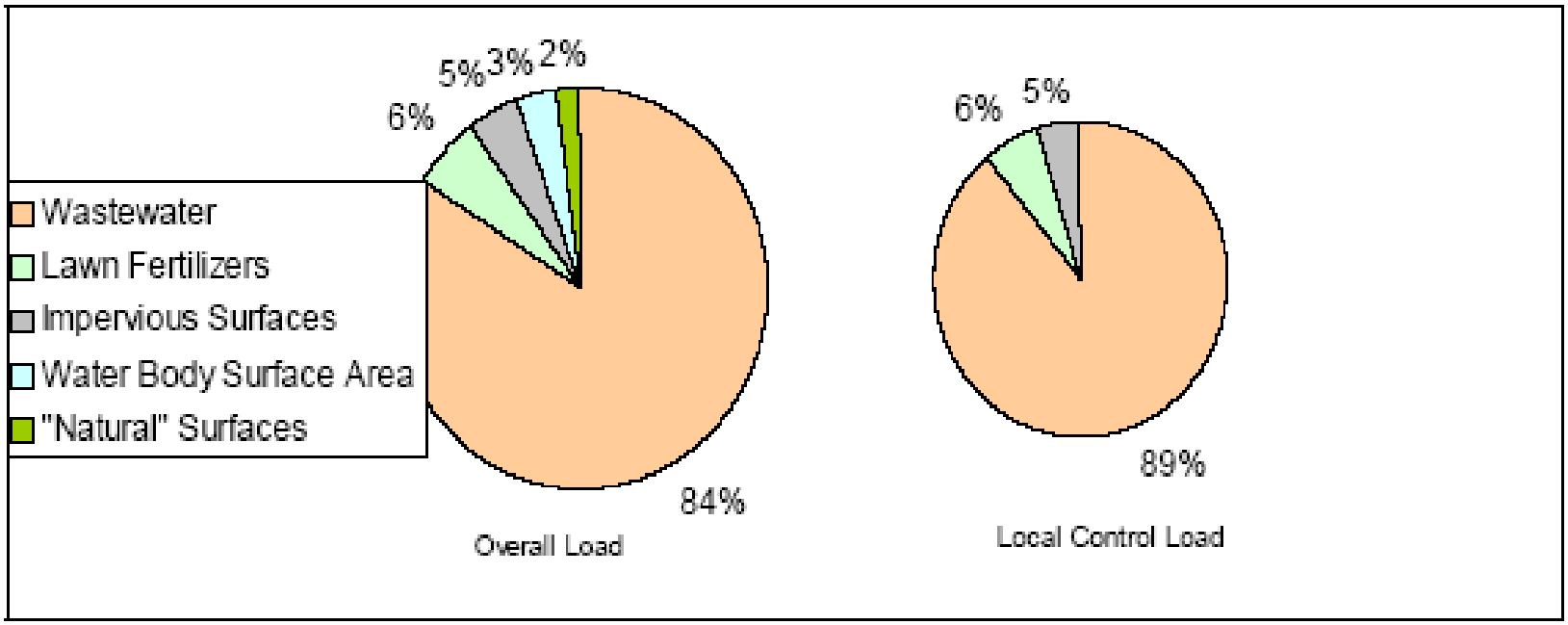

Figure IV-7c. Land use specific unattenuated watershed based nitrogen load (by percent) to Taylors Pond embayment system.

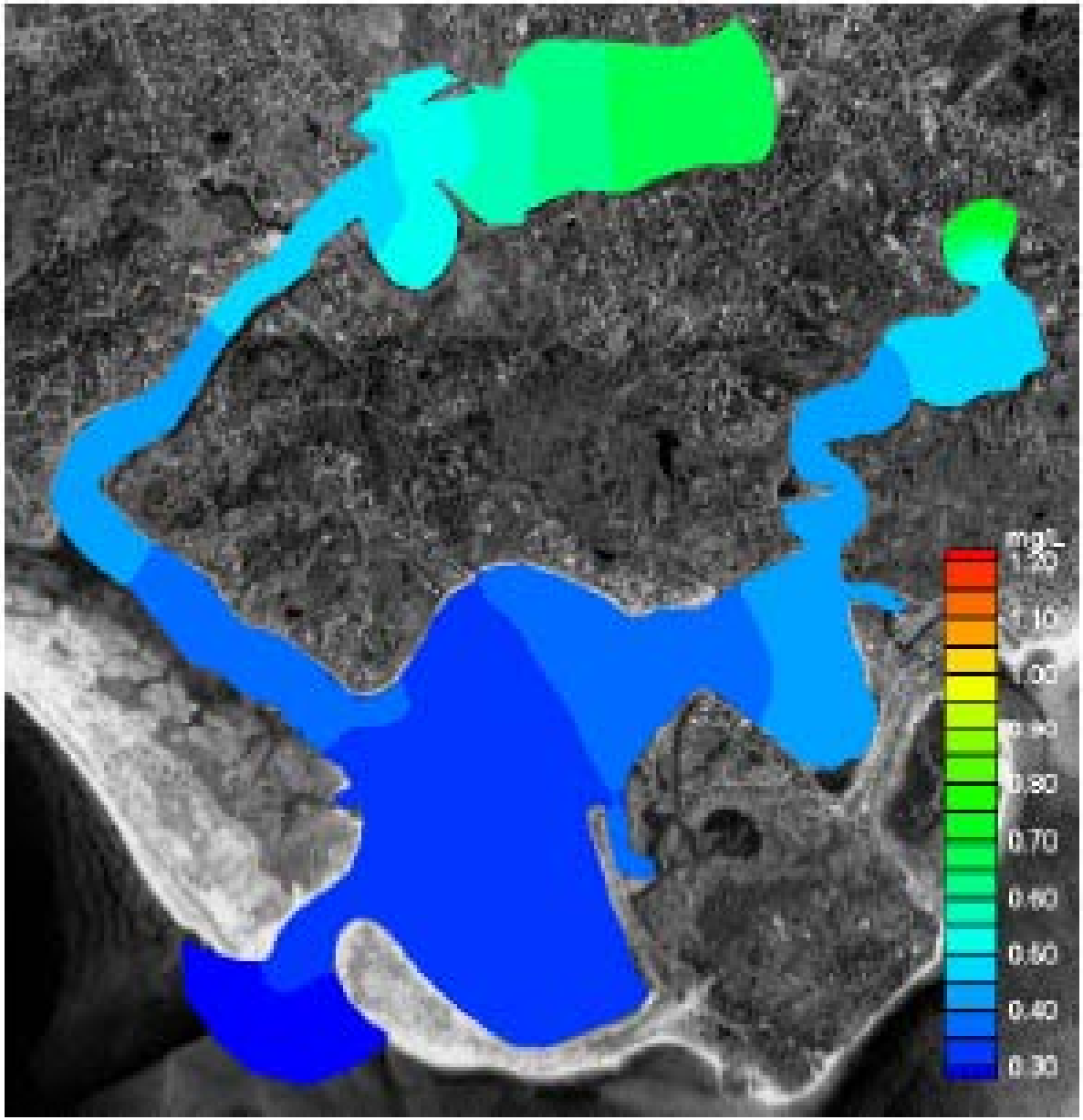

Figure VI-9. Contour plot of average total nitrogen concentrations from results of the present conditions loading scenario, for the Stage Harbor system.

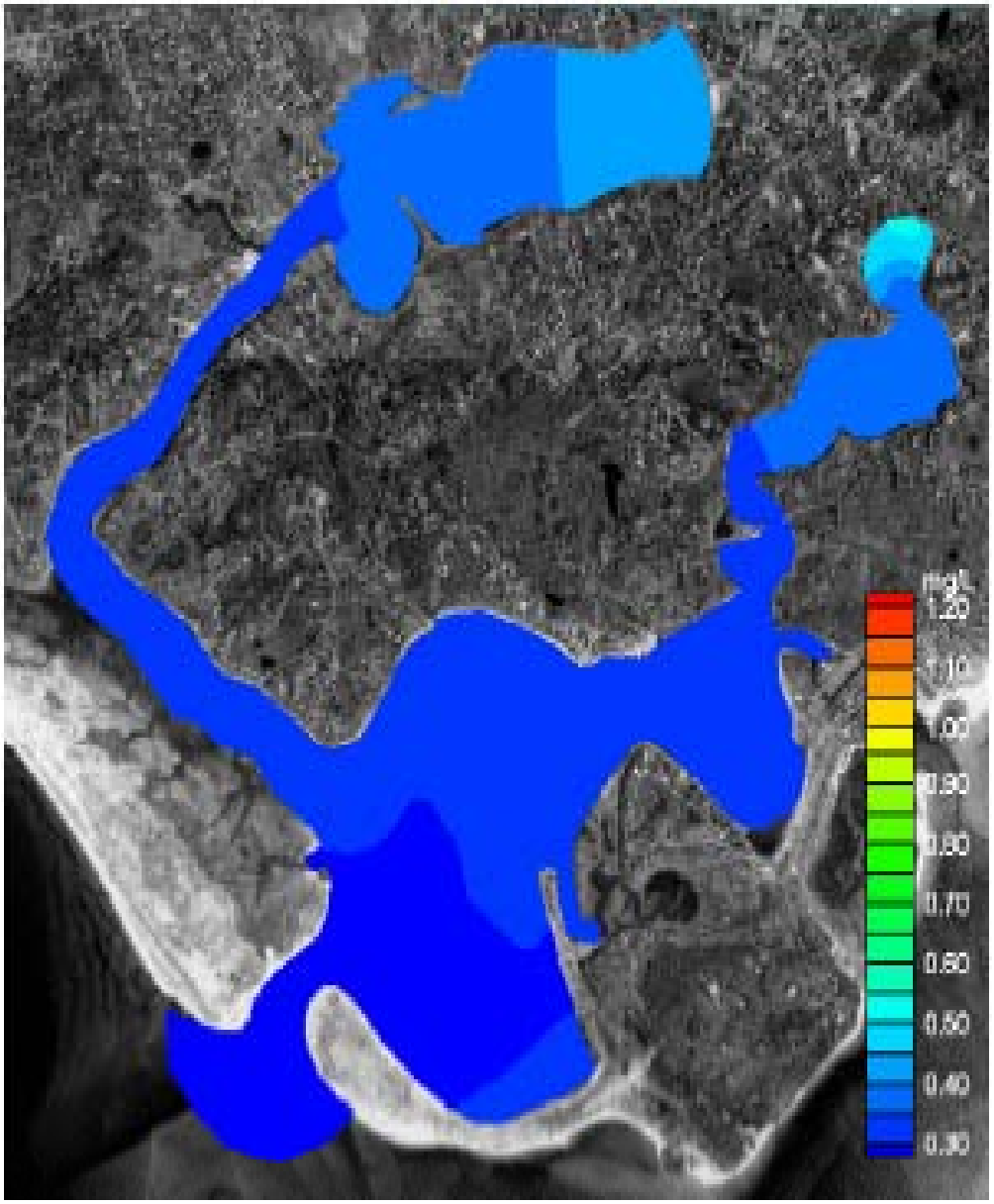

Figure VIII-1. Contour Plot of modeled total nitrogen concentrations (mg/L) in the Stage Harbor system, for threshold loading conditions (0.38 mg/L in both Mill Pond and Oyster Pond).

MEP Implementation

- Watershed-wide focus
- Community driven approach based on CWMP
- Technical approaches
- Institutional approaches

MEP Implementation - Watershed-wide Approaches

- Watershed CWMP
- Watershed-wide permit issued to
  - Municipalities
  - County
  - Management district

- Uniform application of comprehensive local nutrient management regulations

MEP Implementation - Technical Approaches

- Flushing improvements
- Natural Attenuation
- Stormwater Control and Treatment
- Enhanced Wastewater Treatment
- Wastewater Reuse
- Water Conservation

MEP Implementation - Institutional Approaches

- Management Districts
- Land Use Controls
- Nutrient Trading

Implementation Guidance

- DEP has developed Implementation Guidance
  - Companion to technical reports
  - Provides overview of tools that can be used
  - Looks at technical and institutional options

Where Do We Go From Here?

- Watershed based nutrient management planning
- Comprehensive water resources planning

All include community involvement, education and commitment from citizens' groups and municipal, state and federal officials!!

Questions ?????