

A Plan to Address the Total Phosphorus to Sands Pond



**Rhode Island Department of Environmental Management
Office of Water Resources**



Overview of Tonight's Presentation

- Introduction
- Pond and Watershed Description
- Water Quality Data
- Pollution Sources
- Required Pollutant Loading Reductions
- Studies and Data Sources
- Pollution Abatement Measures
- Potential Funding Sources



What is a TMDL?

- The Clean Water Act requires states to monitor the quality of their waters and identify waters that do not meet water quality standards and prepare a 303(d) list of impaired waters.
- A prioritized schedule for completion of water quality restoration studies also appears in the 303(d) list.
- The frame work for these studies is the Total Maximum Daily Load (TMDL) program, administered by RIDEM Office of Water Resources.
- A TMDL is essentially a prescription designed to restore the health of a polluted water body by indicating the amount of pollutants a waterbody can receive and still meet water quality standards.
- TMDLs identify corrective actions necessary to improve water quality and restore designated uses.

Developing the Sands Pond TMDL

Compile/Collect data to characterize impairment

Compare existing conditions to applicable WQ standards

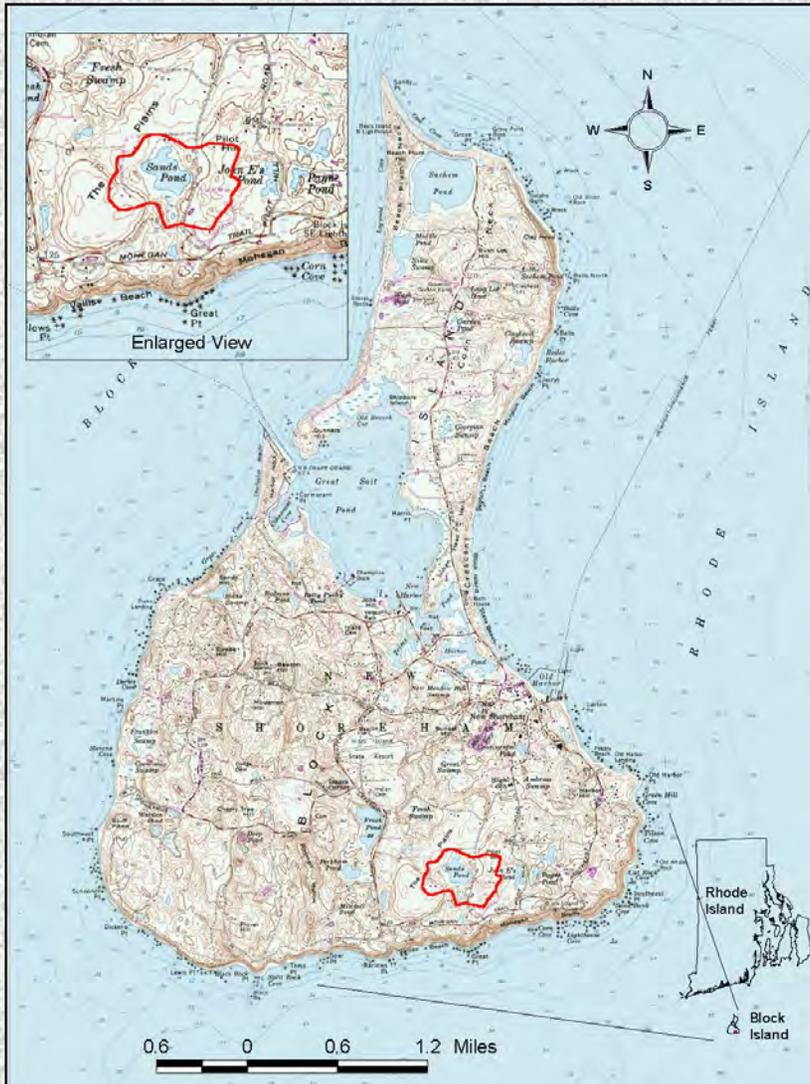
**Determine spatial and temporal extent of impairment
Combine this with pollution source information**

Determine Pollution Reductions Needed to Meet Water Quality Standards

Establish/Recommend Pollution Reduction Strategies Meet Target Reductions

Recommend a Water Quality Monitoring Program to Ensure that Goals are Met

Sands Pond Watershed



Pond Characteristics

- Pond approximately 14.7 acres
- Average depth 7.1 feet
- Watershed approximately 74 acres
- Kettle hole pond



U.S. Geological Survey

Hydrogeology and Water Resources of Block Island, Rhode Island

- 1996 USGS Investigative Report
 - Sands Pond is a surface expression of the water table
 - Surface inflow is negligible due to
 - no direct inflow sources (streams or pipes)
 - land use and vegetative cover within surface watershed
 - soil types
 - Groundwater and precipitation are the major sources of water to the pond

Aerial Photo of Sands Pond





Sands Pond Impairments

DEM 2006 303(d) List of Impaired Waters

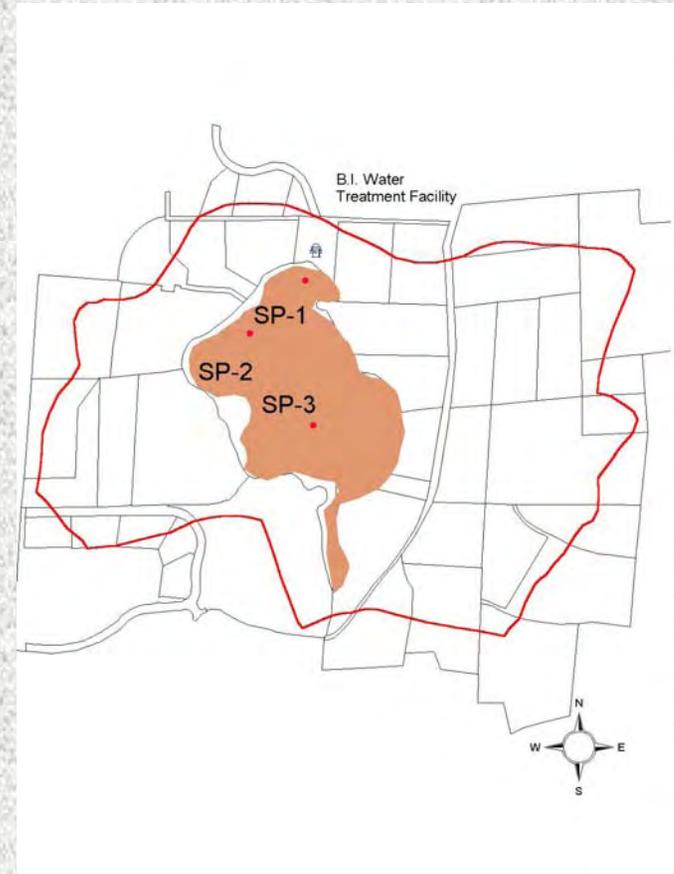
- Phosphorus
- Turbidity
- Excess algal growth/chlorophyll-a
- Taste and odor

TMDL Water Quality Targets Phosphorus

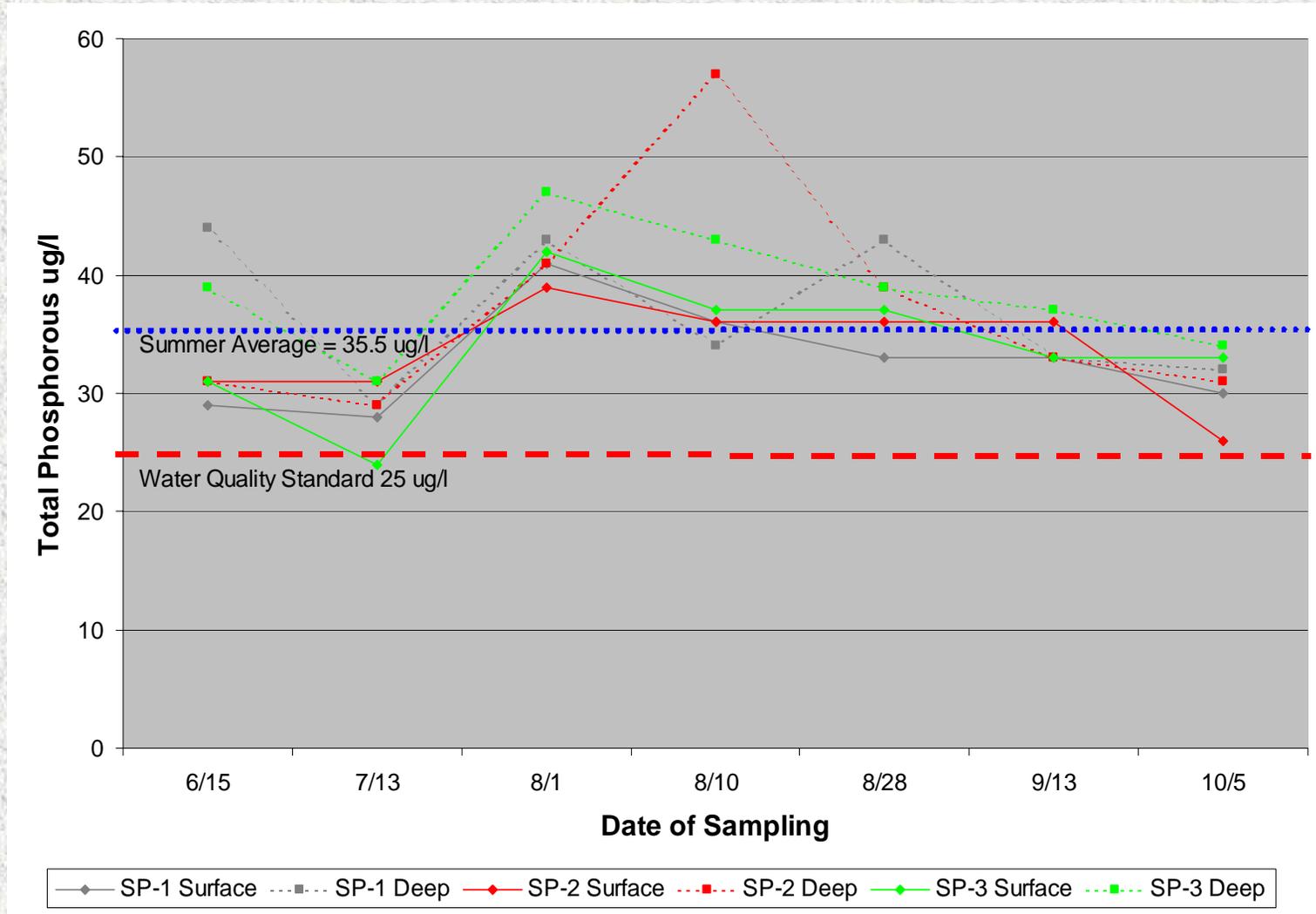
- **RI Water Quality Standards**
 - Criterion 10 (a): Average total phosphorus concentration shall not exceed 0.025 mg/l, unless a different value is needed to prevent eutrophication.
 - Criterion 10(b): None [nutrients] in such concentration that would impair any uses specifically assigned to said class.
- **TMDL Target**
 - Target phosphorus concentration for Sands Pond was set at the criteria level of 0.025 mg/l

RIDEM Summer 2001 Monitoring

- Three sampling stations established in the pond

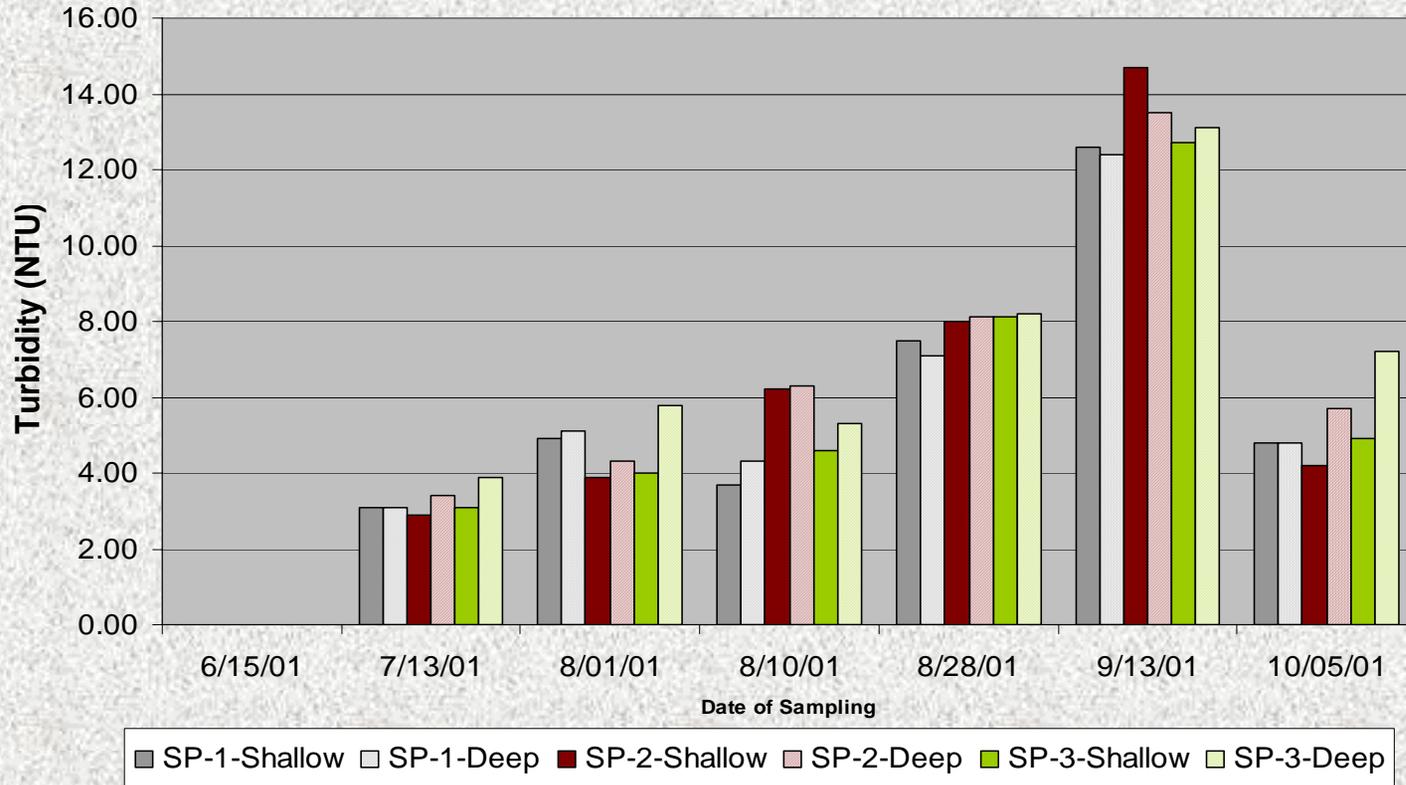


RIDEM Total Phosphorus Summer 2001



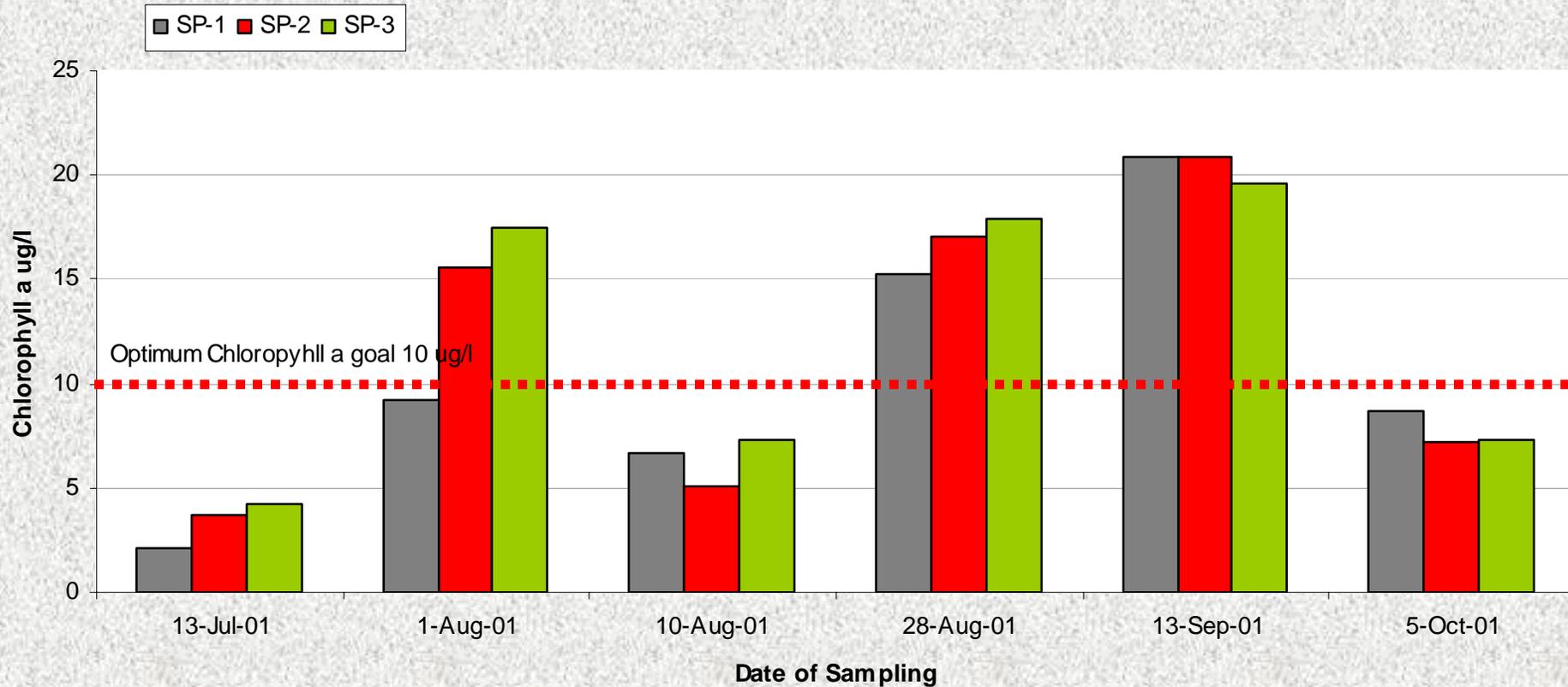
RIDEM Turbidity Summer 2001

Turbidity Levels Sands Pond 2001



Chlorophyll-a

RIDEM Summer 2001



Trophic State Based on Water Quality

	Oligotrophic	Mesotrophic	Eutrophic	Sands Pond Summer Average
Total Phosphorus (ug/l)	<10	10-30	31-100	35.5
Chlorophyll a (ug/l)	<3.5	3.54-9	9.1-25	11.4
Secchi Depth (m)	>4	2-4	1-2.1	0.89



Actual and Potential Pollution Sources

- Internal cycling of phosphorus
- Groundwater inputs
- Waterfowl
- Atmospheric deposition
- Natural background conditions (nonpoint sources)



Internal Cycling

- Although more typical of deep lakes, shallow ponds such as Sands Pond may weakly stratify during the summer
- Decay of organic material consumes oxygen in the bottom waters and sediment of the pond
- Under anoxic conditions the sediment releases phosphorus
- Odor of sulfur from disturbed lake sediment indicates anoxic conditions exist
- High TP concentrations in the summer may indicate phosphorus release from the sediment



Thomann and Mueller Model

Used to Establish Phosphorus Loads

- The basic mass balance for Total Phosphorus in Sands Pond may be expressed as:
- $VdP/dt = W - K_sPV - QP$
- and $K_s = v_s/H$
 - where:
 - K_s = net settling rate of phosphorus
 - v_s = net settling speed
 - H = mean depth of pond (2.2 m)
 - V = Volume of the pond ($1.3 \times 10^5 \text{ m}^3$)
 - P = Annual average Total Phosphorus concentration in pond
 - Q = outflow
 - W = External source loading of phosphorus

Total Phosphorus Loading and Required Reduction

Mean in-pond concentration (ug/l)	Current Load (kg/yr)	TMDL* (kg/yr)	Required Load Reduction (kg/yr)	Required Loading Reduction (% present value)
35.5	6.2	3.9	2.3	37%

*includes a 10% margin of safety



Sands Pond Water Resources

- Past Studies & Data Sources
 - USGS
 - Block Island Water Company Raw Water Data
 - Travassos-Geremia & Associates (TGA) (1997)
 - Chandler Report (2001)
 - Environmental Science Services, Inc. (2002)
- Current Studies
 - RIDEM monitoring (2001)
 - RIDOH Source Water Assessment (2001)

Chandler Report

- Only two species of fish found:
 - Golden shiners and Brown Bullheads
 - Highly tolerant of degraded conditions
- Absence of:
 - Pickerel, bass and sunfish
 - Could have occurred from copper sulfate poisoning or from decreased oxygen levels

Chandler Report

- Possible Causes of Degradation
 - Returning filter backwash into the pond
 - Extreme draw downs of water
 - Pumping well from surrounding groundwater wells
 - Large natural and manmade fluctuations of water levels
 - Copper sulfate treatments



Environmental Science Services, Inc. (ESS)

- ESS hired to determine the quantity and quality of sediments
- Total phosphorus and total kjeldahl nitrogen values both more than twice the upper threshold level = severely polluted
- Proposed solutions
 - Dredging
 - Pond bottom inversion
 - Liner installation
 - Alum treatment

TMDL Implementation

- Good housekeeping measures
 - Fertilizer applications, policing pet waste and discouraging waterfowl from residing within the watershed, low or no phosphorus automatic dishwasher detergents
- Treatment options to reduce the flux of phosphorus
 - Dredging the bottom of the pond
 - Application of a capping material
 - Application of alum



Potential Funding Sources

- Non-point Source Grants (federal)
- Narragansett Bay and Watershed Restoration Bond Fund (state)
- State Revolving Loan Fund



Questions or Comments on the TMDL Document

Total Phosphorus TMDL for Sands Pond, New Shoreham, Rhode Island

Kristen Chantrell
(kristen.chantrell@dem.ri.gov)
DEM, Office of Water Resources
235 Promenade Street
Providence, RI 02908
401-222-4700 extension 7244