#### **Province Lake Watershed Plan Final Presentation**







Province Lake 2014 Annual Meeting Province Lake Golf Club July 19, 2014





## **PRESENTATION AGENDA**

- i. Overview- Description of the Watershed Planning Process (Forrest Bell, FB Environmental)
- ii. Water Quality & Sources of Pollution (Jennifer Jespersen, FB Environmental)
- iii. Water Quality Goal & Actions Needed (Forrest Bell)
- iv. Funding the Plan and Measuring Success (Forrest Bell)
- v. Next Steps (Linda Schier, AWWA and Sally Soule NH DES)
- vi. Questions/Discussion (Watershed Citizens)

## **Your Lake is Precious.**

## What is a Watershed?



A watershed is an area of land that drains into a lake or river.

## **Pollution Sources**

## Past

Point source pollution discharged from pipe

#### Present

Now polluted runoff or nonpoint source pollution (NPS) from many smaller, diffuse sources



## The Trophic Scale of Lakes



## **The Trophic Scale of Lakes**

	NH DES: 8 ppb	N D 12	H ES: Prov ppb 14.3	vince ppb
Oligotrophic		Mesotrophic		Eutrophic

#### **Every lake is different.**

Trophic condition is evaluated with a variety of methods.

DES has total phosphorus thresholds for general lake assessment in NH.

# Speeding aging of lakes



#### OLIGOTROPHIC

- Clear water, low productivity
- Very desirable fishery of large game fish



#### MESOTROPHIC

- Increased production
- Accumulated organic matter
- Occasional algal bloom
- Good fishery



#### EUTROPHIC

- · Very productive
- May experience oxygen depletion
- Rough fish common

#### **10,000's YEARS IN NATURAL CONDITIONS**

#### 10's to 100's YEARS UNDER HUMAN INFLUENCE

# Phosphorus

- <u>Phosphorus</u> is one of the major nutrients needed for plant growth.
- Naturally present in small amounts.
- Generally, as phosphorus increases, the amount of algae also increases.



#### Too Much P= Algae Blooms, Low DO, Fish Kills!

Experimental Lake Area Study Canada

•Top-to-bottom curtain divides lake in two

 Carbon and nitrogen added to one side; Carbon, nitrogen and <u>phosphorus</u> added to other side

## A Quick Note about Measuring Phosphorus...

## (1 kilogram = 2.2 pounds)

#### 100 kg of Phosphorus or 220 pounds = 7.8 28-lb bags of Rock Phosphate Fertilizer\*



\*23.99 ea. From eLawnGarden.com

## So what - that doesn't seem like much!

Soil in this area is about 0.02% Phosphorus\*

•As much as 420 tons per year of sediment per year estimated to reach Province Lake.

•220 lbs of P would be found in these 42 dump trucks of soil that may reach the lake EACH YEAR!



<sup>\*(</sup>San Clements et al., 2010)

#### Forested Watershed



#### Developed Watershed





# 5 to 10 times the amount of **phosphorus** in the runoff from the developed area.

# Water Quality & Property Values

- Declining property values

   affect individual landowners
   and economics of entire
   communities.
- With property rights comes property responsibility.



## **Province Lake** *Physical Characteristics*



- 2 States, 3 Towns
- Lake Area ~ 967 acres
- Watershed 3903 acres
- Avg. depth 9 feet
- Max. depth 16 feet
- Low Flushing Rate- 1.1/year

 Shallow, non-stratified – wind driven system

 Small Watershed relative to lake surface area

# A Rapidly Growing Region

Town	1960	1970	1980	1990	2000	2010	Numeric Change 1960–2010	Percent Change 1960–2010	Average Annual Growth Rate
Parsonsfield, ME	869	971	1,089	1,472	1,584	1,898	1,029	118%	1.18%
Wakefield, NH	1,223	1,420	2,237	3,057	4,252	5,078	3,855	315%	3.15%
Effingham, NH	329	360	599	941	1,273	1,465	1,136	345%	3.45%
Combined	2,421	2,751	3,925	5,470	7,109	8,441	6,020	249%	2.49%













#### Water Resources and Riparian Habitat



Riparian habitat refers to the areas adjacent to lakes, streams and wetlands. It is presented here as land within 250 feet of lakes and wetlands, and 75 feet from each edge of streams.

- The state of Maine has a statewide Mandatory Shoreland Zoning Act (MSZA) which regulates land use activities within 250 feet of lakes and wetlands, and 75 feet from each edge of streams. The town of Parsonsfield, ME has extended the waters protected by the MSZA to entire length of the South River.

Wetlands of Special Significance is a designation in Maine Law that places addititional protections on wetlands that meet a set of criteria described in subsections of 38 M.R.S.A.

Watershed Land Area: 3,903 acres (6.1 mi<sup>2</sup>) Lake Area: 968 acres (1.5 mi<sup>2</sup>)



EFFINGHAM

OSSIPEE

Province Lake Watershed NH/ME State Line

**Town Boundaries** 

Rivers & Streams (6.3 mi)

Roads

Data Sources: ESRI, USGS, NOAA, MEGIS, NH GRANIT, FBE, PLA Projection: NAD 1983 Zone 19N; Created by: FB Environmental - 2014

Province Lake (968 acres) Wetlands (360 acres) Riparian Habitat (686 acres)

33 allo WW RANGE

Maine Shoreland Zone

Wetlands of Special Significance (ME Only) (14 acres)

0.25

0.5

Miles

PARSONSFIELD EFFINGHAM

153

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NEWFIELD

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Project

Area

### Lake Bathymetry and Monitoring Sites

**Province Lake and Watershed** 



#### Watershed Parcels

**Province Lake and Watershed** 



#### **Priority BMP Sites**

**Province Lake and Watershed** 



#### Watershed Management Plan Process



# **Project Timeline**



- Started in March 2013
- Completing in Summer 2014



## Province Lake Watershed Plan "Other Activities"

- ✓ PLA/AWWA Watershed Survey *May 2013*
- ✓ Stream Monitoring- *Summer 2013*
- ✓ Septic Survey *August 2013*
- Sediment Coring- September 2013
- Presented Modeling Results November 2013
- ✓ Develop Watershed Action Plan *Jan. 2014*
- ✓ Write Plan/Install BMPs *Spring/Summer 2014*
- Final Presentation Today!



## Thank You Dr. Jim Haney!



# **Outstanding Public Participation**







#### **SUMMARY & RECOMMENDATIONS**



# **Toxic Cyanobacteria**

- 2,000 species: ~ 40 known to produce toxins
- Anabaena spp.
- Microcystis spp.
- Planktothrix spp.
- Nostoc spp.
- Nodularia spumigena







Microcystis aeruginosa



Planktothrix rubescens



#### **Common Cyanobacteria Genera Found In Lakes**



Gloeotrichia

Source: Jody Connor, NHDES



Lake Monomonac

#### What migh

Province Lake 2010

#### look like?

Bow Lake, Northwood

'ond, New Durham

Source: Jody Connor, NHDES

Showell Pond, Sandown
# **The Trophic Scale of Lakes**







### Lake Stratification





**Figure 1** Complete mixing of water can occur when all water within the lake is generally the same temperature. Wind helps to drive this process.

### WATER QUALITY ANALYSIS

- Summarize WQ Data
- Compare to WQ Standards
- Present Trends
- Provide Recommendations

Set a <u>Reasonable</u> & <u>Achievable</u> Target



FB Environmental Associates 97A Exchange St., Portland, ME (207) 221-6699 www.fbenvironmental.com info@fbenvironmental.com

Province Lake Water Quality Analysis



DRAFT- July 2013

## WATER QUALITY ANALYSIS

≻Water Clarity (Secchi Disk Transparency or SDT)

40

35

30

25

15

(**D**20

- ≻Total Phosphorus (TP)
- ≻Chlorophyll-a (Chl
- Dissolved Oxygen
- \* Color, pH & Turbidit

#### OTHER FACTORS: Hurricane Irene (2011) Hurricane Sandy (2012)





### **ASSESSMENT OF WATER QUALITY**

#### • TOO MUCH PHOSPHORUS!

"Nutrient Indicator" = Phosphorus "Response Indicator" = Chlorophyll-a



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### WATER QUALITY GOAL

### Prevent Cyanobacteria Blooms

Reduce In-lake Total Phosphorus

Reasonable
Attainable
Scientifically-Sound

### 14.3 ppb to 10.8 ppb

**25% reduction** 

3320

# Phosphorus Load Model for Province Lake



# Why Use Modeling?

#### • Help Study Cause & Effect;

#### Make Predictions Using Different Pollutant Scenarios;

#### • Used to Trace Water & Phosphorus through the Watershed.

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	A	В	С	D	
65	Total Septic System Loading			1.43	
66					
68	LAND LISE	BASIN 1	BASINO	BASIN	
69		Eastern Trib PROEFFGC	Hobbs Brook PROEFFHB	Prov. L Direc Draina	
70		AREA (HA)	AREA (HA)	AREA	
71	Urban 1 (Low Density Residential)	1.2	4.6	56.1	
72	Urban 2 (Mid Density Residential/Commercial)	0.0	0.0	17.6	
73	Urban 3 (Roads)	1.0	2.9	55.C	
- 74	Urban 4 (Industrial)	0.0	0.0	0.0	
75	Urban 5 (Mowed Fields)	26.4	0.0	92.4	
76	Agric 1 (Cvr Crop)	0.0	0.0	0.0	
77	Agric 2 (Row Crop)	0.0	0.0	3.6	
78	Agric 3 (Grazing)	0.0	0.0	0.0	
79	Agric 4 (Hayfield)	0.7	0.0	15.2	
80	Forest 1 (Deciduous)	0.0	193.6	184.	





## What Goes Into a Model?

#### **Inputs:**

- o Land Use
- Septic Systems
- Subwatershed boundaries
- Bathymetry
- Precipitation
- Waterfowl
- WQ data as "reality check"



WAKEFIELD

Historical Apparent Color Deep Spot- Mean, Annual, Seasonal, Epilimnetic Province Lake, Effingham, NH



## What Does the Model Tell Us?

### Modeled TP concentration is 14.3 ppb

• Same as Province Lake Measured Water Quality



## Where is all the "P" Coming From?

#### **469 kg/year** Phosphorus to Province Lake



## What is the Greatest Source of P?

### **280 kg/year** P from Watershed Runoff



\*Developed land covers 12% of the watershed, forests 84%.

## **2013 Watershed Survey Results**





Residential	21 Si
Beach Access	14 Si
Roads	12 S



## **2013 Watershed Survey Results**



### **99** kg/year P from 61 Sites Residential **21 Sites Beach Access 14 Sites Roads 12 Sites** Other **13 Sites Prioritized – TOP 20**



### "P" from Wastewater

### **469 kg/year** Phosphorus to Province Lake



### **Types of Systems**



### Wastewater Breakdown

#### **107 kg/year** P from wastewater systems





0.5 1 Miles

0

Data from Maine GIS, NH GRANIT, USGS, and FBE Map by FB Environmental, September 2013

## **Recreational Boating**



## **Boat Induced Turbulence:**

- Rapid increase in <u>turbidity & available phosphorus</u>
- Increased algal growth
- Degradation of light climate

### **Recreational boat traffic may lead to:**

- Persistence of elevated trophic status
- Domination of the phytoplankton community by harmful cyanobacteria

## What About Future Sources of P?



### **Province Lake Buildout Analysis** • Under current zoning, how much land is currently available for development? How Much? • How will the town's appearance change over time? Where Vhen? • What effect will the development have on Province Lake? **Effects?**

### **Buildout Analysis - Inputs**



#### Buildout Results Total Buildable Land



\*Excludes area encompassed by Ossipee and Newfield

#### **Buildout Results** Existing Buildings



#### **Buildout Results** *Projected Buildings (2036)*



#### **Buildout Results** *Full Buildout (2060)*



#### Past, Present & Future Phosphorus from the Land



#### Past, Present & Future Phosphorus in the Lake



### What Can Be Done?

### Water Quality Goal and Actions Needed



## 25% Reduction

Category	Estimated Load Reduction (lbs TP/yr)
Septic Systems	44 - 55
Shoreline BMPs	66 - 99
Roads	110 - 165
Ordinances & Land Conservation	187 - 209
Boating	TBD
Water Quality Monitoring	N/A
TOTAL EST. LOAD REDUCTION	407 - 528 lbs/yr

\*Does not include internal loading reductions

#### **Focus** Area: Septic Systems

SEPTIC TANK

1000

#### GROUNDWATER

SOIL

1 1 2 9

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DRAINFIELD
#### **P Load Reductions** Where Can They Come From?



#### **Focus Area: Residential Shoreland Areas**

#### Focus Area: Route 153



#### **Focus Area: Province Lake Golf Club**

### **Future Development**



**Stormwater/LID Ordinance** 

Protect Large Parcels (>10 acres)





### **THE ACTION PLAN**

The Province Lake Watershed Management Plan Steering Committee should work toward improving and implementing the action plan that helps address threats identified within the following six major categories:

- 1) Septic Systems
- 2) Shoreline Best Management Practices (BMPs)
- 3) Roads
- 4) Municipal Ordinances and Land Conservation
- 5) Recreation/Boating
- 6) Water Quality Monitoring

ACTION TIEM	<b>DESCRIPTION</b>	REPORTER F	FUNDING	SCHEDULE	AIMMAL COST
	Septic System Upgrades	& Technical A	sustance		
Mendatory Inspection & Pumping	<ul> <li>Require inspections and maintenance of septic systems and repair at time of provide transfer.</li> <li>Require inspections and maintenance of septic systems for all new permit requests.</li> </ul>	PLA, Tawrel, State, Landownere	Granza, Tourne, Landownere	2015-2025	\$250/iynem
CommunitySeptic Systems	Install community septic systems for cluster developments (certigrounds & small semps with outhouses)	PLA, Tawrol, Landowrent	MH DES, Grants, Lou- interest Ipans	1016-2018	520-530,000 per communit for initial installation
Targeted Septic Installation	Install new septic systems at high-risk sites (sid systems, on slope, close to water).	FLA, landowners	NH DES, Brants, Landowners	2014-2018	780

# **Funding the Plan**

Category	Estimated Annual Cost	10-year Total
<b>Education &amp; Outreach</b>	22,000	\$220,000
Municipal Ordinances	\$9,600	\$96,000
Shoreline & Road BMPs	\$34,000	\$340,000
Monitoring	\$3,700	\$37,000
TOTAL EST. COST	\$69,300	\$693,000

# **Measuring Progress**

- <u>Environmental</u> Improved Water Quality – less frequent and intense cyanobacteria blooms
- <u>**Programmatic</u>** Number of and Effectiveness of BMPs</u>
- <u>Social</u> More Volunteers; More Education and Participation







### Key to Measuring Success: Monitoring



#### A. Province Lake-Deep Spot ✓ Extend sampling season ✓ Add apparent color **B.** Tributaries ✓ Dry & wet weather monitoring **C.** Cyanobacteria ✓ Keep consistent records of blooms ✓ Collect & analyze samples **D. Watershed/Shoreline** ✓ Resurvey NPS sites every 5 years



The Acton Wakefield Watersheds Alliance and PLA applied for a NH Watershed Assistance Grant for 2015-2016 to address the following action items:

#### **Septic Systems**

- Coordinate with septic haulers to arrange for group pump out discounts
- Identify high risk septic systems and provide funding for professional septic evaluations.
   A program will be developed to provide cost-share funding for failing systems.



#### Next Steps for Province Lake BMPs



The AWWA Youth Conservation Corps will work with landowners to address **residential** polluted runoff issues AWWA will work with the **Province Lake Golf Club** to install buffer plantings along the streams and lakeshore of the course. AWWA & the PLA will coordinate with ME & NH DOTs and local residents to develop a plan to address pollutant load issues from **Route 153**.

The Town of Wakefield DPW will correct additional chronic erosion issues along **Bonnyman Road**. Towle Farm Road intersection project is in progress partnering with the UNH Stormwater Center.



### Next steps for Province Lake Land Conservation

 A workshop will be held for owners of large parcels within the watersheds to inform them of forest management opportunities



### Next steps for Province Lake Recreation & Boating

• Healthy Lake Boating flyers will be developed and distributed



#### Water Quality Monitoring

- Continue with current lake monitoring with the additional parameters of apparent color, alkalinity, chloride, bacteria and total nitrogen
- Recruit additional monitors to sample tributaries
- Employ canine detection to determine source of high bacteria levels



• Looking for Volunteers – if you are interested in volunteering during the next 2-year phase of the Province Lake project please contact Linda Schier with AWWA or Pete Dinger of PLA. There will be a number of opportunities to be involved.



We need your input! For your time today to count as match for our NHDES grant and so that we can be sure to address the issues that concern you please complete your survey form right now.

Everyone who completes and turns in a survey will be entered to win a \$30 gift certificate for dinner at the Wakefield Inn.

> - Survey -Province Lake Watershed Management Plan July 19, 2014

1. The Action Items for the Province Lake Watershed Management Plan fall within six categories. Please tell us which you think are the most to least important to focus on:

Please rate each action category from 1-6 with 1 being the MOST important and 6 being the least

 Septic Systems
 \_\_\_\_\_

 Shoreland BMPs
 \_\_\_\_\_

 Roads
 \_\_\_\_\_

 Land Conservation
 \_\_\_\_\_

 Recreation/Boating
 \_\_\_\_\_\_

 Water Quality Monitoring
 \_\_\_\_\_\_

 Please use the space below to describe your ratings or to tell us any specific action items you feel are important to address:

# **Questions**?