









### Province Lake Action Planning Meeting

Greater Wakefield Resource Center January 18, 2014



#### AGENDA

#### 9:15 – 10:15 am Presentation: Province Lake Watershed

(Forrest Bell & Jennifer Jespersen, FB Environmental)

#### 10:15 – 10:30 am BREAK

#### **10:30 – 11:30 am Small Group Sessions** (Identify & Prioritize Actions)

#### 11:30 – 12:00 pm Report Back/Wrap-Up/Next Steps

#### 12:00 pm Adjourn for Lunch & Networking

#### **Province Lake**

#### **Physical Attributes**



- 2 States, 3 Towns
- Lake Area ~ 967 acres
- Avg. depth 9 feet
- Max. depth 16 feet
- Low Flushing Rate- 1.1/year
- Watershed 7.3 sq. miles
- Shallow, non-stratified wind driven system
- Small Watershed relative to lake surface area

# Why Develop a Watershed Plan?

## **Problem:**

- Province Lake is an Impaired Waterbody
- Historical and Current Cyanobacteria Blooms

#### Solution:

 Investigate Issues and Develop a Systematic Approach for Addressing these Issues.





# **Pollution Sources**

#### Past

Point source pollution discharged from pipe

#### Present

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



# 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!

# 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

# Water Quality & Property Values

- For every 3 ft. decline in water clarity, shorefront property values can decline as much as 20%.
- Declining property values affect individual landowners and economics of entire communities.
- With property rights comes property responsibility





# **Developing the Watershed Plan**

- ✓ Analyze Water Quality Data
- ✓ Collect Background Information & History
- ✓ Complete Modeling Work
- ✓ Set Water Quality Goal
- Write a Really Useful Report & Action Plan







# **Project Timeline**



- Started in March 2013
- Complete 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*
- Present All Modeling Results *November 2013*

Develop Watershed Action Plan – *TODAY* Write Plan/Install BMPs – *Spring 2014* Final Presentation – *July 2014*





#### **SUMMARY & RECOMMENDATIONS**

# **WQ Standards**

"Measurements for ALU ensures that waters provide suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms."



#### **THE PROBLEM**

- Impaired for Aquatic Life Use (High TP & Chl-a)
- Impaired for Primary Contact Recreation (Cyanobacteria)



Photos : Donna Luce, www.bbe-moldaenke.de

# **PHYTOPLANKTON & BACTERIA**

- □ Indicator of general lake water quality
- Abundance of Cyanobacteria- indicates excessive TP
- Increased water temperature and sunlight
- Cyanotoxins are a public health concern

#### Exceeded 70,000 cells/mL:

September 2, 2010 September 6, 2012 (\*No counts in Sept. 2011, below June 2013)



Photo: Anabaena, UNH Center for Freshwater Biology



### 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.



#### GOAL

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

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





DRAFT- July 2013



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

#### Water Quality Monitoring Sites Province Lake Watershed



# **WQ Data Sources**

- 1. NH DES Trophic Reports (5 years)
- 2. NH VLAP (22 years)
- 3. "Other "Historical Data (5 years)

29 Years of Data
1991-2012 (VLAP)



Water Quality Data Available for Province Lake				
Data Source	Agency/Organization	Years Sampled	# of Years Sampled	
NH VLAP	NHDES	1991-2012	22	
NH Trophic Survey	NHDES	1979, 1987, 1988, 2006, 2007	5	

# **WQ Parameters**

- ≻Water Clarity (Secchi Disk Transparency or SDT)
- ≻Total Phosphorus (TP)
- ≻Chlorophyll-a (Chl-a)
- Dissolved Oxygen & Temperature
- \* Color, pH & Turbidity were also assessed



Turbid lake having large algal population results in shallow SDT reading, low clarity

# Water Clarity

- Measured with a Secchi disk
- Characterize existing water quality
- Track long-term trends





Source Maine VLMP



## **INTERIM WATER QUALITY GOAL**

## Prevent Cyanobacteria Blooms

Reduce In-lake Total Phosphorus



## **INTERIM WATER QUALITY GOAL**

Prevent Cyanobacteria Blooms

Reduce In-lake Total Phosphorus

Reasonable
Attainable
Scientifically-Sound

14.3 ppb to 10.8 ppb

**25% reduction** 

## **Future Monitoring Recommendations**

- Include apparent color in future monitoring;
- Conduct sediment coring
- Collect consistent data about cell counts, toxicity and species type for future cyanobacteria blooms;
- **Conduct intensive tributary monitoring** to better understand nutrient & sediment loading;
- Extend VLAP monitoring into mid-October to capture fall conditions

# Phosphorus Load Model for Province Lake



# Lake Loading Response Model (LLRM)

- Began as university teaching tool
- Evolved over many years
- Used on >30 NH lakes
- Large Excel spreadsheet format



## **Possible Source of Phosphorus**

- Atmosphere, from industry and exhaust
- Land Use
  - Row crops, pasture, urban areas *very high*
  - Forest and wetlands *very low*
- Septic Systems
- Waterfowl
- Internal loading from sediments



## **Province Lake Model Inputs**

#### **Inputs:**

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



## **Province Lake Model Inputs**

#### Land Use Data

- Edited Layers:
  - × Watershed boundaries
  - × Digitized buildings
  - × Road overlay
  - Double-checked pasture vs. hay



0.5

1 Miles

469 kg/year

#### Modeled TP concentration is 14.3 ppb

• Same as Province Lake Measured Water Quality

#### **Phosphorus Load Estimate:**



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

#### **By Category**

Watershed Runoff

60%



Wastewater

23%





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





Developed Land*	158 kg/yr	56%
Forests	107 kg/yr	38%
Agriculture	14 kg/yr	5%
Wetlands	2 kg/yr	1%

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

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

#### **By Category**








81% of wastewater load from septics >20 yr old, cesspools, outhouses.







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



### P Load Reductions Septic Systems

and the second s								
A CONTRACT	Estimated P	Full Year	Water per Person per	P	Water	P I oad		
A destand to be	Reduction			()		(kg/vr)		
New Septic System (<20	System (<20 Convert All Aging							
years old)	90%	Systems and						
Old Septic System	80%	<b>Cesspool/Outhouses</b>						
Cesspool, Outhouse	75%	to New Systems = $47.5$						
			Kg TP					
Electric, Composting,								
Portable Toilet	95%	50% Reduction = 23 kg TP				0.0		
Other	60%					3.2		
Totals		000			/1,057	107.2		



## **P Reduction** *Other Sources*

## Residential BMPs

Lower priority, buffer enhancement, or missed in survey **[20 – 30 kg P/yr]** 

## Agriculture

5% of land area. Potential for opportunities **[5 – 10 kg P/yr]** 



## Boat Traffic

Limit re-suspension of sediments into the lake – **[7 to 166 ppb, > 231** kg/yr]

# **Boat Induced Turbulence:**

- Rapid increase in Total Dissolved Solids
- Increase in available phosphorus
- Rapid increase in turbidity
- Increased algal growth
- Degradation of light climate

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

- Persistence of elevated trophic status
- Suppression of macrophyte and fish communities
- Domination of the phytoplankton community by harmful cyanobacteria

## P Reduction Other Sources

### Golf Course

Likely historic more than current due to the fact that course has been using phosphorus-free fertilizers for 12 years.

### [5-10 kg P/yr reduction seems realistic]



## P Reduction Totals

- High Priority BMPs
- Lower Priority BMPs
- Septic Systems
- Agriculture
- Boat Traffic

- [50 75 kg P/yr]
- [20 30 kg P/yr]
- [20 kg P/yr]
- [5-10 kg P/yr]
- [? (> 231 kg/yr)]
- <u>Golf Course</u> [5-10 kg P/yr]

\* TOTAL: [100 – 145 kg P/yr]

### <u>GOAL:</u> 113 kg P/yr

\*Does not include internal loading reductions

## **Potential BMP Demo**



Boat Launch on Bonneyman Road

# **Province Lake Watershed Buildout Analysis**

Effingham and Wakefield, New Hampshire Parsonsfield, Maine







## **Buildout Analysis**

Town	1 <b>96</b> 0	1970	1 <b>98</b> 0	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%















### Buildout Results Total Buildable Land



#### **Total Buildable Area**

Province Lake Watershed = 3,591 acres\*

2,347 acres of buildable land (65% of total area)

#### **Buildable Area by Town**

Effingham – 1,142 ac. (66%) Parsonsfield – 704 ac. (60%) Wakefield – 501 ac. (75%)

\*Excludes area encompassed by Ossipee and Newfield

### **Buildout Results** *Buildable Land by Subwatershed*



### Buildout Results *TimeScope*



### Buildout Results Existing Buildings



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



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



### **Province Lake Future Phosphorus Loading**



### **New Development**

ame

Shady Ln

STUBO

### **Old Development**

nesiRdi

EMains

Million .

### **Province Lake Watershed** *Estimated Phosphorus Loading*



### **Province Lake Buildout** *In-Lake Phosphorus Concentrations*





## **Questions?**



## SMALL GROUP INTERACTIVE SESSION

- **Group 1 Roads-** Jamie Houle
- Group 2 Septic Systems- Wendy Garland
- **Group 3** Shoreline Residential- Sam Wilson
- **Group 4** Mun. Ord. & Land Cons.- Eric Williams
- Group 5 Water Quality Monitoring- Jen Jespersen
- **Group 6 Recreation & Boating-** Forrest Bell

### Monitoring Plan Key to Measuring Success



## 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
## P Reductions Needed to Reach Water Quality Goal Province Lake, NH

