Lake Carmi Phosphorus TMDL

Public comment briefing

VT Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division

9-11-2008
Franklin, VT

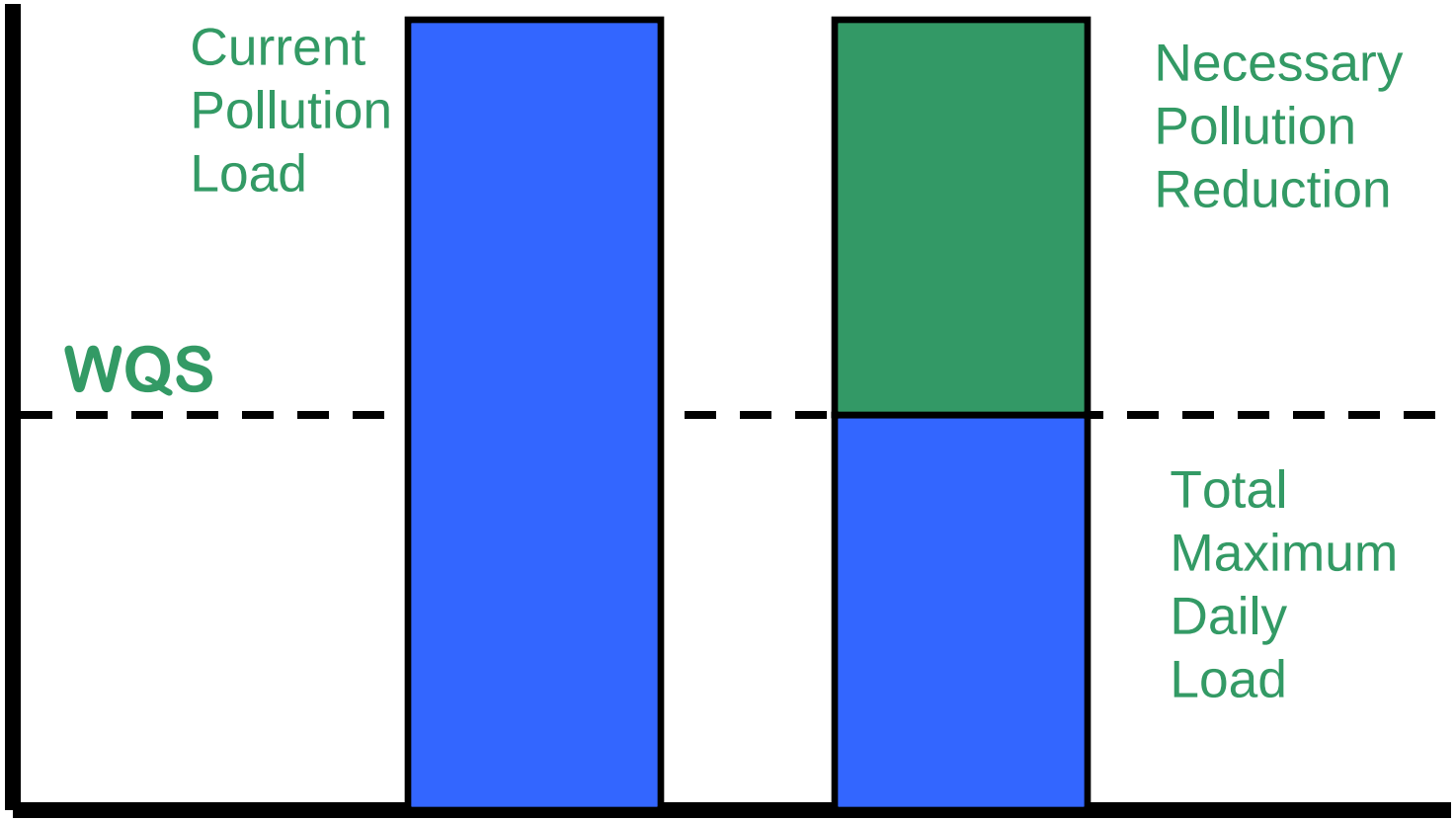
Informational Meeting

- Describe TMDL and respond to questions
- NOT a hearing, comments need to be submitted in writing

What is a TMDL?

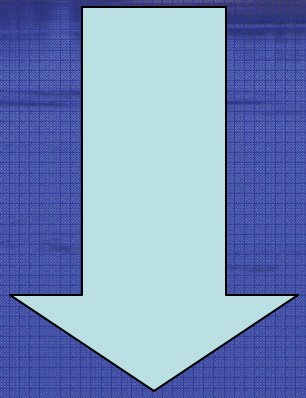
- Clean Water Act requirement for 303d listed impaired waters
  - establishes the allowable pollutant loading from all contributing sources at a level necessary to attain the applicable water quality standards.
  - Allocates that load among point and non-point sources
- Ultimately approved by EPA to ensure compliance with Federal Clean Water Act

What is a TMDL?



What is a TMDL?

- Establishes a loading target - Science



- Sets up implementation plan - Policy

Clean Water Act Requirements for TMDLs

- Waterbody, pollutant, sources, priority
- Water quality standards, targets
- Loading capacity
- Margin of safety
- Allocations
- Seasonal variation
- Reasonable assurances
- Public participation

Water Quality Standards & Targets

- Lake Carmi fails to provide for many aspects required in the WQS…impaired
- TMDL describes derivation of target phosphorus concentration and relationship to WQS

Concentration → WQS

Loading Capacity

- Greatest amount of a pollutant that a water can receive without violating water quality standards

- Analysis provides the link between loading and WQS

Loading → Concentration → WQS

Margin of Safety

- Accounts for uncertainty that the total loading capacity will attain WQS
- Can be either implicit or explicit

Pollutant Allocations

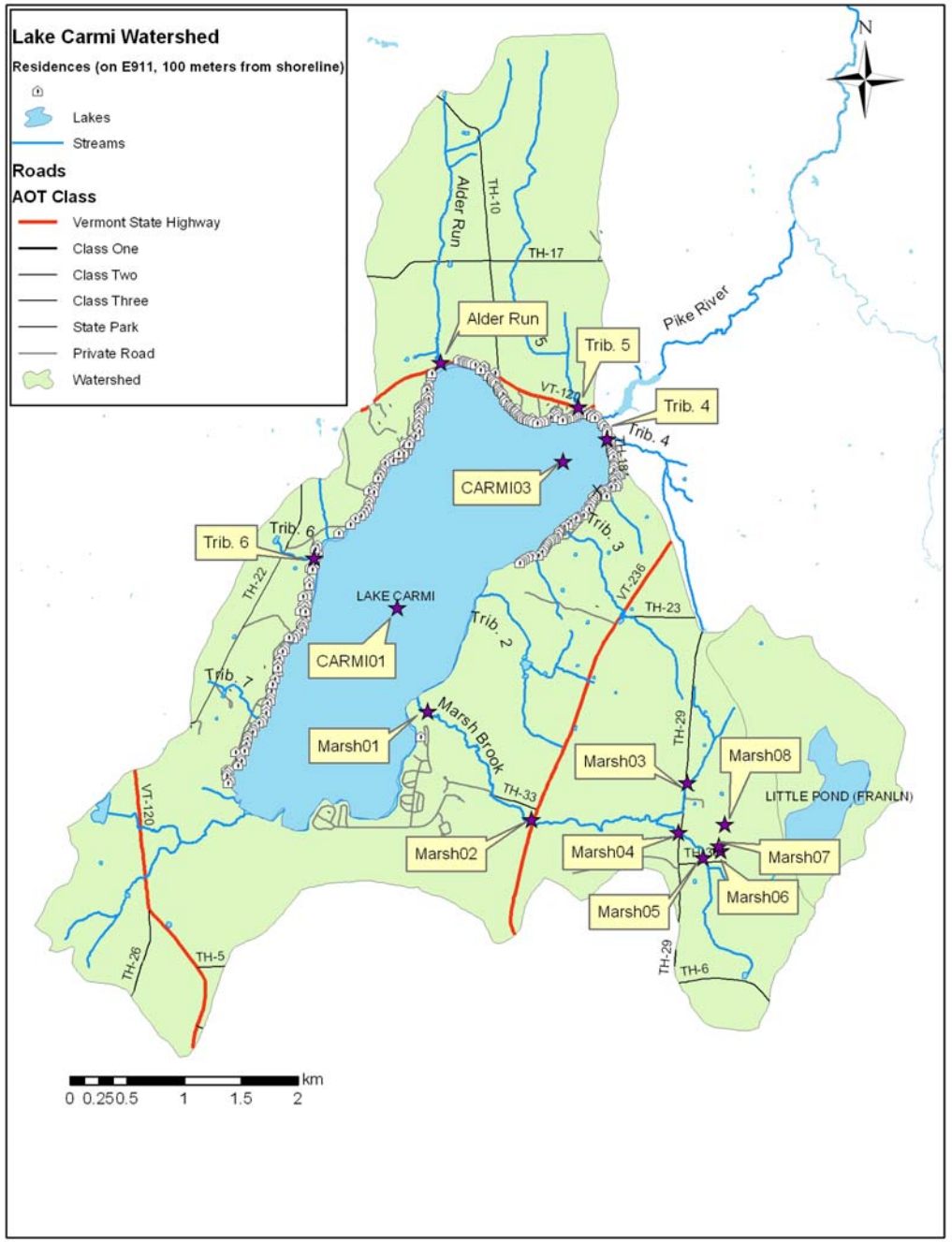
- TMDL must allocate between point sources (WLA) and nonpoint sources (LA)

TMDL = WLA + LA + MOS

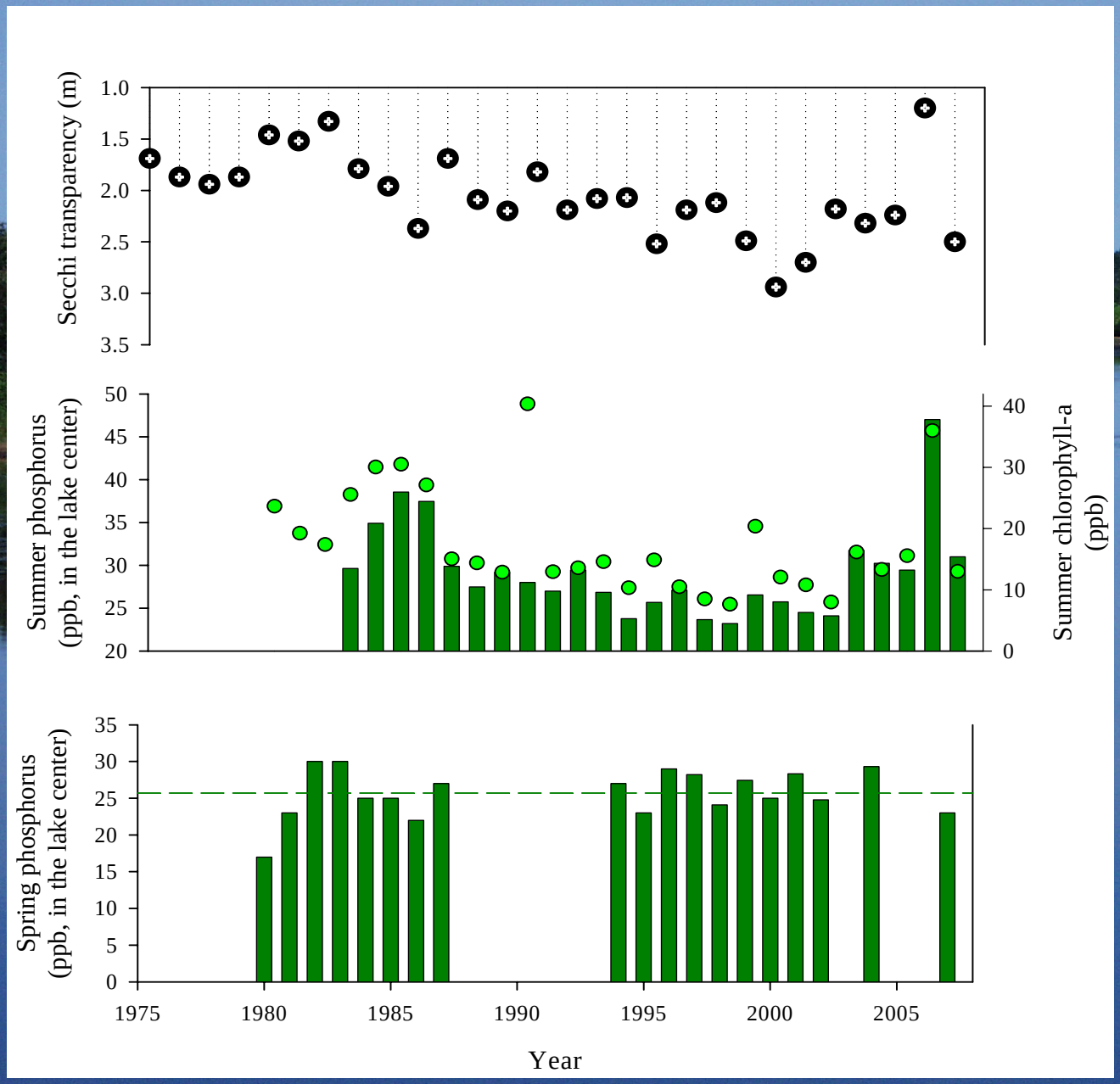
Background

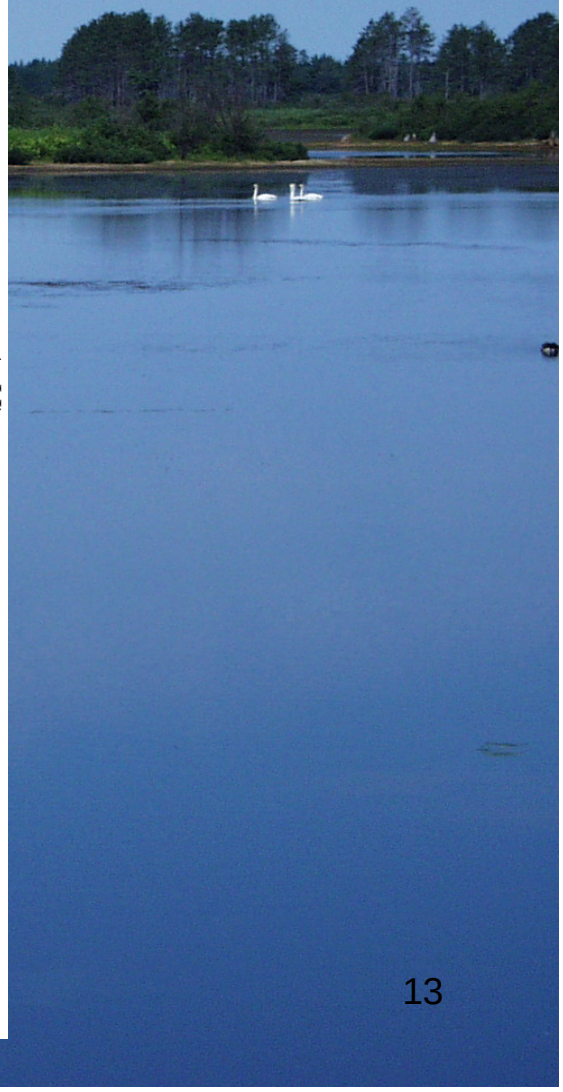
- Long history of algae blooms
- This algae results from excessive phosphorus loading from the watershed
- In-lake algae conditions vary along a north-south axis. Things are worst in the NE cove.

Background


Lake Carmi Watershed
Residences (on E911, 100 meters from shoreline)
Lakes
Streams
Roads
AOT Class
Vermont State Highway
Class One
Class Two
Class Three
State Park
Private Road
Watershed
N
Alder Run
TH-10
TH-17
Pike River
Trib. 5
VT-120
Trib. 4
TH-18
CARMI03
Trib. 6
Trib. 3
TH-22
VT-236
LAKE CARMI
TH-23
Trib. 2
CARMI01
Trib. 7
Marsh Brook
Marsh01
TH-29
Marsh03
Marsh08
LITTLE POND (FRANLN)
TH-33
Marsh02
Marsh04
Marsh07
Marsh06
Marsh05
TH-26
TH-5
TH-6
km
0 0.250.5 1 1.5 2

Background


Secchi transparency (m)
1.0
1.5
2.0
2.5
3.0
3.5
Summer phosphorus (ppb, in the lake center)
50
45
40
35
30
25
20
Summer chlorophyll-a (ppb)
40
30
20
10
0
Spring phosphorus (ppb, in the lake center)
35
30
25
20
15
10
5
0
1975
1980
1985
1990
1995
2000
2005
Year



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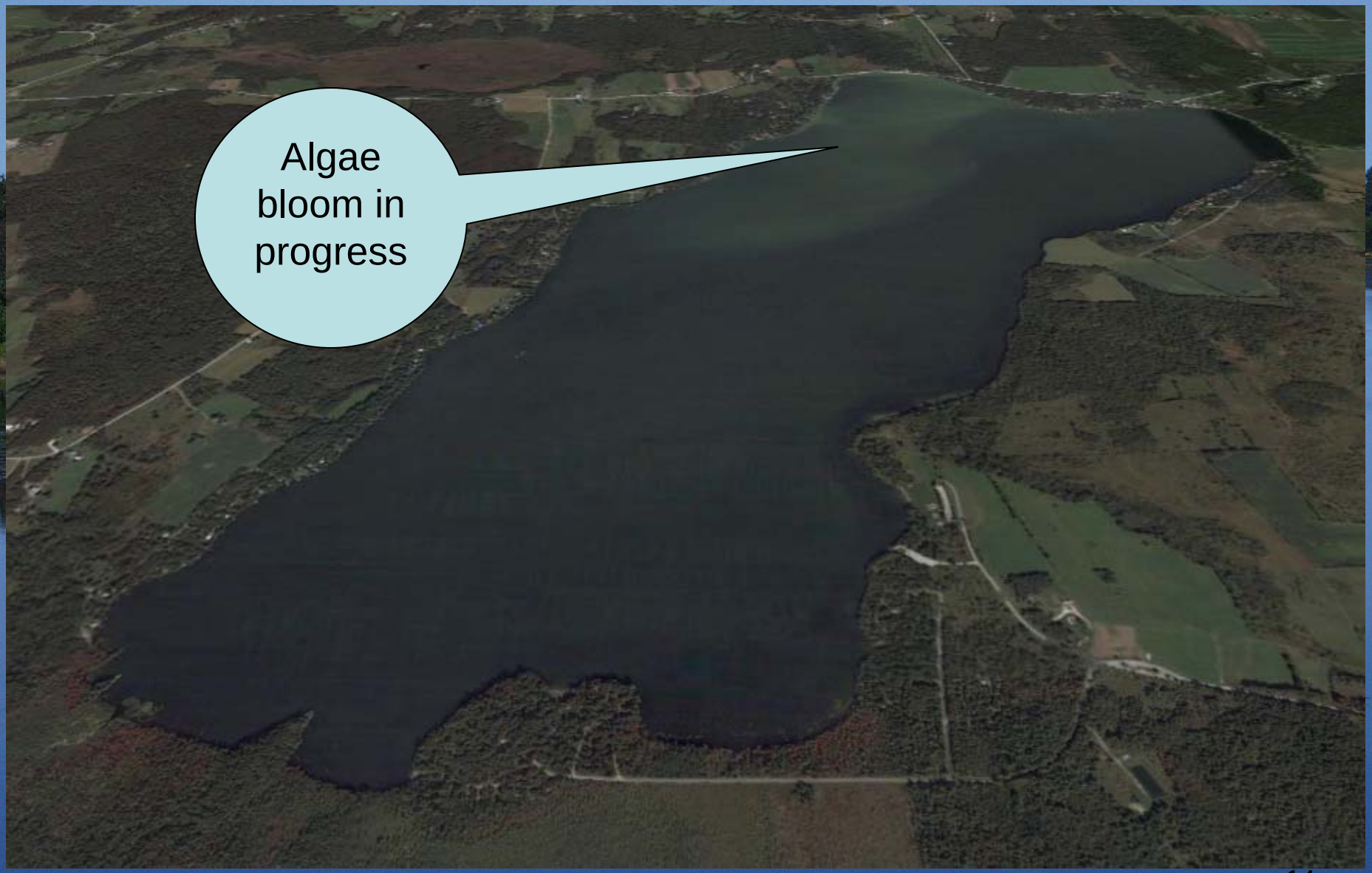
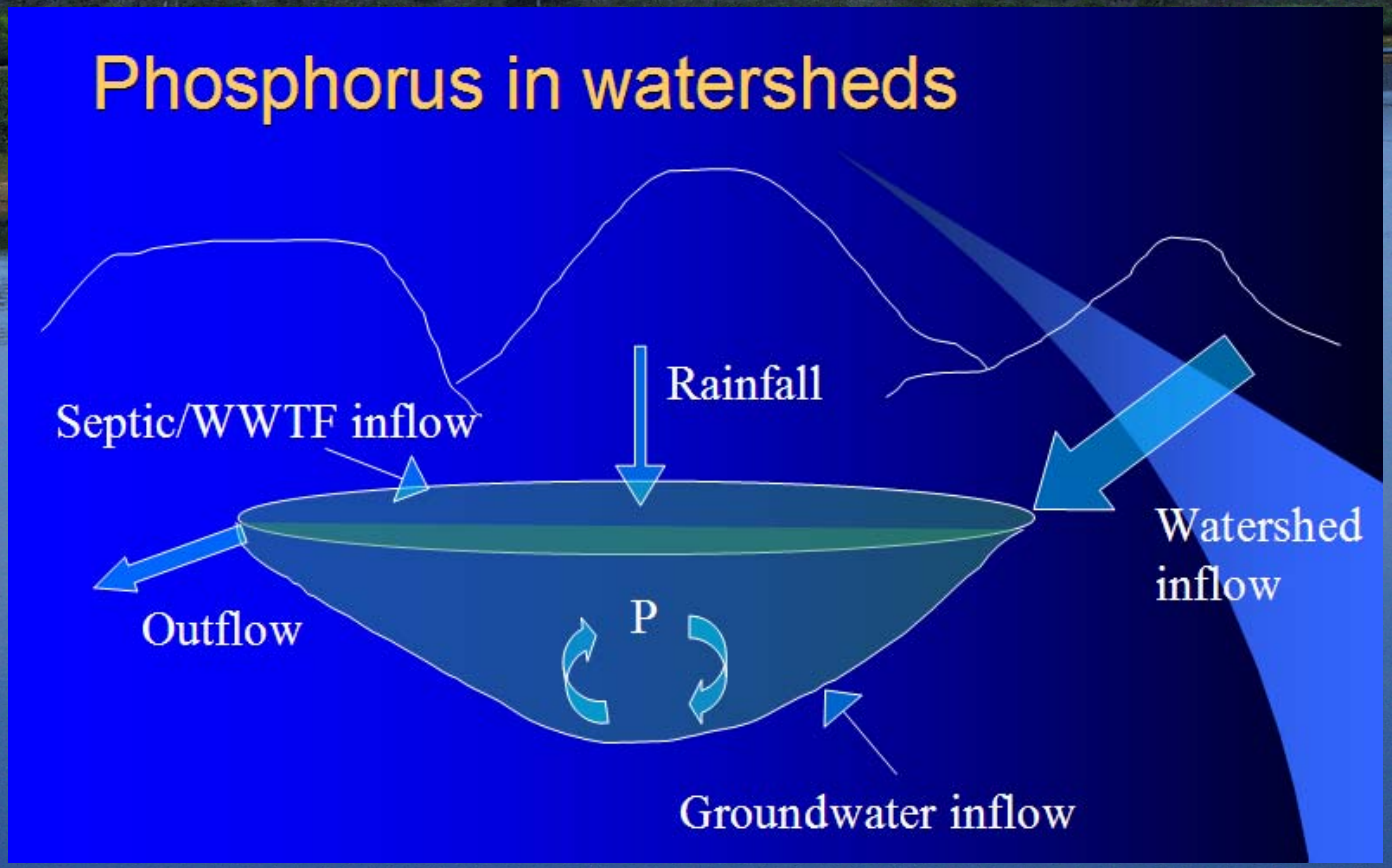


Background

What are the current phosphorus loads to Lake Carmi?



Phosphorus loads – land export

Land Use	Acres	Export coefficient [1] kg/ha/yr	Corrected load kg/yr	Loading %
Agriculture	2,748	1.78	1188	85%
Urban – lakeshore	100	2.52	61	5%
Urban – low density	62		38	2%
Forest	2,090	0.04	20	1%
Non-contiguous Wetlands[2]	722	0.15	26	2%
Other water[3]	586	0	0	0%
Lake Surface[2]	1,402	--	88	5%
Total	7,710	--	1,421	100%

1)Coefficients taken from Troy et al., 2007.
2)Direct deposition of phosphorus to contiguous wetlands and the lake surface was calculated using the approach of the Lake Champlain TMDL (VTDEC and NYSDEC, 2002).
3)Direct deposition of phosphorus to non-contiguous ponds and tributaries was considered negligible.

Phosphorus loads – septic

Low	Most likely	High
2 kg/yr	15 kg/yr	49 kg/yr

Assumptions:

- 206 camps
- 3 persons/camp
- ½ year occupancy for these 3 persons
- 3.3 g / person / day P “produced.”

Phosphorus loads – internal

Method	Kg P/yr
1. From a complete mass budget	-154 kg
2. From growing season in situ phosphorus increases	254
3. From in situ phosphorus increases in the fall	1011
4. From phosphorus release rate and anoxic area, using most likely p release rates	191
Mean for methods 1,2, and 4	97

Phosphorus loads - Carmi State Park WWTF

- Recirculating textile filter for effluent treatment,
- Storage in a lagoon
- Spray disposal
- Not a point source…this is an indirect discharge
- Estimated discharge as
  - Daily flow x operation days x max. measured groundwater P

15,500 gal/day x 120 days x 215 µg/L P x 3.81x10-9 = *1.5 kg/yr*

Phosphorus loads – summary

Source of phosphorus load	Value used to calculate this TMDL (kg/yr)
Watershed tributaries[1]	1,421
Septic loads	15
Internal loads	97
Load from Lake Carmi State Park WWTF[2]	2
Total annual load	1,535

1) Includes 88 kg phosphorus delivered directly to the lake surface from atmospheric deposition

2) This WWTF is permitted as an indirect discharge using a leachfield design. As such, it is being treated as part of the non-point source load in the TMDL.

Numeric Water Quality Criteria

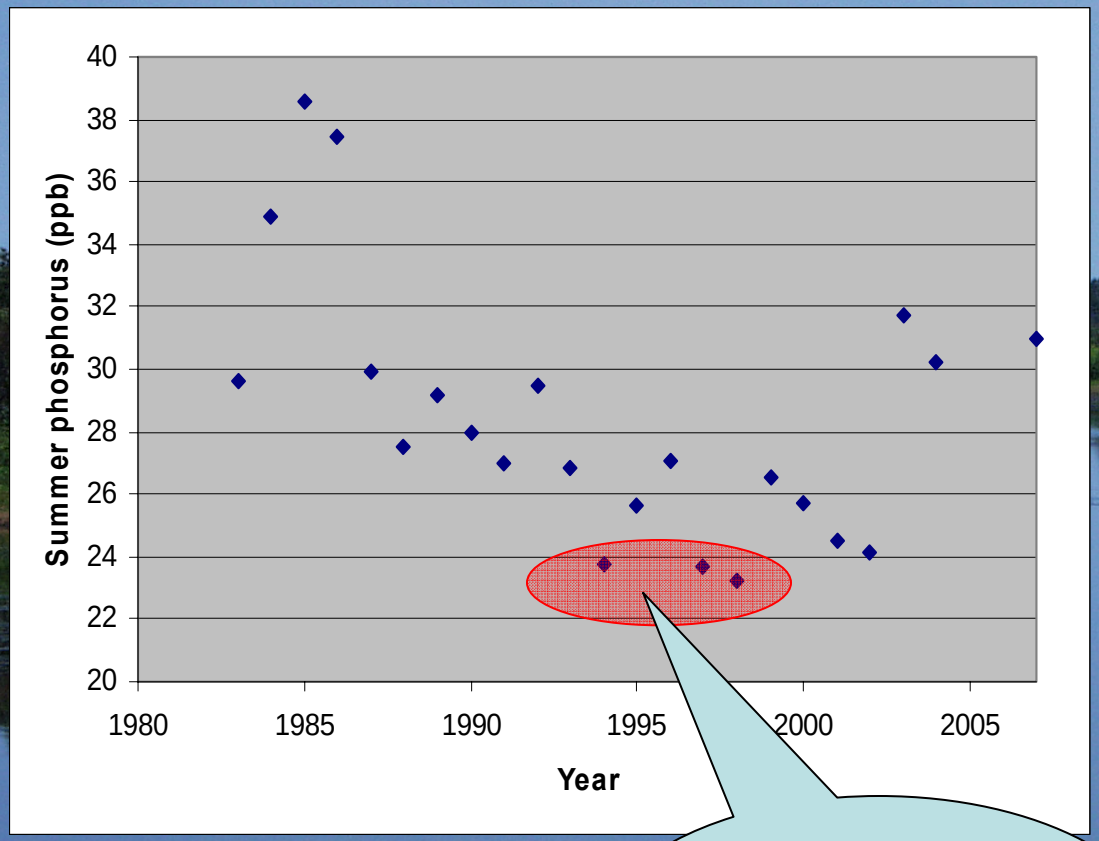
(…)

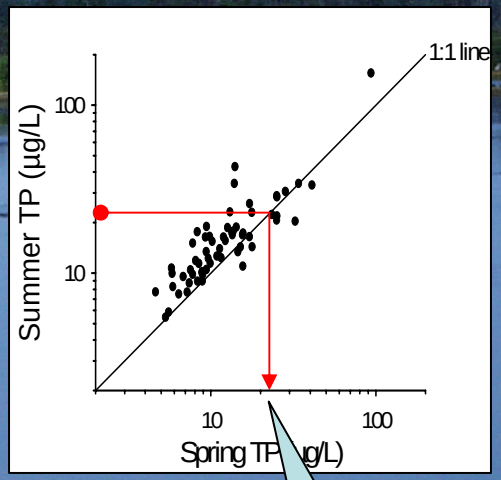
All waters - general policy

In all waters, total phosphorous loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses. (…)

This needs to be translated into a number, so we can determine how much P load reduction is necessary

Numeric Water Quality Criteria





Best three years data had summer TP concentrations of 23-24 ppb, and chlorophyll-a concentrations ≤ 10 ppb

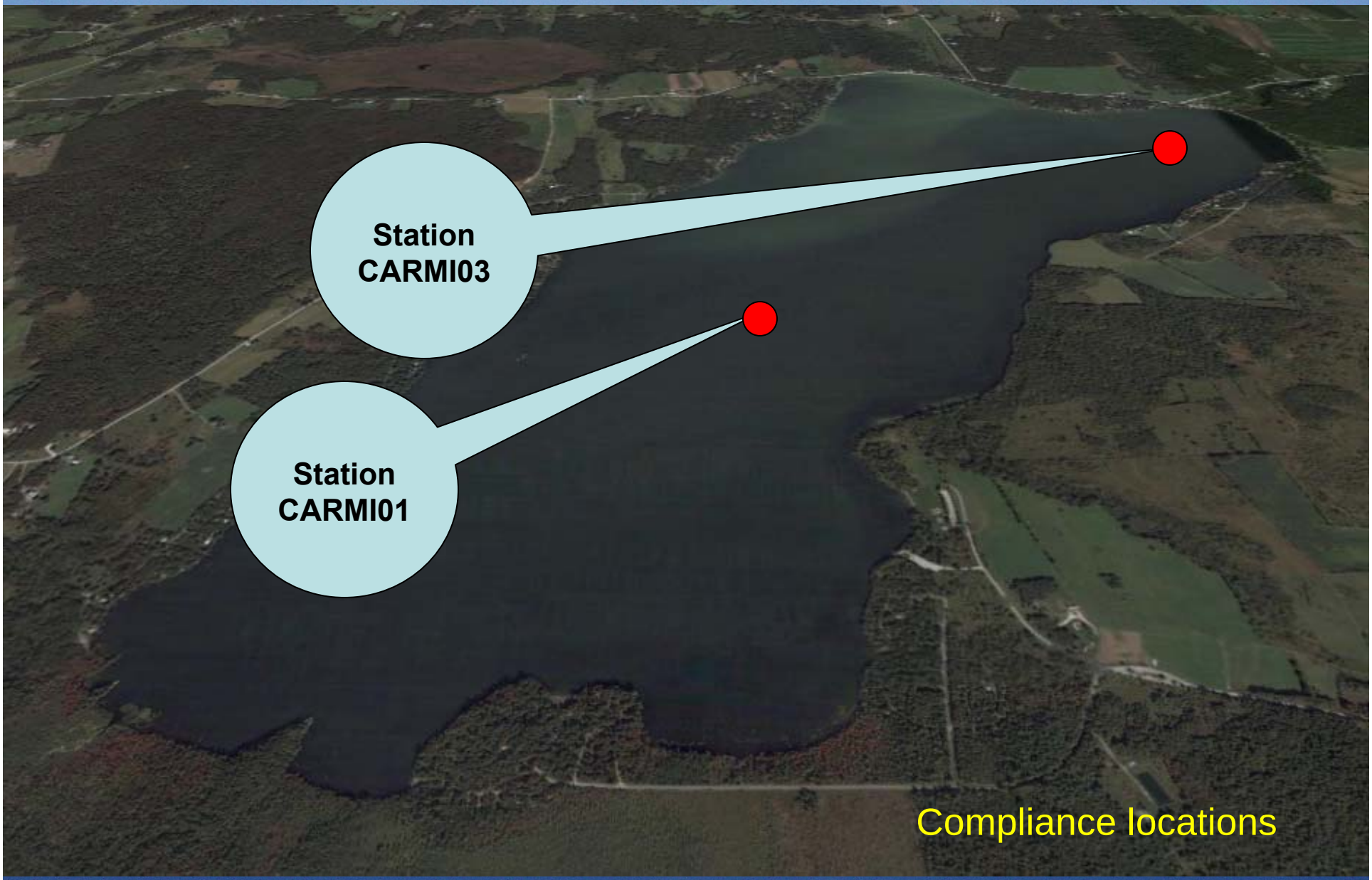
This equates to a spring TP value of 22 ppb

The mean summer P concentration in the lake is 28 ppb
The target Spring P concentration is 22 ppb

Numeric Water Quality Criteria

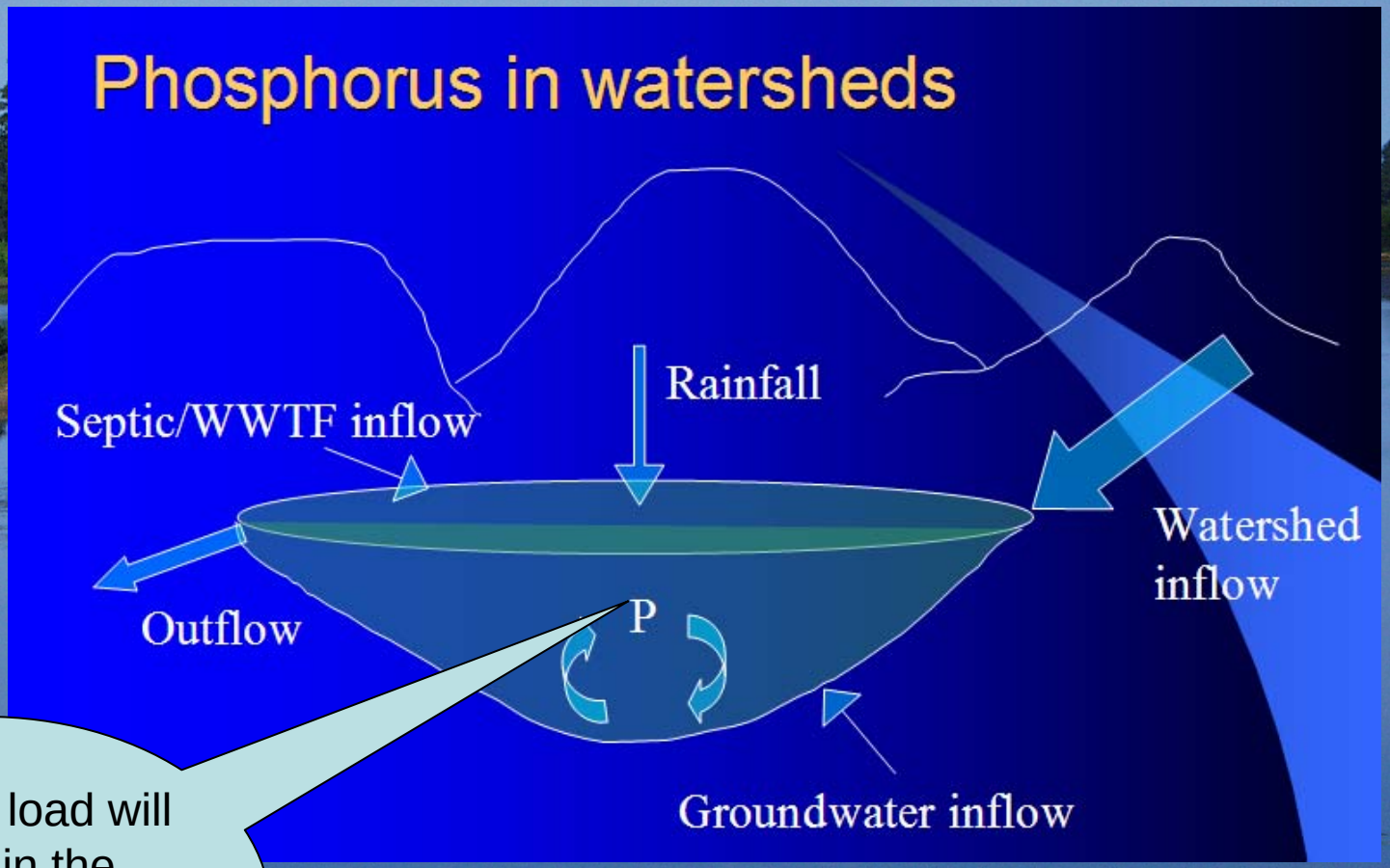
- Compliance with the target will be measured at both the central monitoring station, and the NE Cove monitoring station.
- Lake Carmi will be considered to meet Water Quality Standards when spring total phosphorus concentrations of 22 ppb are attained at both of these stations.

Numeric Water Quality Criteria



Compliance locations

Total Loading Capacity



At what P load will we attain the target in-lake concentration of 22 ppb?

Process

- Create a model that accurately predicts in-lake P from P loads
- Use that model to run “what-if” scenarios to determine at what loads P targets will be attained.

Total Loading Capacity

Modeling in-lake P concentration from loads

Lake phosphorus model Mean 2007 GSM* TP: 28 ppb Mean ANN** TP: 26 ppb	Total P (predicted), ppb	Range of prediction	Model prediction type
Nurnberg, 1984 Oxic	27	12-43	ANN
Vollenweider, 1982 Shallow Lake/Res.	29	12-49	ANN
Rechow, 1977 water load < 50m/year	35	17-51	GSM
Vollenweider, 1982 Combined OECD	35	15-60	ANN

***GSM: Growing season mean phosphorus**

****ANN: Annual mean phosphorus, calculated by WILMS as the average of spring total phosphorus and GSM**

Total Loading Capacity

"What-if" scenarios predict load to attain 22 ppb

Lake Phosphorus Model	Modeled starting concentration (ppb)	Current load (kg/yr)	Total loading capacity (kg/yr)	Load reduction required (kg)	Final concentration (ppb)
Nurnberg, 1984 Oxic	27	1,535	1,168	367	22
Vollenweider, 1982 Shallow Lake/Res.	29	1,535	1,056	479	22
Rechow, 1977 water load<50m/year	35	1,535	960	575	22
Vollenweider, 1982 Combined OECD	35	1,535	924	611	22
Average			1,027	508	

Allocating the total loading capacity

- The Total Loading Capacity is divided into three components:
  - Margin of Safety
  - Wasteload Allocation (point sources of P)
  - Load Allocation (non-point sources of P)

Margin of Safety

- Margin of safety is explicit
- DEC has selected a 10% of the Total Loading Capacity as a margin to ensure compliance with the target concentration

1,027 kg * 0.1 = 103 kg

Wasteload Allocation

- No Point Source discharges exist currently.
- Therefore, no wasteload allocation is provided in this TMDL.
- Any new point source discharges will require re-opening of this TMDL.

0 kg

Non-point Source Load Allocation

- Load allocation is remainder of the total loading capacity:

1,027 kg – 103 kg – 0 kg = 924 kg

Total loading capacity

Margin of safety

Wasteload allocation

Load allocation

7. Total Maximum Daily Load

TMDL Component	kg/yr	
Current load	1,535	
Wasteload allocation	0	
Load allocation	924	
Margin of safety	103	
Total loading capacity	1,027	
Load reduction required	611	40%

Implications on regulated activities and future growth

- WWTF: reopen TMDL to create wasteload allocation
- Stormwater construction & multi-sector permits: allowable under TMDL if all conditions of permit are met
- Stormwater operational permits: allowable under TMDL, incorporated into LA

Implications on regulated activities and future growth (con't)

- Large / medium farm operation permits: allowable under TMDL if all permit conditions are met

- Future growth: incorporated into LA

Comment Submittal Info

- Deadline: September 26, 2008
- Written comments only
- Email to: tim.clear@state.vt.us
- Send to:

  VT Department of Environmental Conservation
  Water Quality Division
  103 South Main Street
  Waterbury, VT 05671-0408
  Attention: Tim Clear

- For TMDL documents and info: www.vtwaterquality.org

Implementation plan

- Plan is predicated on four objectives:

  1) Complete execution of the Action Plan.

  2) Adherence of watershed residents and businesses to applicable State regulations pertaining to septic design and maintenance, and State enforcement of these regulations.

  3) Enforcement of Accepted Agricultural Practices, requirements for best management practice implementation, and comprehensive nutrient management planning.

  4) Enforcement of Accepted Management Practices for Logging jobs in Vermont, and permitting of heavy forest cuts as required by 10 V.S.A. 83 §2625.