

Bathymetry Changes Caused by a Tropical Storm

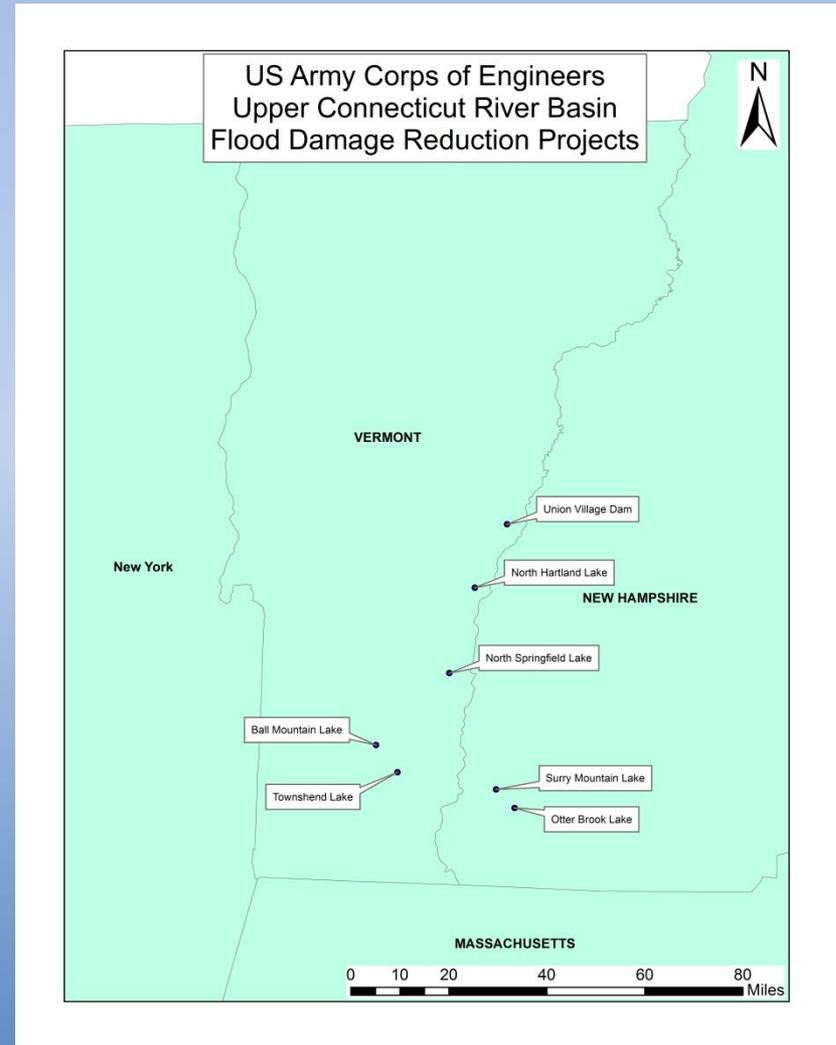
Chris Scheiner and Gary Pelton
US Army Corps of Engineers

Outline

- Tropical Storm Irene
- River flooding
- Resulting lake bathymetry change

Upper Connecticut River Basin

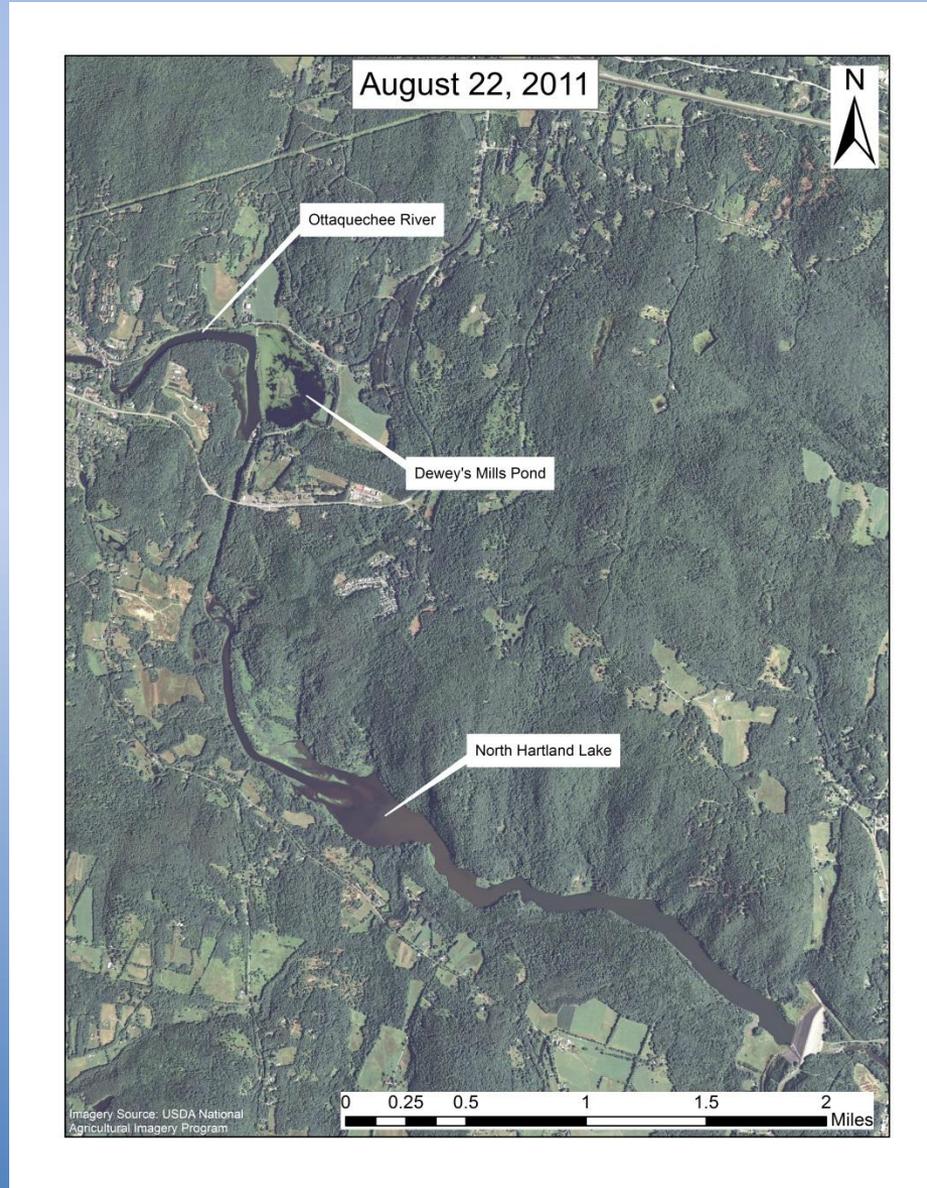
- Dams on Connecticut River tributaries
 - Reduce Connecticut River flooding by limiting tributaries
 - Dams hold back water in the tributaries until the Connecticut River passes flood stage



Tropical Storm Irene

- August 28, 2011
- Caused near-record pool heights
 - North Hartland Lake: 100 feet above normal
- Ottaquechee River
 - Quechee, VT
 - Reached flood stage
 - Overtopped a dike on Corps property

North Hartland Lake Project



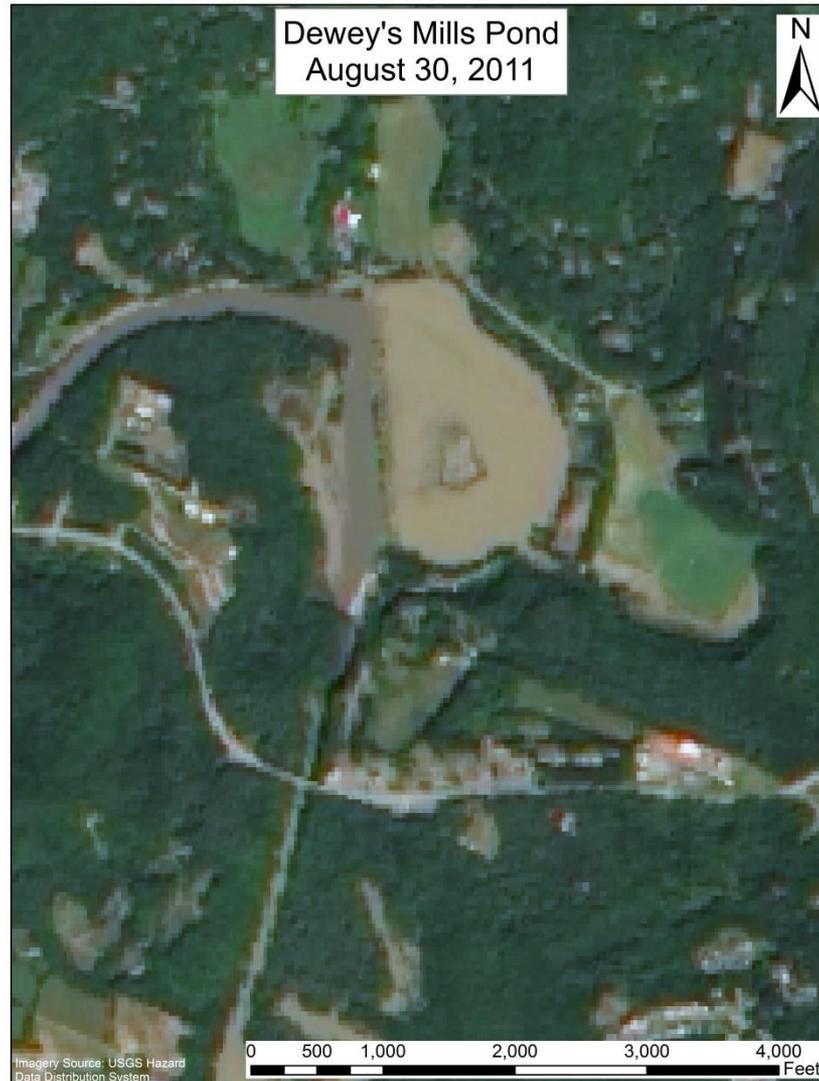
North Hartland Lake Project



Dewey's Mills Pond



Dewey's Mills Pond



Dewey's Mills Pond



Dewey's Mills Pond



Dewey's Mills Pond



Bathymetry

- Sediment 1-2 ft. deep on dry land
- Potential underwater impact
- Survey performed in 2007
- Comparison survey

Bathymetry

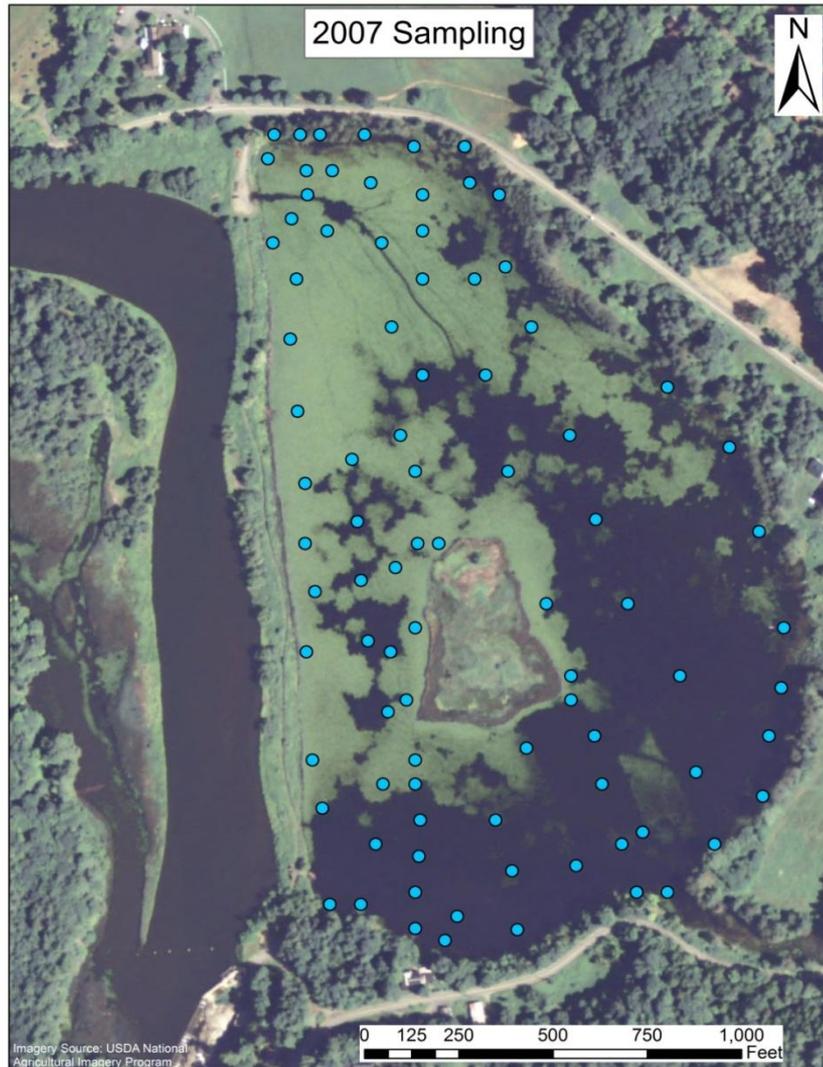


Sounding Pole

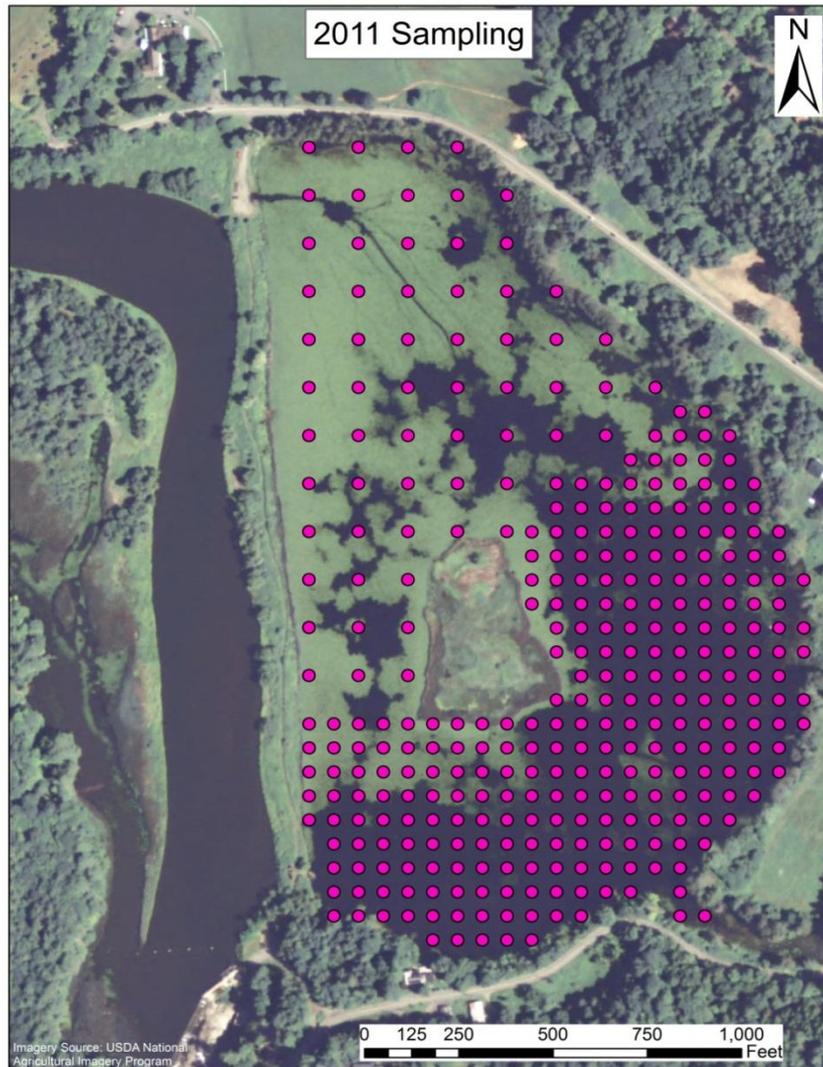


Sounding Line

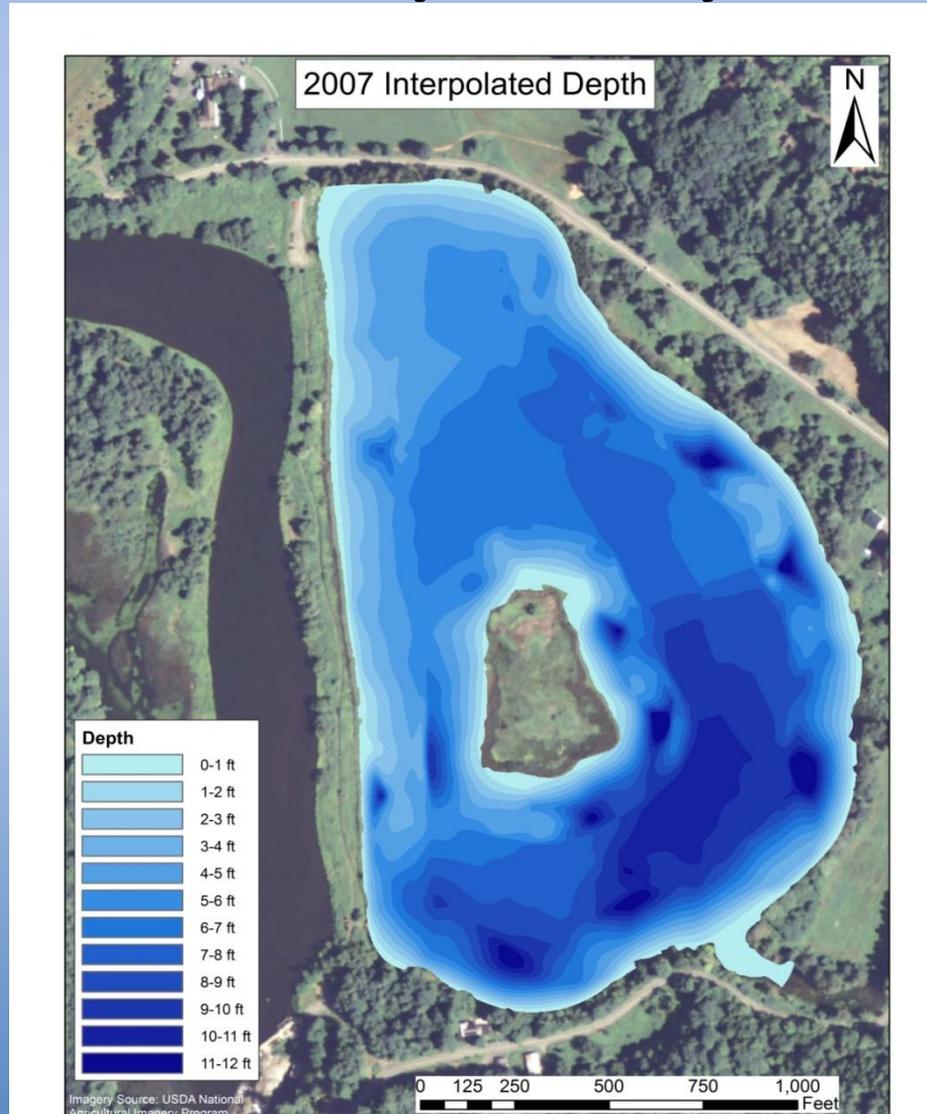
Bathymetry



Bathymetry

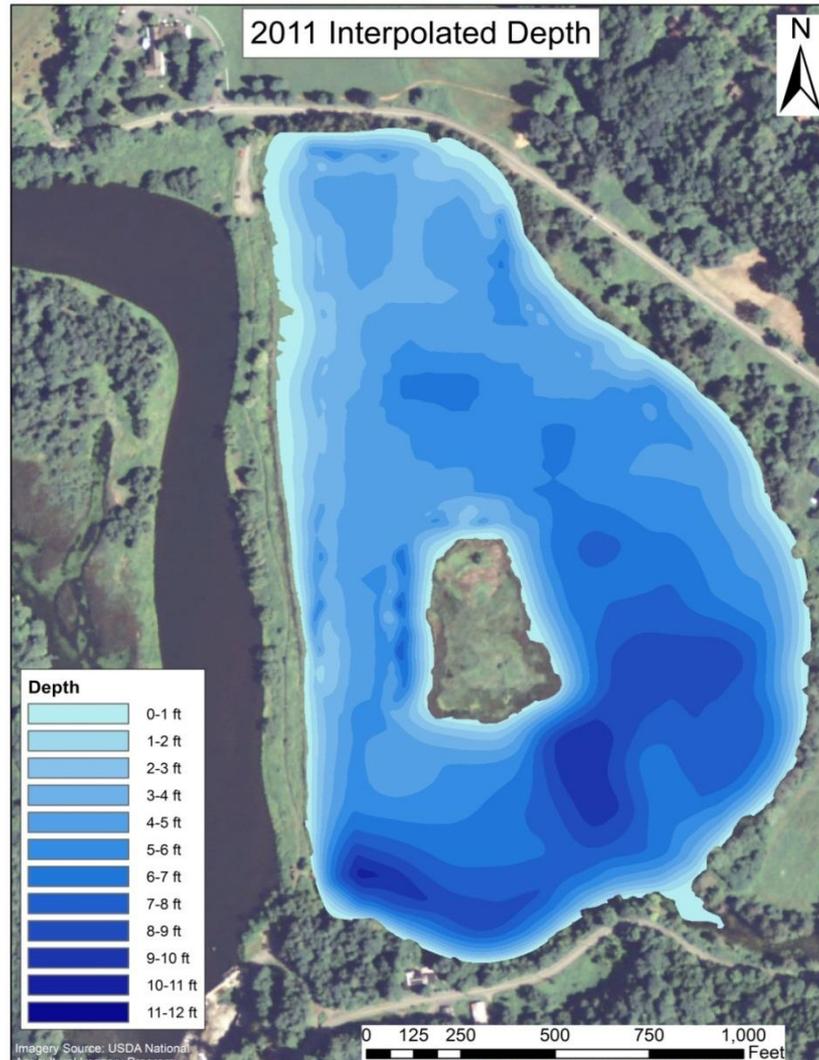


Bathymetry



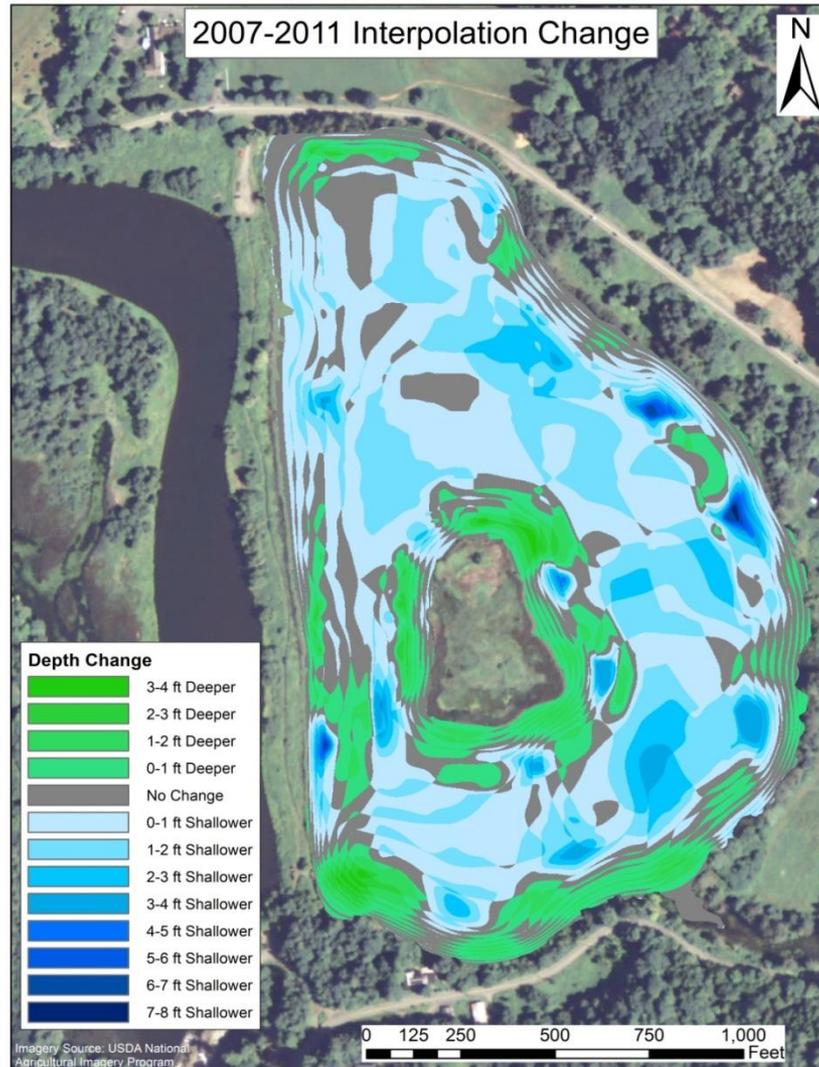
Local polynomial interpolation (RMSE: 1.38 ft.)

Bathymetry



Local polynomial interpolation (RMSE: 1.12 ft.)

Bathymetry

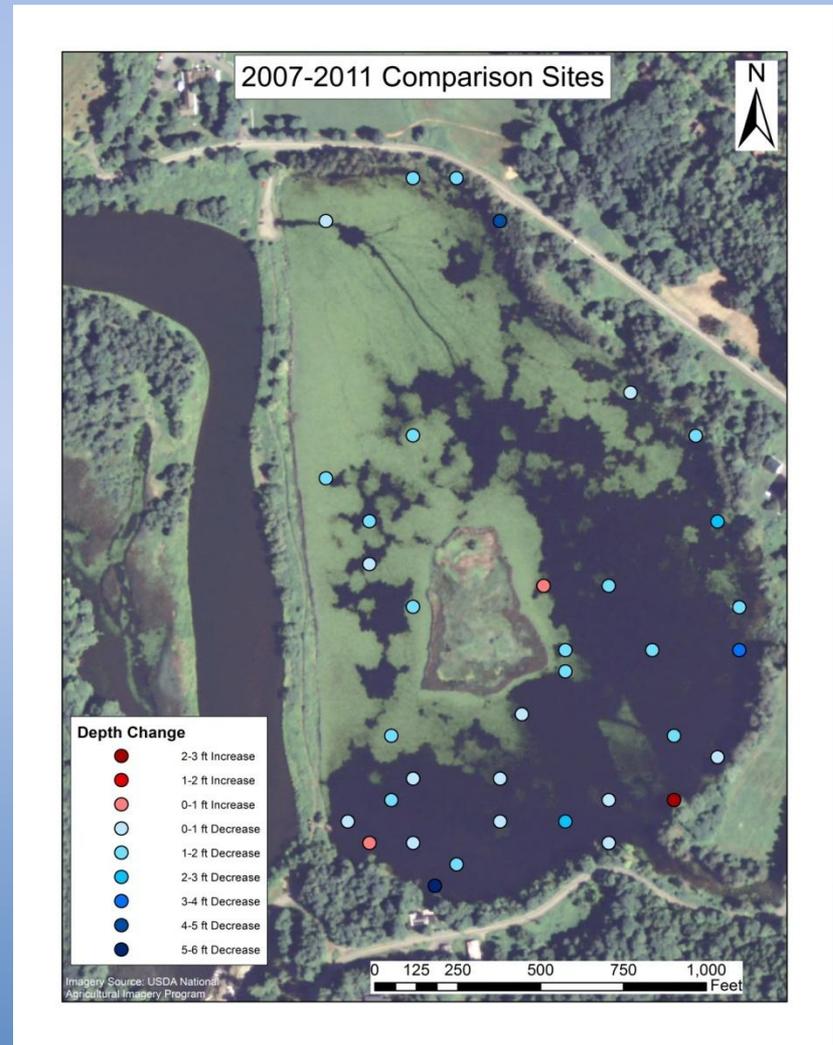


Bathymetry



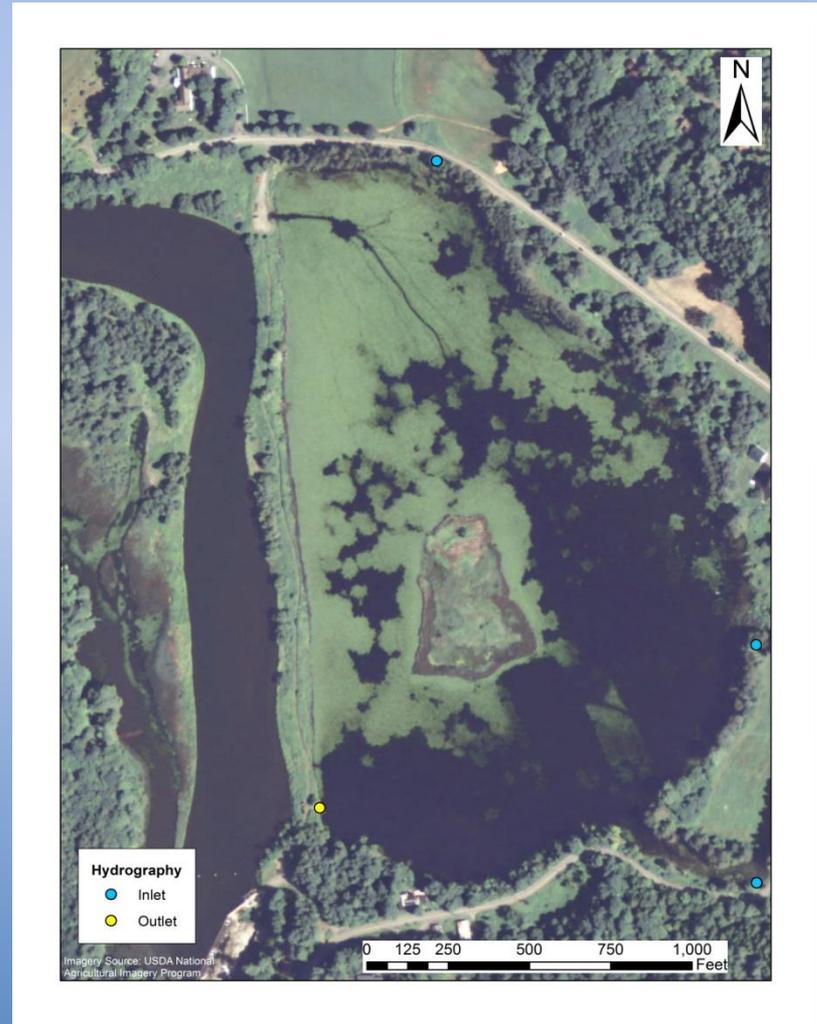
Sediment Deposition

- 36 sites
- Change varied:
 - Min. 2.5 ft. deeper
 - Max. 6 ft. shallower
- Average change:
 - 1.4 ft. shallower



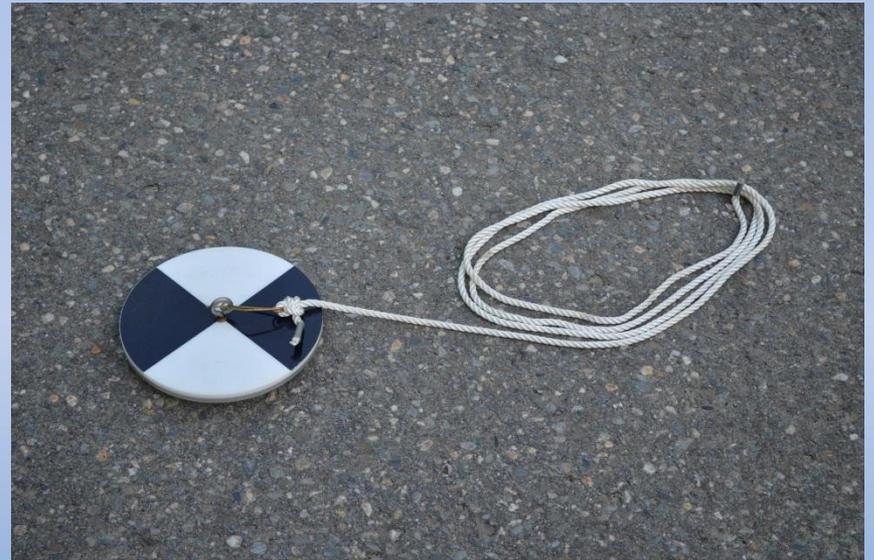
Hydrography

- Sediment deposition
 - Attributable to normal inflow over four years?
 - Only caused by flooding?
 - Knowledge of sediment loading required
 - Can be estimated from water clarity



Water Clarity

- Secchi disk depth
 - 6 inches @ 1 week
- Clarity vs. Loading
 - Case studies
 - Estimated loading @
70mg sediment/L water



Secchi Disk

Sediment Deposition

- Comparison sites
 - Average depth change: 1.4 foot decrease
- Pond area
 - 52 acres
- Sediment addition
 - 74 acre-feet
 - 3.2 million ft³

Sediment Deposition

- Sediment transported
 - Sediment: clay/sand mixture
 - Estimated average density 87 lb/ft³ dry
 - ~140,000 tons sediment

Sediment Deposition

- Estimated loading: 70mg sediment / L water
- 140,000 tons sediment
- 1.6 million acre-feet water

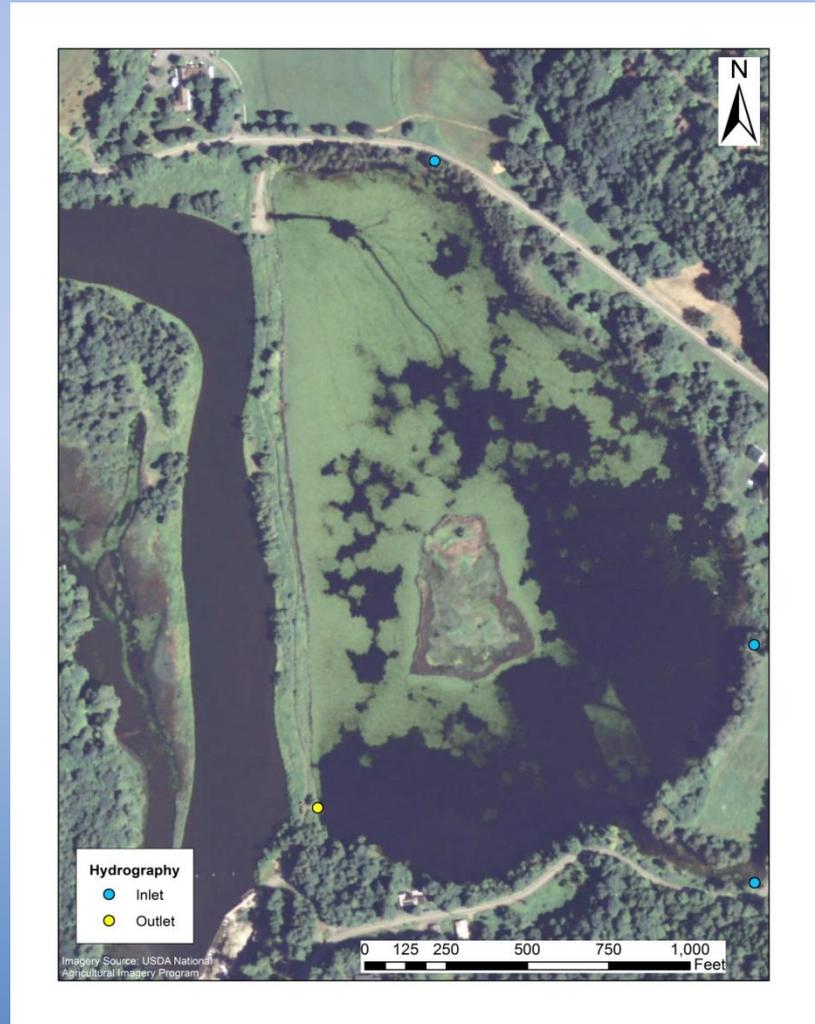
-WY DEQ. 2009. Ocean Lake TMDL for Sediment. Fremont County, WY. 46p.

-D. Rasmussen. 2002. South Branch Root river Watershed Clean Water Partnership Study. Chapter 6. Filmore County, MN. 19p.

-B Spear, D Smith, B Largay, J Haskins. 2007. Turbidity as a Surrogate Measure for Suspended Sediment Concentration in Elkhorn Slough, CA. The Watershed Institute. 26p.

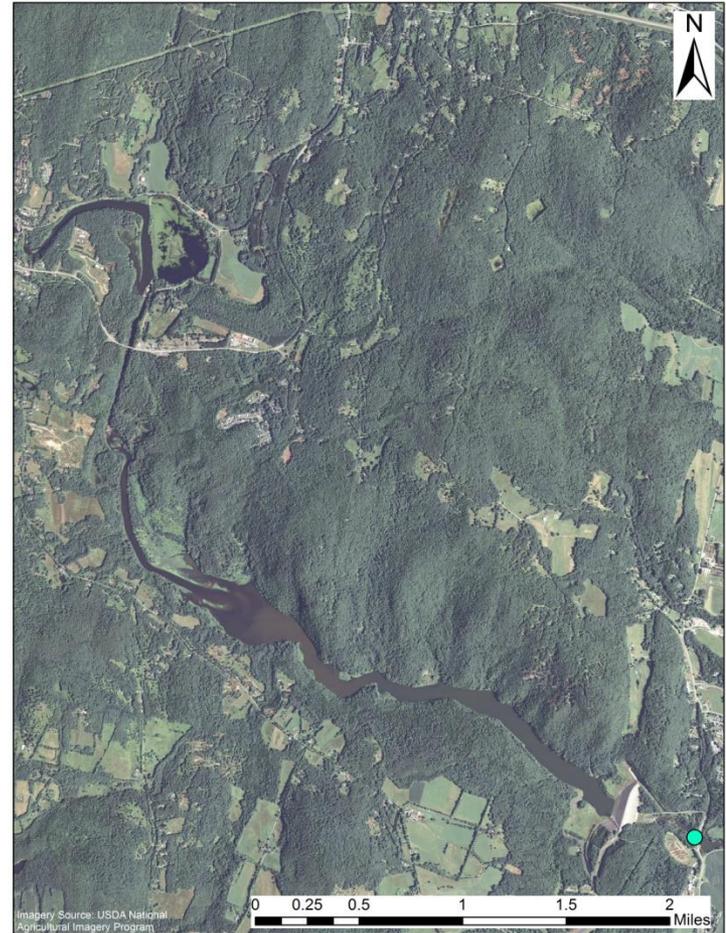
Sediment Deposition

- Required flow
 - 1.6 million acre-feet water
- Three inlets
 - Combined flow ~ 1.2 cfs
- Time to transport estimated sediment
 - 1600 years



Sediment Deposition

- Required flow
 - 1.6 million acre-feet water
- Gauge station flow
 - 4400 cfs
- Time to transport estimated sediment
 - 5.5 months



Sediment Deposition

- Not enough time
 - 2 days, not 5 months
- Possible estimate errors
 - Deposited sediment overestimated
 - Water flow underestimated
 - Loading underestimated

Summary

- Normal flow conditions can't be responsible
- Circumstantial evidence suggests flooding is major cause
- Further refinement of calculations may verify

Equipment Accuracy

- Garmin GPSmap 62st
 - 5+ satellites
 - Accuracy 10-15 feet
- Sampling site spacing 60-120 feet
- Average slope ~2%
- Accuracy acceptable
- Wind- larger impact



GPSmap 62st

Conclusions

- Significant bathymetry changes possible during major storm events
- Recreational-grade GPS equipment suitable for small-scale bathymetric surveys

Questions?

