Carnelian-Marine-St. Croix Watershed District
Focused Watershed Management

- Introductions
- Focused Watershed Management
- This Initiative
- Existing Data
- Resident Goals/Concerns
- CMSCWD Cost Share/BMP Grants
- Next Steps

Carnelian-Marine-St. Croix Watershed District
Focused Watershed Management

History
•2008 Strategic Planning Sessions
•2010 Comprehensive Plan

Goals
•Preserve water quality in highest value resources
•Keep water resources off impaired waters list
•Allocate District financial resources

Criteria
•Declining Trend
•Homeowners' Association
•Removal from Impaired List

Clean Water Partnership

Overall Program Objectives

Protection of non-impaired waters

Addressing non-point sources of pollution

Funding Structure

50% match (cash or in-kind)

Local sponsor – Carnelian Marine-St. Croix Watershed District

Clean Water Partnership Structure

Phase I: Diagnostic Study

Primary outcome – implementation plan that identifies the combination of education, best management practices (BMPs) and other activities needed to protect or restore water quality. Sets the stage for additional grant funding.

Phase II: Implementation

Putting in place the BMPs and other activities identified in the first phase. In addition, education, new land use ordinances, and a variety of other methods designed to reduce non-point pollution are implemented. A phase II project is typically a three to four year project.

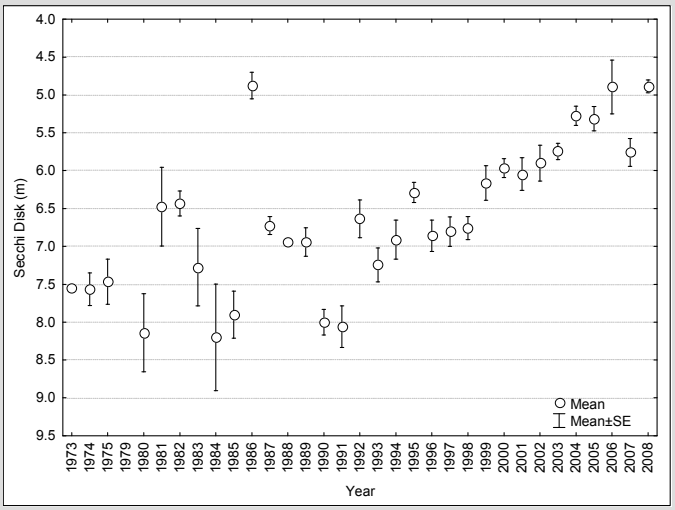
Phase III: Continuation

Additional BMP implementation. Continuations are awarded, subject to the availability of funds, before the other applicants during that funding cycle, i.e. they are not ranked with the other projects but are awarded first.

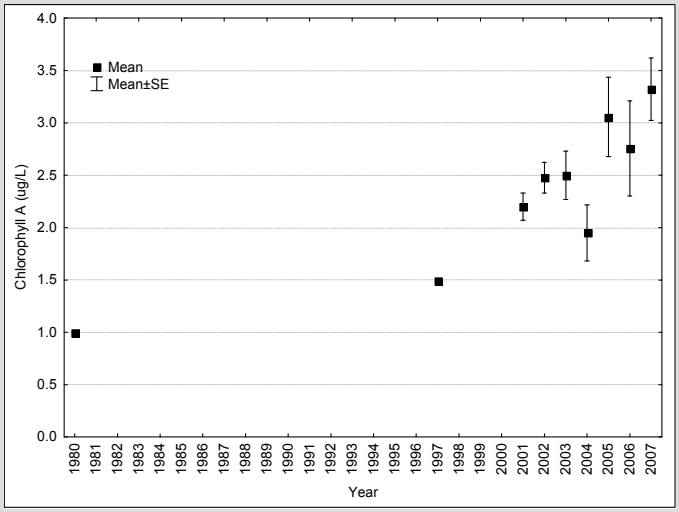
Outline

I. **Long-term water quality trends for Square Lake**
   - why are we here?
II. **History of recent studies of Square Lake & logic for current study**
III. **Explanation of work plan**

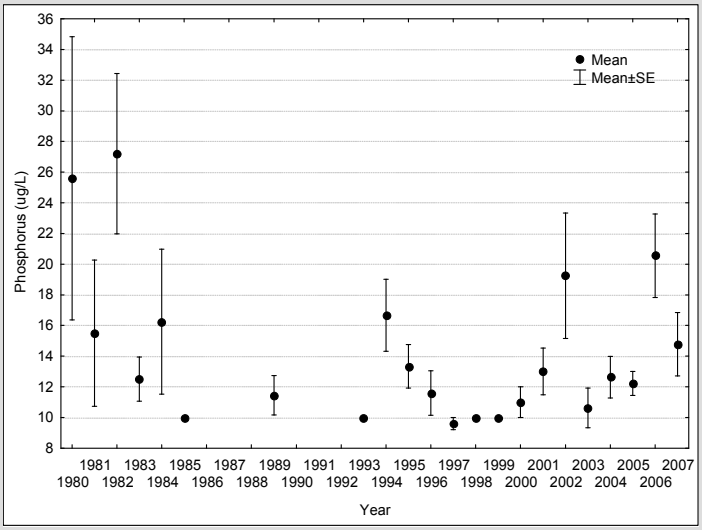
Long-term trend: Water transparency



Long-term trend: Surface water Algae (Chlorophyll a)



Long-term trend: Surface water total phosphorus



Bottom-up vs. top-down effects

Bottom-up

- nutrient loading to lake can cause increased abundance of algae and decreased water clarity

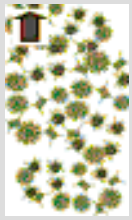
Top-down

- Food web effects – balance of predators and prey

Not mutually exclusive

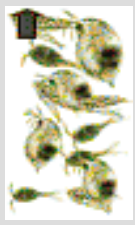
Lake Biological Interactions





Turbid

Management focus → zooplankton




Clear

Photos courtesy of Lakes of Missouri Volunteer Program

Square Lake Implementation Plan Refinement

2002 CWP Diagnostic Study: identified some watershed P sources and in-lake biology (especially impact of rainbow trout stocking) as problems.

2004-2005 LCMR study: examined impact of rainbow trout predation on *Daphnia* population dynamics
- found that trout preferentially consume *Daphnia*
- however, trout not responsible for the majority of *Daphnia* mortality
- recommended a more holistic examination of predators responsible for *Daphnia* mortality

This study:
- to collect more data on sources of nutrients to the lake & to assess diets of a variety of potential *Daphnia* predators
- to provide targeted implementation recommendations to protect Square Lake's water quality

Recap of LCMR study (2004-2005)

Purpose of study

To evaluate the impact of rainbow trout predation (& the time of year that trout are stocked) on the population dynamics of *Daphnia pulicaria* & the lake's water clarity

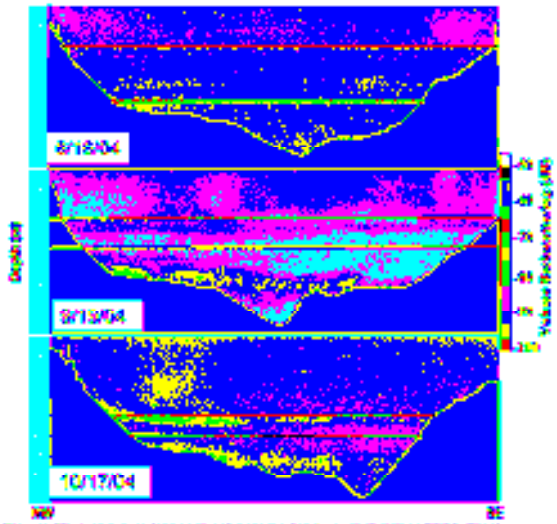
- **Trout stocking schedule manipulated**
  - Year one (2500 trout stocked in autumn & 2500 in spring)
  - Year two (trout not stocked in autumn, 5000 stocked in spring)

Expectations:
- over-wintering *Daphnia* population expected to be larger in 2nd year of study (2005)
- larger *Daphnia* population would exert stronger grazing pressure on algae and maintain clearer water than in 1st year of study when trout stocked in autumn

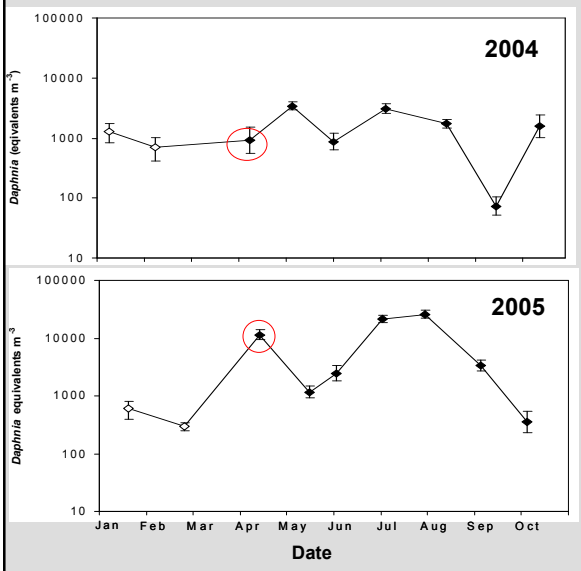
Methodology

- *Daphnia* & trout population sizes monitored using sonar
- Angler creel survey done to quantify harvest of trout
- Stomach content analyses of trout to assess diet
- Water quality data (Secchi clarity, Chl a, TP) collected

Sonar data - example



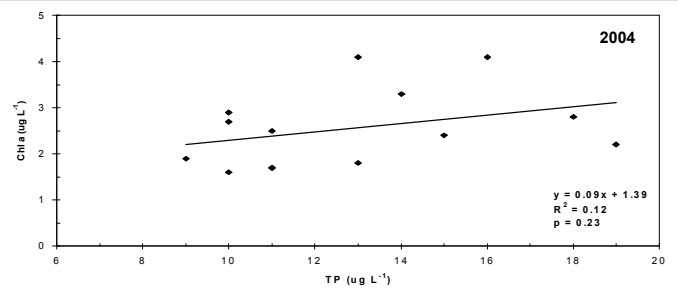
Daphnia population dynamics (2004 & 2005)

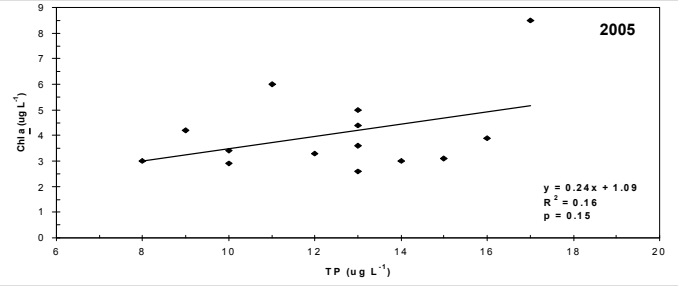


Daphnia population much larger after ice-out in 2005
- consistent with expectation

However, large population did not persist

Bottom-up control on algae levels?

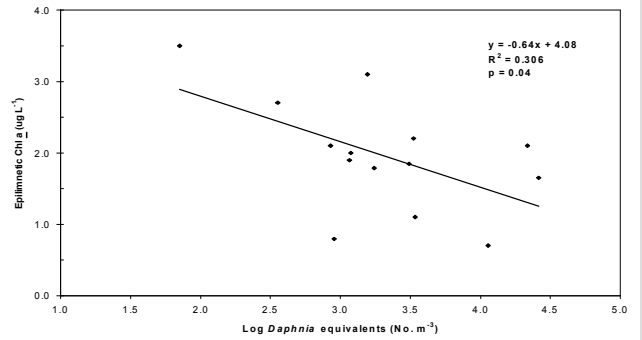




Positive correlation between algae (Chl a) and total phosphorus (TP) levels

- Not statistically significant though

Top-down control on algae levels?



Significant negative correlation between algae (Chl a) levels and *Daphnia* population density

- Indicates that 'top-down' effect of grazing by *Daphnia* on algae is important

2004-05 LCMR study findings cont.

- Stomach content analyses showed that rainbow trout preferentially feed on large-bodied *Daphnia*
  - however, predation by trout did not account for the majority of *Daphnia* mortality.

Recommendation:

- Future research should aim for a more holistic quantification of predation on *Daphnia* by rainbow trout and other likely predators such as other zooplanktivorous fish (e.g., sunfish, minnows) and *Chaoborus* larvae.

This study

What is controlling the population of *Daphnia pulicaria*? (Who is eating them?)

Are there other stressors that are also contributing to water quality decline, or could contribute in future?

Outcome: To provide specific management recommendations in an implementation plan to improve the water clarity in Square Lake

In-lake data collection

1) Zooplankton & *Chaoborus*

- Net tows
- Sonar
- Work done by Dr. Leif Hembre & students (Hamline University)

2) Fish

- Monthly seining
  - By Dr. Phil Cochrane (St. Mary's University)
  - Samples given to Hembre lab for analysis
- Angling to sample larger fish (not likely to be obtained from seining)
  - Using gastric lavage technique
  - Primarily interested in what rainbow trout & bluegill sunfish are eating

Tilt the fish up, insert the tube. Make sure fish handler's hands are wet.

Once the tube is inserted, tilt the fish downward and push the plunger Be sure to hold the fish over a container to catch the contents as they flow out.

In-lake data collection

3) Water quality

- 2x/month, Apr-Oct
  - TP, TKN, chl-a, Secchi transparency

3) Aquatic vegetation

- Survey – summer 2010

Groundwater Data Collection

Groundwater may be 70% of volume and phosphorus load to lake. Need to evaluate GW as a source and prevent any P increases due to GW.

Samples from existing wells in groundwater-shed – P concentration

Watershed Data Collection

Wetland investigation: in 2002 study – high volumes coming from adjacent wetland. We will monitor flow out of wetland, and P concentrations in and out of wetland.

Field reconnaissance: ID locations for BMPs, evaluate agricultural practices

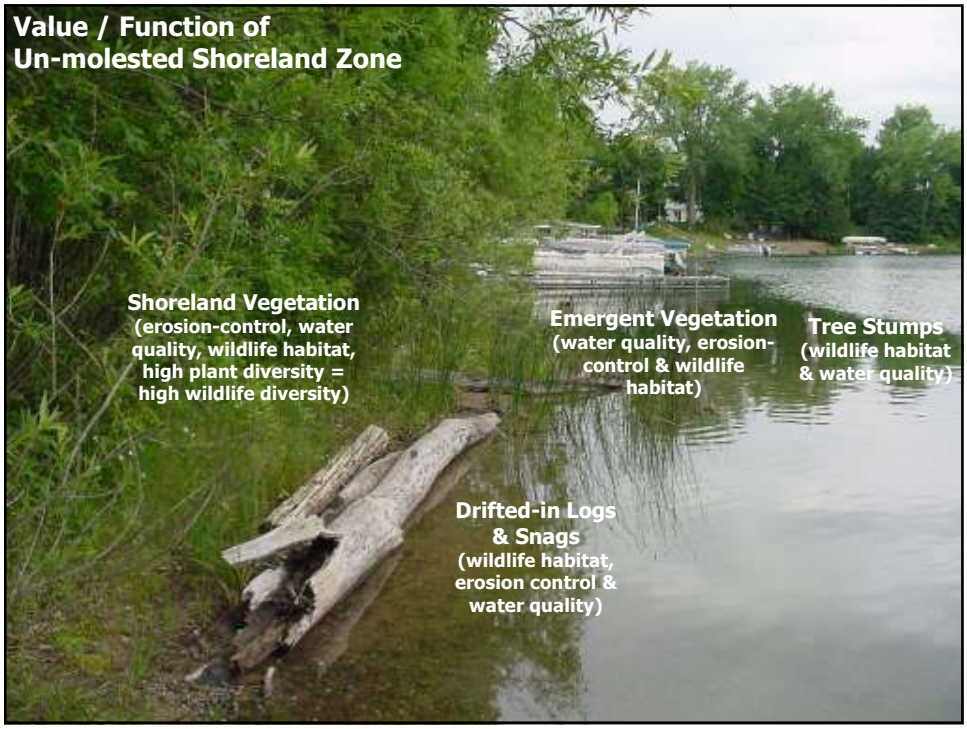
Carnelian-Marine-St. Croix Watershed District
Focused Watershed Management

Resident Goals/Concerns

Carnelian-Marine-St. Croix Watershed District
Cost Share Grants for BMP Projects


Apple Valley
Dakota SWCD


Soil loss from mowing
to water's edge
Coon Lake


Value / Function of
Un-molested Shoreland Zone
Shoreland Vegetation
(erosion-control, water quality, wildlife habitat, high plant diversity = high wildlife diversity)
Emergent Vegetation
(water quality, erosion-control & wildlife habitat)
Tree Stumps
(wildlife habitat & water quality)
Drifted-in Logs & Snags
(wildlife habitat, erosion control & water quality)


Gustafson Residence
Lake Johanna – Ramsey County photo by RCWD

Designed and Installed by:
Savanna Designs

Project Schedule

Summer 2010

Data collection

Fall, winter 2010/11

Data analysis

Spring 2011

Discussions with technical advisory committee (DNR and other agencies) to develop set of recommended management practices

Summer 2011

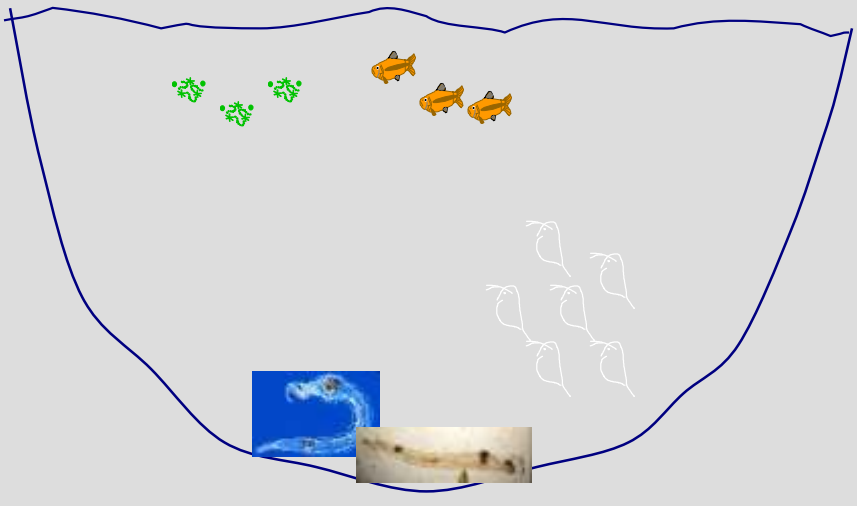
Stakeholder meeting #2

Complete diagnostic study report

Fall 2011

Complete implementation plan

Vertical migration - day



Vertical migration - night