

US EPA ARCHIVE DOCUMENT

Impairment to Aquatic Invertebrate and Fish Assemblages caused by Heavy Metals in the Acid Rock Drainage from Ely Mine near Vershire, Vermont

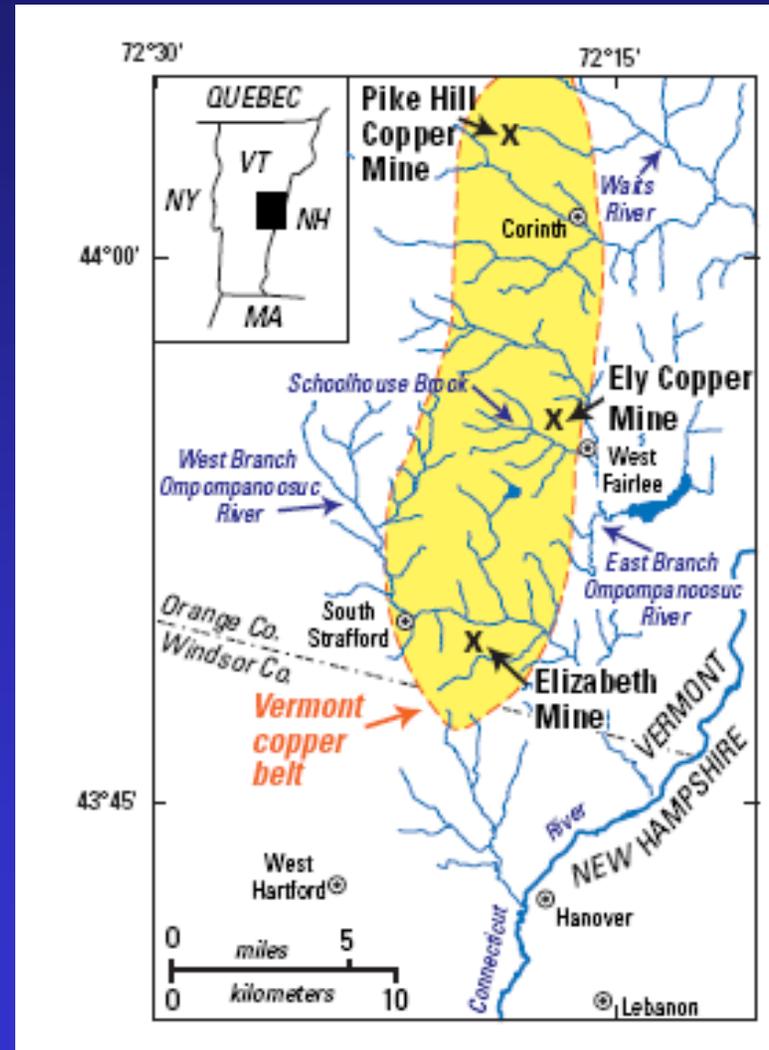
USGS Water Science Center

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Invertebrate Samples processed by
EcoAnalysts, Moscow, Idaho
a proud supporter of NEAEB





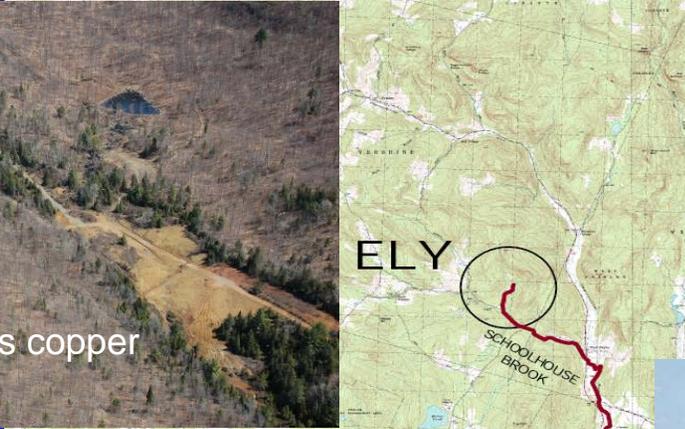
Pike Hill Mine
5,000 tons copper



of three mine
and Sites in Vt
Hill Mine
line
beth Mine
are part of the
deposit



Ely Mine
17,000 tons copper

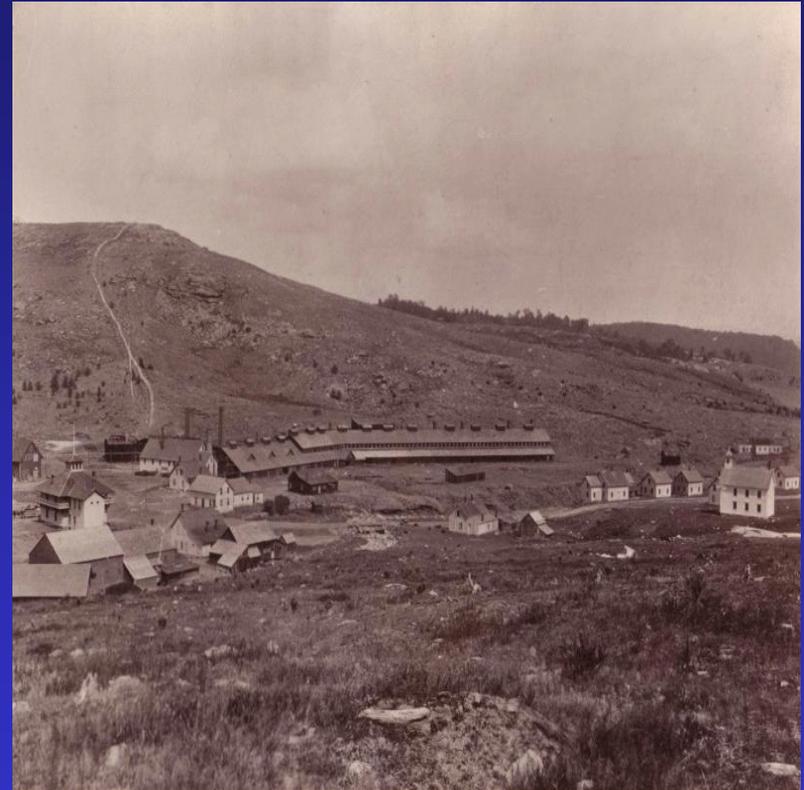


Elizabeth Mine
50,000 tons copper

Early History of Ely Mine

Operated from 1821 to 1920

- Major production from 1853-1905
- One of most productive Cu mines in country during 1870's.
- 100,000 tons of waste material



Characteristics of Mine Sites

- Mine wastes are acid-generating and can leach metals in excess of aquatic ecosystem standards.
- Metals in waters down-gradient of mine sites exceed water quality standards.
- Metals in sediments exceed the probable effects concentrations for aquatic biota.



Recent History of Ely Mine

- **2001 - Added to USEPA National Priorities List**
- **2003 to 2004 - Geochemical characterization of mine waste**
- **2006 - Assessment of aquatic biota to determine impairment.**





in cooperation with U.S. Environmental Protection Agency

**Health and Safety Plan for the Ely and
Pike Hill Copper Mine Superfund Sites,
Orange County, Vermont**

Scientific Investigations Report
U.S. Department of the Interior
U.S. Geological Survey



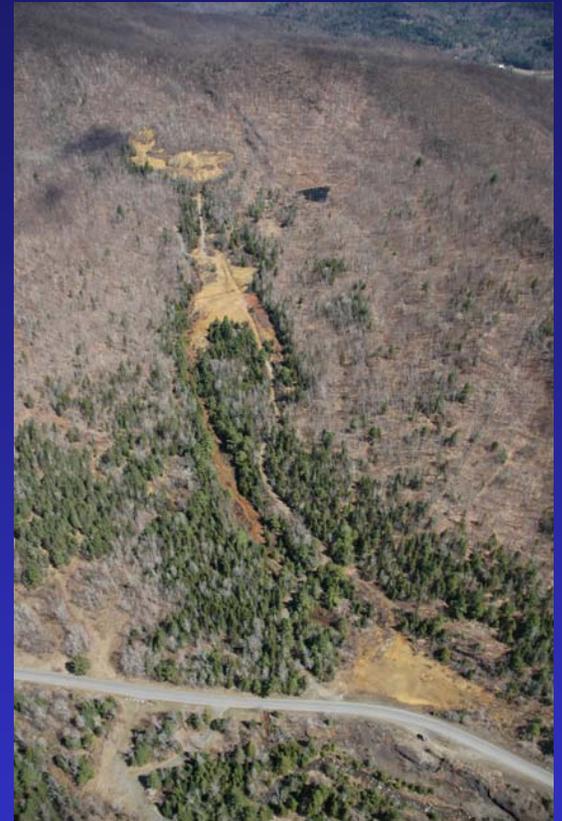
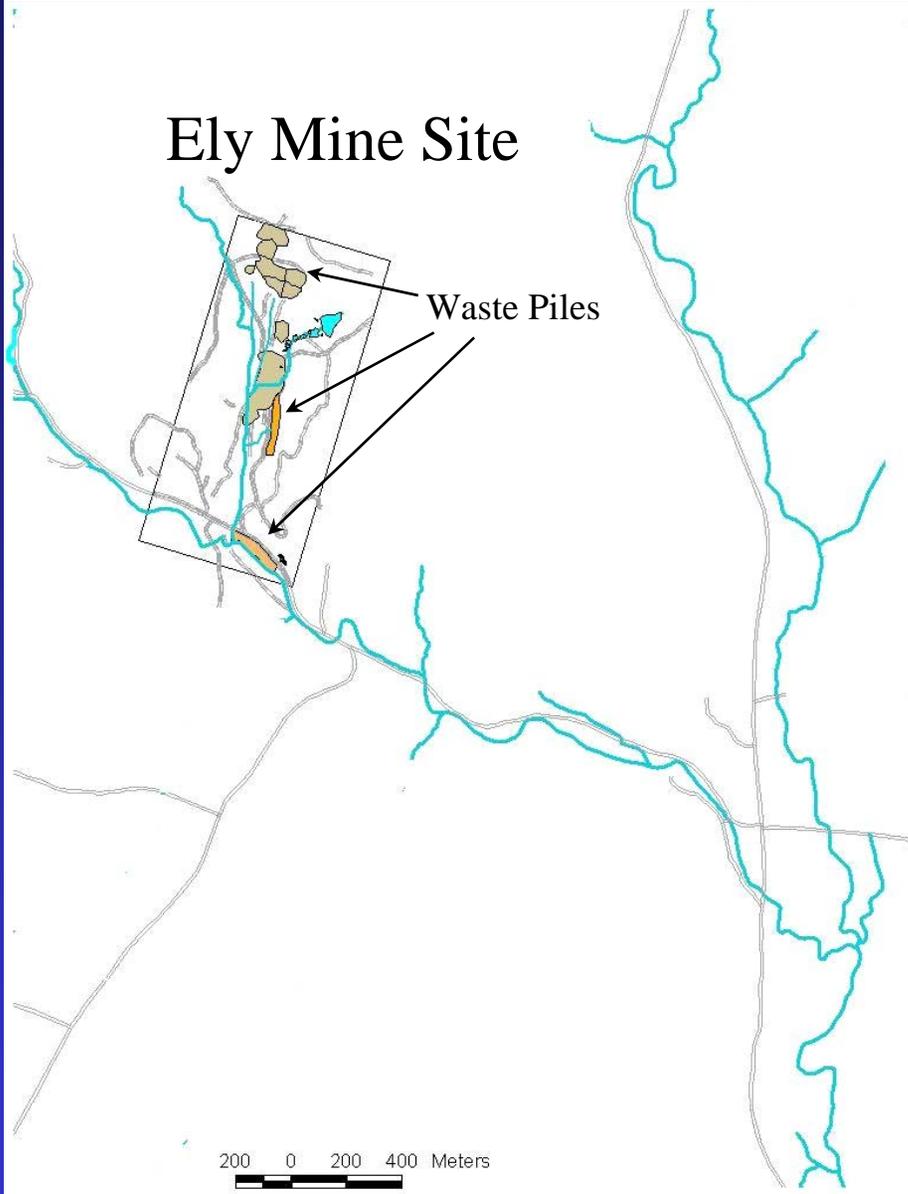
Ely Mine Aquatic Assessment

Objectives

- Characterize metal contaminants
 - surface water
 - sediment
 - pore water
- Surveys of biological assemblages
 - Invertebrates in riffles
 - Invertebrates in depositional sediments
 - Invertebrates in shoreline vegetation
 - Fish in 100 meter stream segment
- Relate contaminants to impairment of the biological assemblages



Ely Mine Site



Ely Mine Aquatic Assessment

General Overview

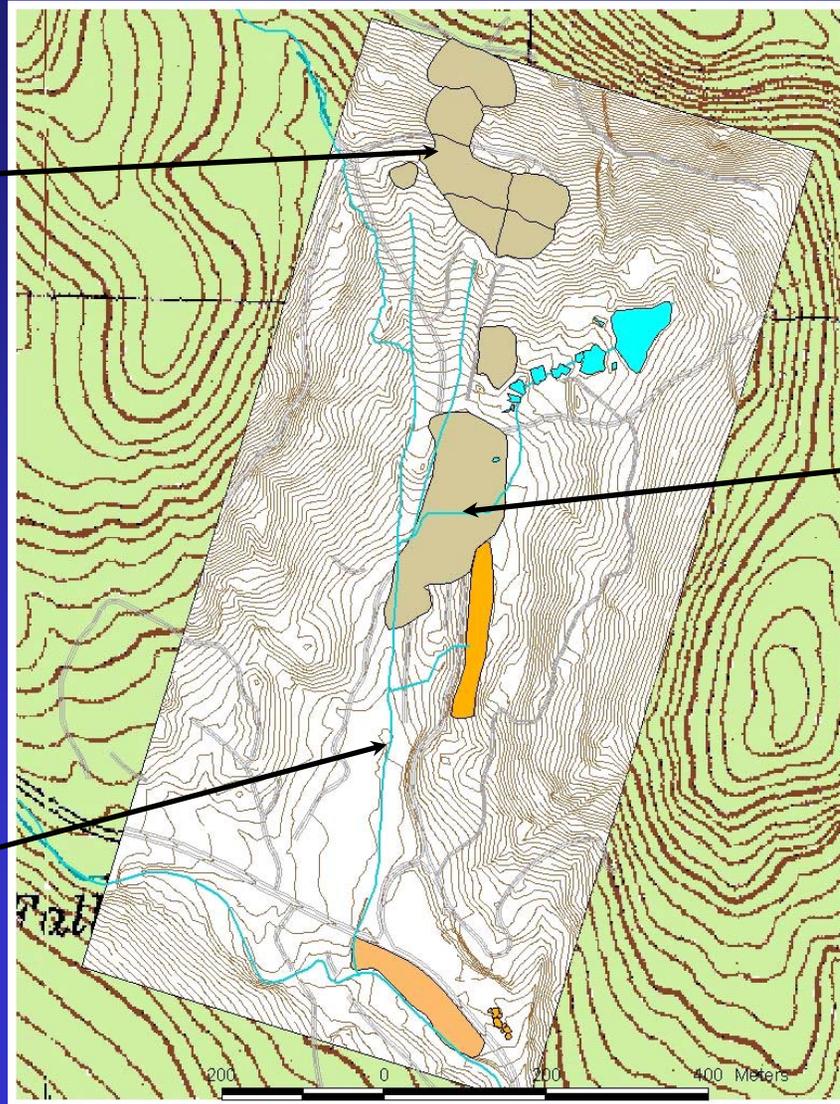
Waste Rock



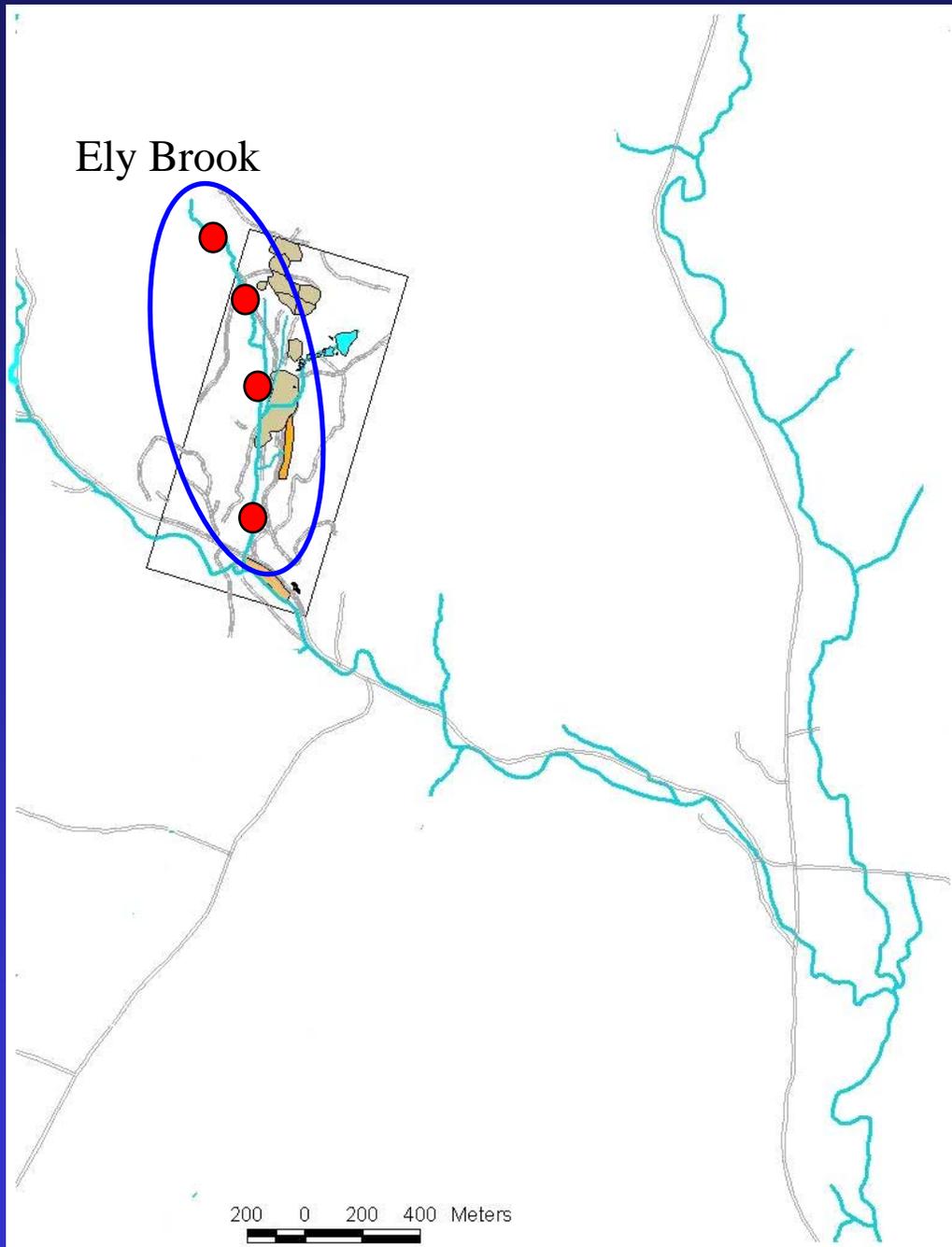
Tributary to Ely Brook



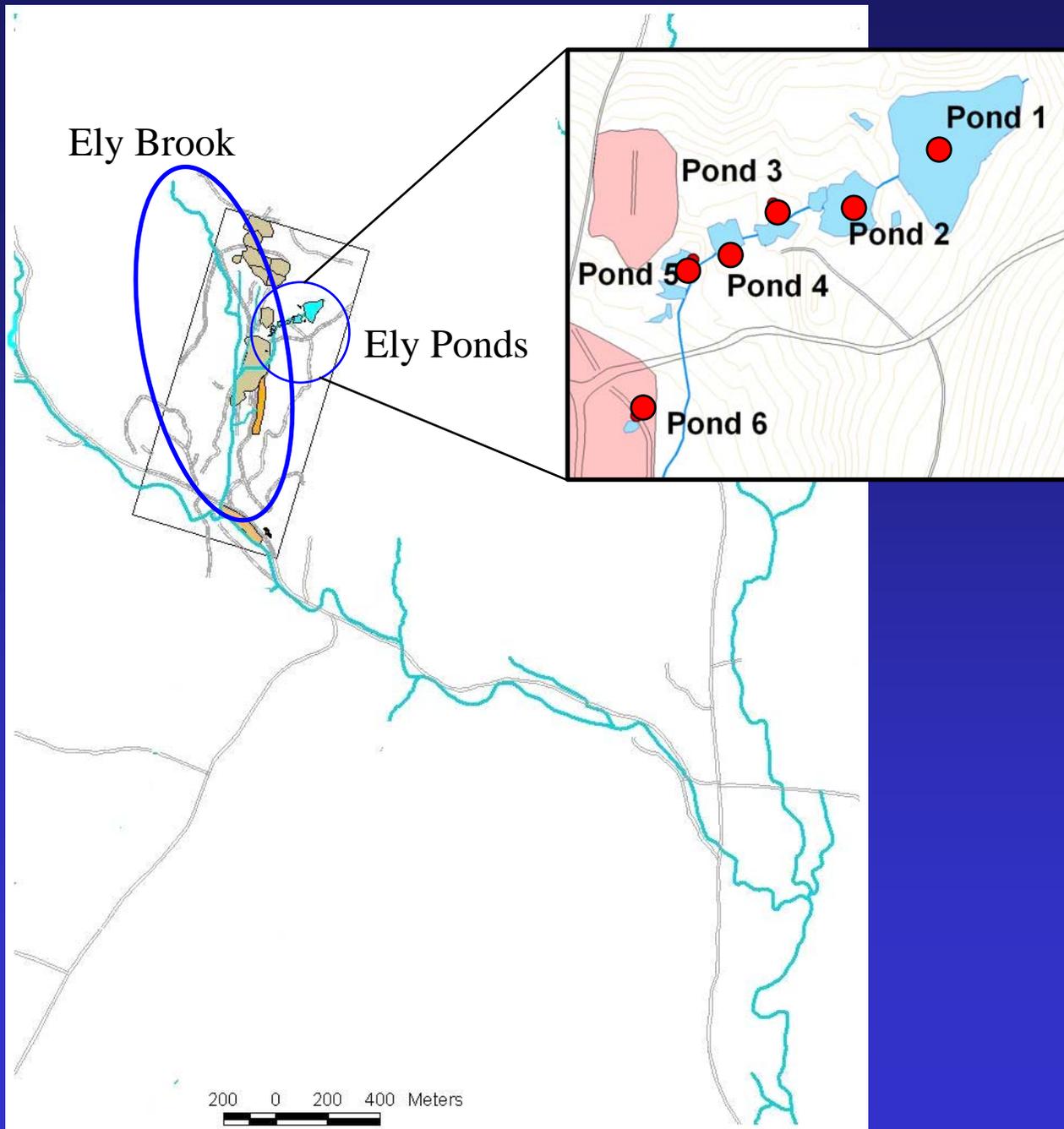
Ely Brook

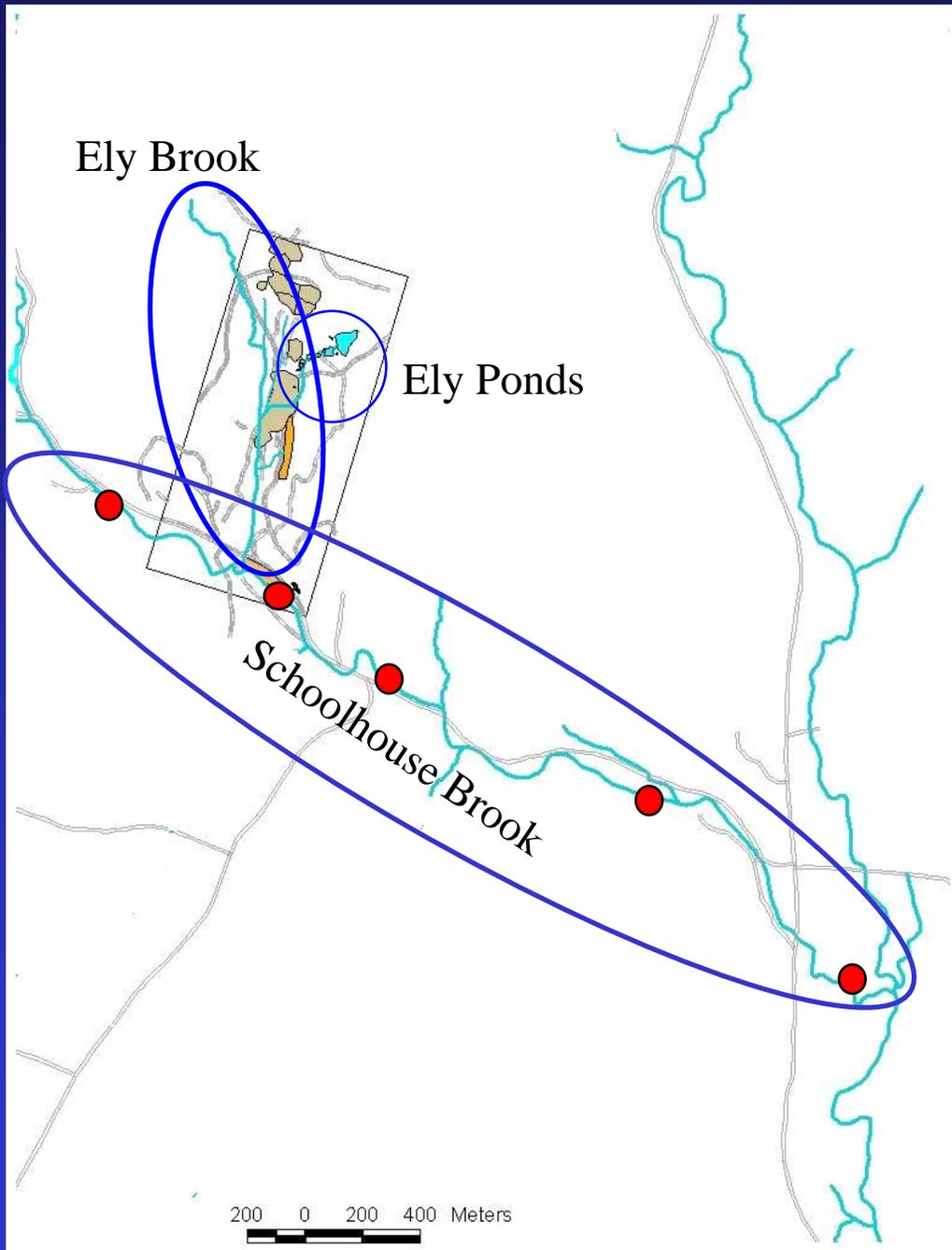


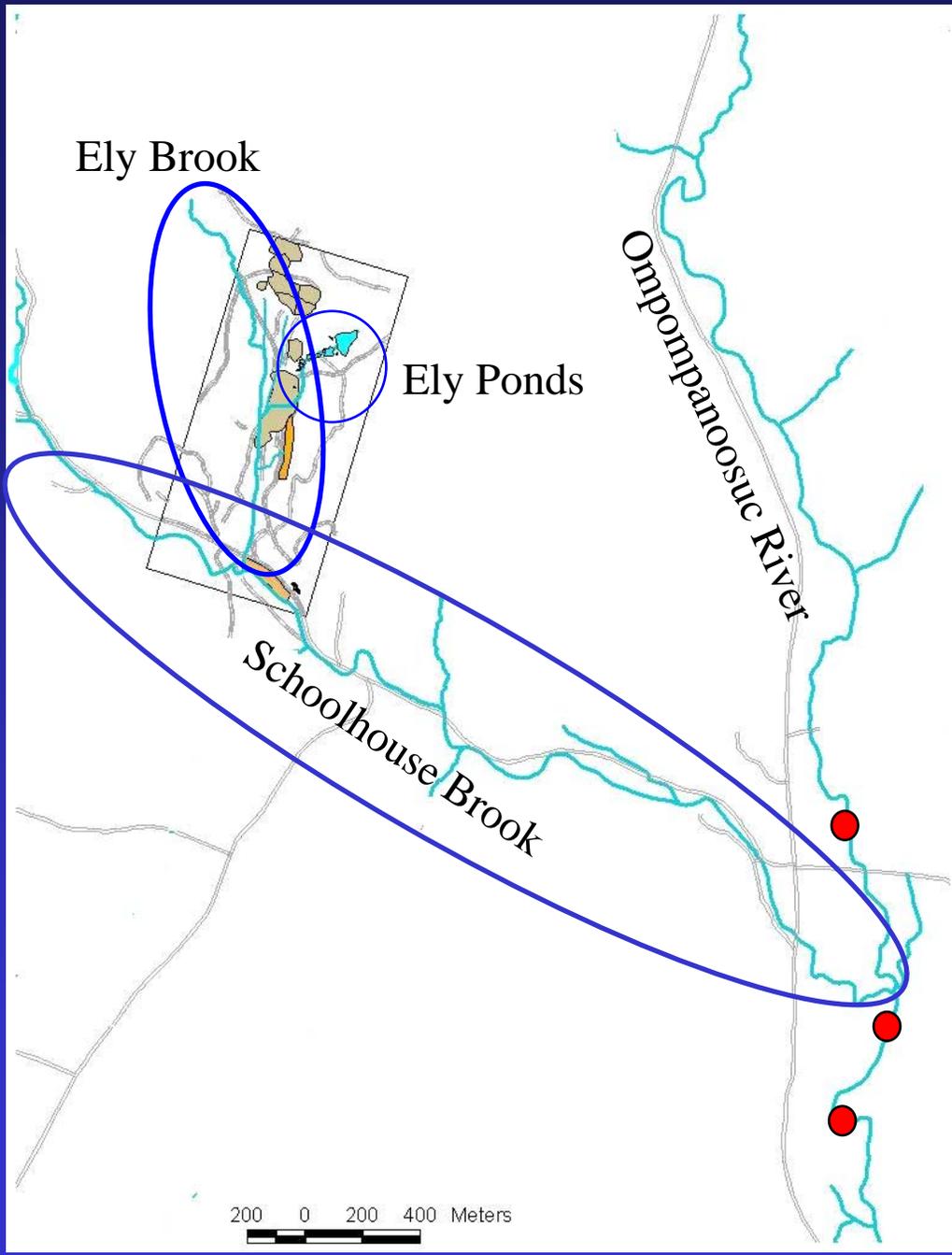
Ely Brook

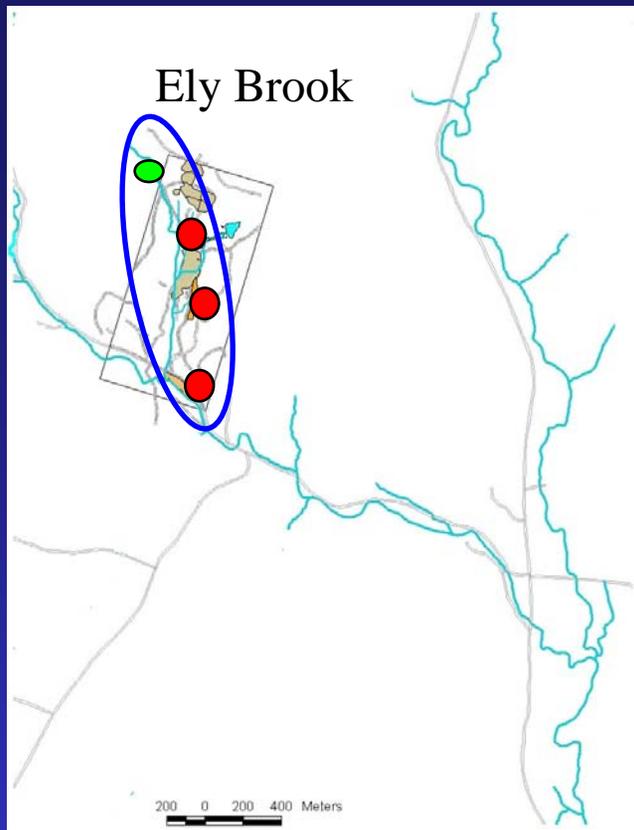


200 0 200 400 Meters

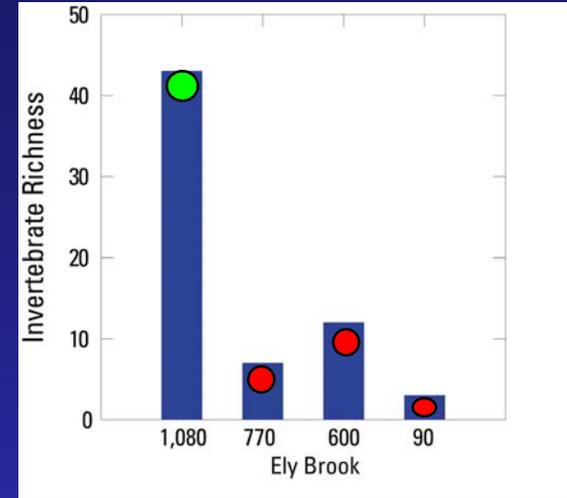
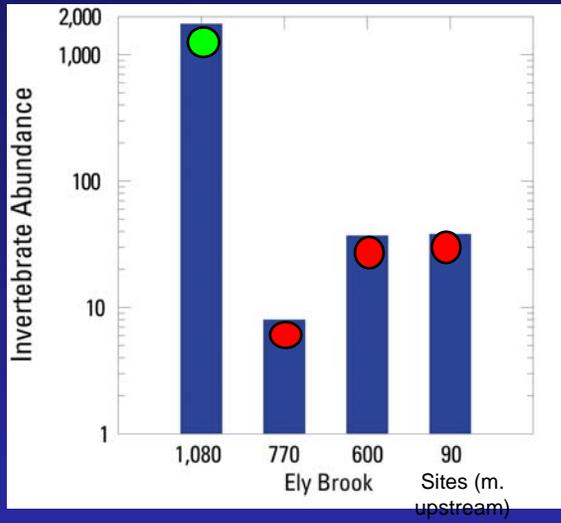




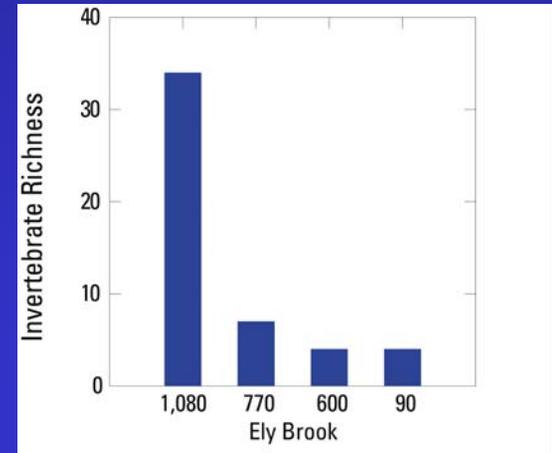
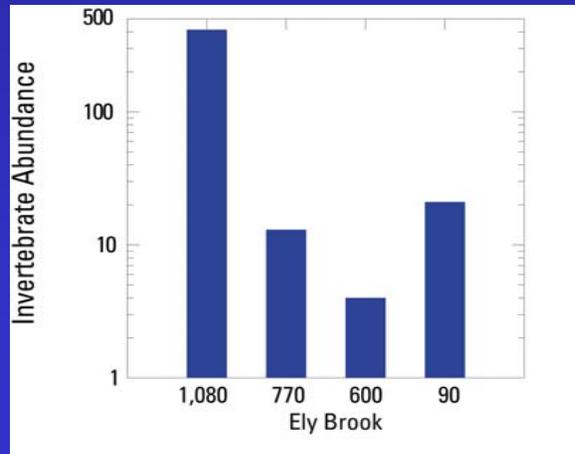




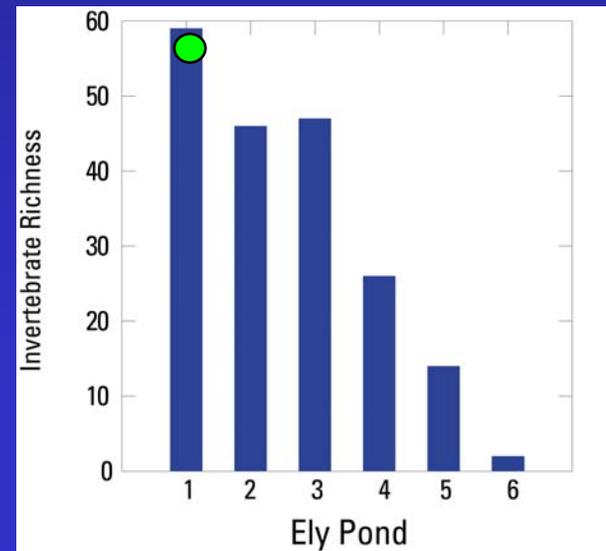
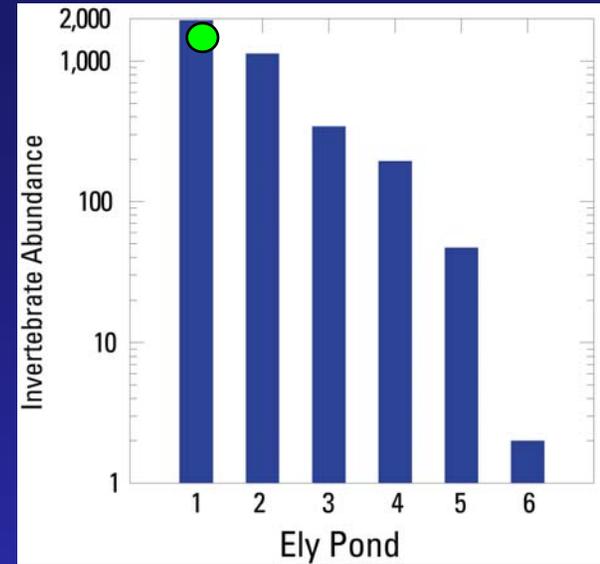
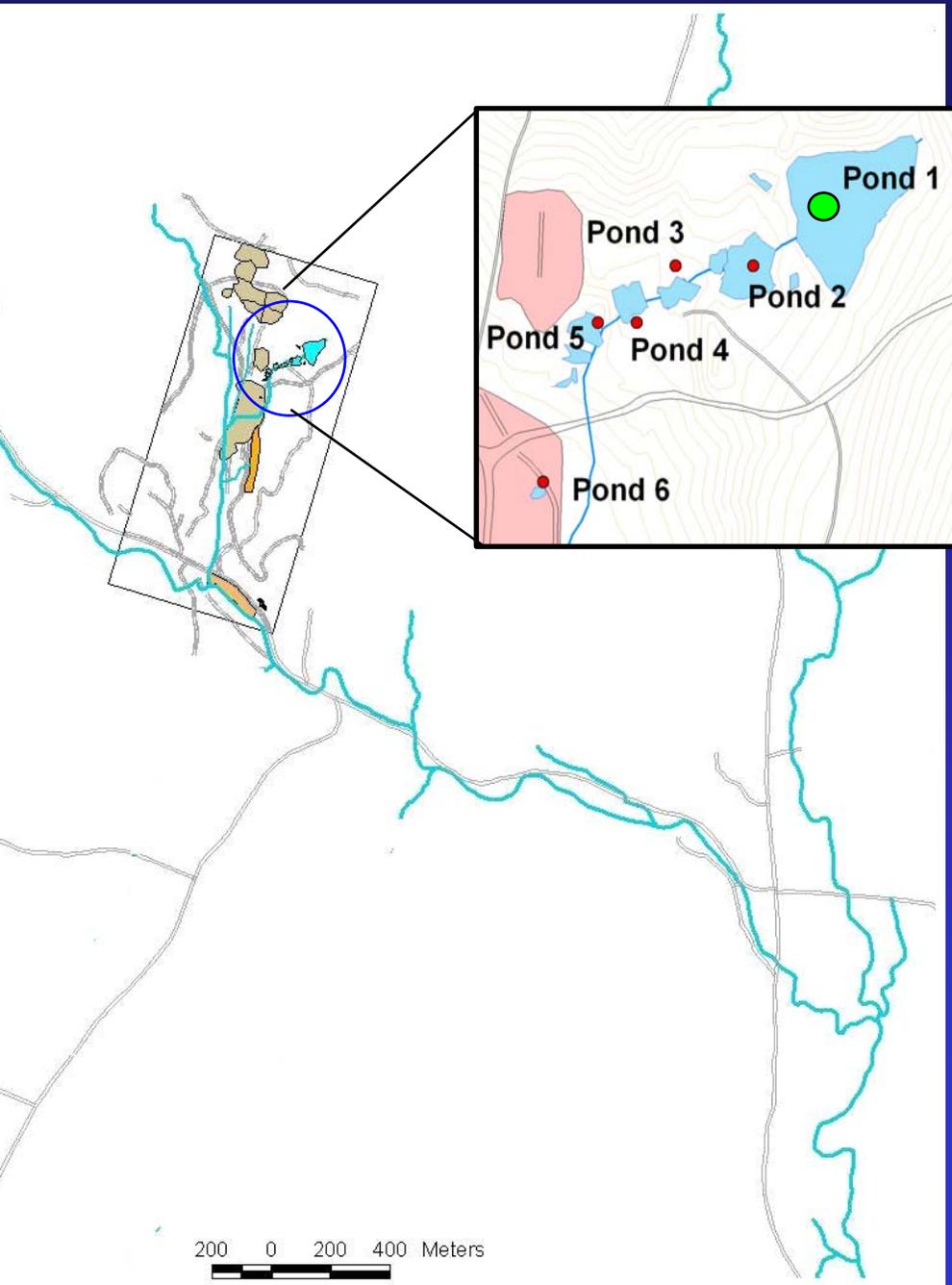
Macro invertebrates from riffles



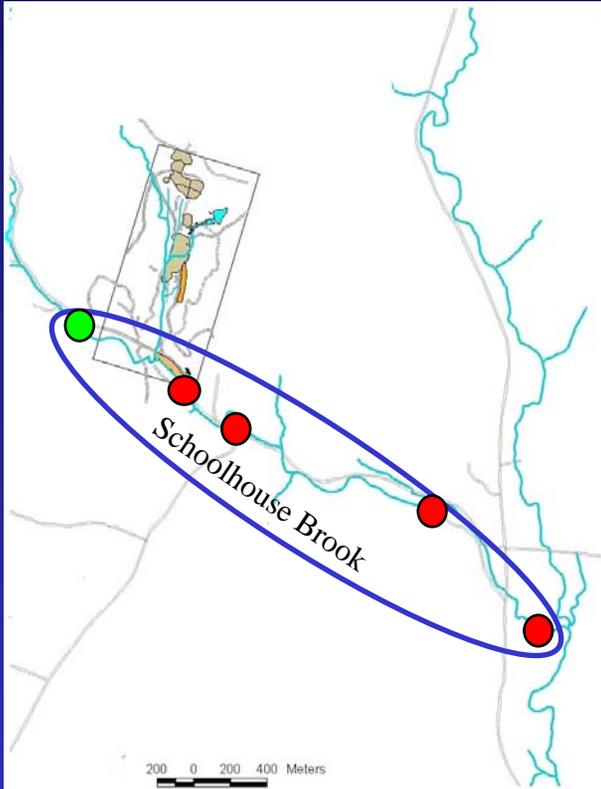
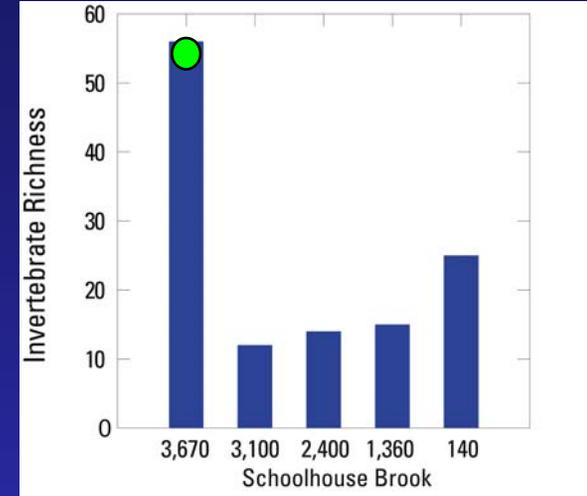
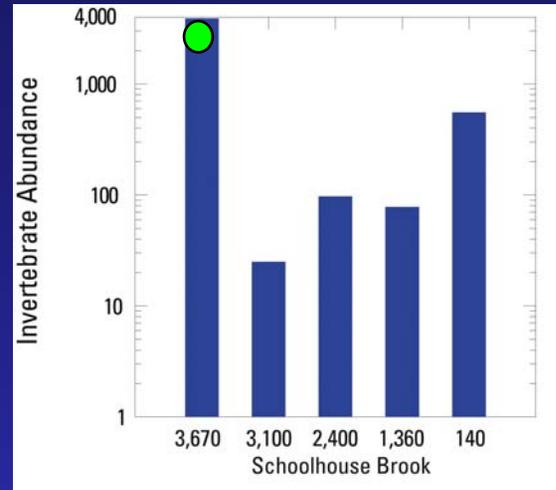
Macro invertebrates from sediment



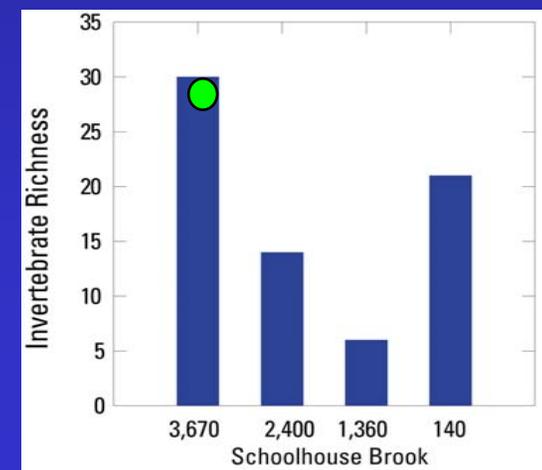
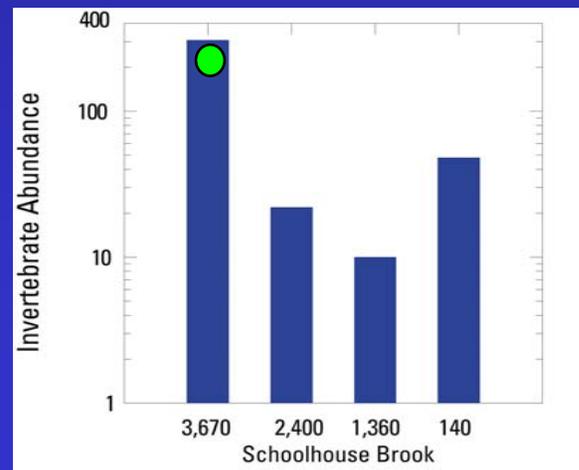
Invertebrates in littoral vegetation



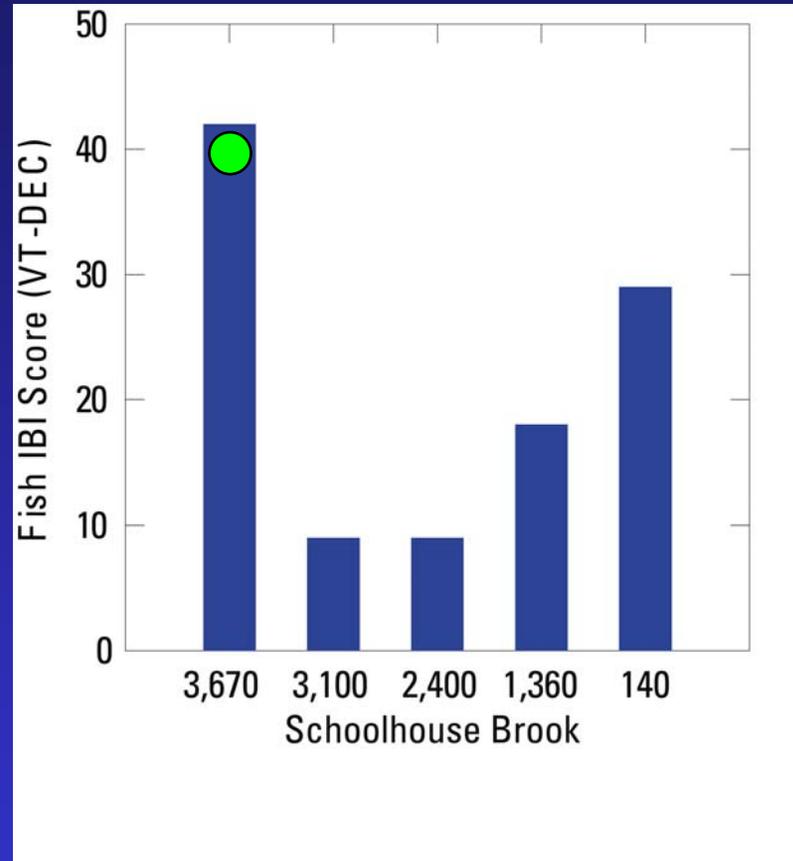
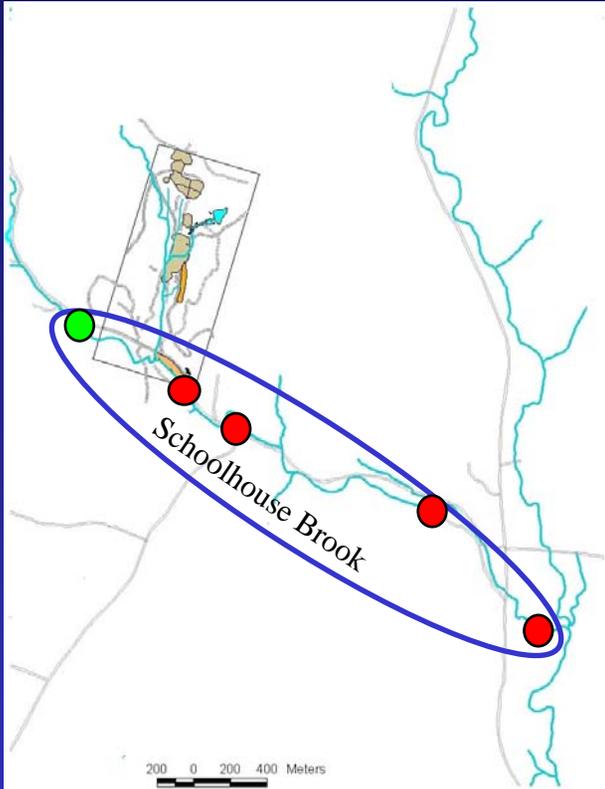
Invertebrates from riffles



Invertebrates from sediment



Fish Assemblage Survey



The Hazard Index

- **Based on the sum of the relative toxicity of**
 - Copper
 - Cadmium
 - Lead
 - Nickel
 - Zinc
- **Derived by**
 - Use of a reference toxicity value (RTV) for each element
 - (Exposure concentration at which chronic effects are observed)
 - For each element, divide actual concentration by the RTV for a hazard quotient (HQ)
 - (HQ = Observed Concentration ÷ RTV concentration)
 - Add the five HQ values together for the Hazard Index (HI)
 - (HI = Cu_{RTV} + Cd_{RTV} + Pb_{RTV} + Ni_{RTV} + Zn_{RTV})
- **Calculated separately for**
 - Surface Water
 - Sediment
 - Sediment Pore Water

Preliminary Results of HI and assemblage response

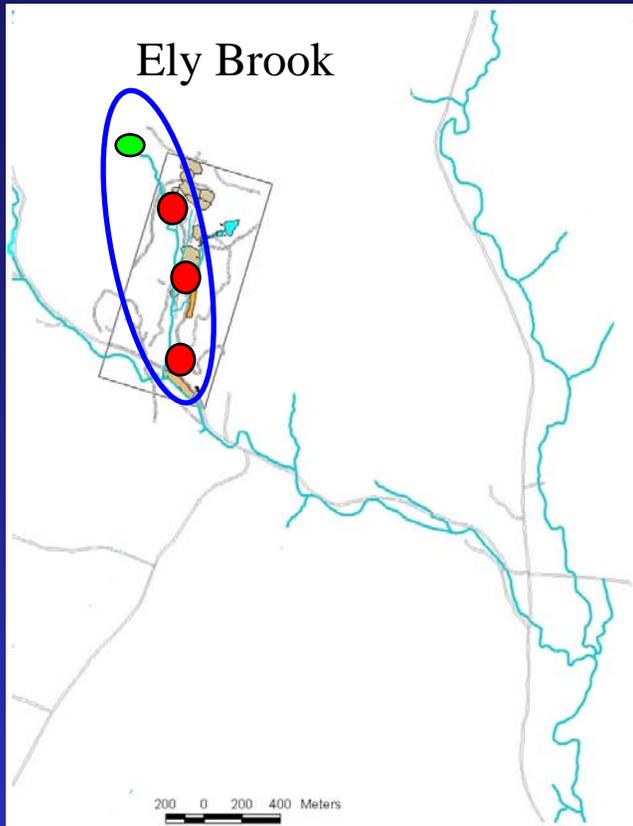
- In all cases, and regardless of water body, the biological samples correlated strongest to HI value of the water to which the assemblage was most directly exposed.

– Riffle Invertebrates: HI_{surf} HI_{pore} HI_{sed}

– Littoral Invertebrates: HI_{surf} HI_{pore} HI_{sed}

– Sediment Invertebrates: HI_{surf} HI_{pore} HI_{sed}

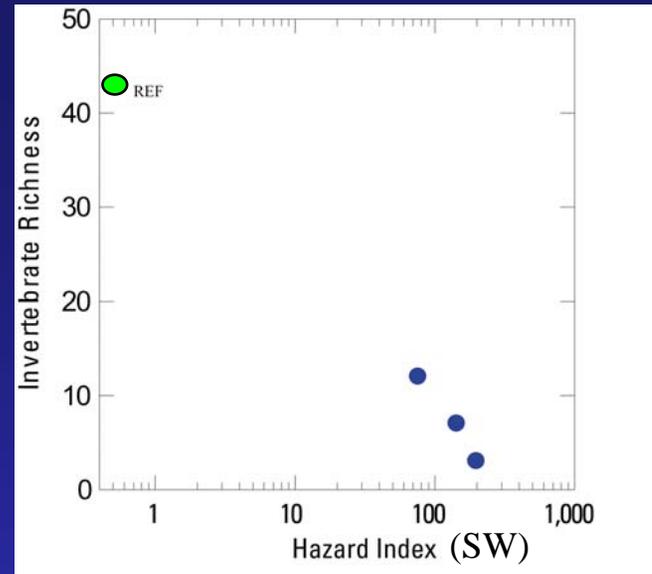
– Fish Assemblages: HI_{surf} HI_{pore} HI_{sed}



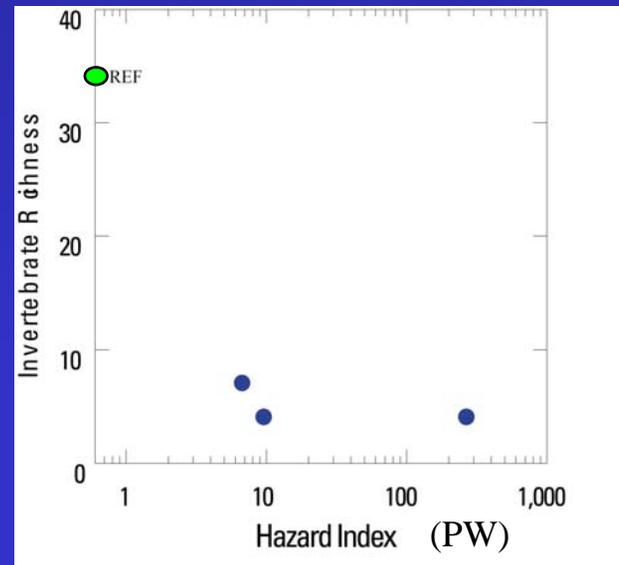
Ely Brook

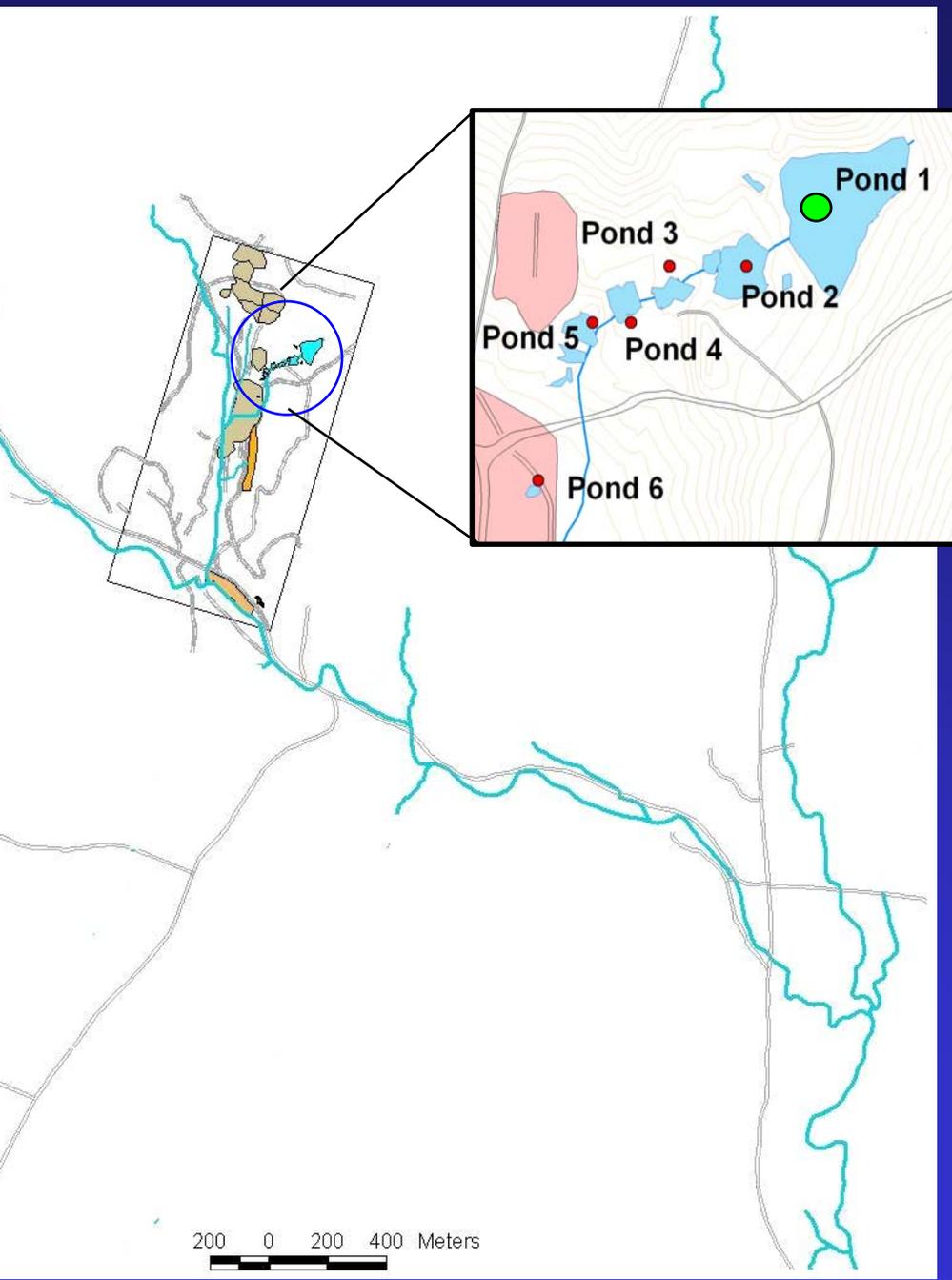
Hazard Index and Richness

Macro invertebrates from riffles

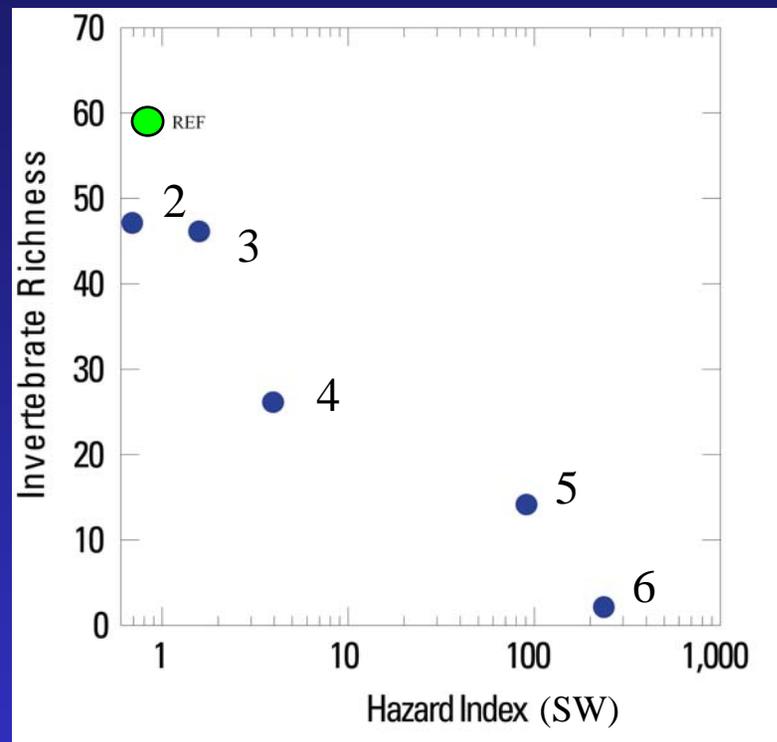


Macro invertebrates from sediment



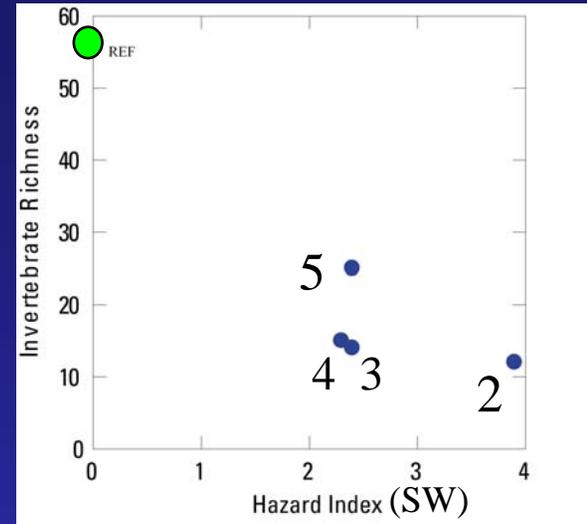
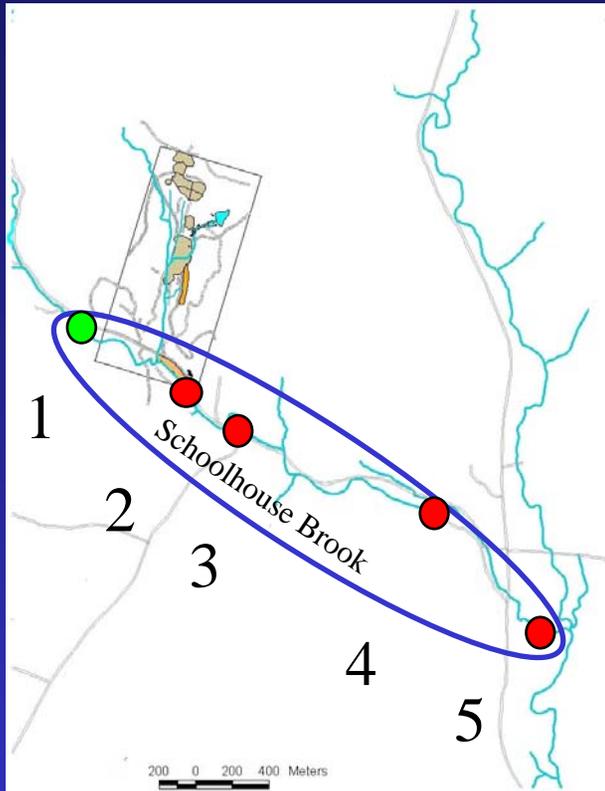


Invertebrates in littoral vegetation

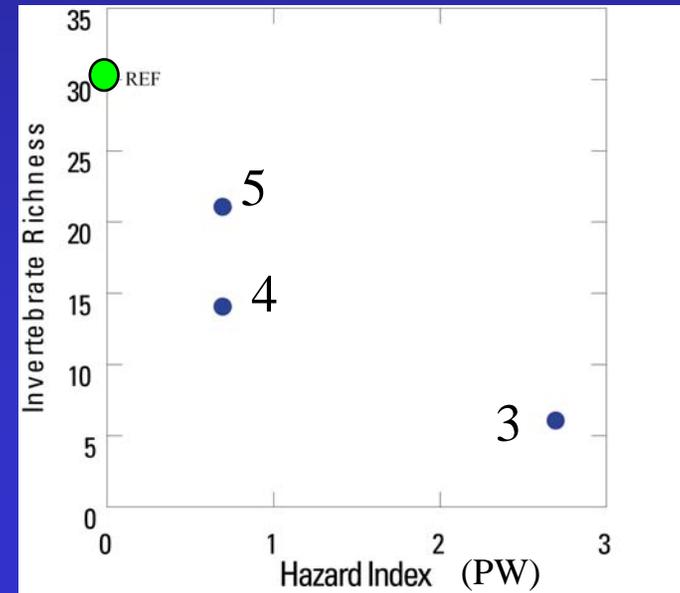


Ely Ponds
Hazard Index and Richness

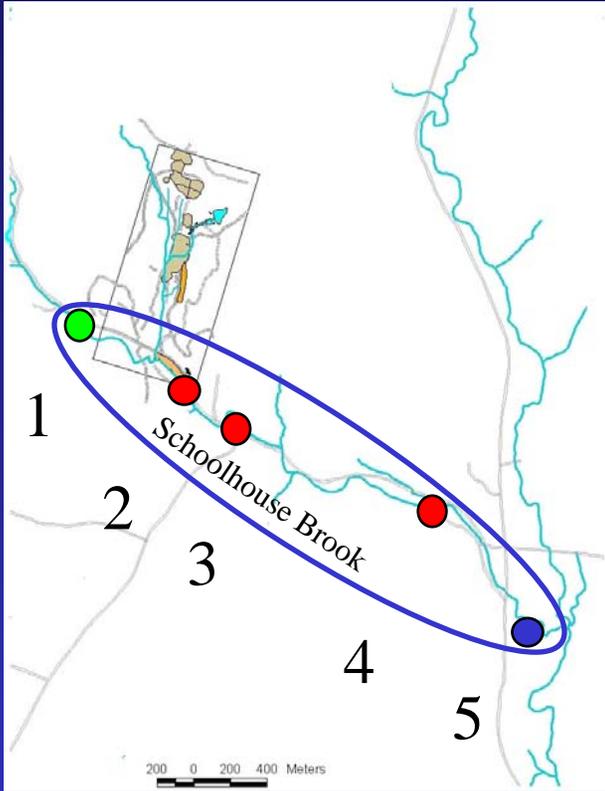
Invertebrates from riffles



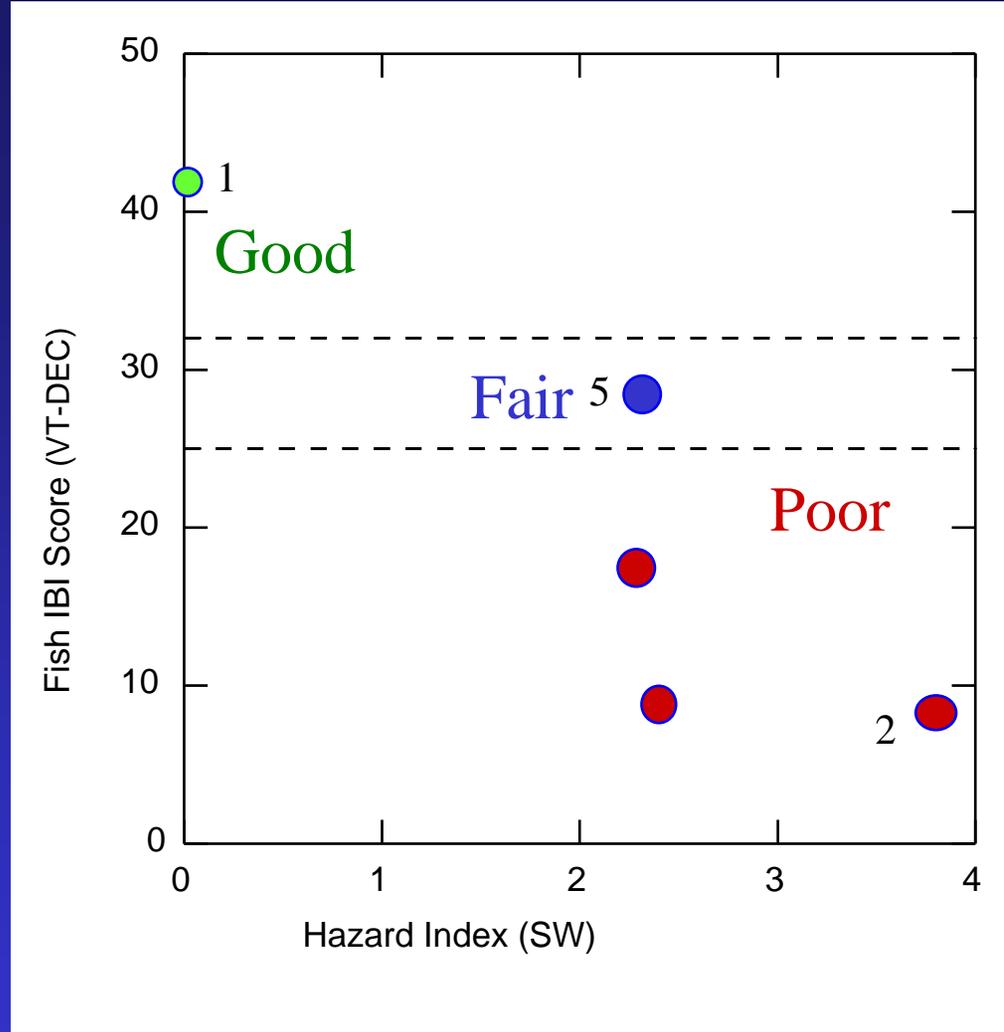
Invertebrates from sediment

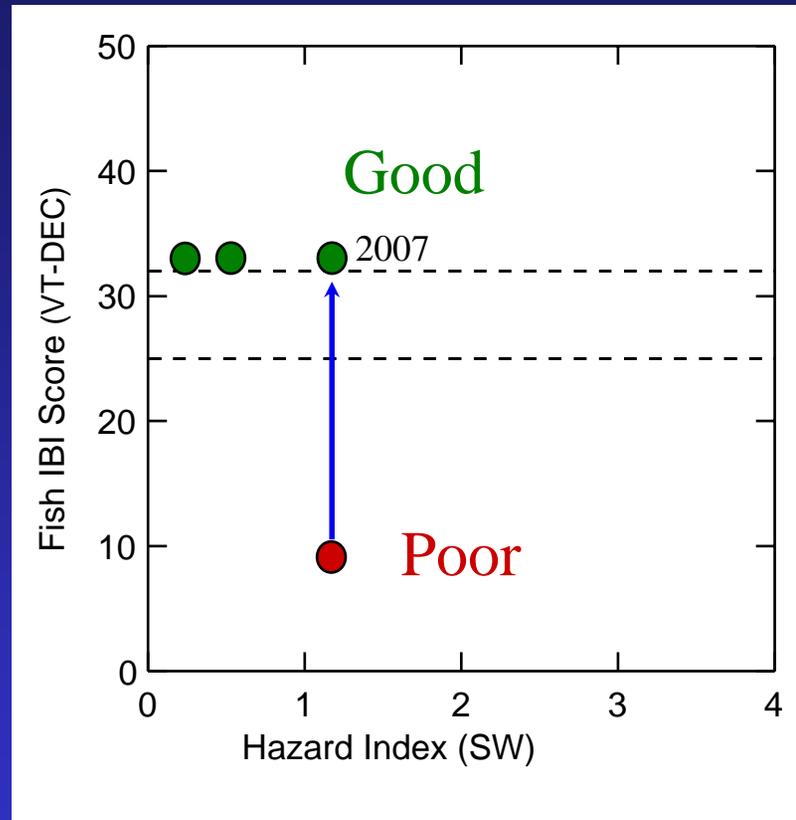
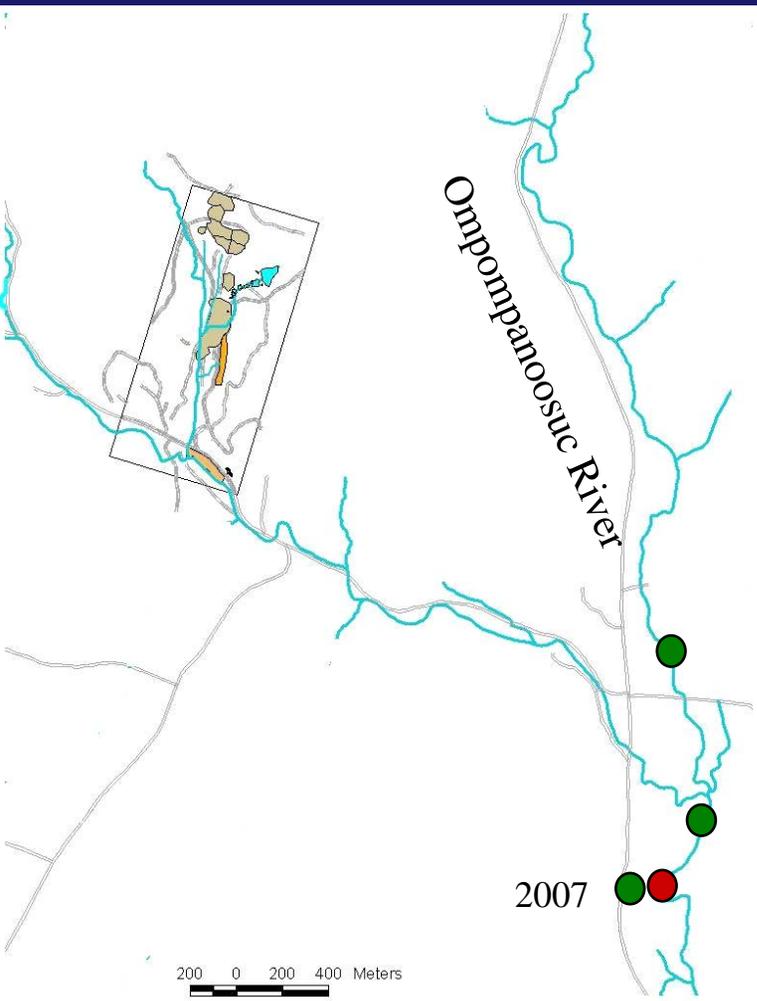


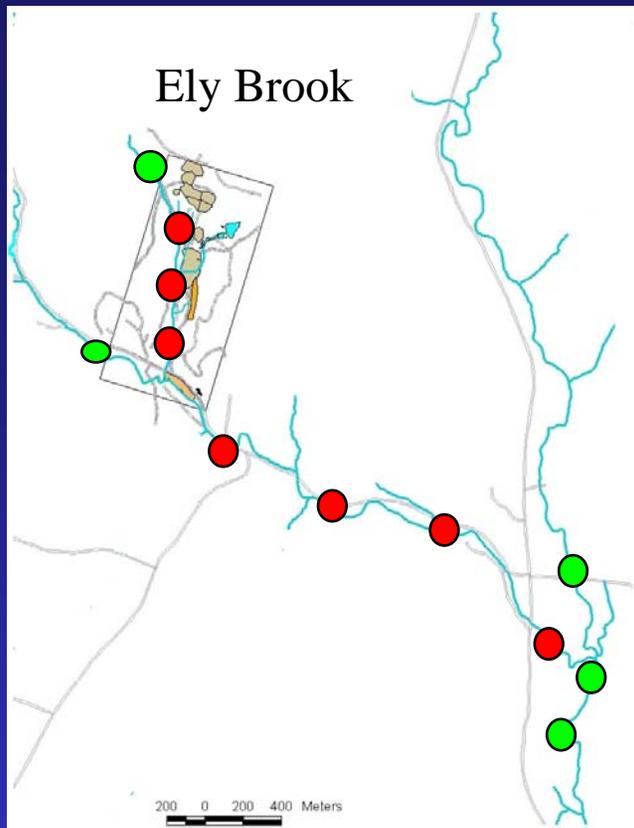
Schoolhouse Brook
Hazard Index and Richness



Schoolhouse Brook
Hazard Index and Fish







IN CONCLUSION

Are the waterways impaired to the extent that they fail Class B Standards?

Site	Invert. Assess.	Fish Assess.	Aquatic Life Use (Class B)
EB 1	VG-Good	no fish	Support
EB 2	Poor	no fish	Fail
EB 3	Poor	no fish	Fail
EB 4	Poor	no fish	Fail
SHB 1	Good	Excellent	Support
SHB 2	Poor	Poor	Fail
SHB 3	Poor	Poor	Fail
SHB 4	Poor	Poor	Fail
SHB 5	Poor	Fair	Fail
OMP 1	Exc-VG	Good	Support
OMP 2	Good	Good	Support
OMP 3	Good	Poor→Good	Support