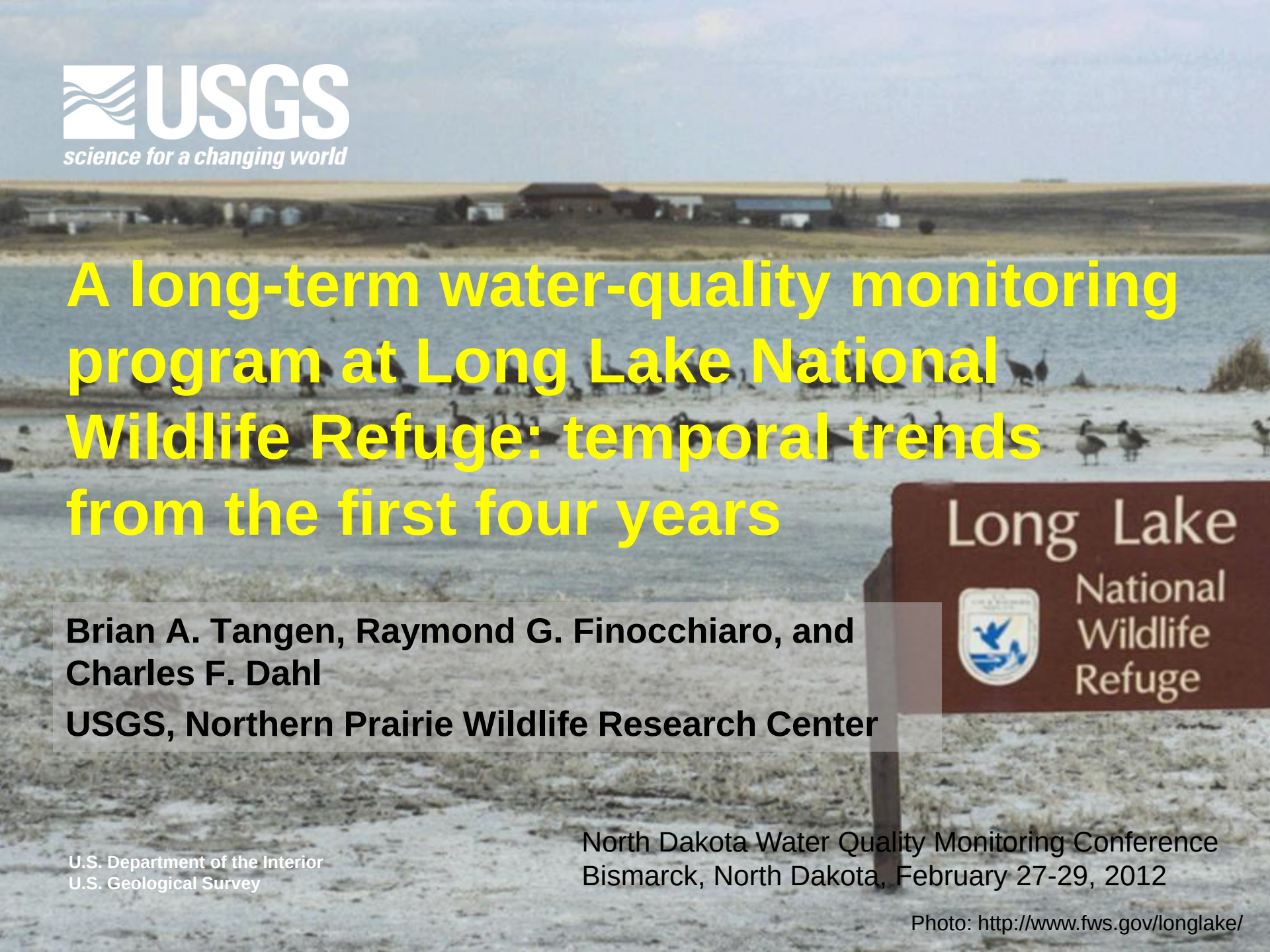


A long-term water-quality monitoring program at Long Lake National Wildlife Refuge: temporal trends from the first four years

Brian A. Tangen, Raymond G. Finocchiaro, and Charles F. Dahl

USGS, Northern Prairie Wildlife Research Center

U.S. Department of the Interior
U.S. Geological Survey

North Dakota Water Quality Monitoring Conference
Bismarck, North Dakota, February 27-29, 2012

Photo: http://www.fws.gov/longlake/

Partners

- **USFWS,** LLNWR staff
- **ND Dept. of Health,** Mike Ell & staff
- **USGS ND Water Science Center,** Steve Robinson & staff
- **USGS Northern Prairie Wildlife Research Center,** Ray Finocchiaro, Charlie Dahl, Brian Tangen, Robert Gleason

NORTH DAKOTA DEPARTMENT of HEALTH

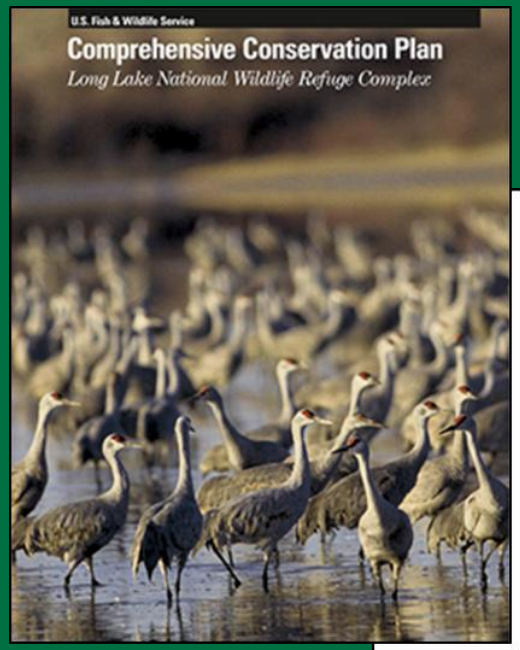
U.S. FISH & WILDLIFE SERVICE

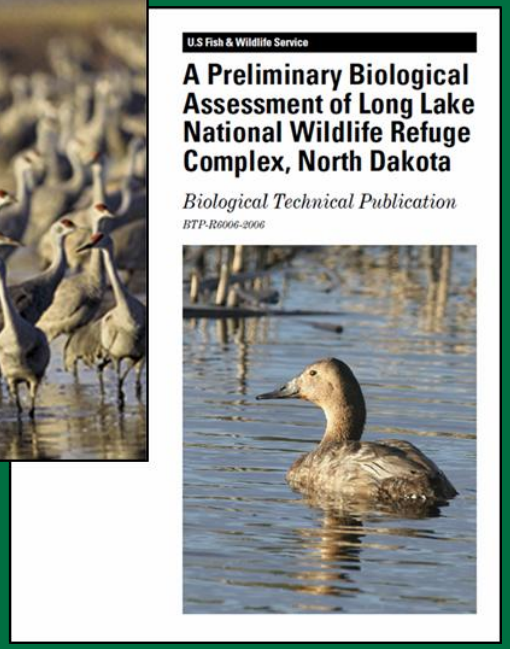
USGS science for a changing world

USGS

Overview

- Long Lake National Wildlife Refuge (LLNWR)
  - 65-km^2
  - 4 management units
  - Habitat for migratory birds and waterfowl
- Biologic assessment / CCP
  - Evaporates and chemicals
  - Impact to plants, aquatic invertebrates, and birds
  - Research, inventory, and monitoring





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Monitoring program

- USGS, USFWS, NDDH
- Initiated in 2008
- Goals:
  - Protocol
  - Baseline data
  - Identify potential water quality issues
  - Evaluate management strategies

USGS

Water quality data

- Characterize Long Lake
- Evaluate temporal & spatial trends
- Automated loggers
  - Specific conductance
  - Water level
- Bi-monthly samples
  - Hand-held
  - Water samples
- NDDH
  - Major ions
  - Nutrients
  - Elements
  - SC / pH

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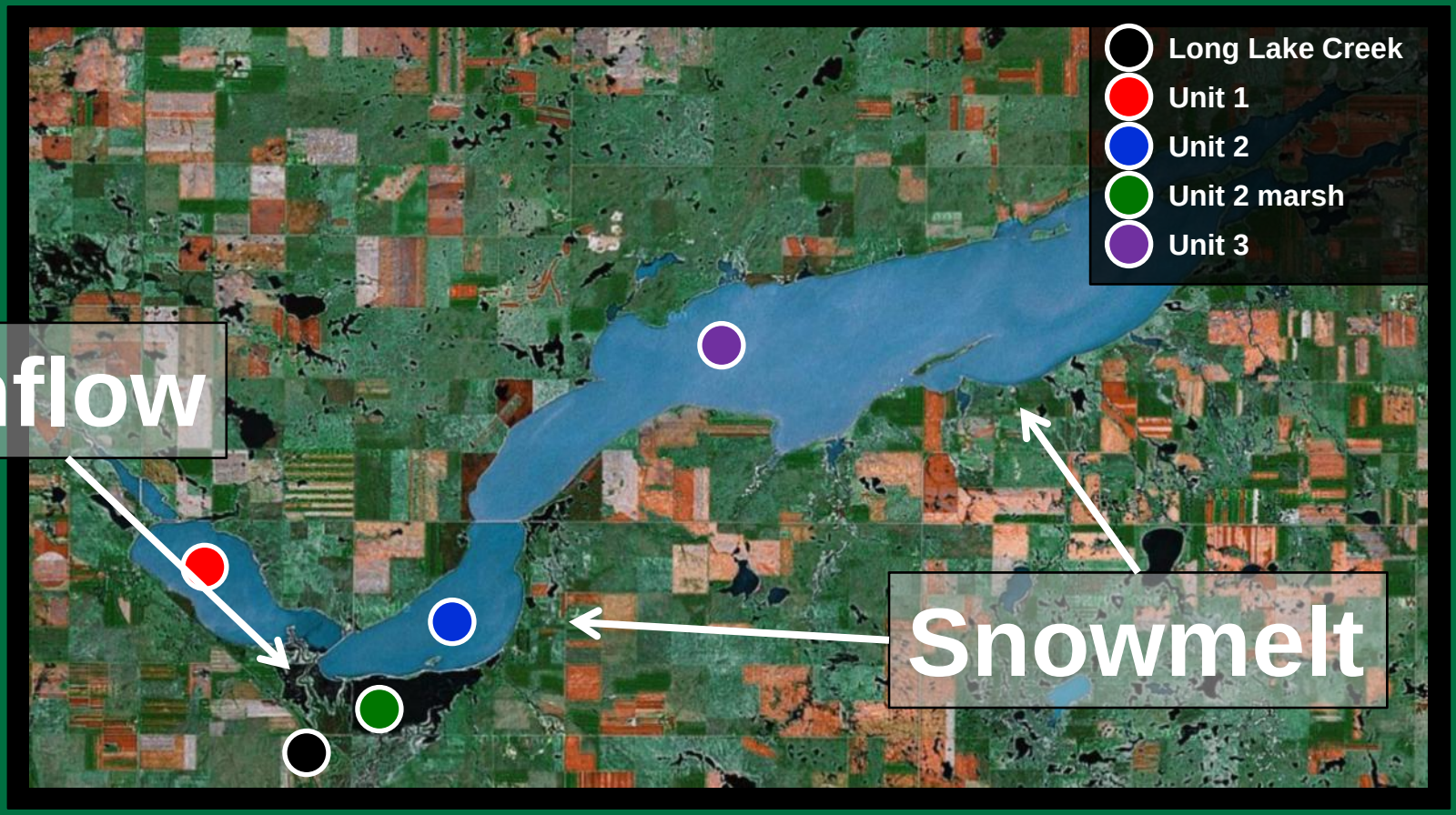
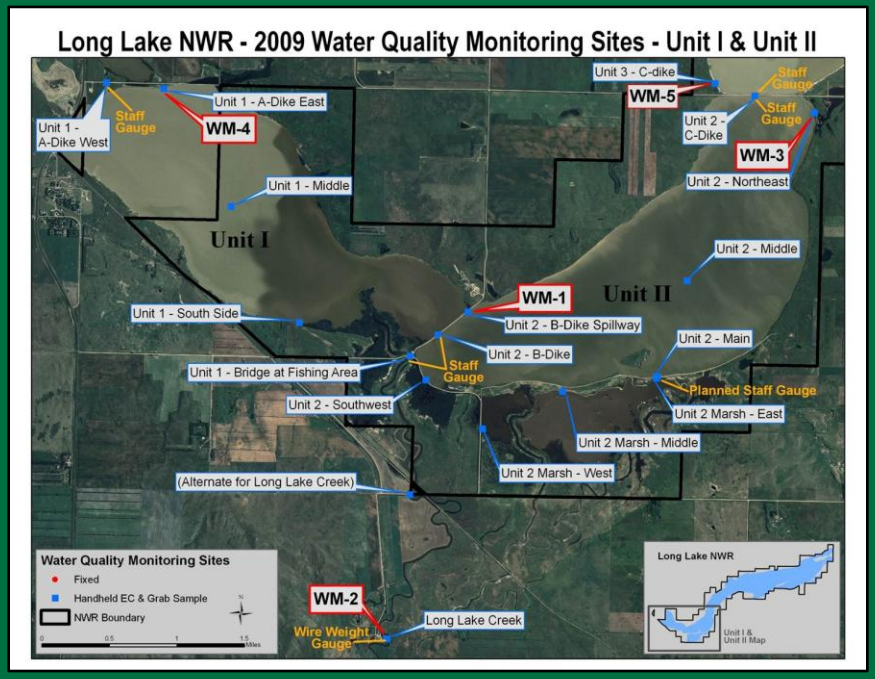
Long Lake management units

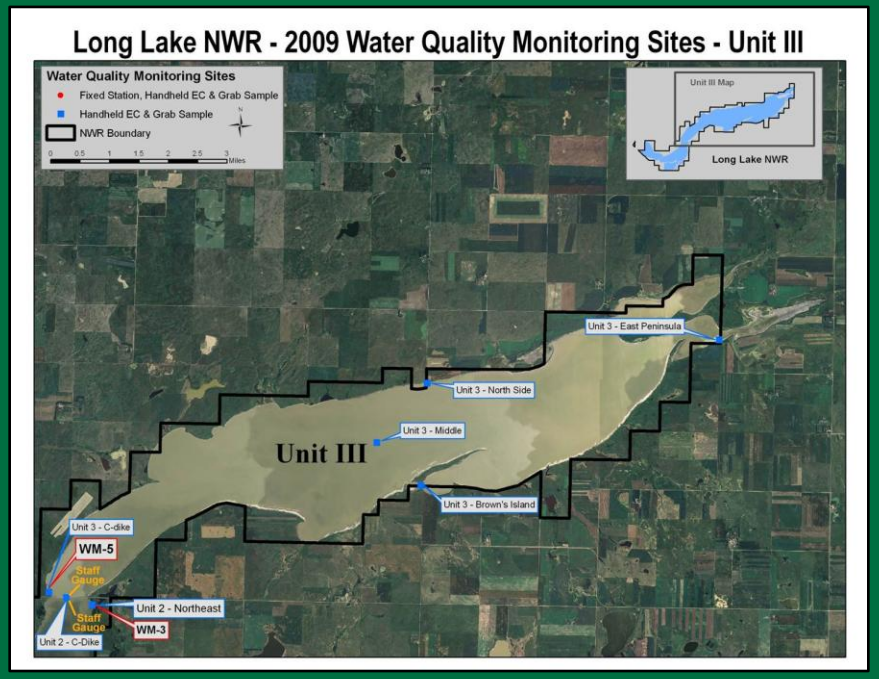


Gradient

USGS

Sample locations





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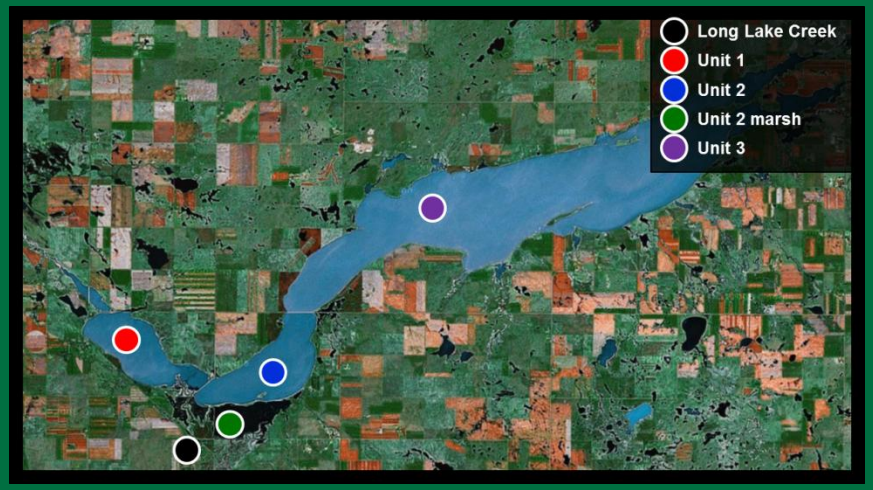
Preliminary results

- Specific conductance
- Water levels
- Dominant ions
- Elements
- 2008-2011



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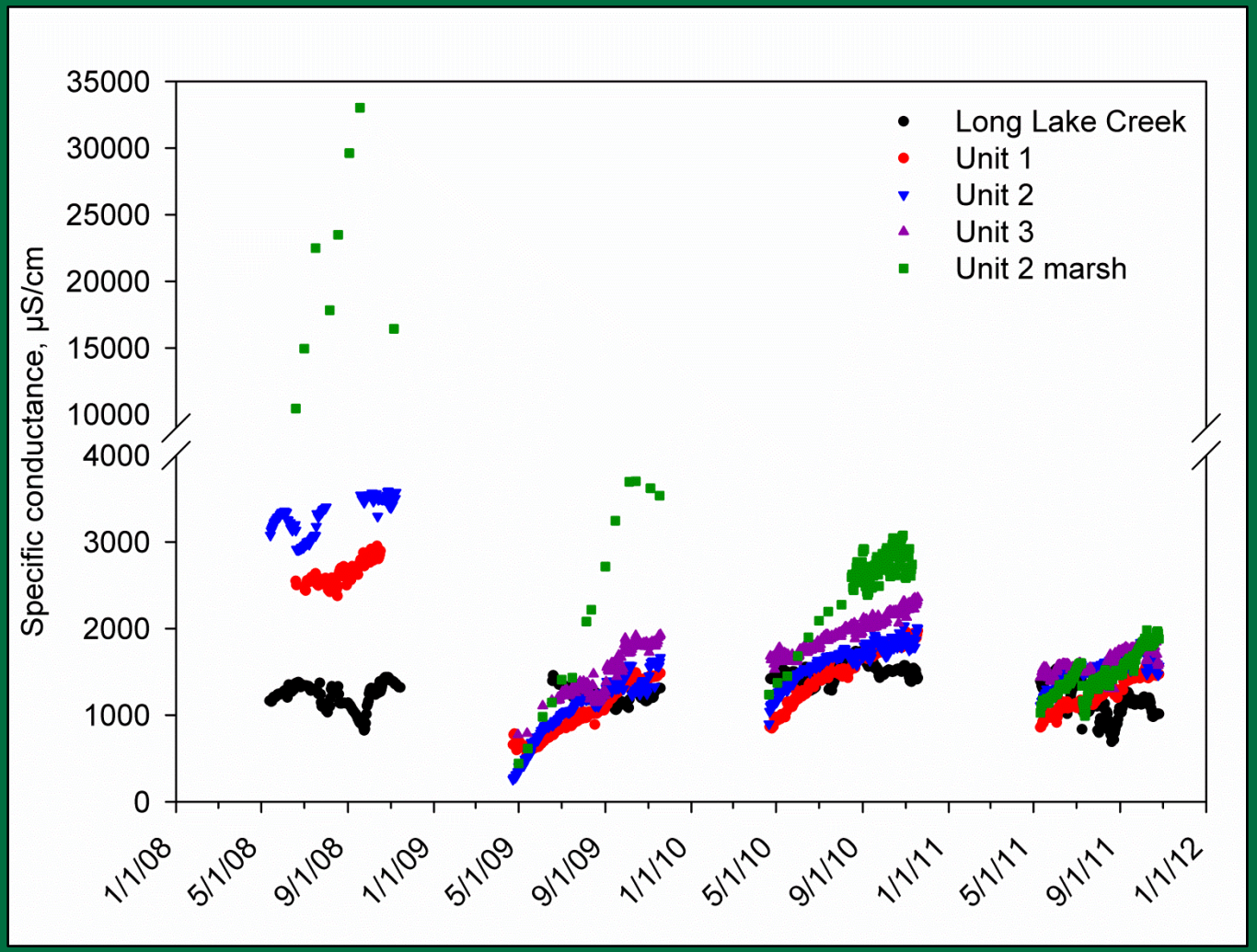
Specific conductance



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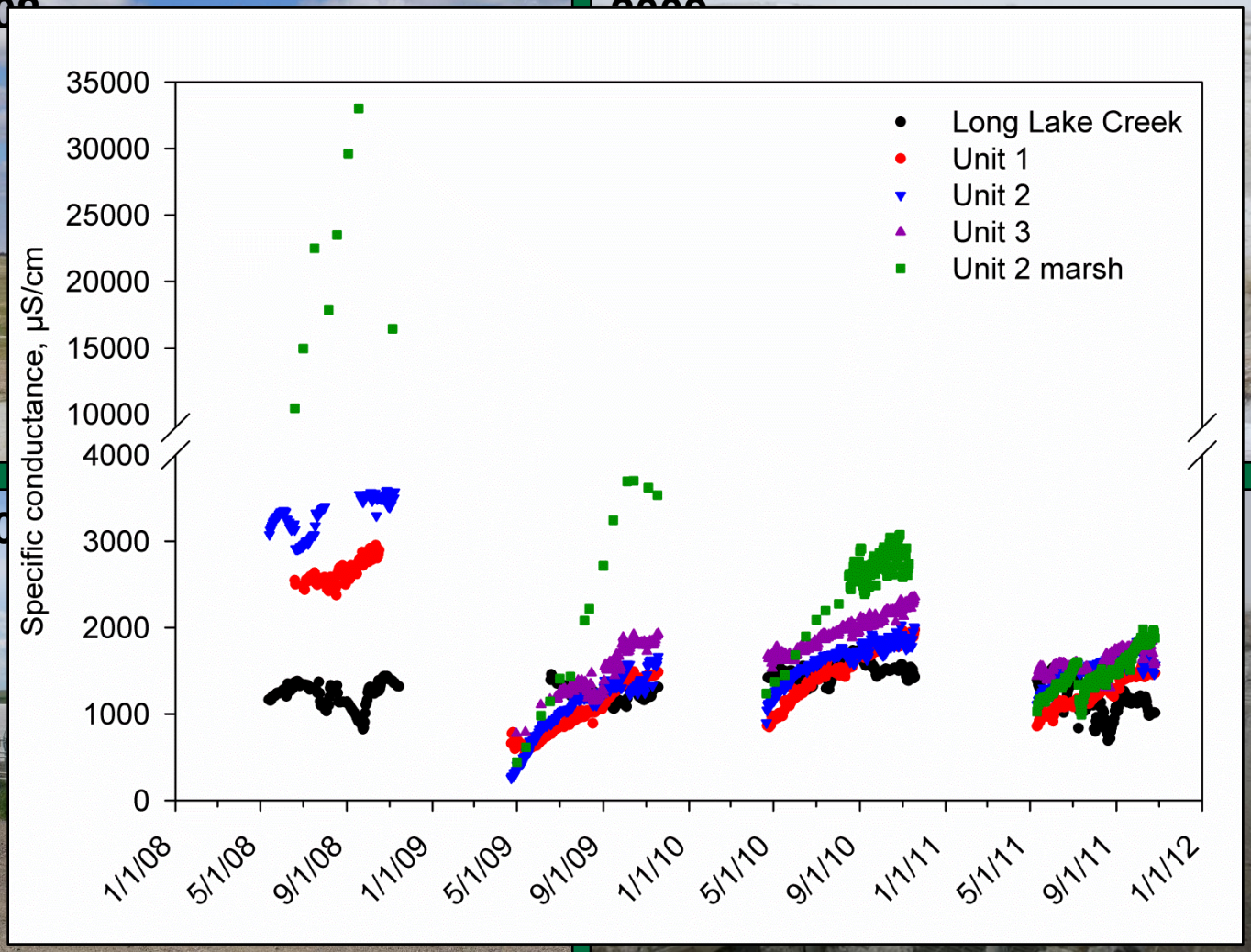
Interannual trends



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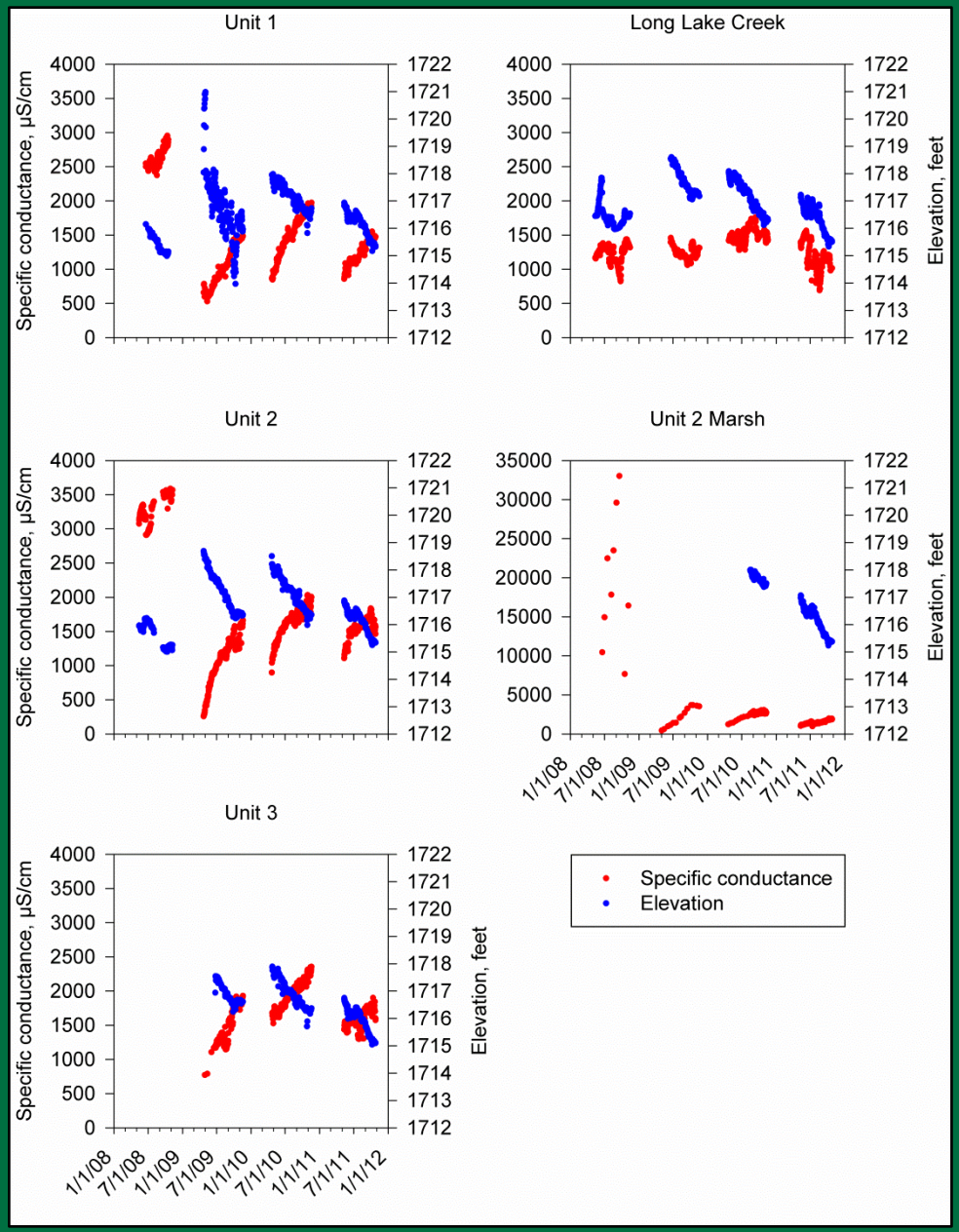
Seasonal trends

- Specific conductance
- Water level

- Evaporation
- Evapoconcentration
- Dilution



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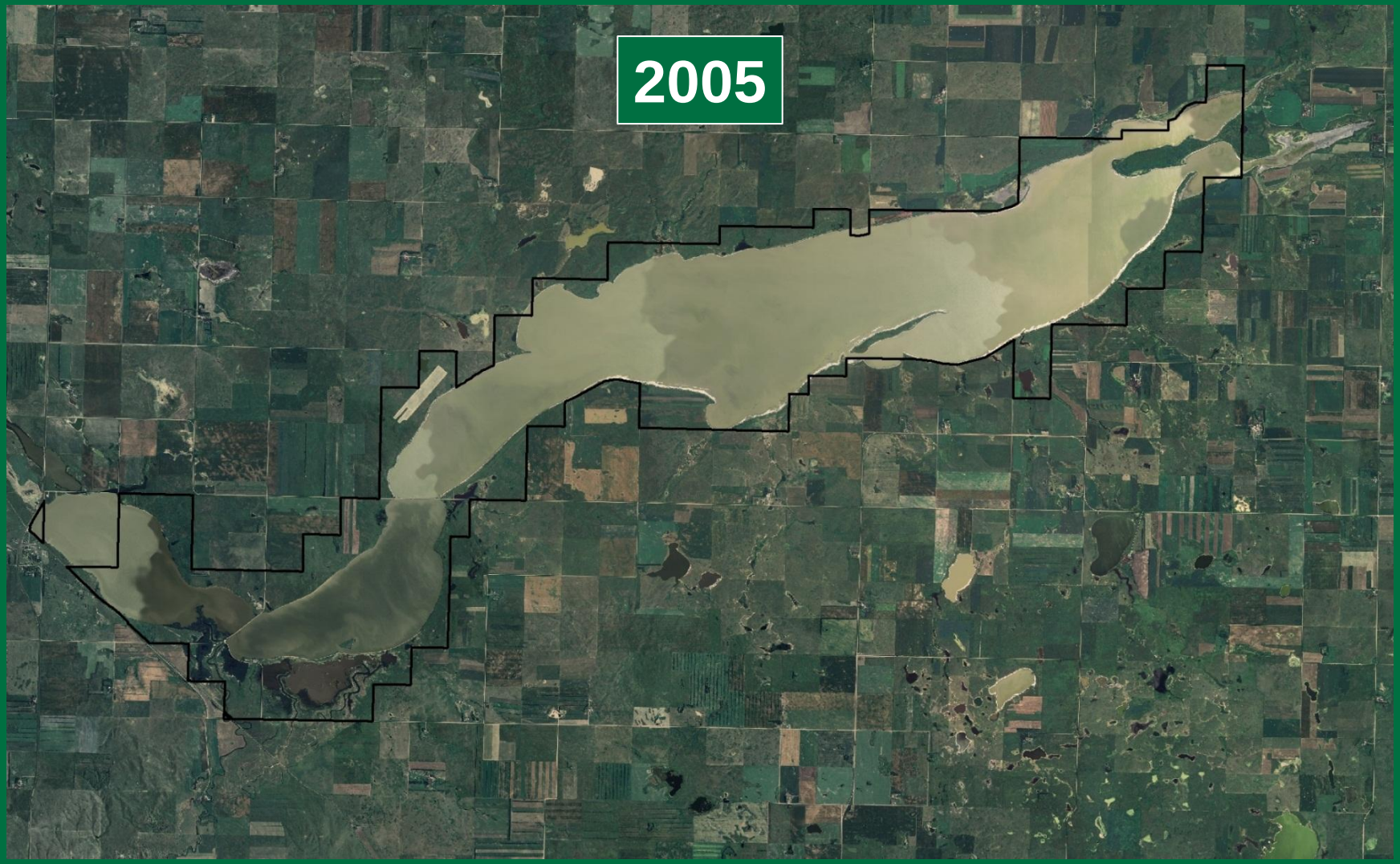
Long Lake NWR, 2005-2009



USGS

Photos provided by USFWS: ~August-September

Deflation & salt loss

http://cimss.ssec.wisc.edu/goes/blog/archives/category/hydrology/page/2

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Ions

- Composition
- Concentrations
- Ca^{2+}, K^{+}, Mg^{2+}, Na^{+}
- Cl^{-}, CO_3^{2-}, HCO_3^{-}, SO_4^{2-}

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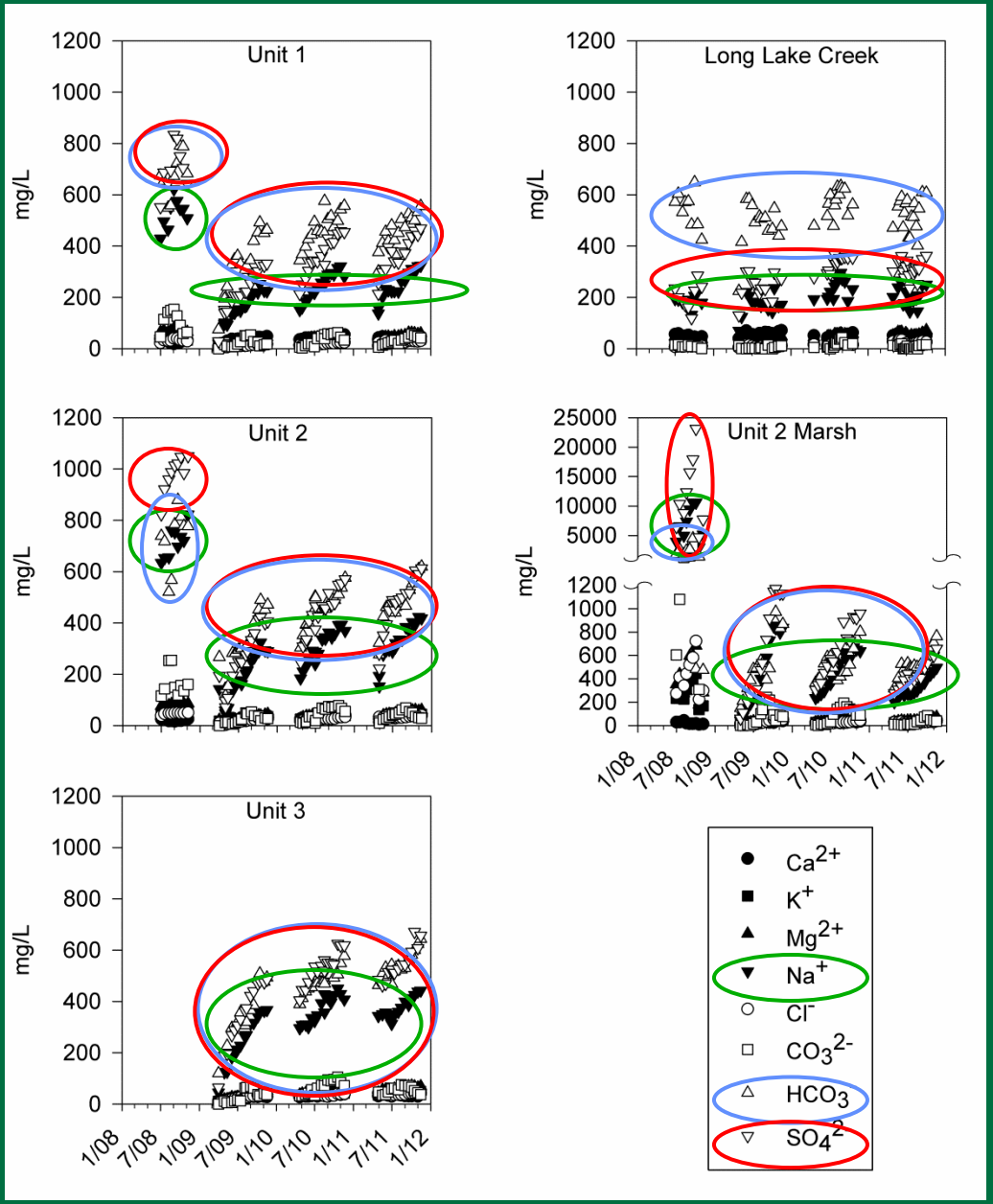
Ions

- Na^+
- HCO_3^-
- SO_4^{2-}



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Elements, metals, nutrients

- Ag, Al, As, B, Ba, CO_3, Ca, Cl, Cr, Cu, Fe, HCO_3, K, Mg, Mn, Na, Ni, Pb, Sb, Se, SO_4, Zn
- N, NH_3, NO_3, NO_2, P
- SAR, SC, TDS, pH

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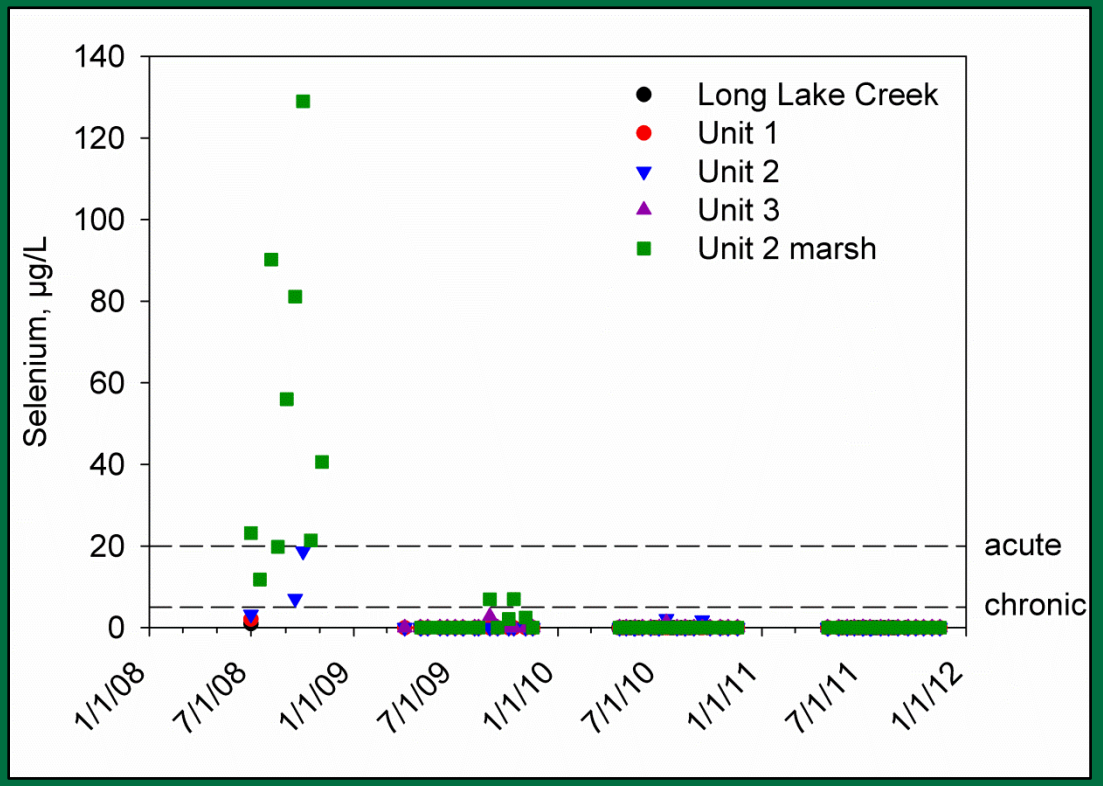
Example: Selenium

- Evapoconcentration
- Dilution



*acute and chronic standards for aquatic life, ND Dept. of Health water quality criteria

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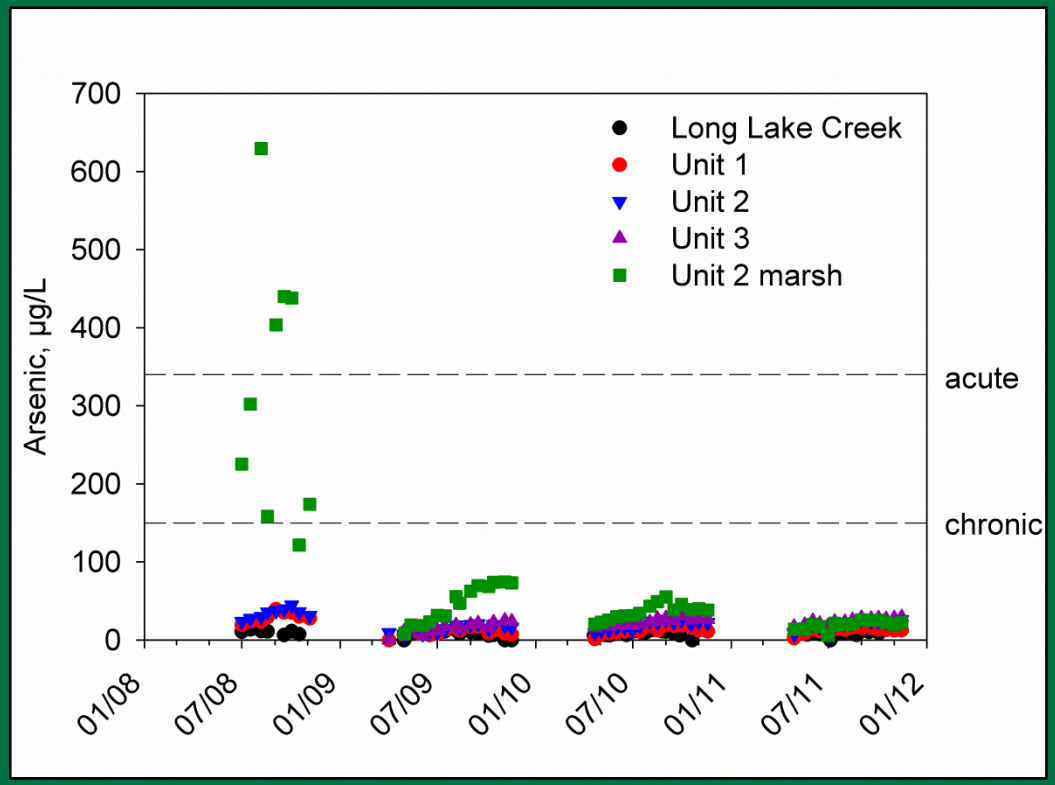
Example: Arsenic

- Evapoconcentration
- Dilution



*acute and chronic standards for aquatic life, ND Dept. of Health water quality criteria

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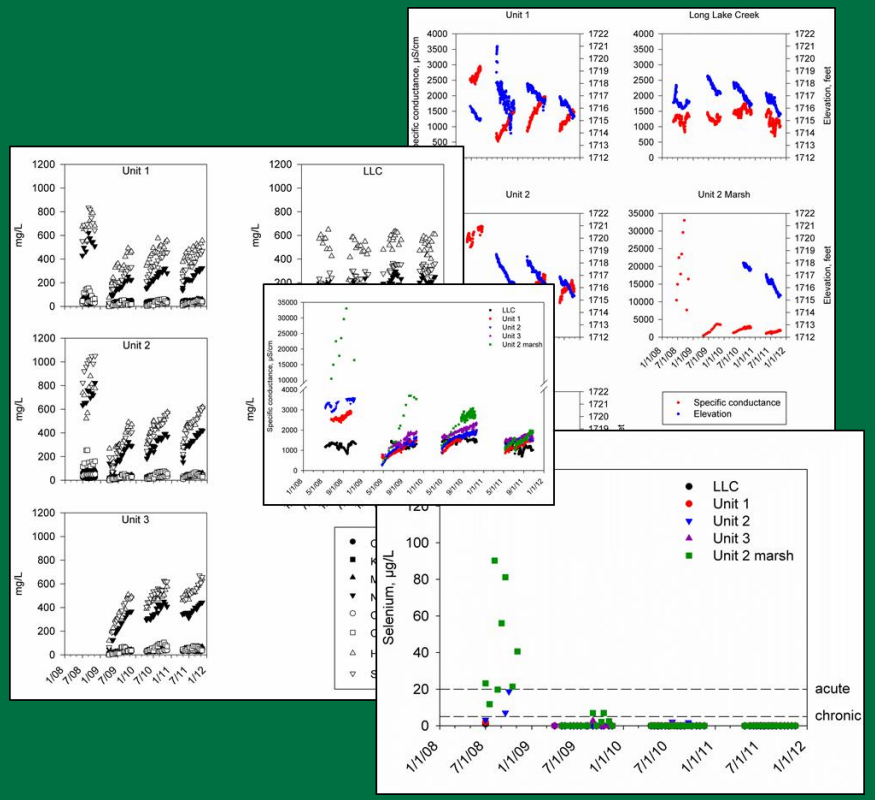
Lessons learned: sampling protocol

- Significant temporal variation
  - Seasonal
  - Interannual
- ➢ Long-term monitoring
- Spatial variation
  - Minimal within units
  - Greater among units
- Labor/$$
  - Loggers
  - # sites

USGS

Lessons learned: baseline data

- Dominant ions
  - Na^+, HCO_3^-, SO_4^{2-}
- Temporal & spatial variation
  - Specific conductance
  - Water chemistry
- Freshness gradient
- Dilution/concentration
- Monitoring/comparisons
  - Timing of samples



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Moving forward

- Continue monitoring
- Examine trends
- Additional data?
  - Soils
  - Biotic communities
- Evaluate management goals / objectives

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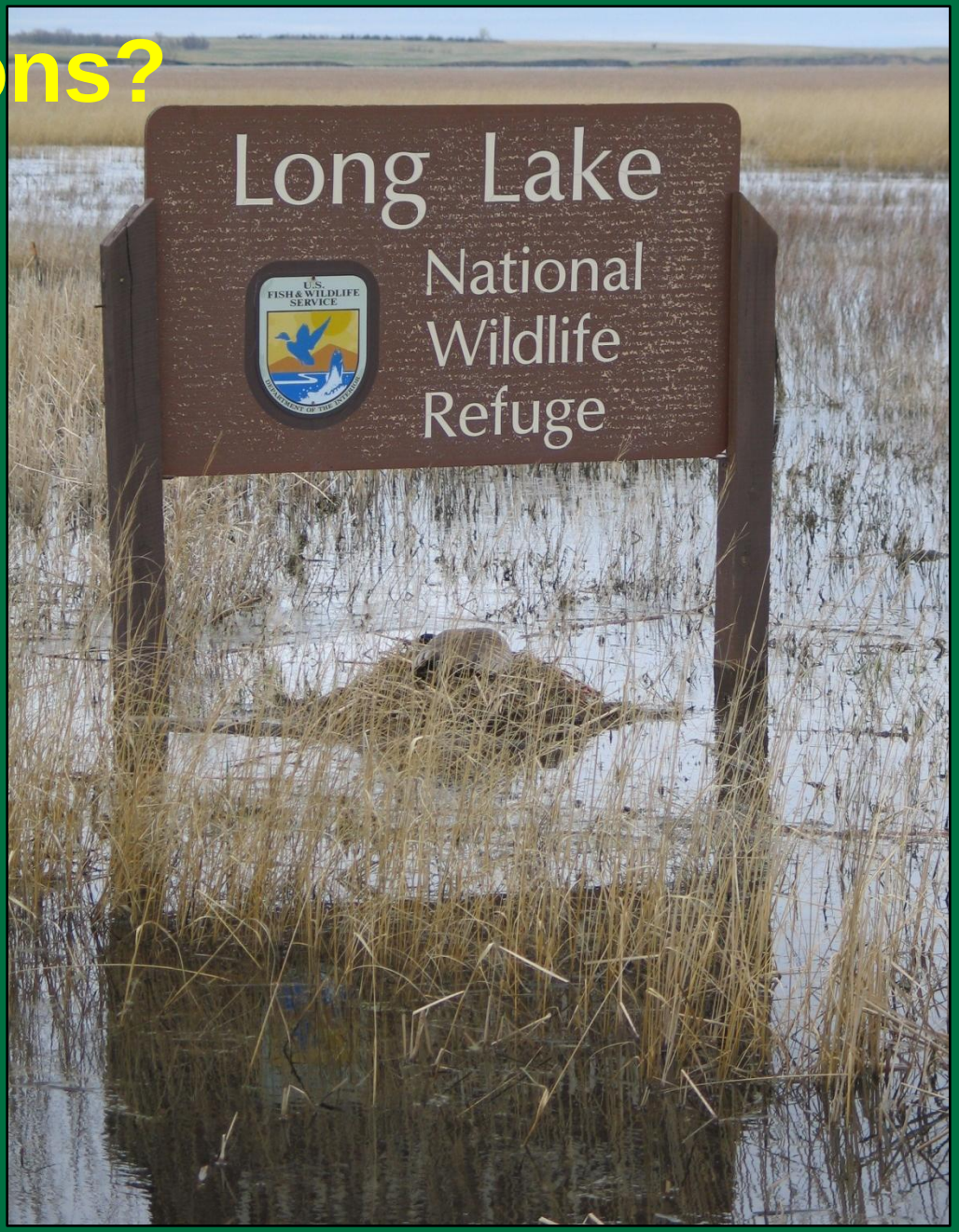
Questions?



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