

Water Quality Studies on the Great Salt Lake, Utah Developing a Selenium Standard

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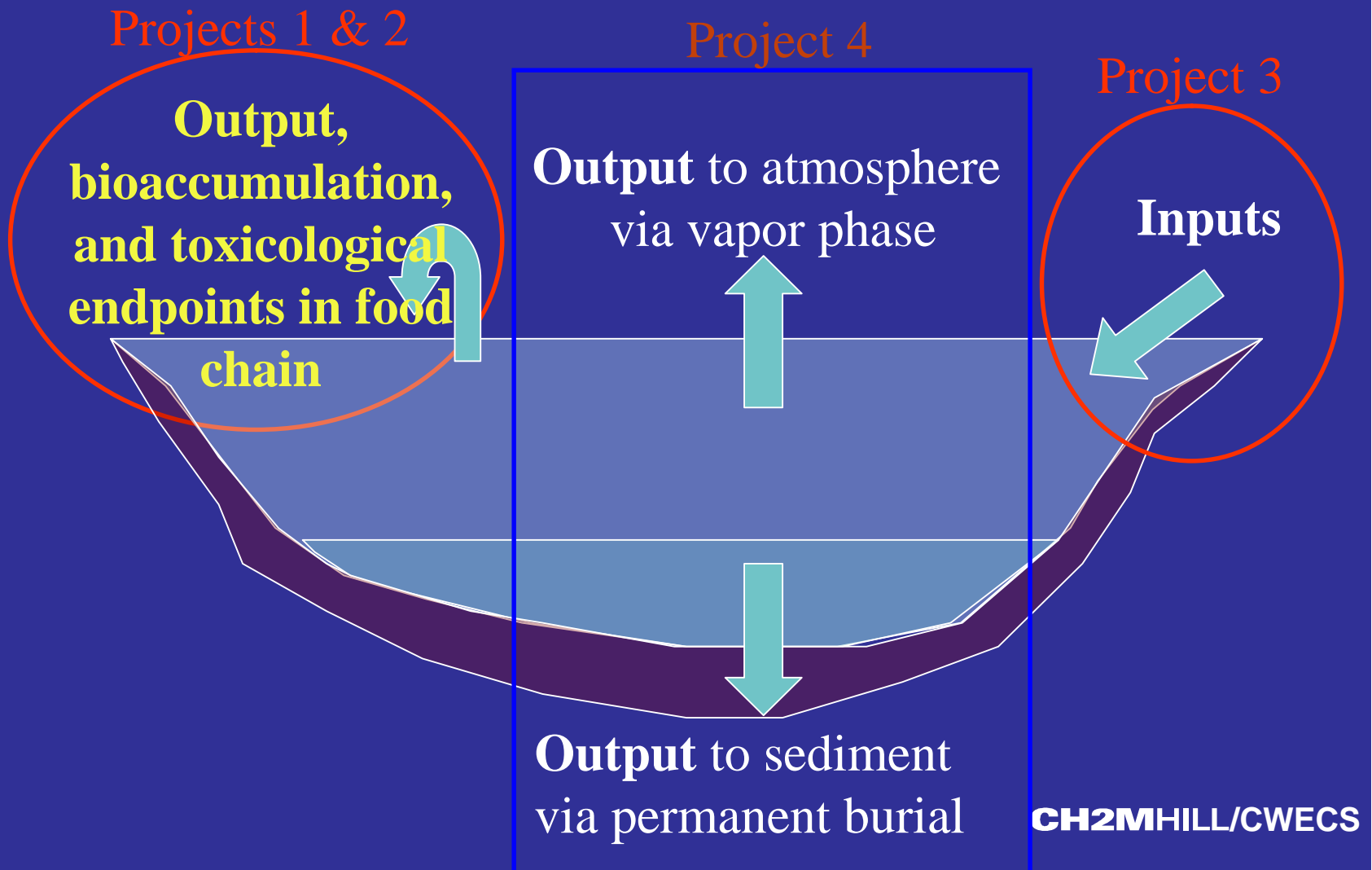
Great Salt Lake Water Quality Studies

Program Objective:

**Set a Site-Specific Numeric
Water Quality Standard for
Selenium for the Open Waters
of the Great Salt Lake**

**What activities are necessary to
achieve an interim Selenium
standard by September 2007?**

Science Panel Identified Four Projects to Meet Objective





Project 1 – Avian Ecology

- **Principal Investigators**
 - Michael Conover, PhD [USU]
 - John Cavitt, PhD [Weber State]
 - Clay Perschon
- **Project Advisors**
 - Gary Santolo, MS



Project 1 – Avian Ecology

Project Objective

Determine Se flux from bird diet to critical end points by determining ambient selenium concentrations in water, brine shrimp, brine flies, other food items, birds and bird eggs.



Project 1 – Avian Ecology

Project Objective

Determine potential selenium effects on critical end points

- *biomagnification*
- *reproductive effects*
- *tissue burdens & survival*

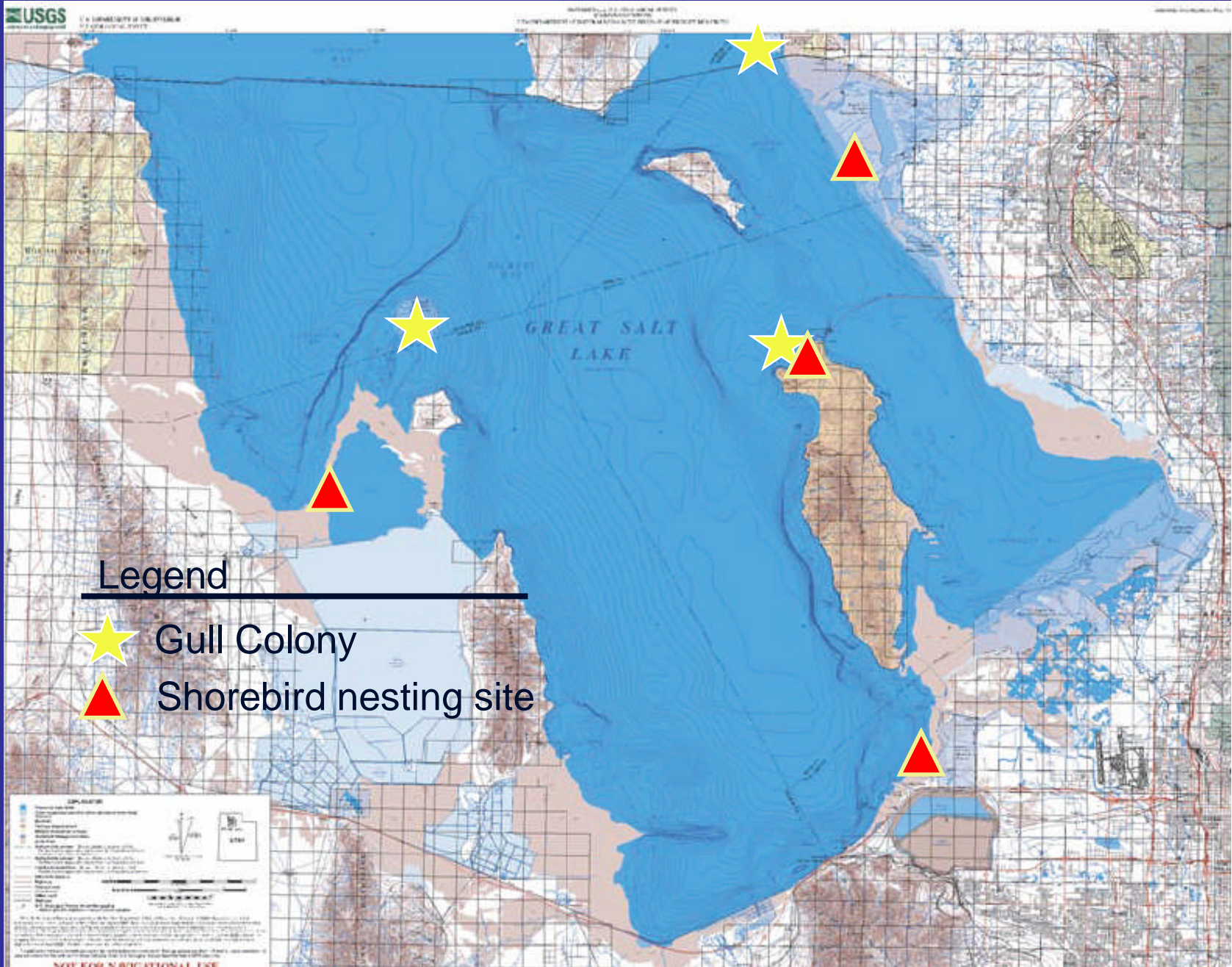


Project 1 – Avian Ecology

Project Tasks

1. Identify Nesting Sites [Completed]
 - *Avocets/Stilts – 4 locations*
 - *California Gulls – 3 locations*
2. Locate Foraging Areas [Completed]
3. Collect Adult Birds [Completed]
4. Sample Food Items, Sediment and Water [Completed]

Sampling Locations





Project 1 – Avian Ecology

Project Tasks

5. Collect Eggs [Completed]
6. Revisit Nests to Check for Deformities [Completed]
7. Determine Se Concentrations [In Process]
8. Collect Over-wintering Birds
 1. Eared Grebes (October – January)
 2. Ducks (December – March)



Project 2 – Aquatic Ecology

- **Principal Investigators**
 - Wayne Wurtsbaugh, PhD [USU]
 - Brad Marden [Parliament Fisheries]
- **Project Advisor**
 - Earl Byron, PhD



Project 2 – Aquatic Ecology

Project Objective

Determine spatial and temporal variation in Se concentrations in the water and in pelagic and benthic food web components leading to the birds of interest.



Project 2 – Aquatic Ecology

Project Tasks

1. **Collect Periphyton, Brine Fly Larvae, Pupae and Adults in Benthic Habitats for Se Analyses** *[Field Work Completed]*
 - *Preliminary Study to Determine Link to Bird Diet (Two Locations)*
 - *Test Benthic Sampling Protocols That Have Never Been Used on GSL*
 - *Includes Sampling at Sandy, Muddy and Stromatolite Locations*



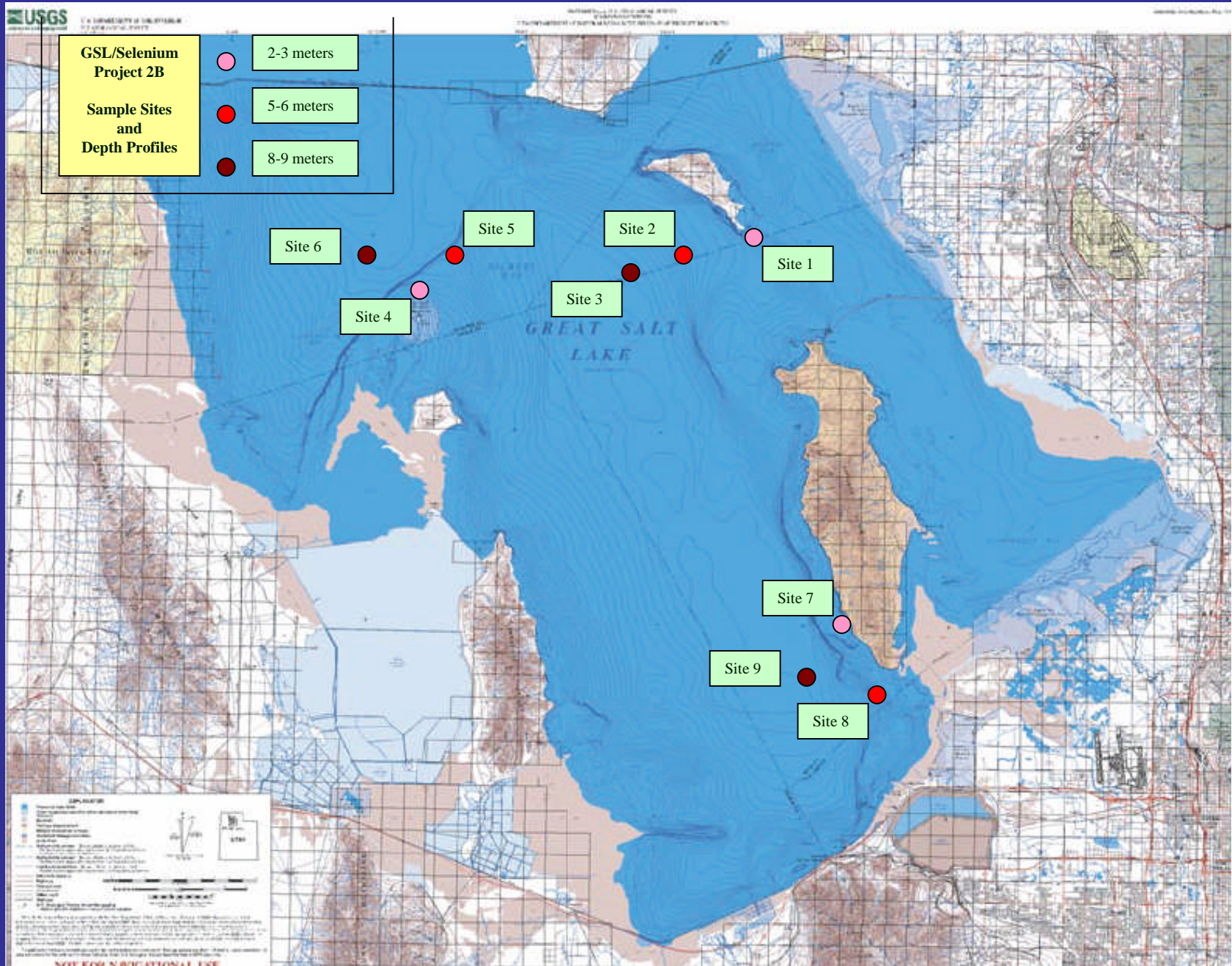
Project 2 – Aquatic Ecology

Project Tasks

2. Synoptic Survey of Water, Seston & Artemia *[In Process]*

- *Document the Temporal and Spatial Characteristics of Total Se Concentration in Water and Correlate with Seston and Artemia Tissue Concentrations*
- *Correlate Isotopic ^{15}N & ^{13}C Levels with Se Concentration in Artemia tissue*
- *Monitor Primary Production Indicators and Record Artemia Population Dynamics*

Sampling Locations



Project 3 – Selenium Loads

- **Principal Investigators**
 - Dave Naftz, PhD [USGS]
 - Bill Johnson, PhD [UofU]
- **Project Advisor**
 - Earl Byron, PhD





Project 3 – Selenium Loads

Project Objective

Measure discharge and Se loads from various sources to open waters of the Great Salt Lake to understand inputs to the ecosystem.

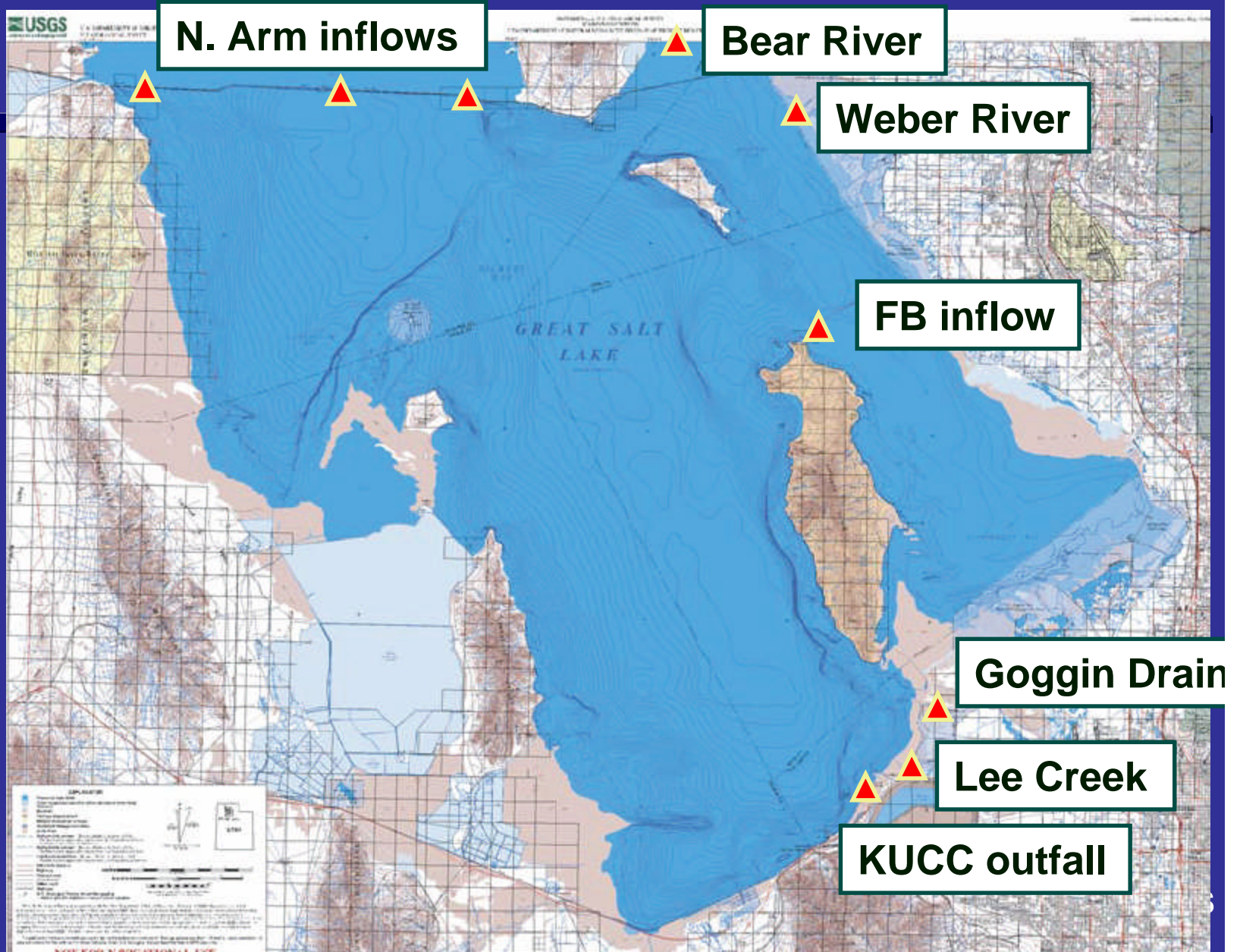


Project 3 – Selenium Loads

Project Tasks

1. Analyze USGS Archived Samples for Se Loads [**Outside Contract Completed.**]
2. Install Stream Gages on all Primary Point Sources of Se Loading to the Main Body of GSL [**Completed. See USGS Website**]
3. Monitoring/Modeling of Se Loadings to GSL (Natural & Point Sources) [**In Process/2007**]
4. Estimation of Se Load to GSL From Groundwater (Duke University) (**Outside Contract**)

Gage Locations





Project 4 – Se in Vapor/Sediment

- **Principal Investigators**
 - Bill Johnson, PhD [UofU]
 - Dave Naftz, PhD [USGS]
- **Project Advisor**
 - Earl Byron, PhD



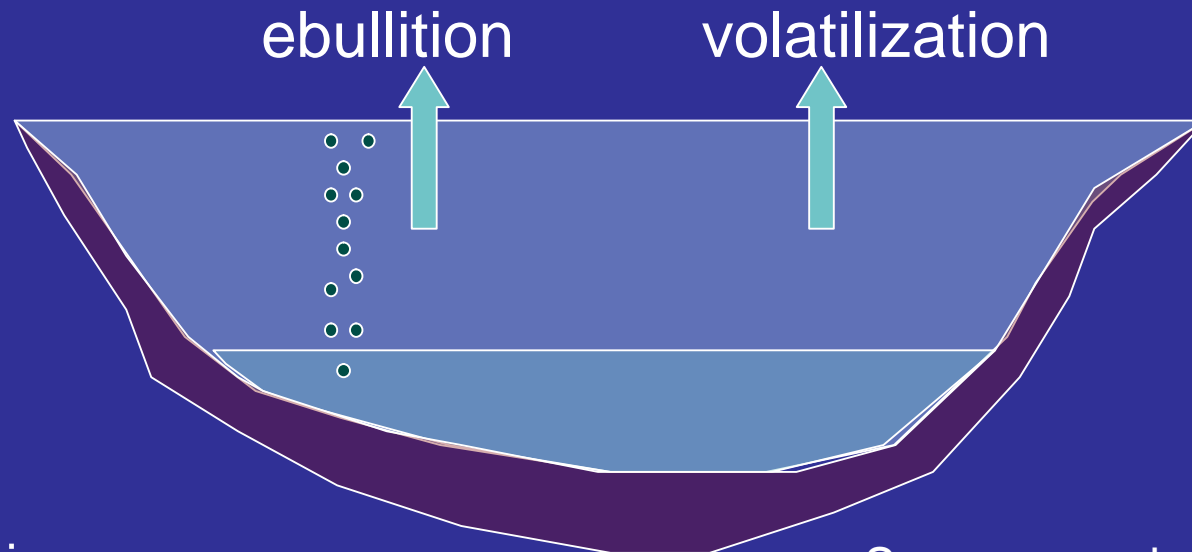
Project 4 – Se in Vapor/Sediment

Project Objective

1. Are volatilization and ebullition (bubbling) significant release mechanisms for Se from the GSL?
2. Is Se stored in sediment and do mixing events re-mobilize the Se?
3. Does changing water elevation/lake area re-introduce Se into the water column?

Project 4 – Se in Vapor/Sediment

Task 1. Vapor Selenium Flux

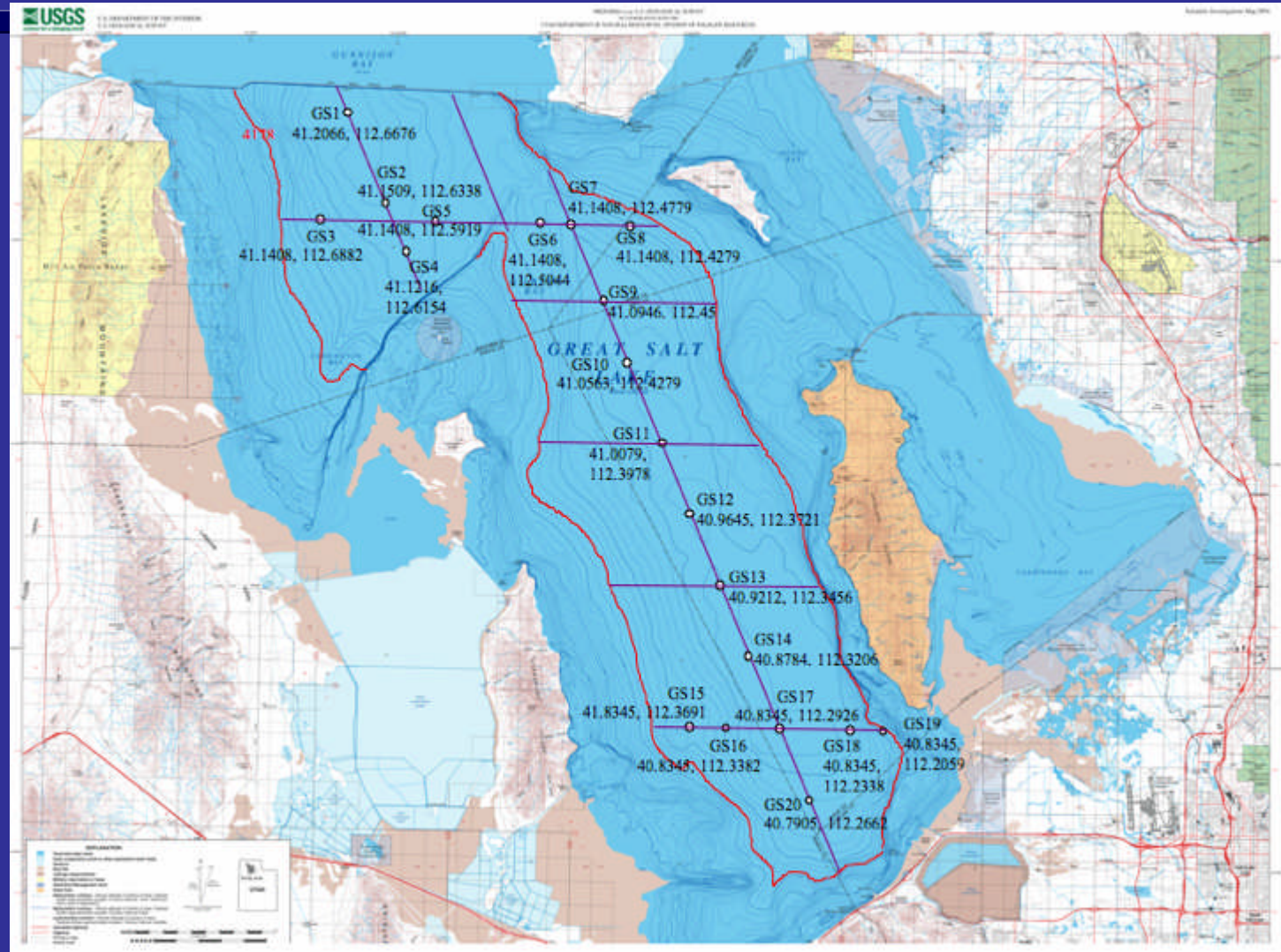


Ebullition:

- 20 locations
- 5 depths
- Semi-monthly
- Boat-mounted total dissolved gas probes
- Vapor collection via floating flux chamber

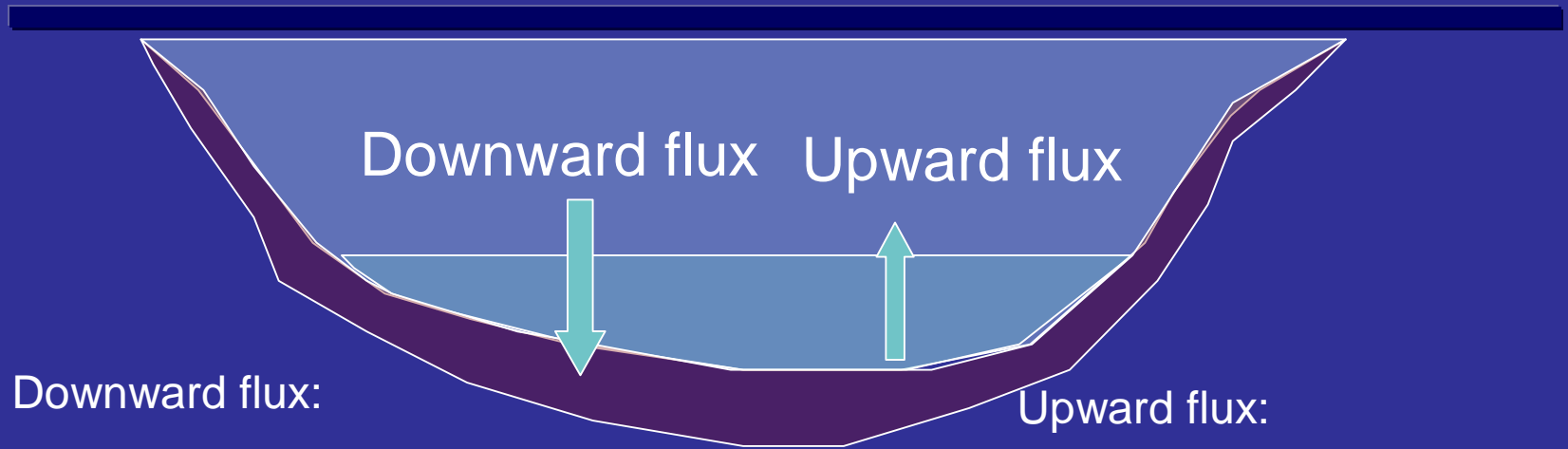
- Se vapor analyzed via quadrupole mass spectrometry
- Sediment grab samples for total organic carbon and total Se

Project 4 – Se in Vapor/Sediment Total Dissolved Gas sampling locations



Project 4 – Se in Vapor/Sediment

Task 2. Sedimentation Flux



Downward flux:

- 2 sediment traps on lake bottom
- Sampled semi-monthly
- Water column samples at 2 depths at 2 locations
- Sampled semi-monthly

Upward flux:

- Thermistor string and turbidimeter deployed at five depths at two locations
- Retrieved semi-monthly
- Water column sampled following storm events

Total Se by extraction then HG-AA
Se phase identification by and FFF-ICP-MS

CH2MHILL/CWECS

Project 4 – Se in Vapor/Sediment

Task 3. Lake Area Change/Permanency

Still-exaggerated depth to width ratio



Lake area change:

- 20 cores (submerged and exposed)
- Sequential extraction to determine Se release upon lake area change, e.g. submergence

Permanency:

- 3 cores
- Dating by ^{137}Cs
- Selenium accumulation rates over past
- Comparison to present sedimentation rate
- Yields permanency of sedimentation

Total Se by extraction then HG-AA
Se phase identification by and FFF-ICP-MS
Overall Se budget will be developed in this task



Program Support Task

Objective

Provide technical direction, peer review/quality control, and coordination of all activities to achieve program objective while minimizing risk of challenge.



Program Support Task

Project Tasks

1. Planning and Design
2. Coordination/Management
3. Technical Oversight
4. Establish Data Quality Objectives
5. Quality Assurance/Data Management



Project Schedule

- **Project 1: 4/2006 - 5/2007**
- **Project 2: 4/2006 – 11/2006**
- **Project 3: 3/2006 – 5/2008**
- **Project 4: 6/2006 – 5/2007**

Project Costs

Project 1	\$312,900
Project 2	\$163,300
Project 3	\$213,600
Project 4	\$347,000
Program Support	\$198,700
Undefined Support for '07/'08	\$106,200
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Subtotal	\$1,341,700
<i>USGS Matching Funds</i>	<i>\$124,000</i>
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Total Cost	\$1,465,700



Great Salt Lake Water Quality Studies

**Science Panel Meeting:
August 9-10 @ 8:00 am
Dept. Natural Resources Bldg.
Room # 2000**

Questions?