Water Quality Studies on the Great Salt Lake, Utah

Developing a Selenium Standard

Steering Committee Meeting

August 21, 2006.

William O. Moellmer, Ph.D.
Utah Division of Water Quality
Jeff DenBleyker
CH2MHill

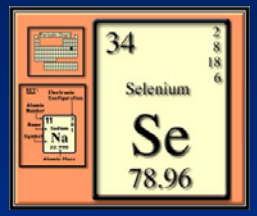
Great Salt Lake Water Quality Studies

Program Objective:

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

Status of Projects to achieve an interim Selenium standard by September 2007

Biomagnification up the Food Chain



Selenium in the Water

0.7 ug/l -> 4 mg/l

Brine Fly

How much does the Se bio-magnify between the water and the bugs?

Brine Shrimp

Biomagnification up the Food Chain

Brine Flies & Brine Shrimp →

Eared Grebe

California Gull

Black-Necked Stilt

How much does the Se bio-magnify between the bugs and the birds?

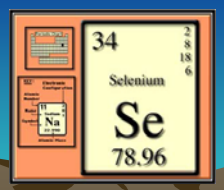
Biomagnification up the Food Chain

Birds → Chicks

How much does the Se bio-magnify between birds and the chicks?

Biomagnification up the Food Chain

BFA: BioAccumulation Factor



BFA?

Water

Brine Flies & Brine Shrimp

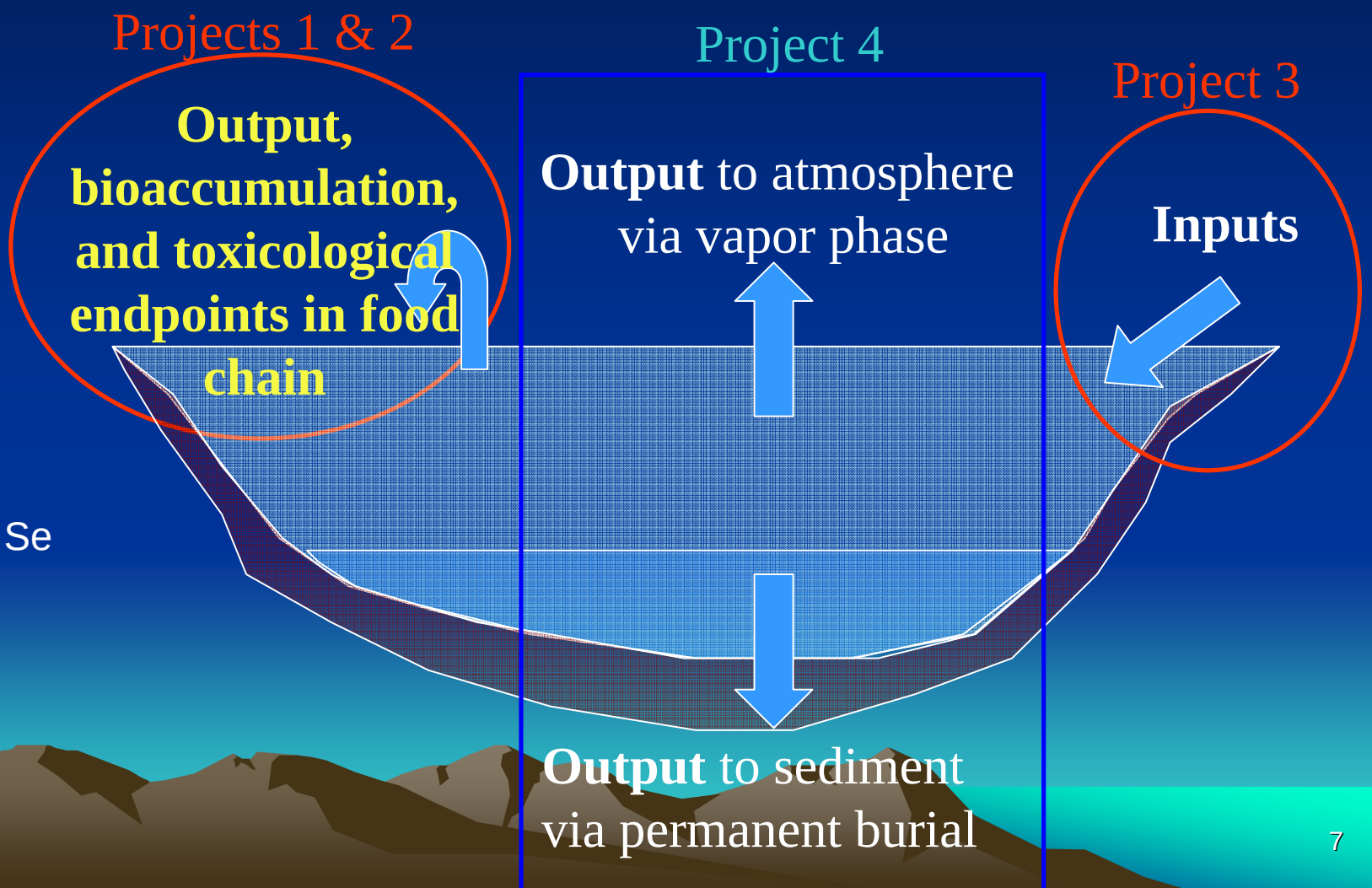
BFA?

Birds

BFA?

Chicks

Science Panel Identified Four Projects to Meet Objective



Is the chemistry such as that the concentration of Se in the lake is independent of input sources?

Contract Status

- All planned work is under contract and under way
- Contracts with labs were just recently executed

Project 1 – Avian Ecology

- Principal Investigators
  - Michael Conover, PhD [USU]
  - John Cavitt, PhD [Weber State]
  - Clay Perschon [UDWR]
- Project Advisor
  - Gary Santolo, MS [CH2MHill]

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.

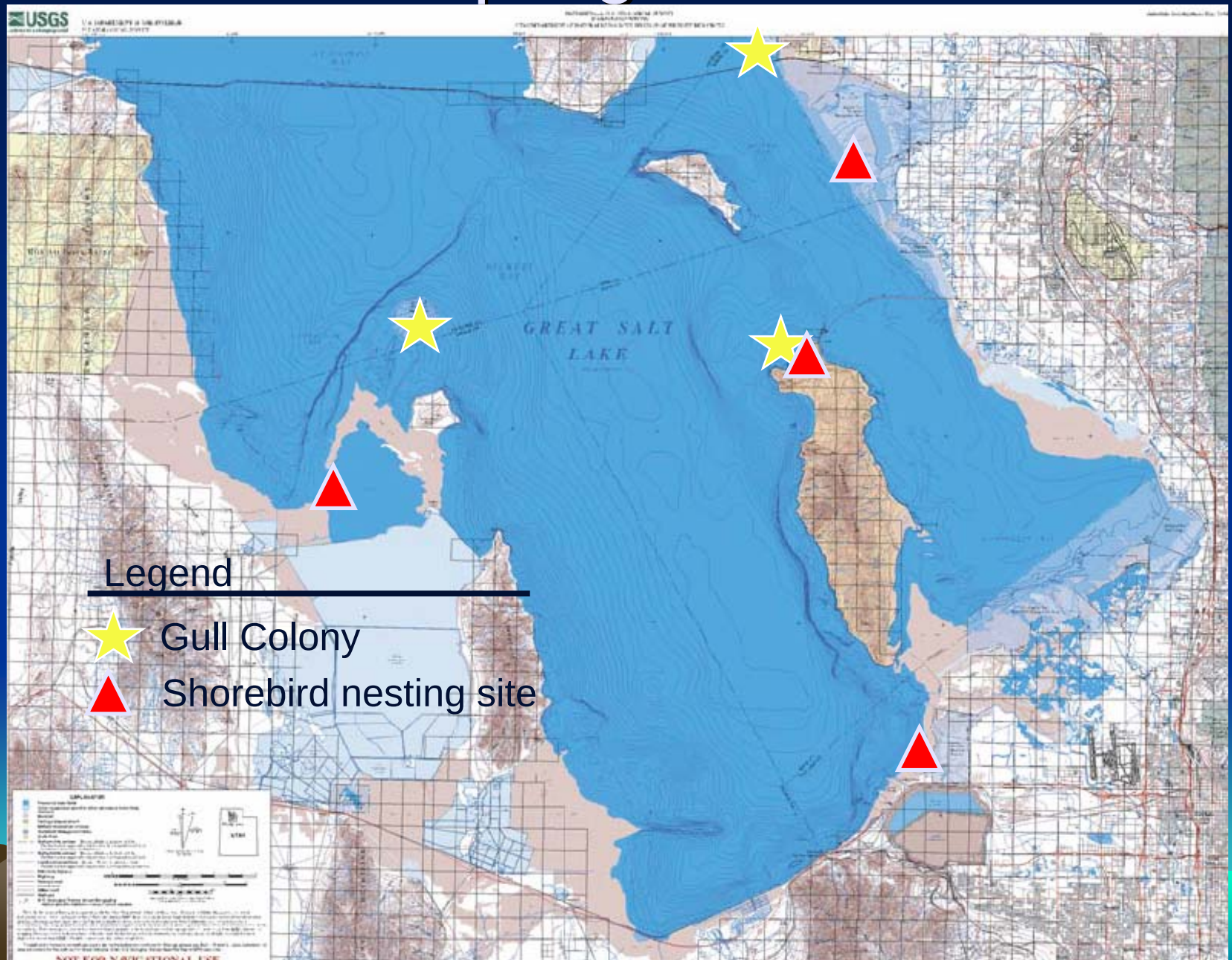
Project 1 – Avian Ecology

Project Tasks

1. Identify Nesting Sites [Completed]
   - Avocets/Stilts – 4 locations
   - California Gulls – 3 locations

Photos: Dr. John Cavitt

Sampling Locations



Project 1 – Avian Ecology

Project Tasks

2. Locate Foraging Areas [Completed]
3. Collect Adult Birds [Completed]
4. Sample Food Items, Sediment and Water [Completed]

Photos: Dr. John Cavitt

Project 1 – Avian Ecology

Project Tasks

5. Collect & Dissect Eggs [Completed]
6. Revisit Nests to Check for Deformities [Completed]

Photos: Dr. John Cavitt

Project 1 – Avian Ecology

Project Tasks

5. Determine Se Concentrations
   [In Process]
6. Collect Over-wintering Birds
   1. Eared Grebes (October –January)
   2. Ducks (December – March)

Project 1 – Avian Ecology

Samples Collected

Adults:

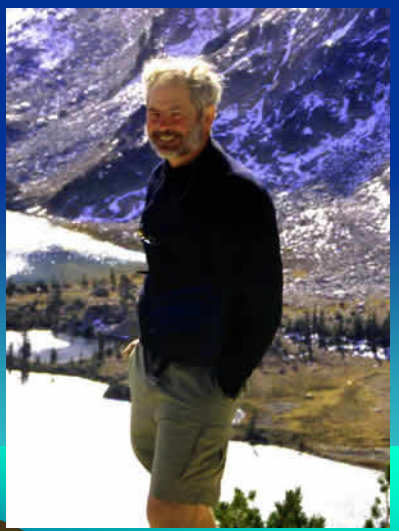
- Ogden Bay – 5 AMAV, 5 BNST
- Bridger Bay – 5 AMAV
- Saltair – 5 AMAV
- Gull colonies – 12 each, total of 36

Eggs:

- Bridger Bay – 19 AMAV
- Ogden Bay – 20 AMAV; 18 BNST
- Saltair – 7 AMAV
- West Carrington – 1 AMAV
- Gull colonies – 24 each, total of 72

Project 2 – Aquatic Ecology

- Principal Investigators
  - Wayne Wurtsbaugh, PhD [USU]
  - Brad Marden [Parliament Fisheries]
- Project Advisor
  - Earl Byron, PhD [CH2MHill]



Project 2 – Aquatic Ecology

Project Objective

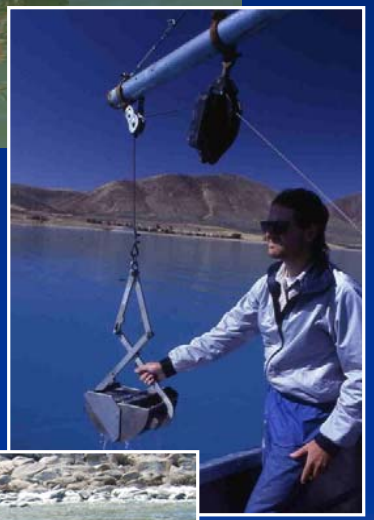
Determine spatial and temporal variation in Se concentrations in the water and in pelagic and benthic food web components leading to the birds of interest.

Project 2 – Aquatic Ecology

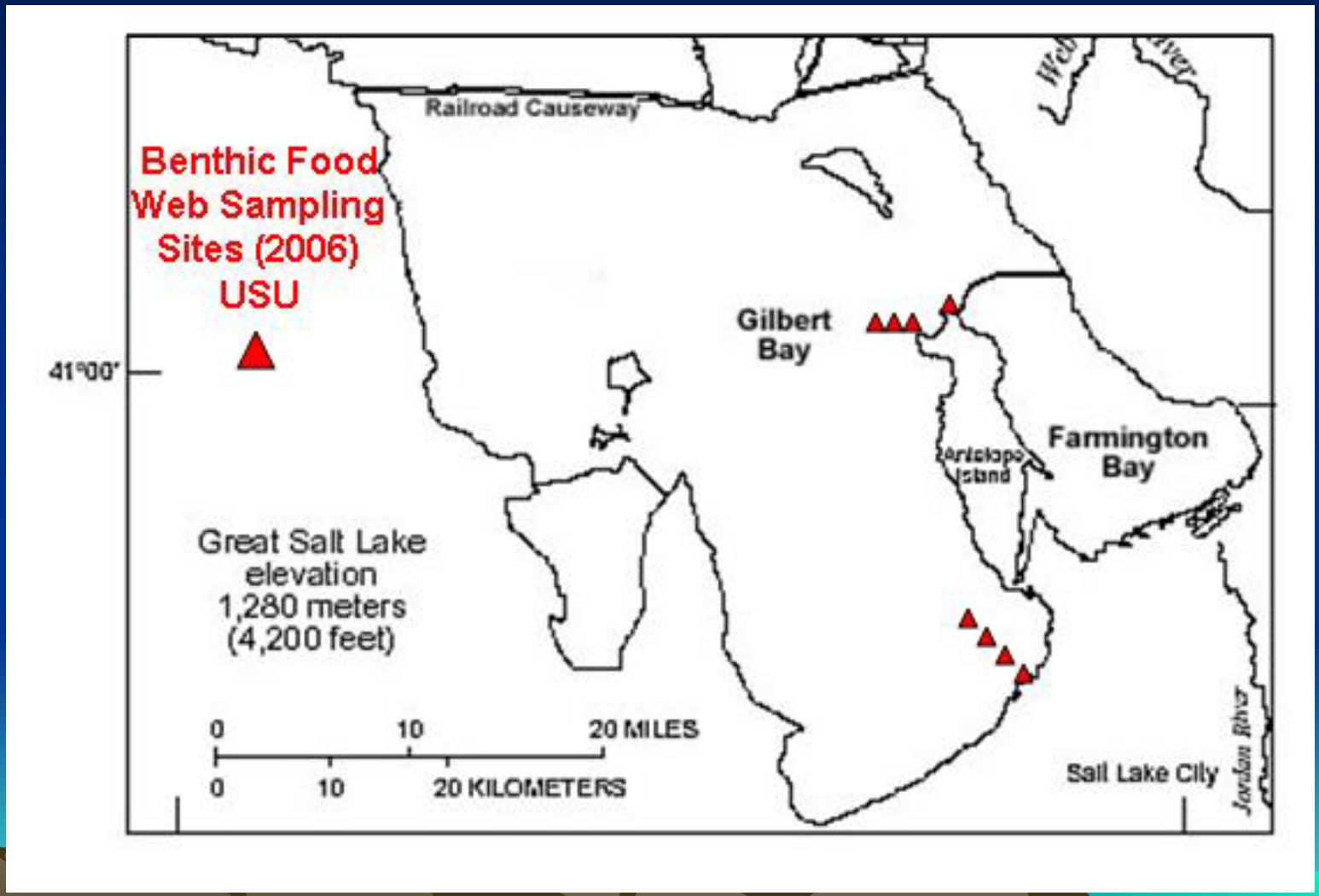
Project Tasks

2A. 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**



Sample Locations



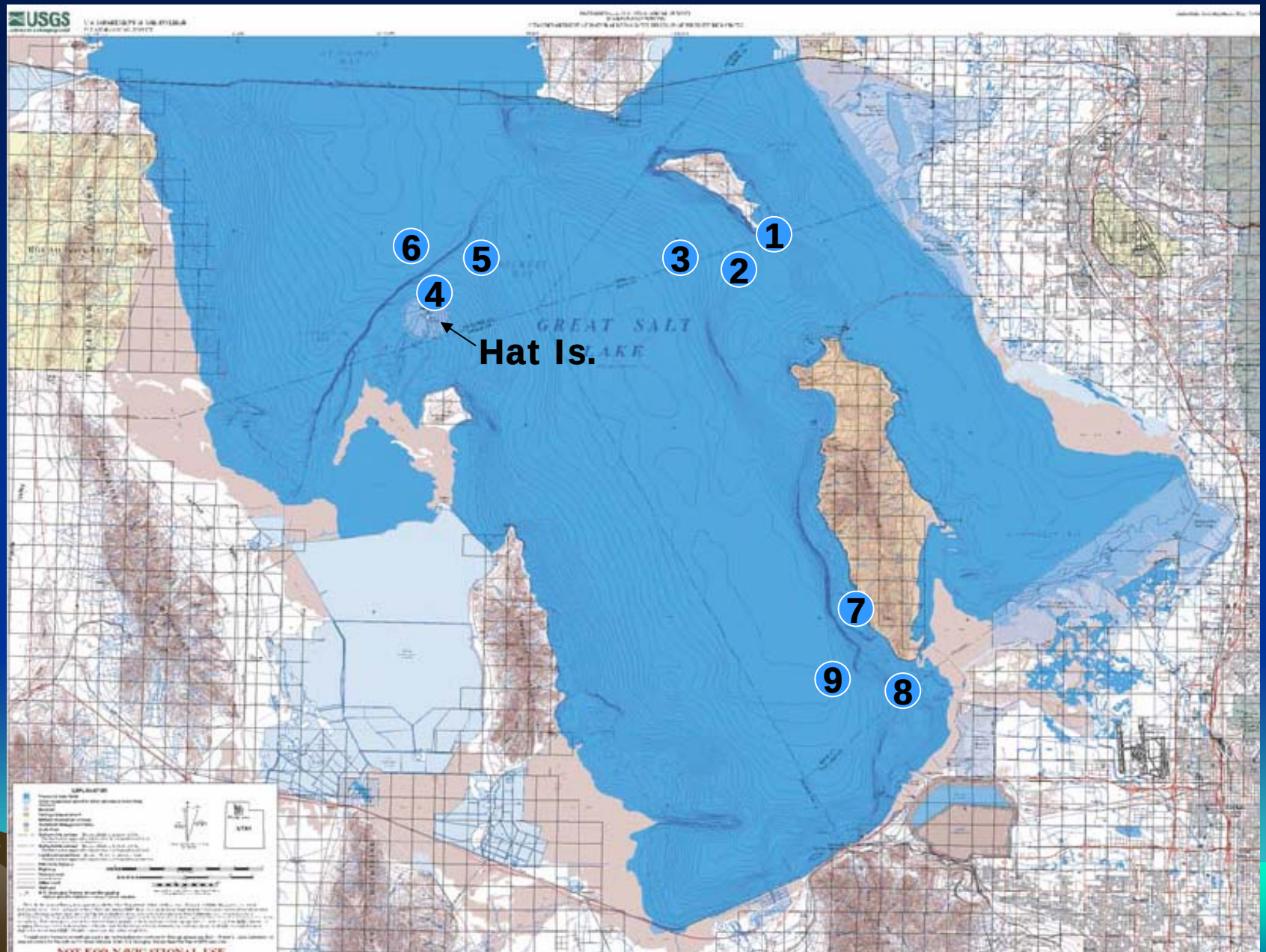
Project 2 – Aquatic Ecology

Project Tasks

2B.Synoptic Survey of Water, Seston & Brine Shrimp [In Process]

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

Sampling Locations



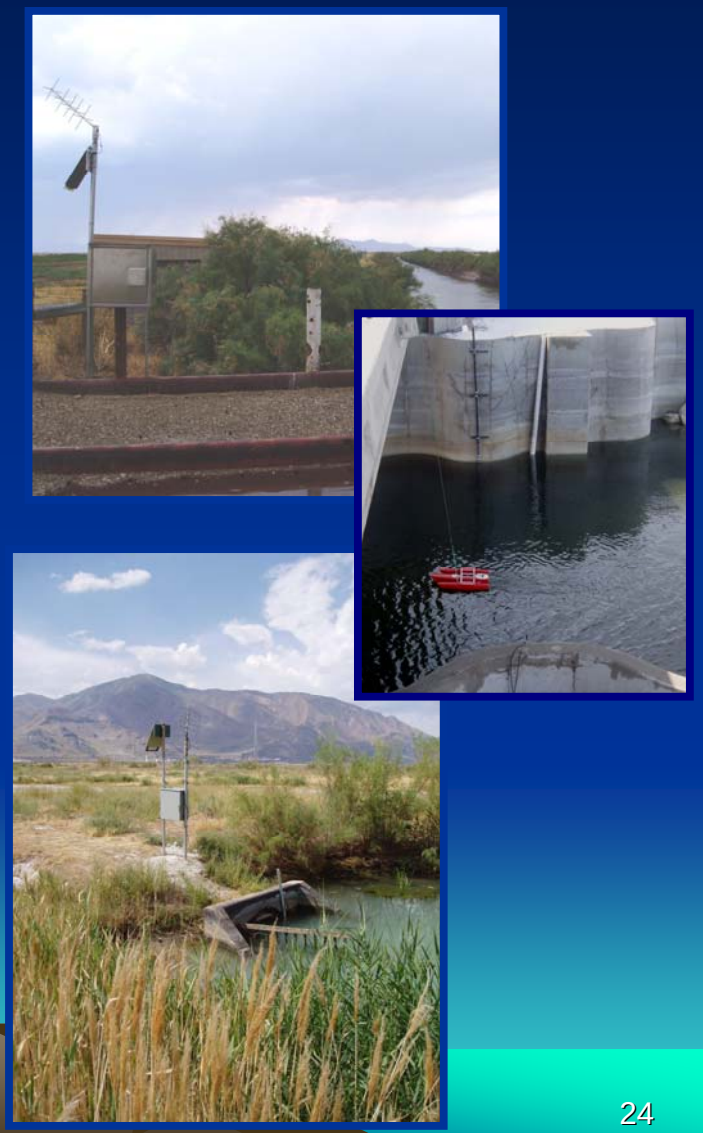
Project 3 – Selenium Loads

- Principal Investigators
  - Dave Naftz, PhD [USGS]
  - Bill Johnson, PhD [UofU]
- Project Advisor
  - Earl Byron, PhD [CH2MHill]

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.

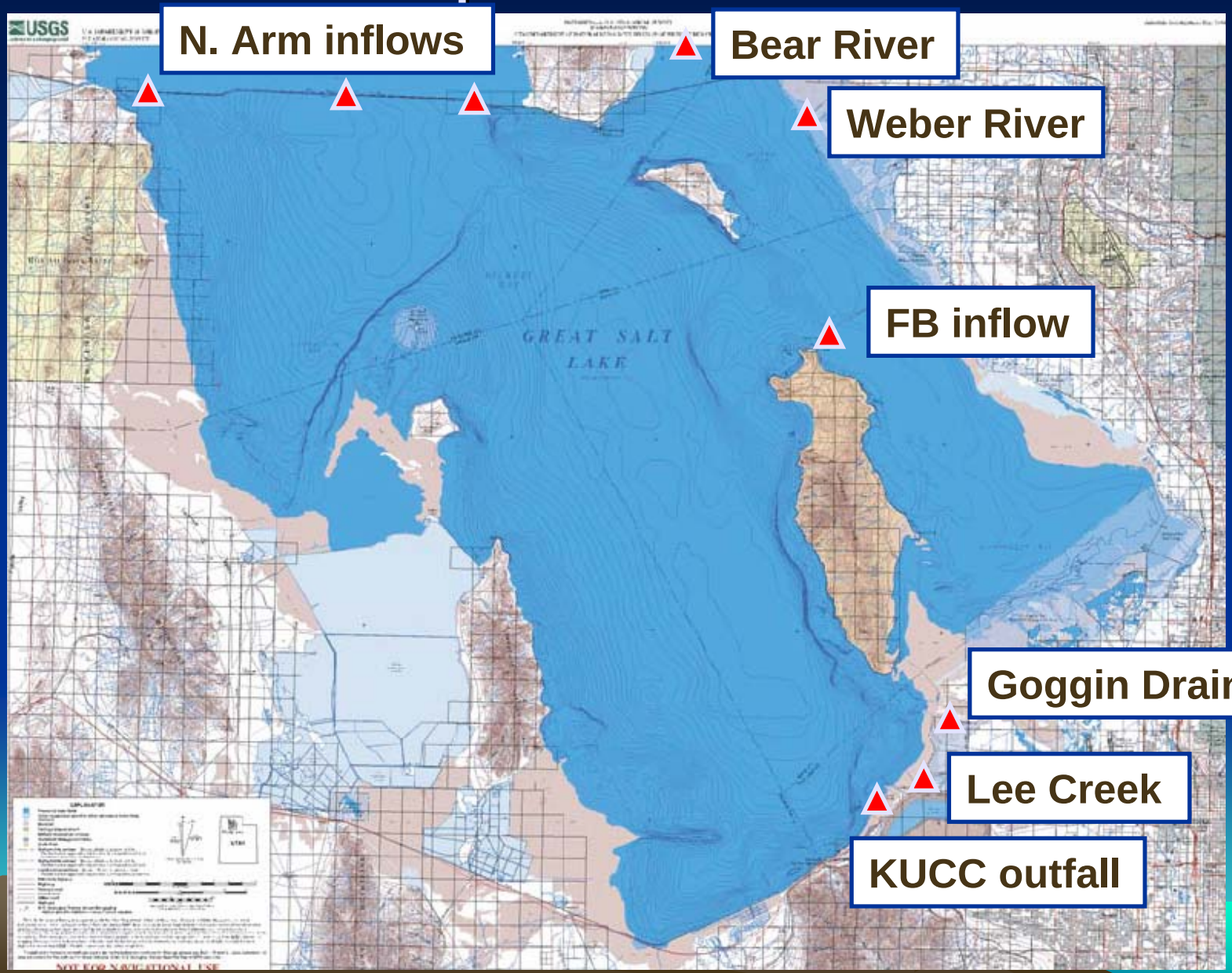


Project 3 – Selenium Loads

Project Tasks

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

Sample Locations



Project 4 – Se in Vapor/Sediment

- Principal Investigators
  - Bill Johnson, PhD [UofU]
  - Dave Naftz, PhD [USGS]
- Project Advisor
  - Earl Byron, PhD [CH2MHill]

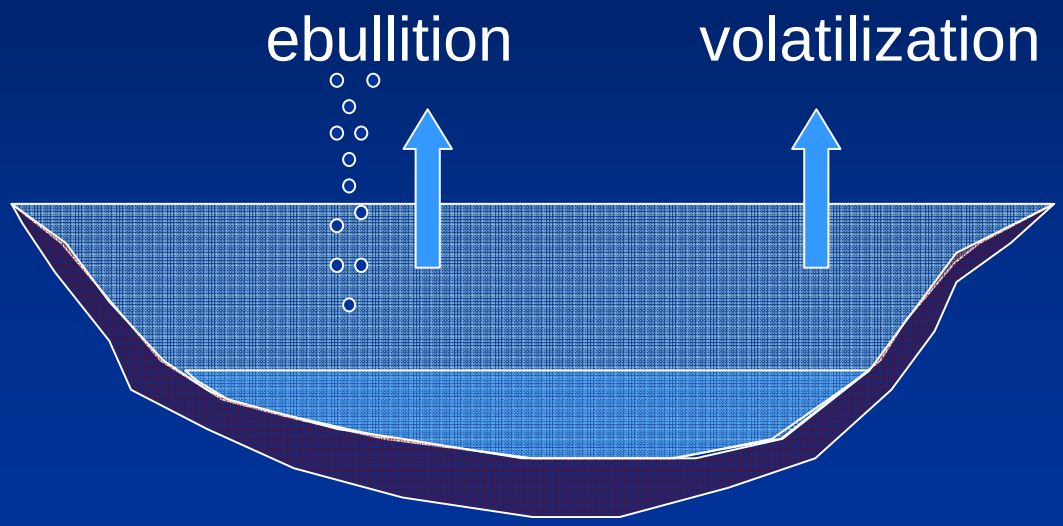
Project 4 – Se in Vapor/Sediment

Project Objective

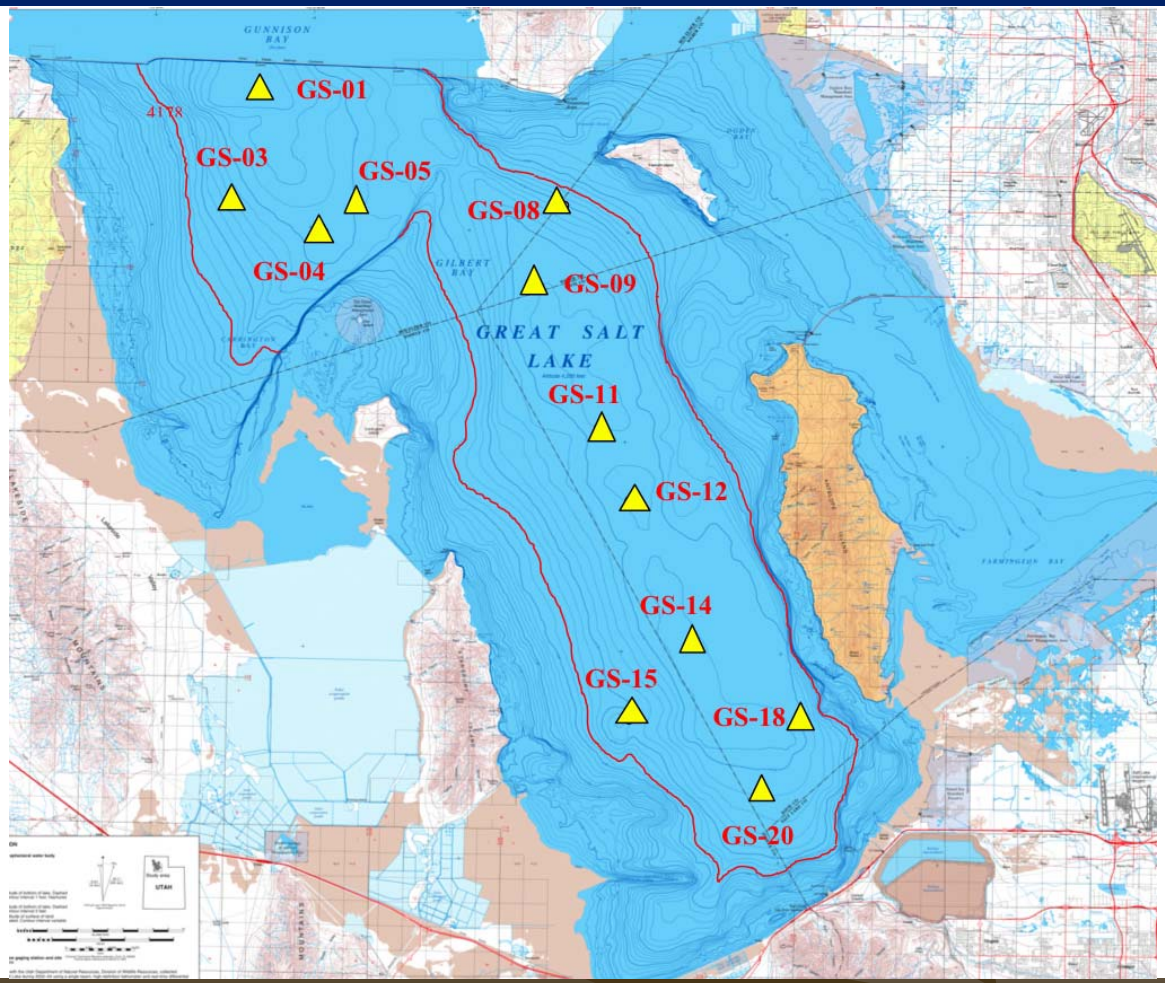
1. Are volatilization and ebullition (bubbling) significant release mechanisms for Se from the GSL?
2. Is Se stored in sediment and do mixing events re-mobilize the Se?
3. Does changing water elevation/lake area re-introduce Se into the water column?

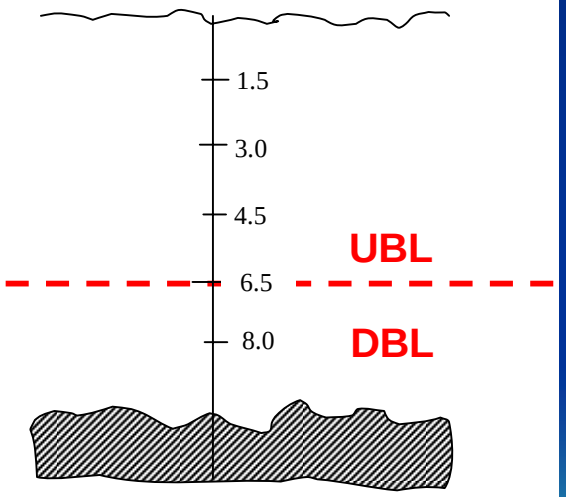
Project 4 – Se in Vapor/Sediment

Task 1. Vapor Selenium Flux



Vapor Flux
Total Dissolved Gas sampling locations



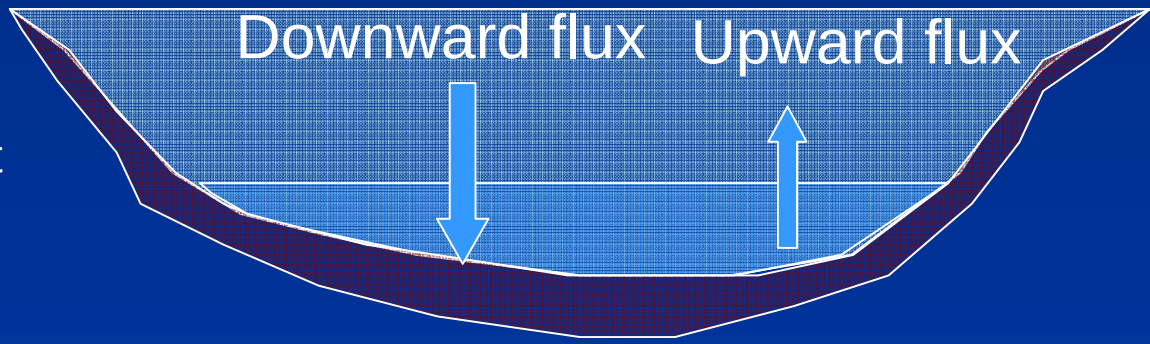


TDG profile

Project 4 – Se in Vapor/Sediment

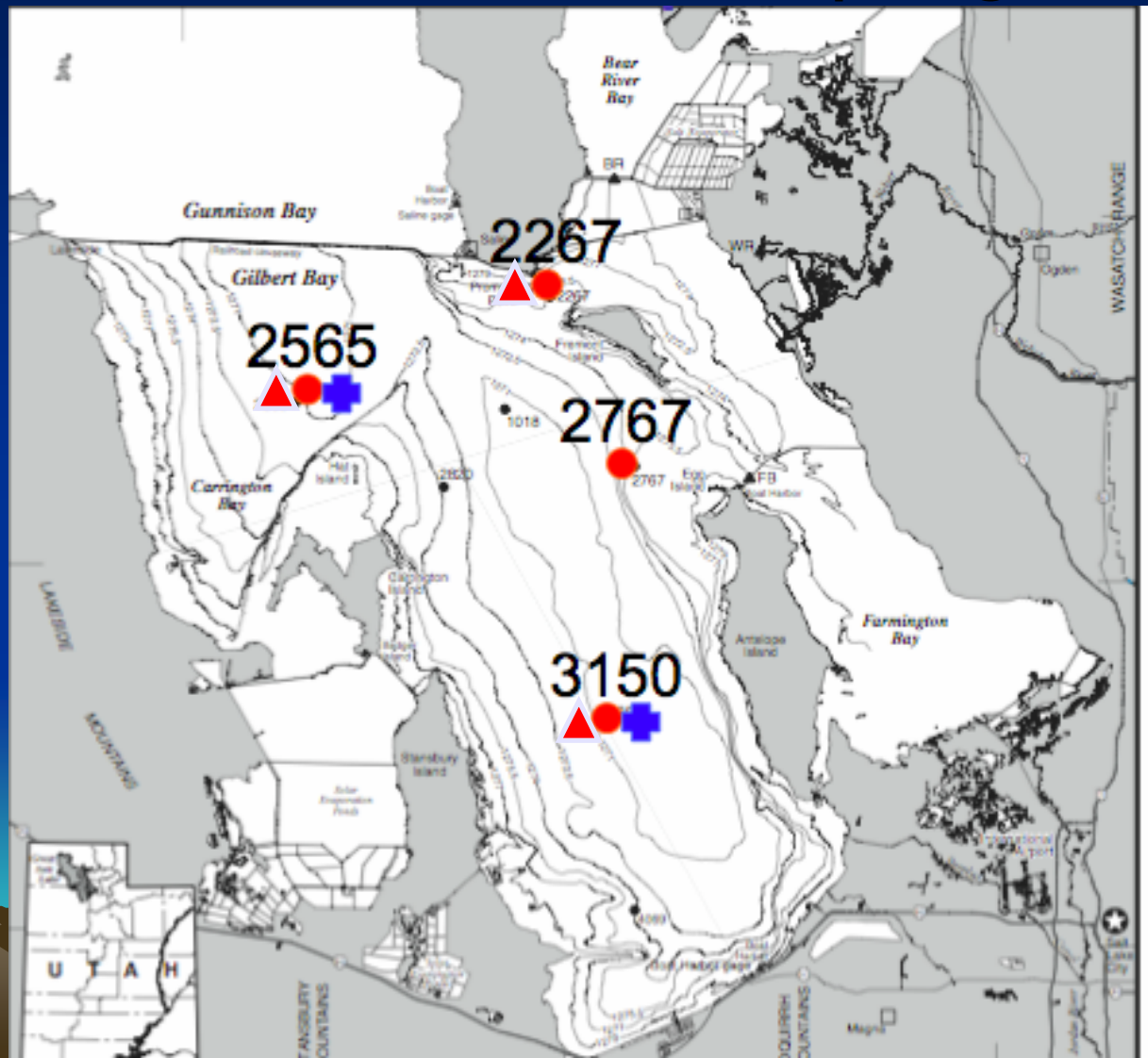
Task 2. Sedimentation Flux

1. Collect Box Cores to evaluate historical burial rate
2. Collect/analyze sediment to evaluate solubilization
3. Evaluate downward flux with sediment traps
4. Evaluate upward flux with thermistors and acoustic device



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

Sediment Flux
Sediment Sampling Locations



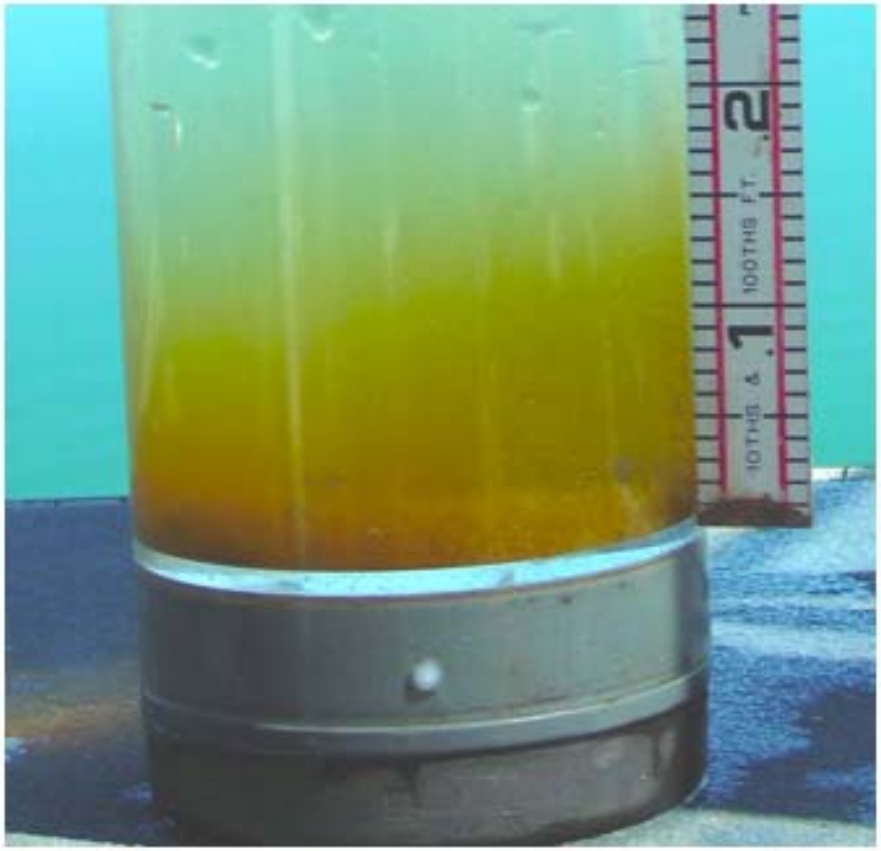
- Box Cores
- Sediment Trap
- Thermistor String

Sediment Coring: July 2006

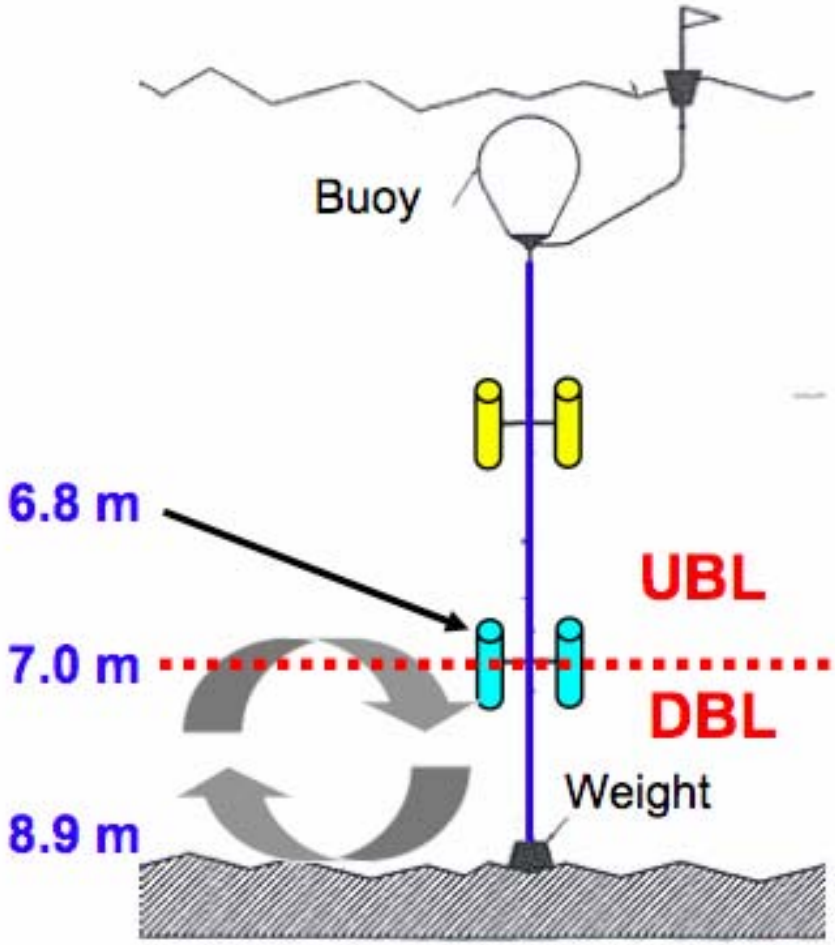
Releasing the box core

Slicing the gravity cores

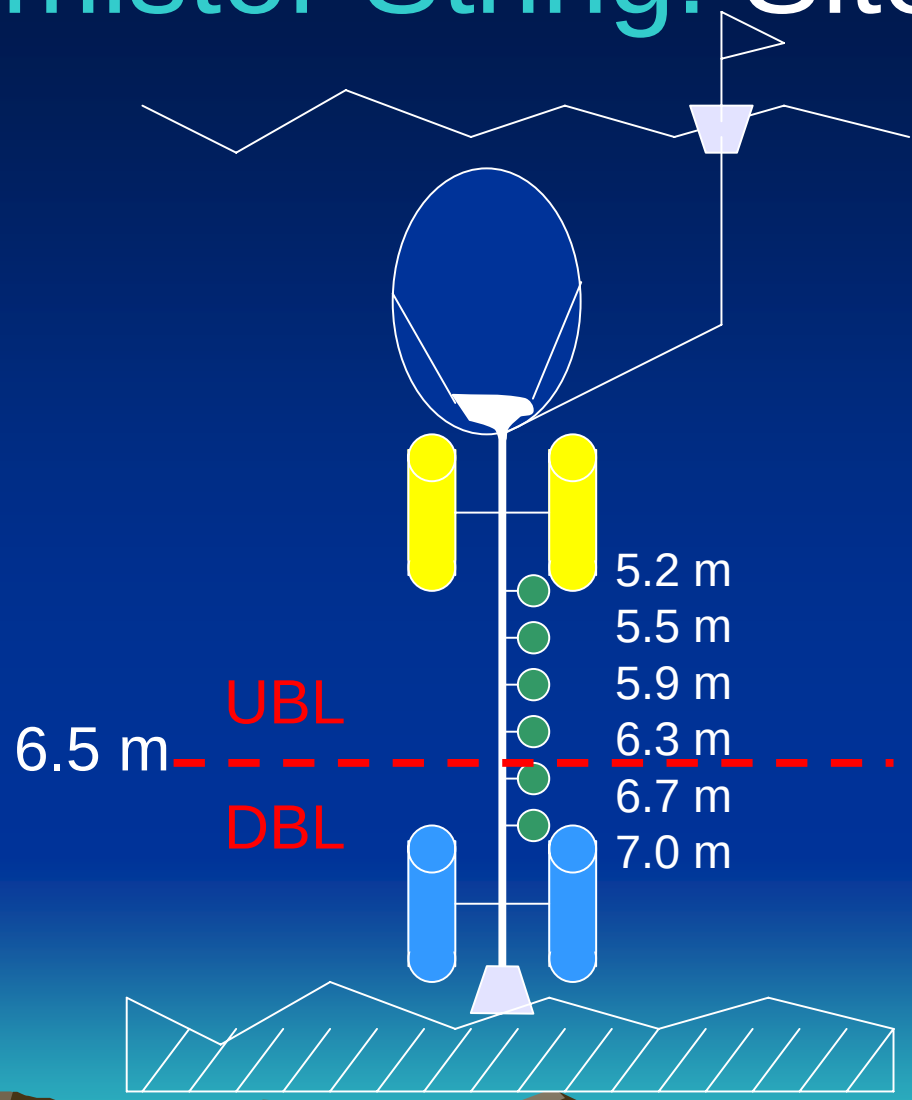
Sediment Traps: Site 3510



Sediment captured from 6/27 to 7/28

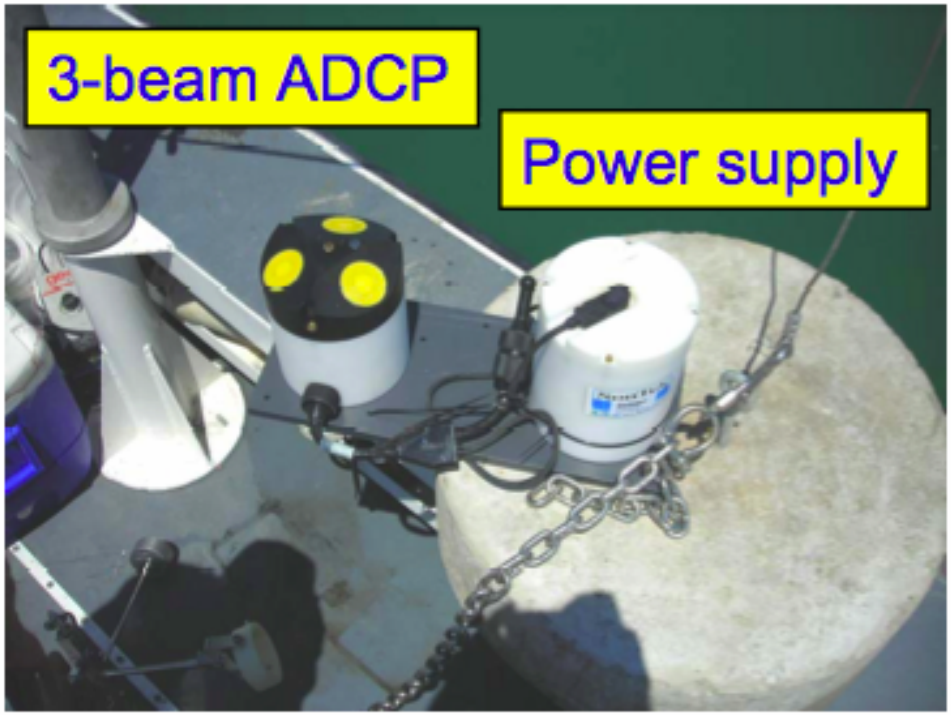


Thermistor String: Site 3510

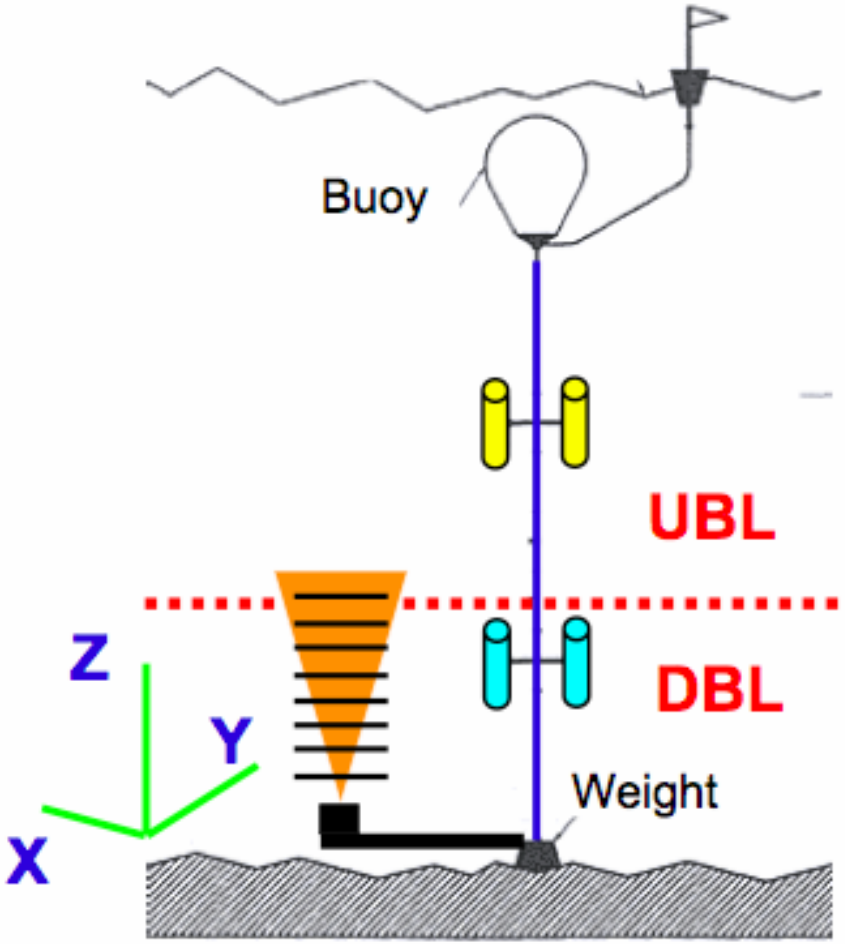


SEDIMENT RESUSPENSION

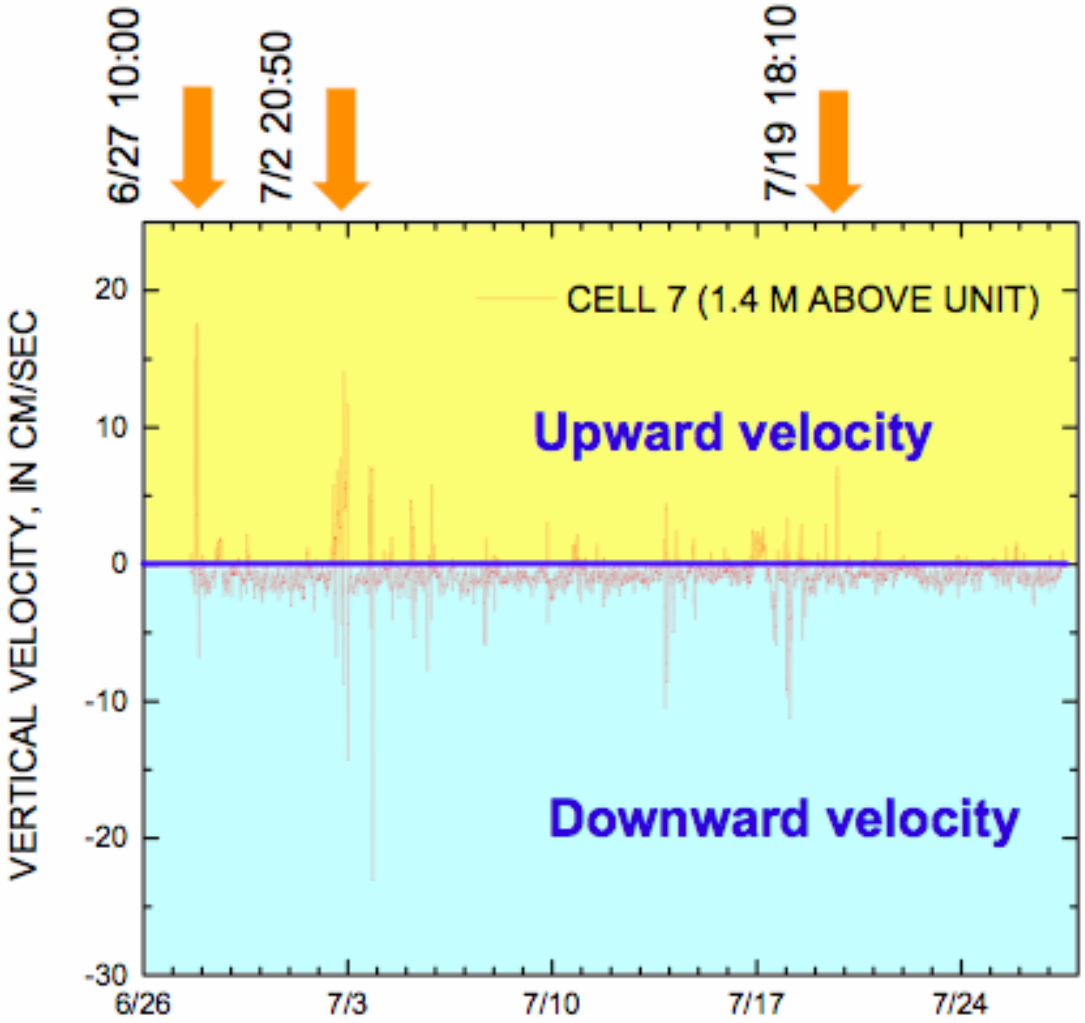
20 minute interval/10 bins

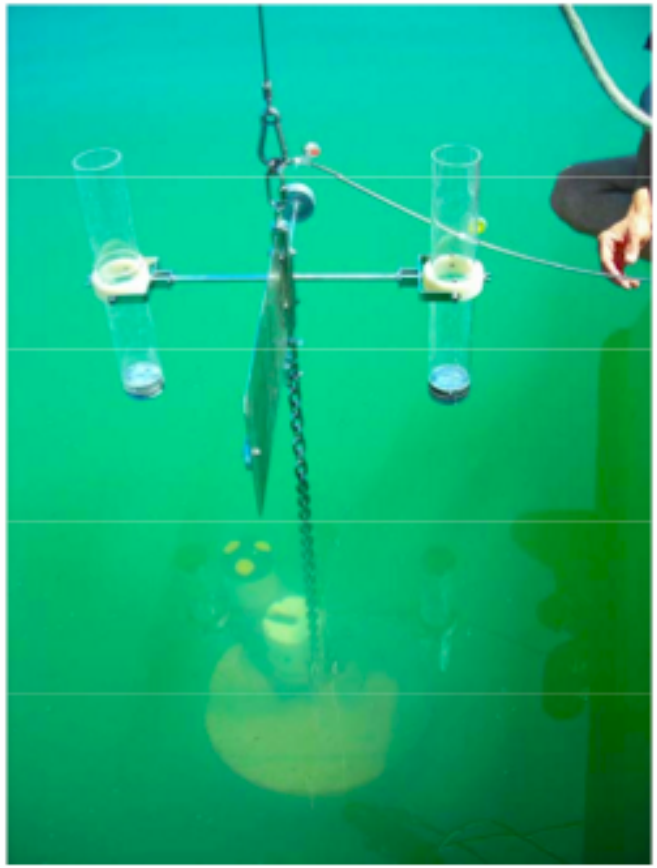


Sediment trap and ADCP installation at site 3510



Vertical velocity measurements





Saying good-bye to $20K

Project Schedule

Final Reports

- Project 1A: December 31, 2006
- Project 1B1: December 31, 2006
- Project 1B2: May 15, 2007
- Project 2A: December 31, 2006
- Project 2B: February 15, 2006

Interim Reports

- Project 3: December 31, 2006
  - Final Report: Year 2 12/31/07, Years 1-3 9/30/08
- Project 4: March 31, 2006
  - Final Report: Vapor 5/31/07, Sediment 8/31/07, Budget 8/31/08

Project Costs

Overall Program Budget (2006 – 2008)
(For all Defined Work including labs)

• Project 1 – Birds	$312,900
• Project 2 – Food Chain	$163,300
• Project 3 – Selenium Loading	$213,600
• Project 4 – Selenium Flux	$347,000
• CH2M HILL Program Support	$198,700
• Undefined Support for ’07/’08	$106,200
• TOTAL	$1,341,700

Great Salt Lake Water Quality Studies

Next Science Panel Meeting

- –Conference Calls Monthly
- –Next Meeting: November 15-16, 2006

Questions?