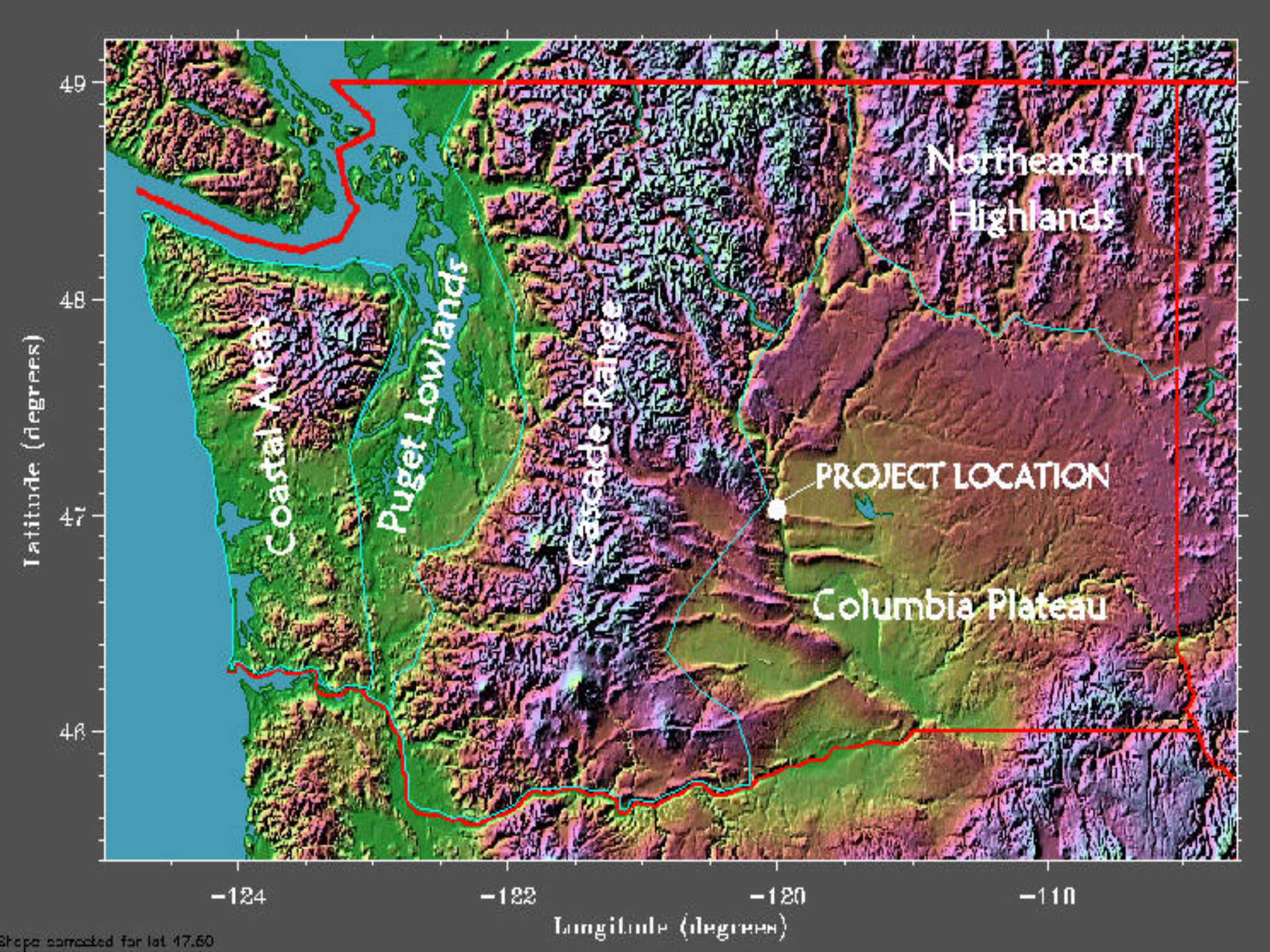
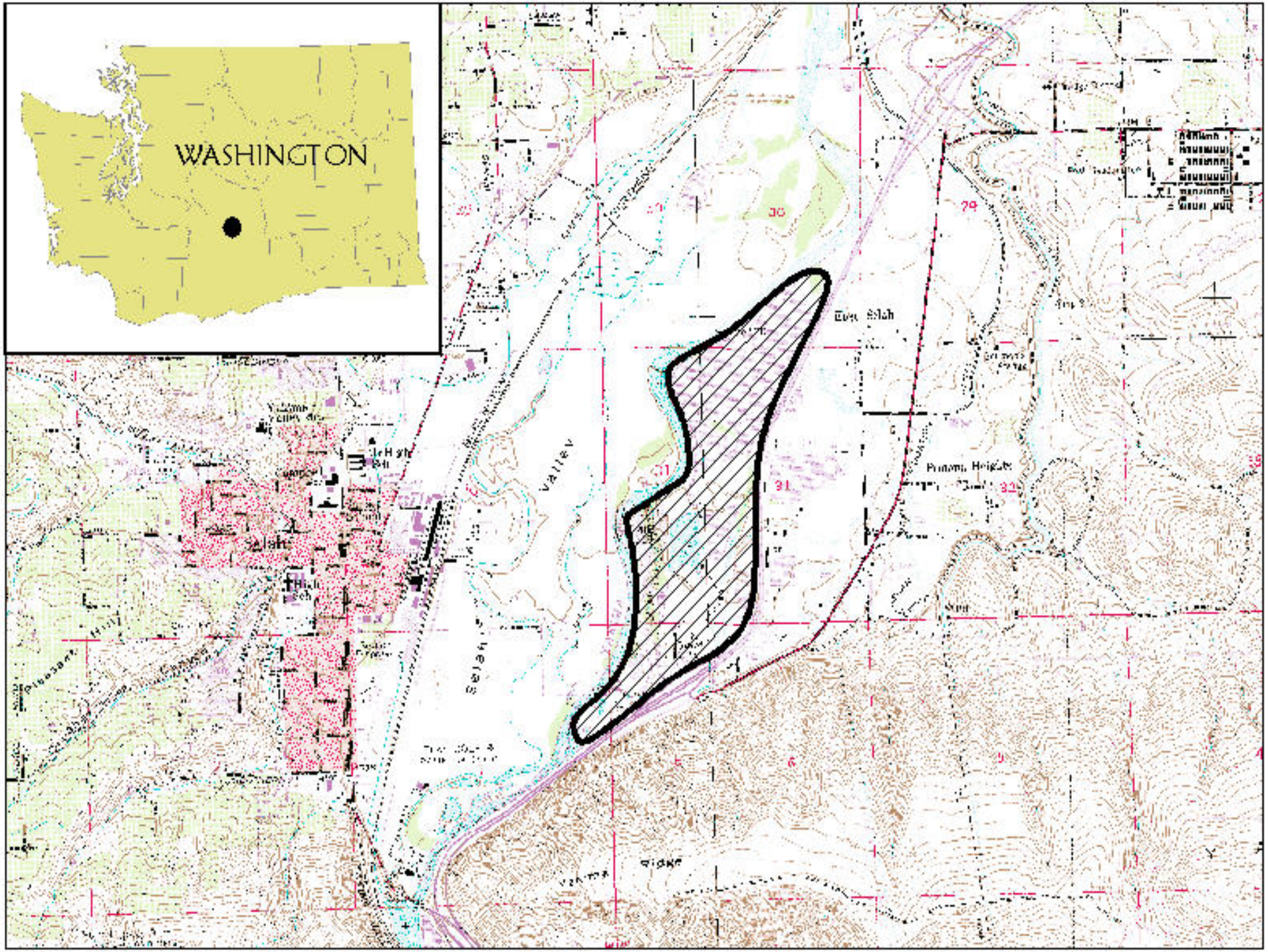
Thermal Transport Investigation Selah Lakes Gravel Mine

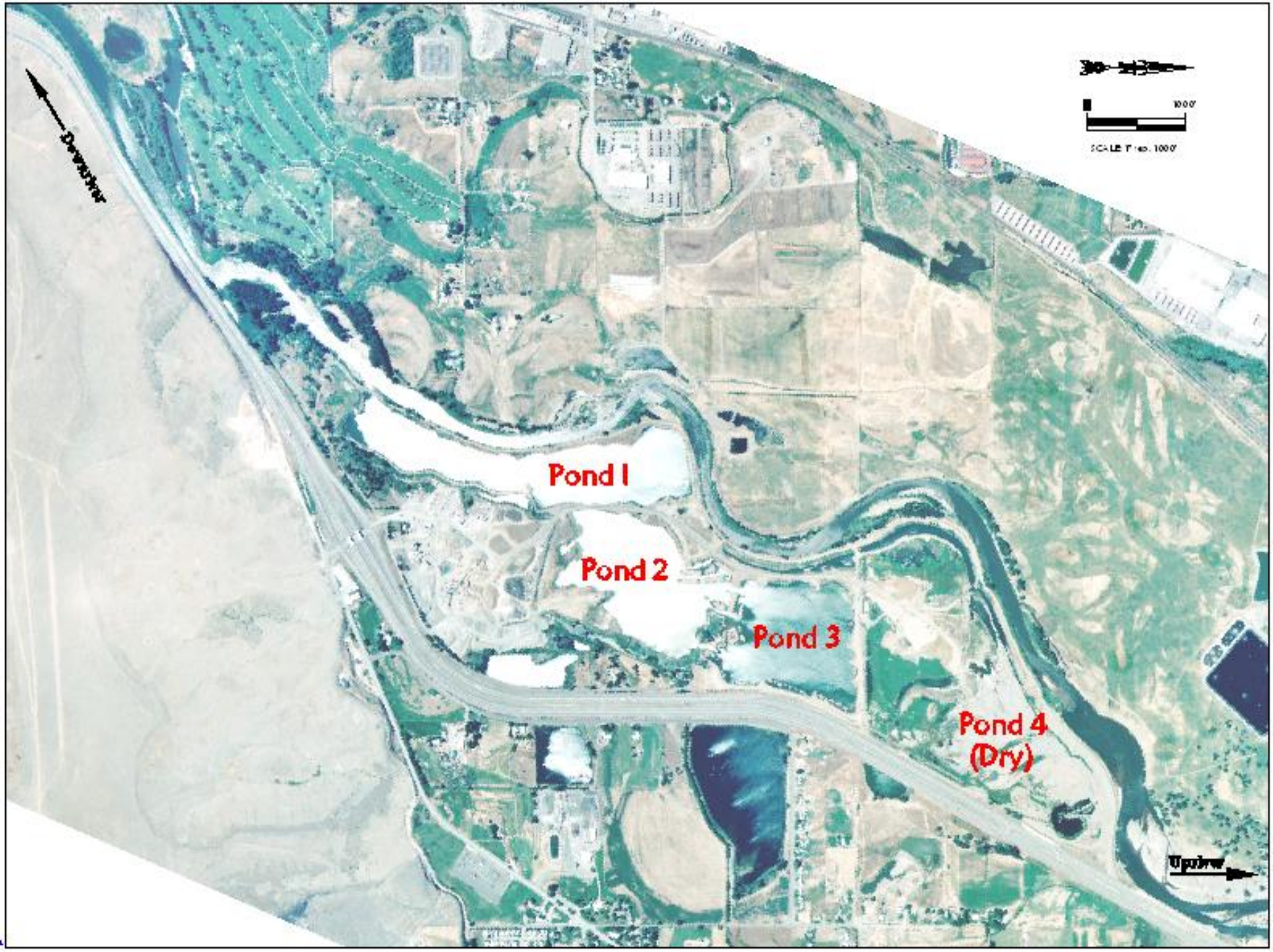
1999-2003

DAVID BROWN & Associates, Inc.

Consultants in the Earth Sciences


Northeastern Highlands
Coastal Area
Puget Lowlands
Cascade Range
PROJECT LOCATION
Columbia Plateau
49
48
47
46
Latitude (degrees)
−124
−122
−120
−118
Longitude (degrees)
Shape corrected for lat 47.60


WASHINGTON
Valley
Ridge
Potomac Heights


Downstream
1000'
Pond 1
Pond 2
Pond 3
Pond 4
(Dry)
Upstream

Project History

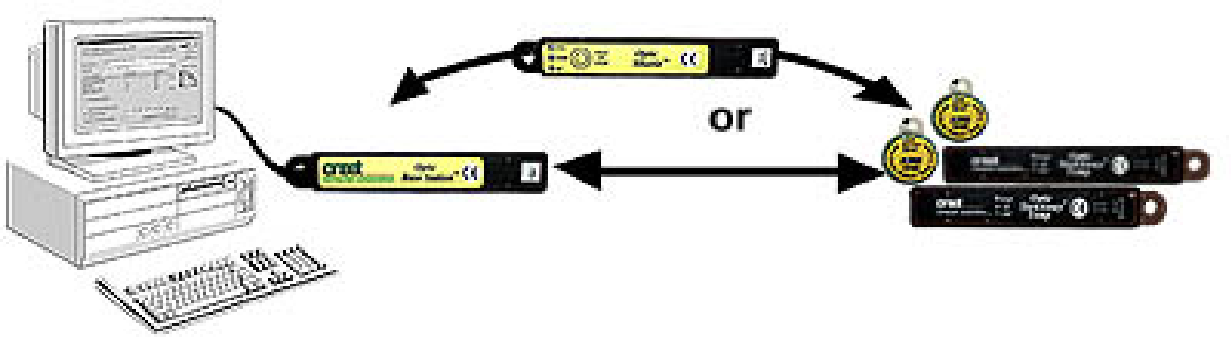
- Regulatory Involvement
- David Brown & Associates introduced to project

Methodology

- Initial techniques used to collect water temperature data

Methodology

- Onset Optic StowAway® continuous data loggers

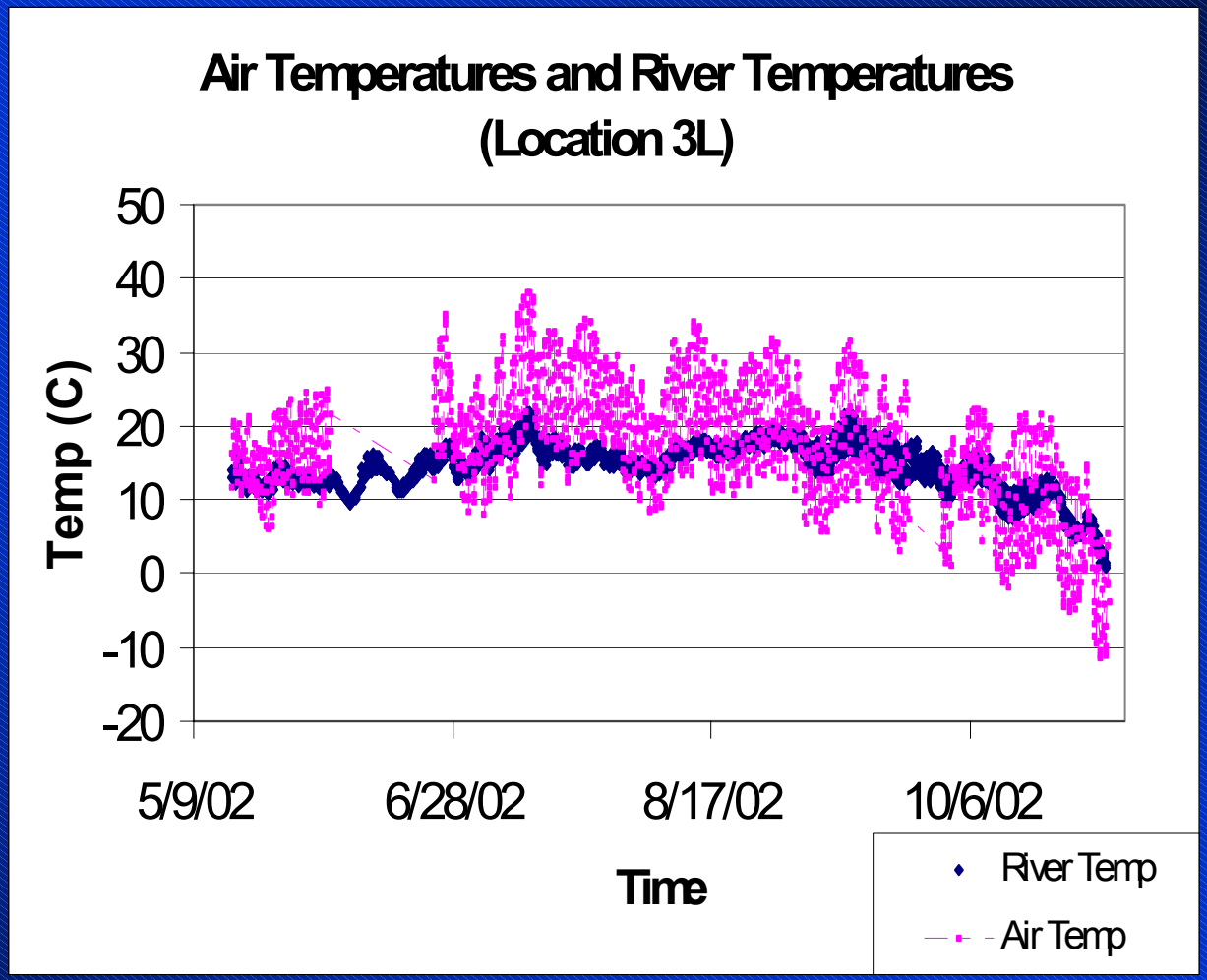


Methodology

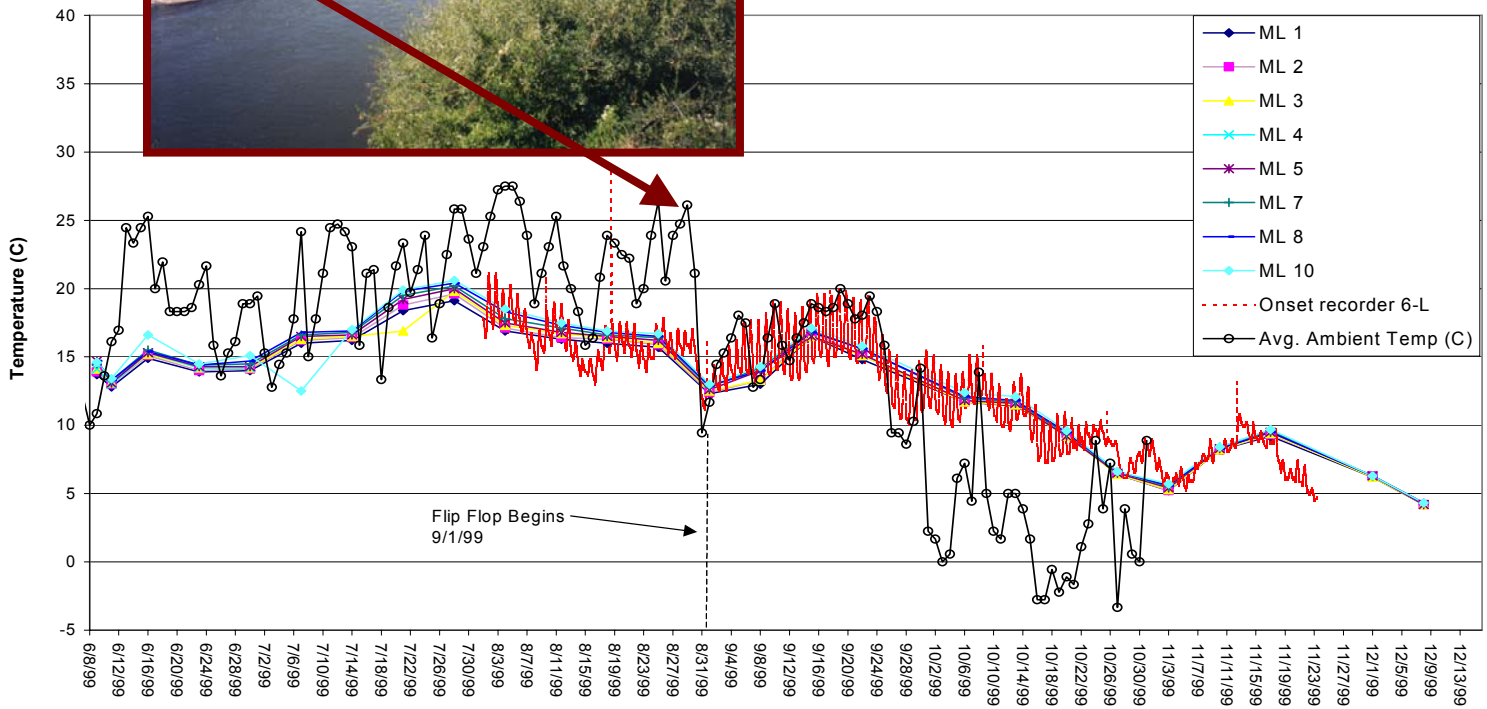
- Water Rockets for sensor protection which allow water to flow through

Atmospheric Data

- Weather Station installed at the on site Selah Office.
- GroWeather Software used to collect data point every 30 min.
- NOAA Weather Station (Selah 2 NE) located across the Yakima river was used for data comparison.

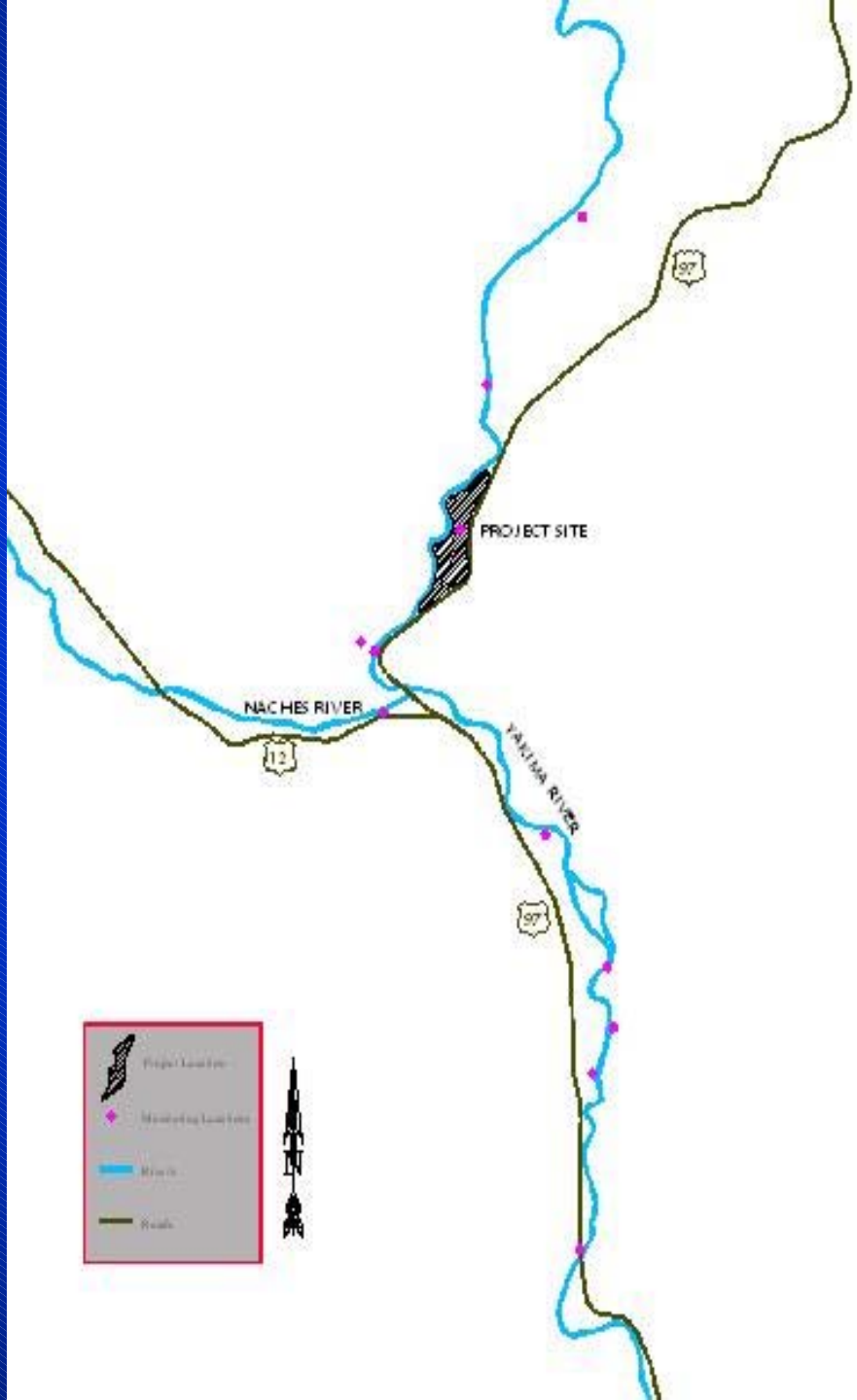


Naches River entering the Yakima River during "Flip-Flop"



**Note: Air temperatures collected from Selah NOAA station #457522*

Monitoring Locations



Sensor Locations at Selah Lakes Site

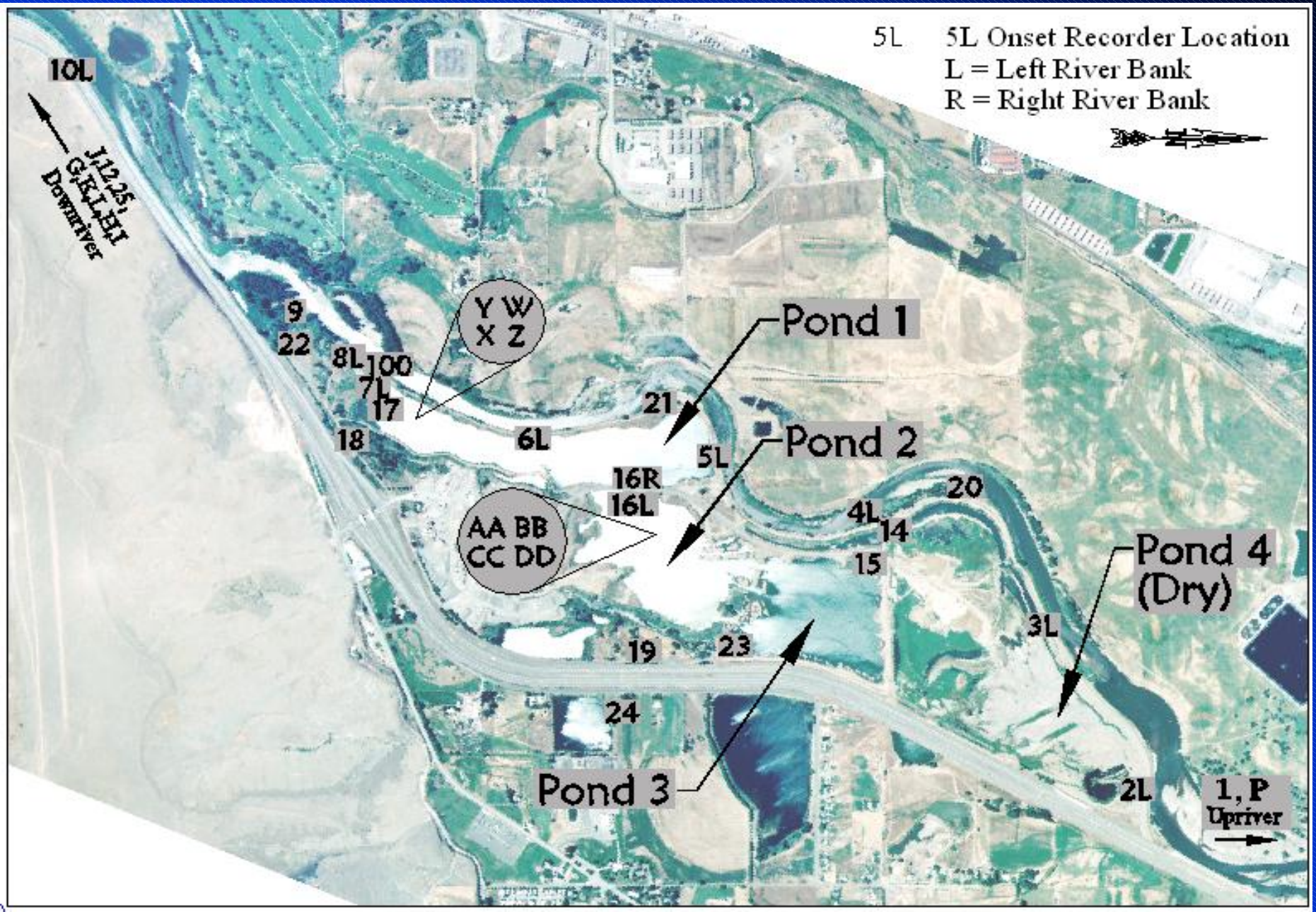
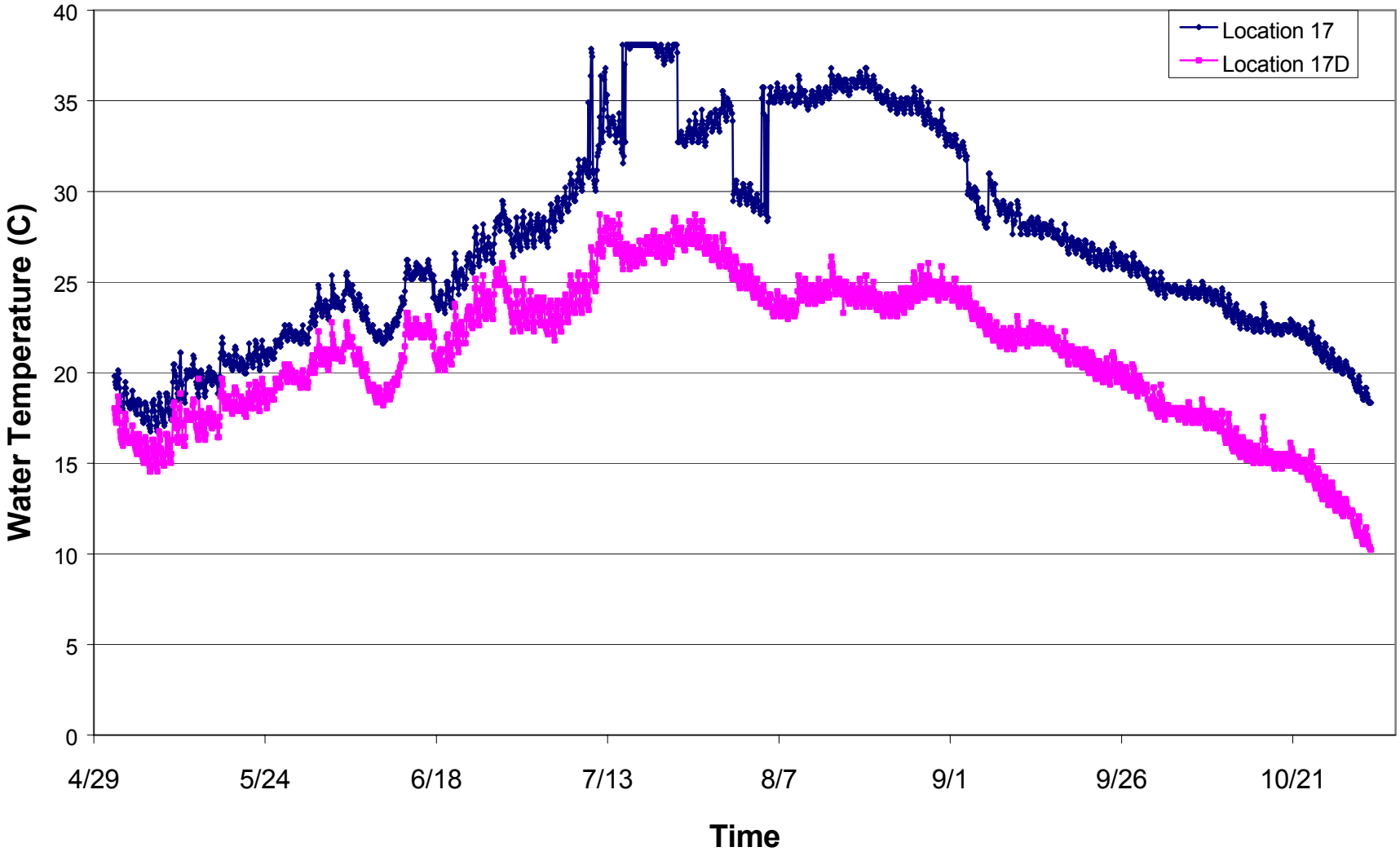
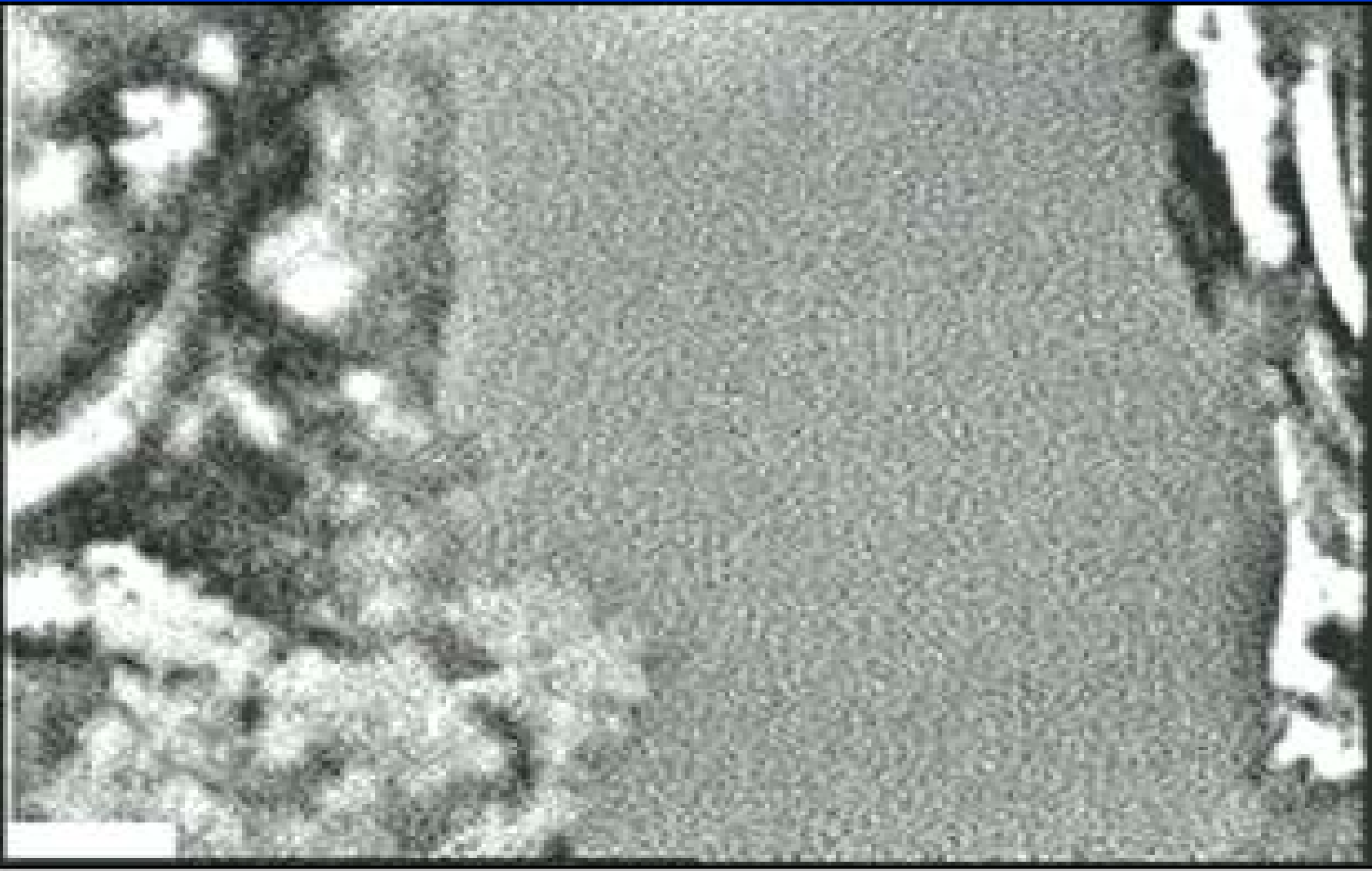


Figure 1. Quality Control Plot Comparing Water Temperatures Recorded at Locations 17 and 17D Between 5-2-0 2 and 11-1-02.

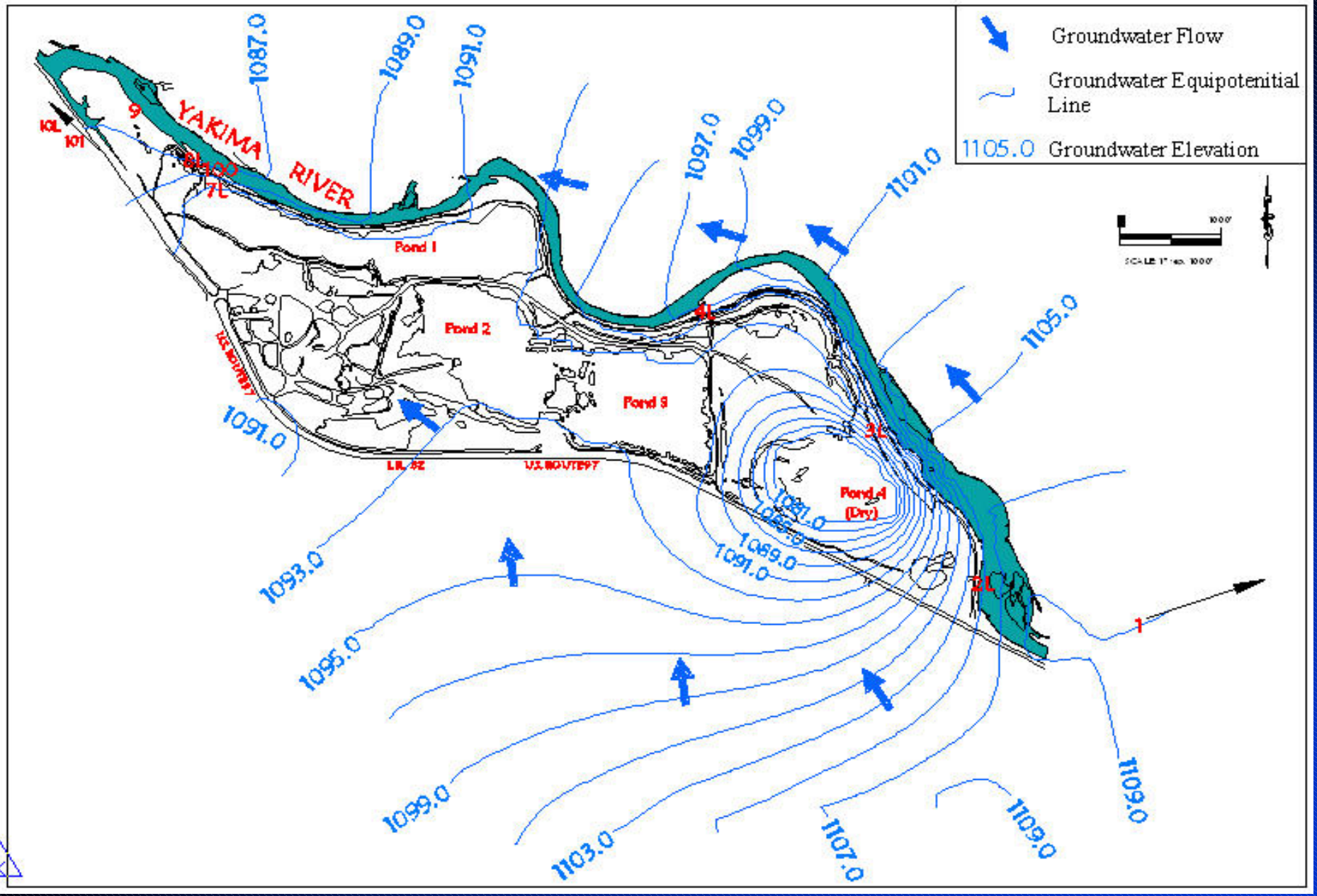


Infrared Video

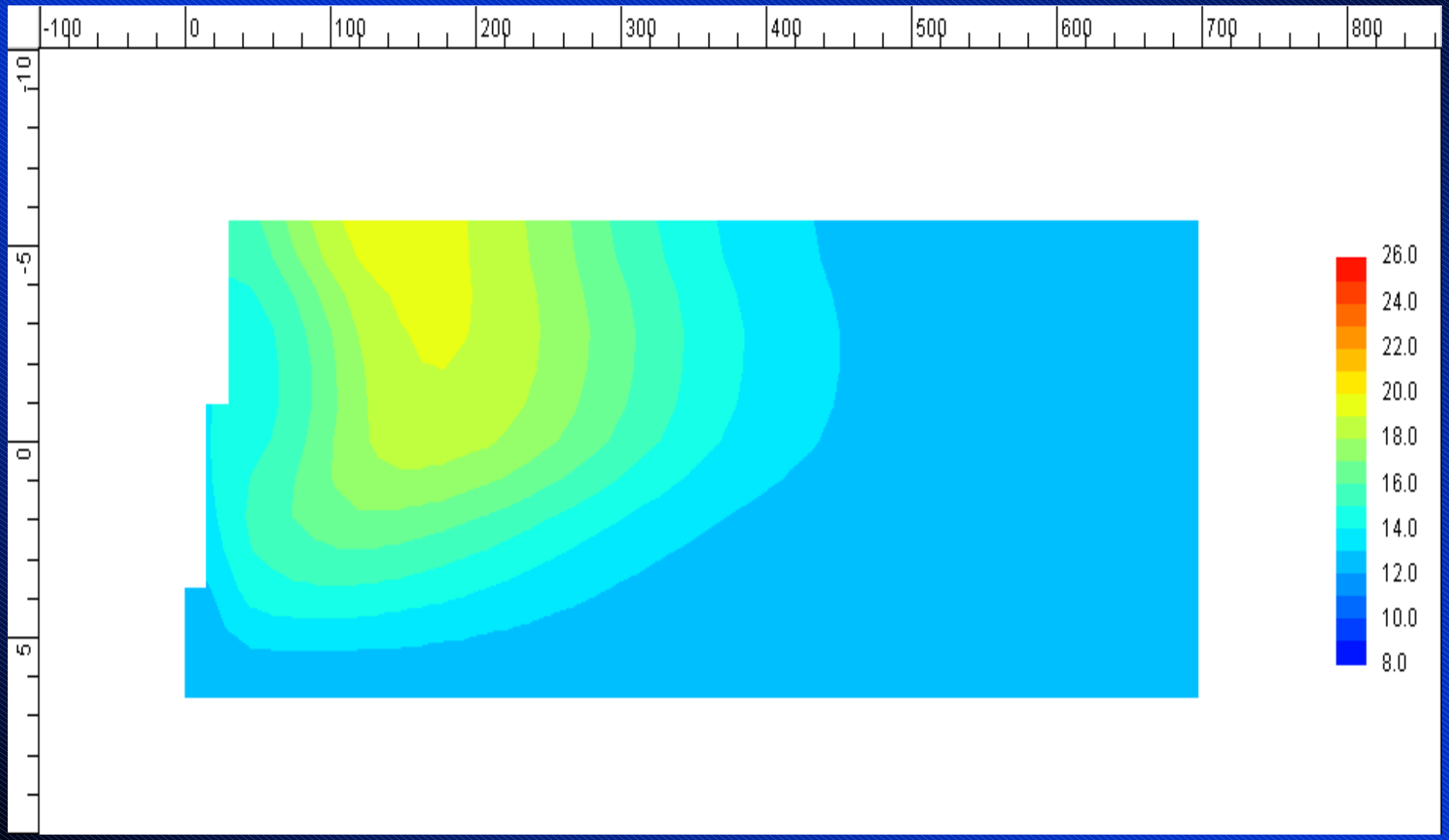


083199.mpg

MODFlow® Groundwater Model

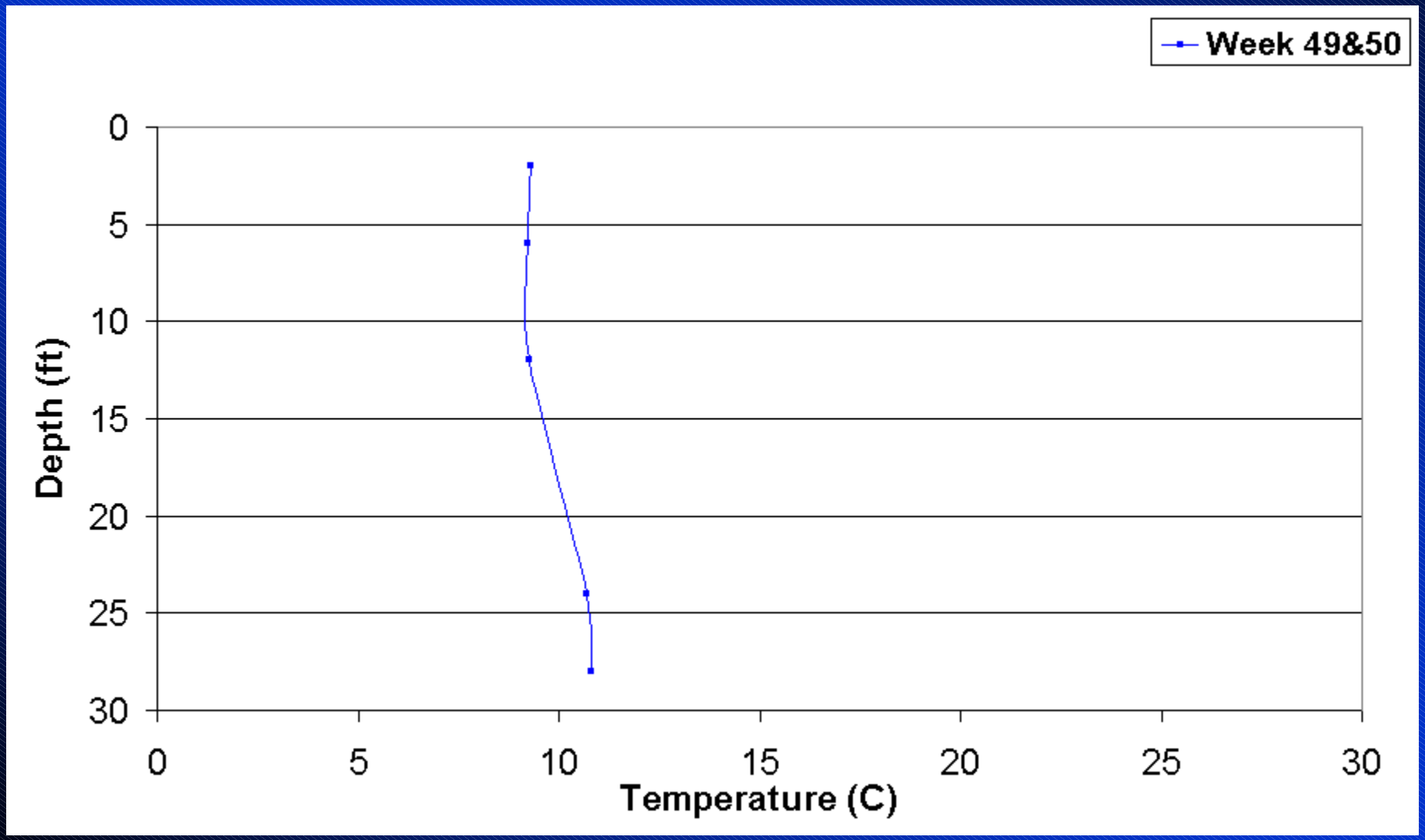


Thermal Modeling



Pond System

- Pond Temperature with Depth

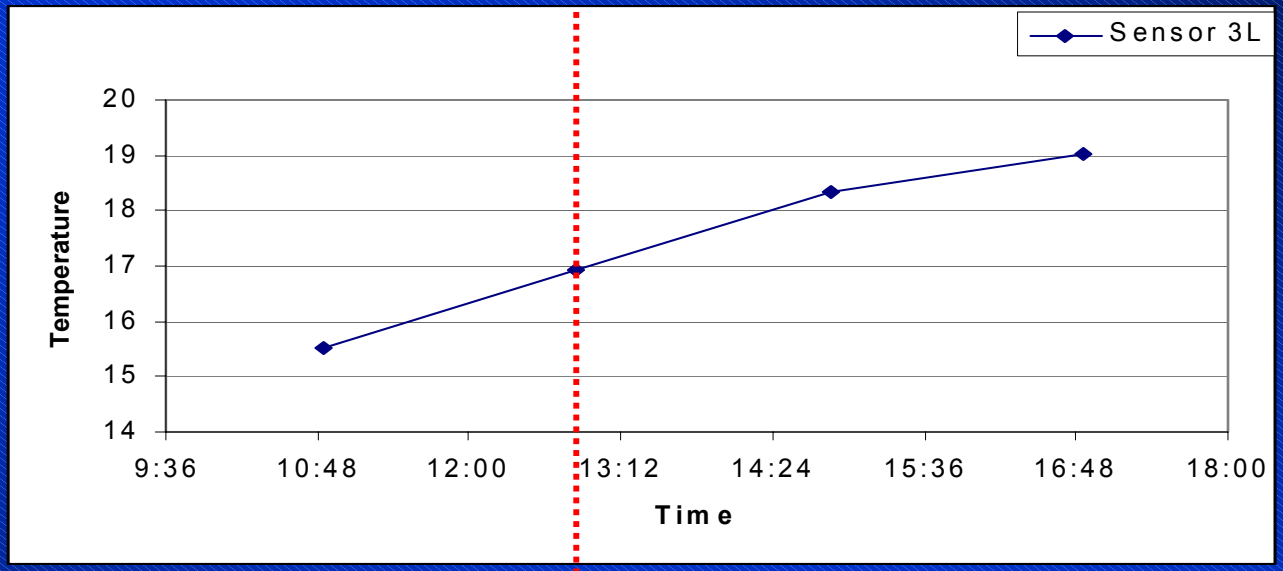


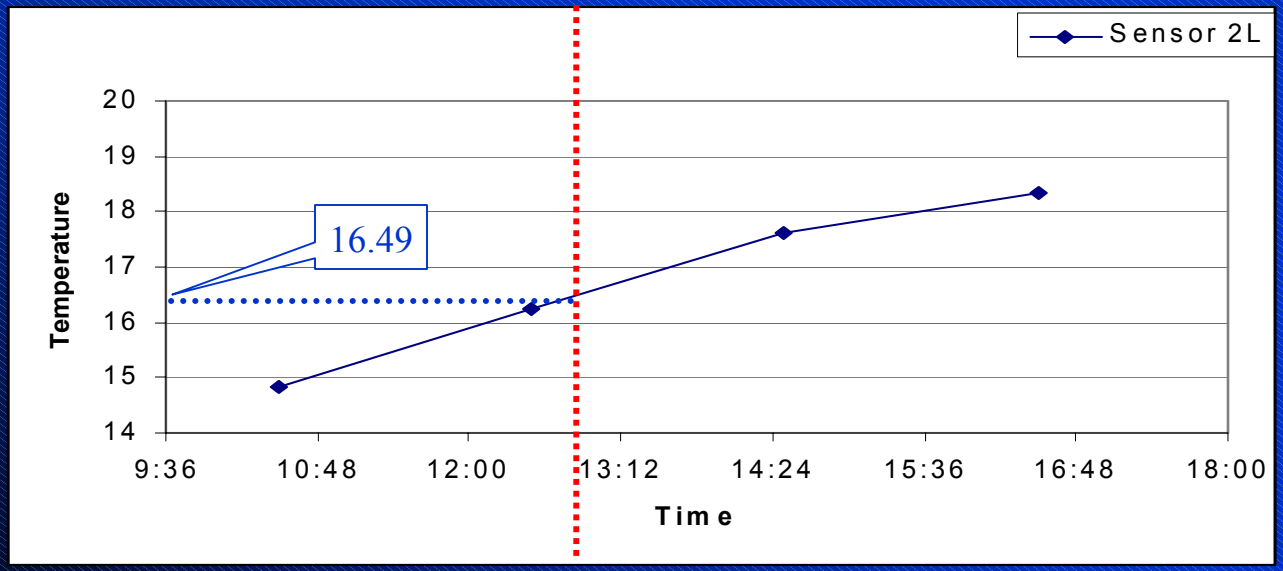
Thermal Gradients

- Development of Gradients as a way to see if heating or cooling over the river reach adjacent to the Selah Site.

- Unified time scales for direct comparison from one adjacent sensor to the next

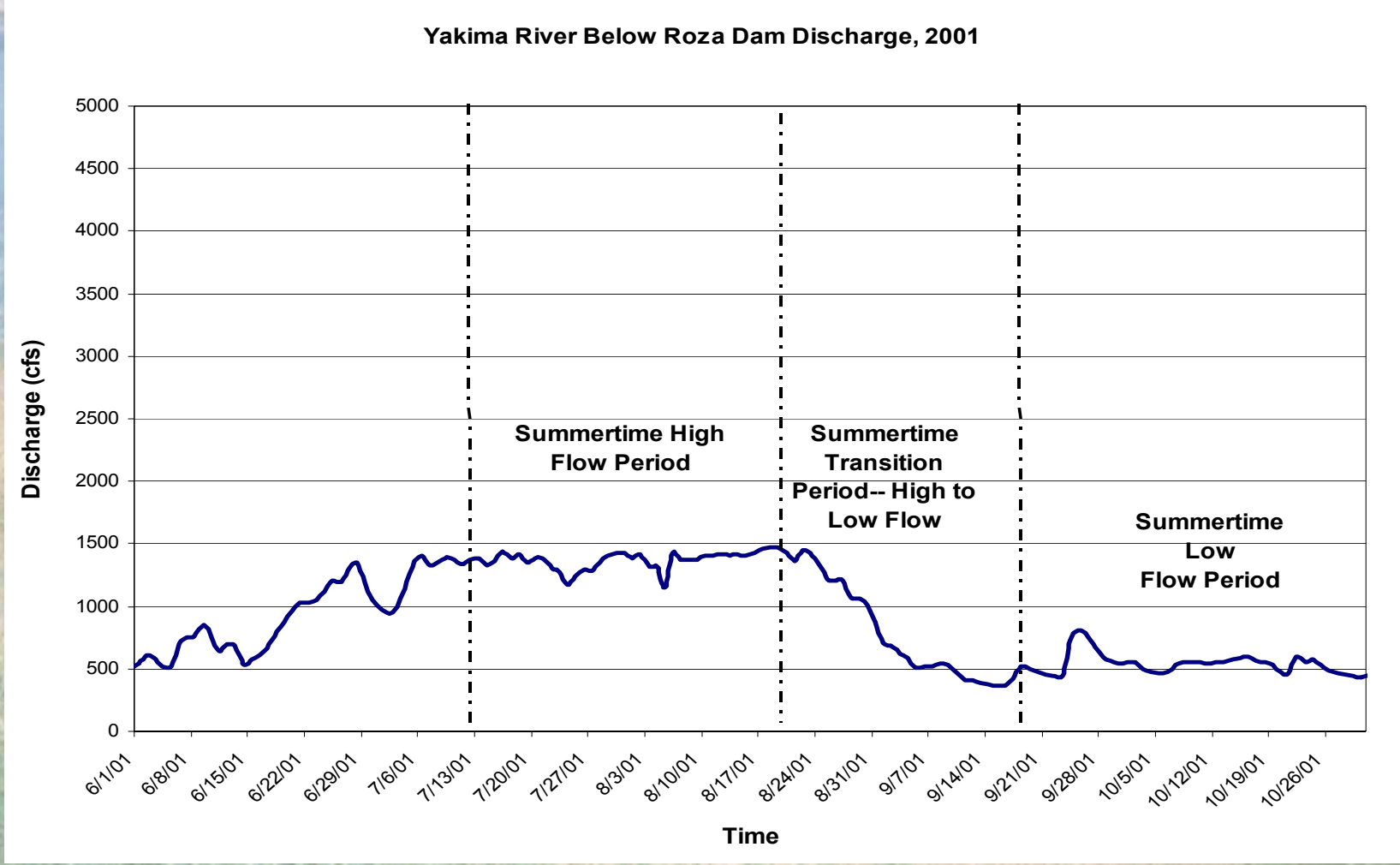
Linear Regression Analysis





Thermal Gradients

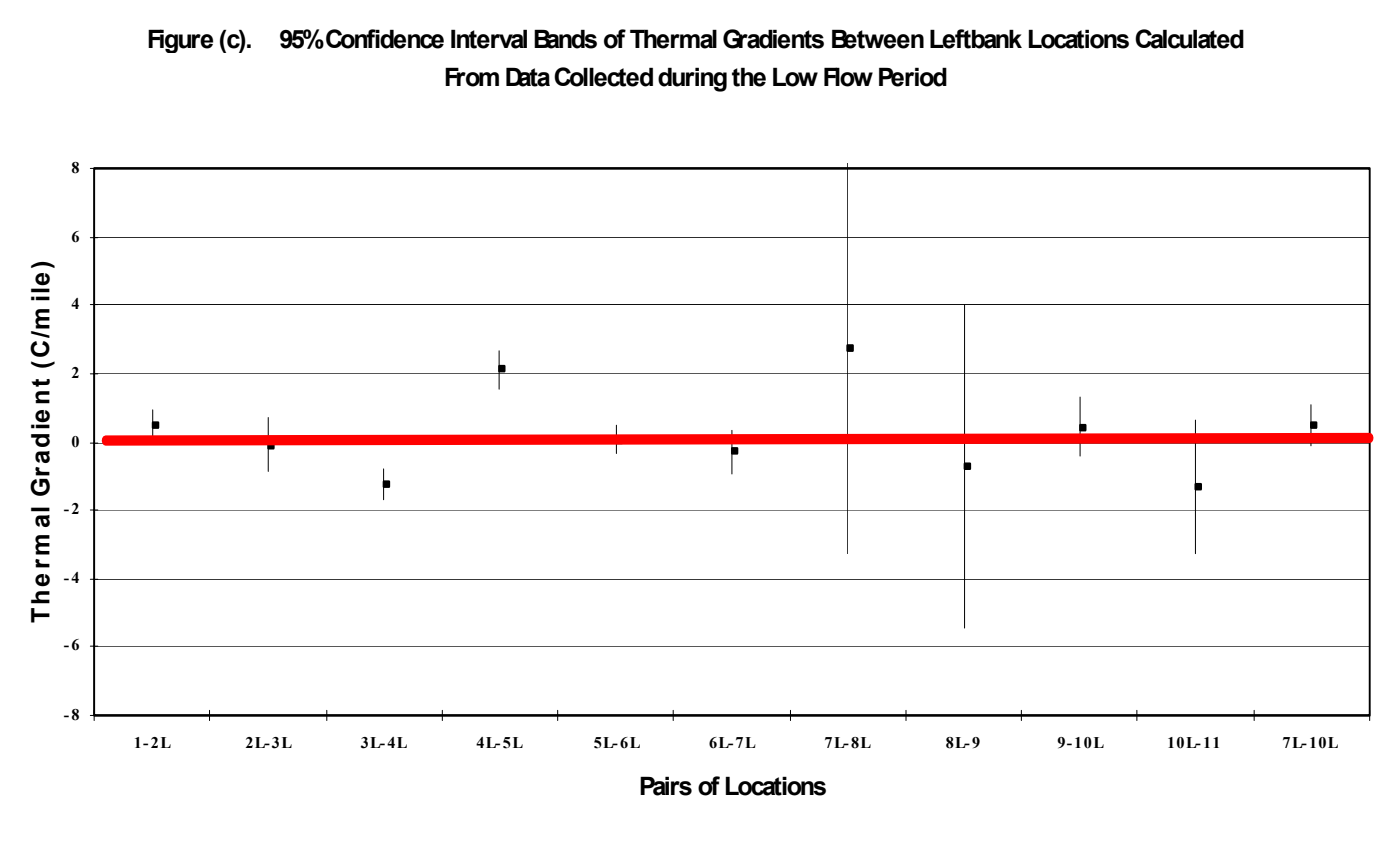
- Data grouped into three distinct time periods based on Yakima River discharge levels



Statistical Analysis of Gradients

- Mean Value and Standard Deviation
- 2-sided T-test: probability that the mean thermal gradient within a particular block was significantly different from zero

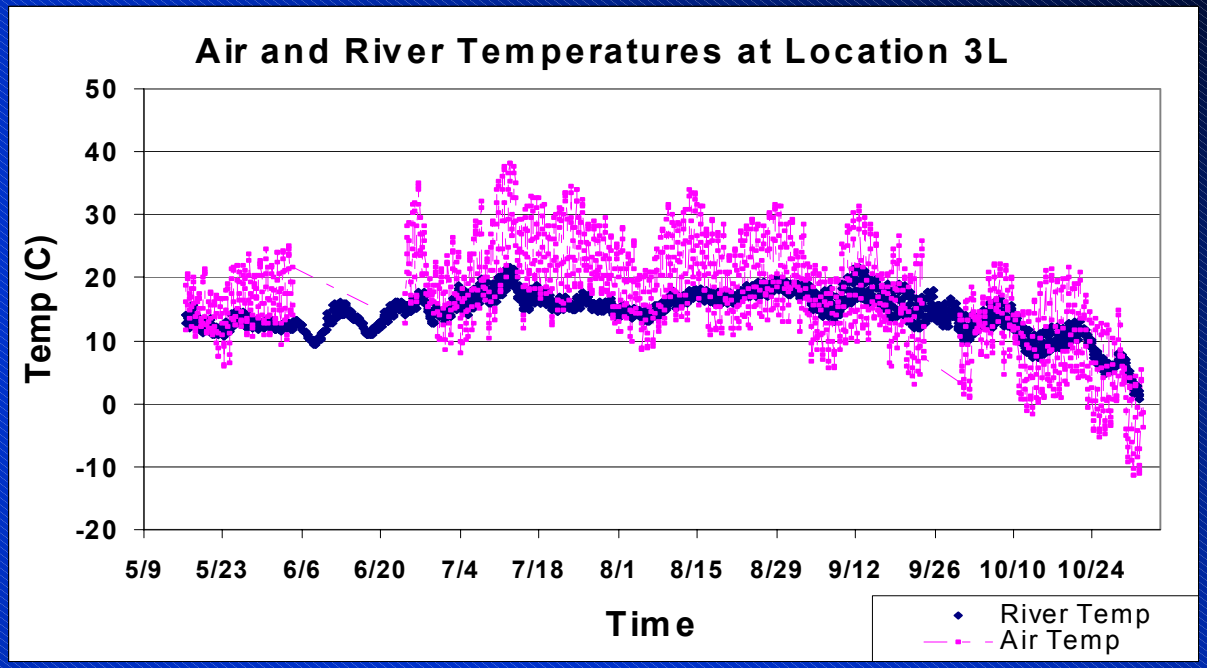
Results of T-test

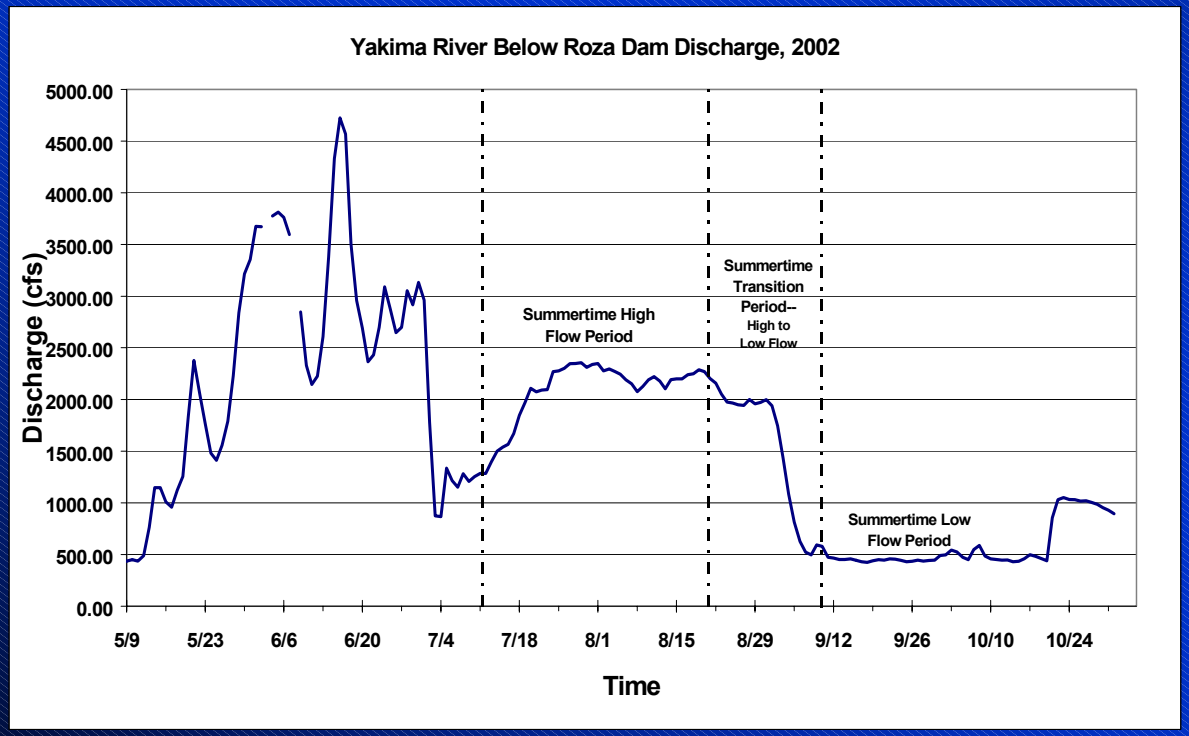


Confidence Intervals

Pond to River Thermal Calculations

- Main concern of leakage from the ponds was the potential thermal impacts to the river
- Washington DNR Requirements
- Rate and Temperature of Seepage Waters


Air and River Temperatures at Location 3L
Temp (C)
50
40
30
20
10
0
-10
-20
5/9
5/23
6/6
6/20
7/4
7/18
8/1
8/15
8/29
9/12
9/26
10/10
10/24
Time
River Temp
Air Temp


Yakima River Below Roza Dam Discharge, 2002
Discharge (cfs)
5000.00
4500.00
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Summertime High Flow Period
Summertime Transition Period-- High to Low Flow
Summertime Low Flow Period
5/9
5/23
6/6
6/20
7/4
7/18
8/1
8/15
8/29
9/12
9/26
10/10
10/24
Time