

Water Quality Studies

*Chehalis Basin Strategy: Reducing Flood
Damage and Enhancing Aquatic Species*

*Technical Workshop
Olympia, Washington
October 31, 2013*



Outline

- Summary of past water quality studies
- Objectives of the water quality study
- Study overview
- Preliminary results
- Other ongoing tasks
 - Riparian shade surveys
 - Infra-red flight surveys
- Remaining water quality tasks

Historical Water Quality Issues in the Chehalis Basin

- Chehalis River above Newaukum River confluence
 - Temperature
 - Fecal coliforms
- Chehalis - Centralia Reach
 - DO
 - BOD
 - Ammonia-N
- Black River
 - Total phosphorus
 - Dissolved oxygen
 - Fecal coliform

Existing TMDLs and Previous Studies

- From Chehalis River Multi-Parameter TMDL Water Quality Data Review (November 2010)
 - Upper Chehalis Dissolved Oxygen TMDL, 26 segments (Jennings and Pickett 2000)
 - Upper Chehalis Temperature TMDL, 19 segments (Ecology 2001)
 - Grays Harbor/Chehalis Fecal Coliform Bacteria TMDL, 23 segments (Rounry and Pelletier 2001)
 - Upper Chehalis Fecal Coliform Bacteria TMDL, 17 segments (Ahmed and Rounry 2004)
 - Upper Chehalis River Dry Season TMDL, 19 segments (Pickett 1994a)
 - Black River Wet Season Non-Point Source TMDL, 7 segments (Coots 1994)
 - Black River Dissolved Oxygen and Phosphorus TMDL, 3 segments (Pickett 1994)
- USGS studies on groundwater (Ely et al. 2008; Gendaszek 2011)
- Chehalis River Basin Fish Studies (Anchor QEA 2012)

Data Gaps Identified in the 2012 Chehalis River Fish Study

- Additional water quality characterizations beyond TSS and BOD
- A need for improved characterization of thermal and nutrient loads from tributaries
- A need for improved characterization of groundwater's contribution to stream temperature
- Lack of riparian shading assessment
- Meteorological data lacking in upper reaches

Objectives and Study Design

Water Quality Studies

Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species



Water Quality Study Objectives

- Provide an evaluation of baseline water quality in the Chehalis River
- Provide a data set for model calibration
 - Refining existing water quality models, or
 - Develop new/improved models
 - Address data gaps identified in the 2012 fish study
- Data collection only during this phase
- Provide fish biologists important data

Water Quality Study Design

- Continuous temperature monitoring
 - 12 locations overall
 - Covers mainstem Chehalis River and major tributaries
- Synoptic low-flow water quality surveys
 - 3 surveys
 - Designed to measure nutrient and BOD loads
- Diurnal surveys at select locations
 - Characterizes daily fluctuations in dissolved oxygen, pH and temperature

Water Quality Study Design (continued)

- Depth profiles of water quality parameters at select locations
- Boat survey in Centralia reach
 - Historically problematic reach with thermal stratification and low DO in summer
 - Characterization of the DO and temperature regime
- Groundwater temperature surveys
 - To provide an estimate of temperature mitigation in gaining reaches
 - Focus primarily on mainstem reach above Newaukum River confluence

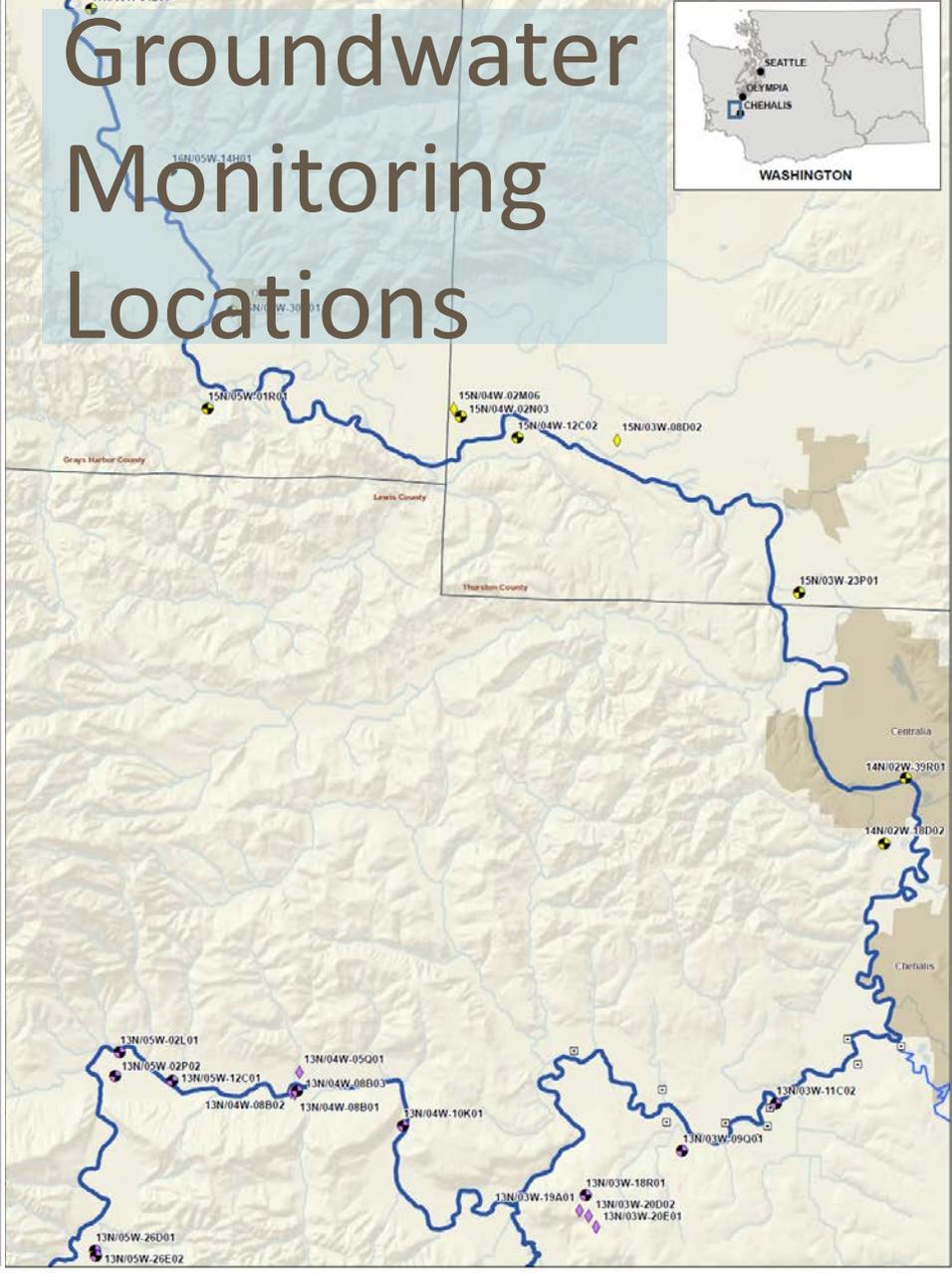
Other Program Elements to Support Water Quality Modeling

- Riparian shade surveys
 - Review of LiDAR data to identify vegetation type and density
 - Field surveys in May 2014 to ground truth (using hemi-view) vegetation type and canopy density classifications
 - Assessments will provide inputs needed for temperature modeling
- Adding meteorological sensors to rain gage on Chehalis River near Thrash Creek
 - Will provide wind speed and direction, dew point temperature, and incident solar radiation
 - Data available to public through early warning system website
- FLIR thermal imaging

Surface Water Monitoring Locations



Groundwater Monitoring Locations



● Ecology Water Quality Station — Chehalis River
● Ecology Flow Station
● USGS Flow Station
● USGS Flow Station (Seasonal)
▲ Anchor QEA, LLC Station
■ Dam Site

NOTE:
 HLab = HydroLab Sonde
 WQ = Water Quality
 WTemp = Temperature Tidbit
 USGS = U.S. Geological Survey

↑
 Miles
 0 1.25 2.5 3.75 5

Groundwater Well
● Primary
◆ Primary Backup
◆ Secondary
◆ Secondary Backup
■ Ecology EIM Temperature Well
— Chehalis River

NOTES:
 1. Primary wells were selected based on their proximity to gaining reaches in the critical sections of the Chehalis River and will be targeted first.
 2. Primary backup locations will be targeted if it is not possible to obtain permission to access the primary wells.
 3. Secondary wells were also selected based on their proximity to gaining reaches but are in reaches where warming is not expected significantly. These will be targeted if there is sufficient time left for monitoring after the primary wells are completed.
 4. Groundwater wells monitored in 2011 USGS study but not selected for temperature sampling are not shown.
 5. Groundwater wells in Environmental Information Management (EIM) System with temperature information downstream of the Newaukum River confluence with the Chehalis River are not shown.

↑
 Feet
 0 4,500 9,000 13,500 18,000

Water Quality Study Schedule

Task	Jul-2013	Aug-2013	Sep-2013	Oct-2013	Jul-2014
Tidbit Deployment and Temperature Data Download	Deployed week of 7/29		Downloaded during second low-flow water quality survey	Downloaded and reset if needed	Download during WQ Survey
Synoptic Low Flow Water Quality Monitoring and Flow Measurements		First of three completed week of 8/5	Second of three completed week of 9/16		Third of three
Boat Survey on the Centralia Reach					Planned for mid- to late July
Groundwater Surveys		First of three surveys completed 9/4-9/6		Second of three completed 10/14 – 10/16	Third of three
FLIR Flight Surveys			Partially completed		TBD

- A draft Quality Assurance Project Plan (QAPP) was submitted in August
- A revised plan was approved by Ecology on October 10, 2013

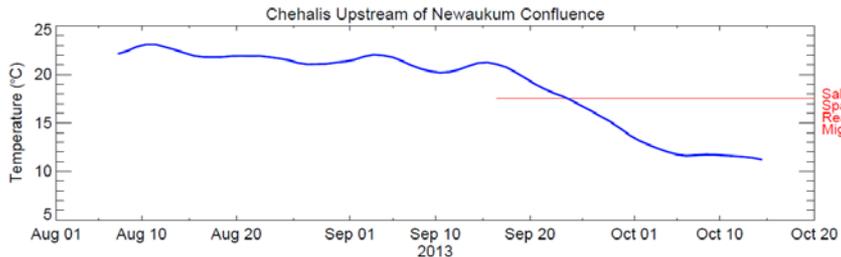
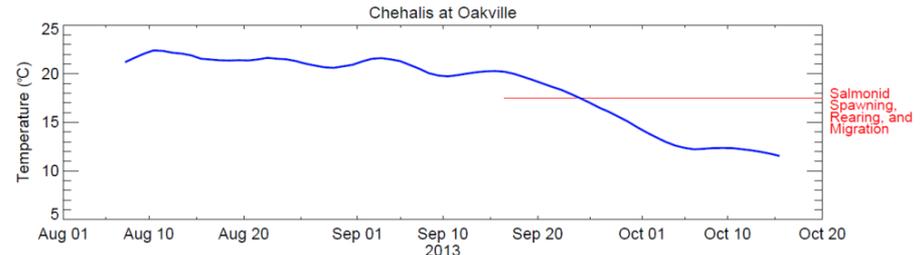
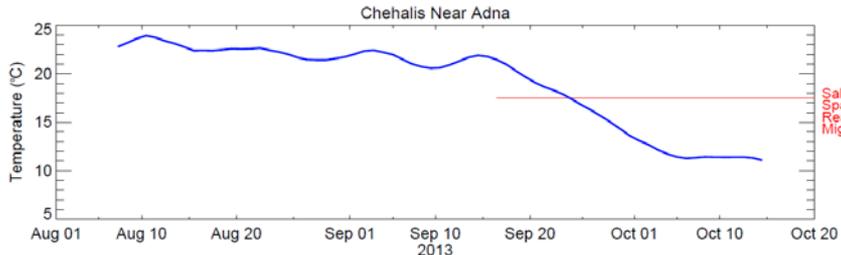
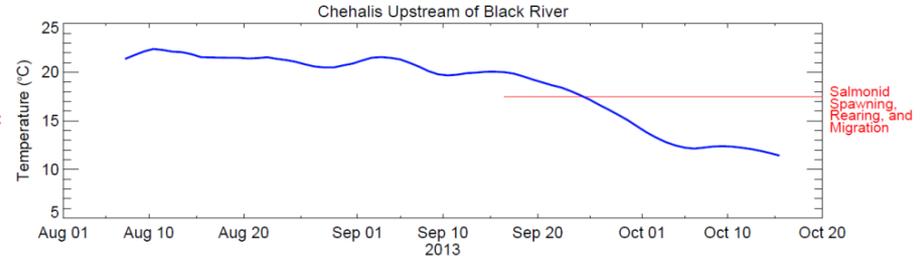
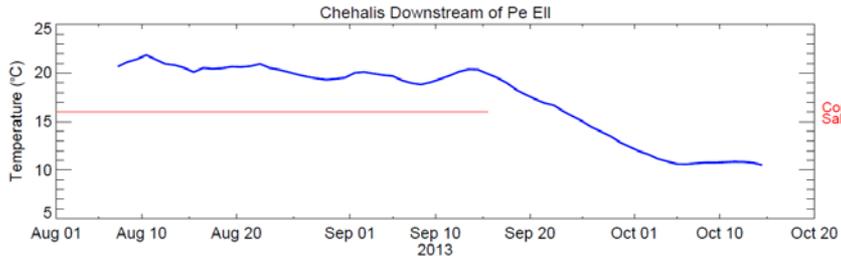
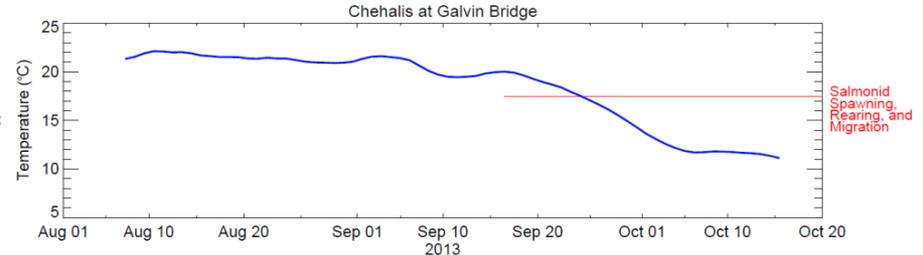
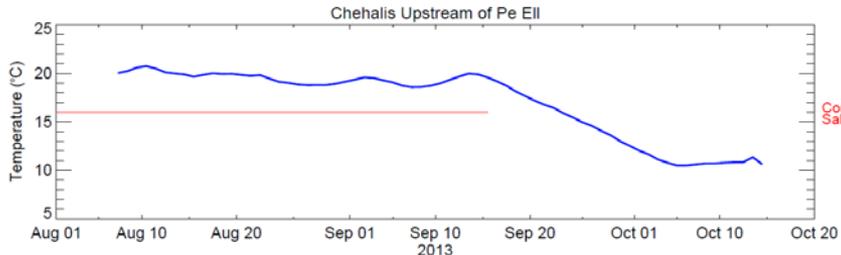
Preliminary Findings

Water Quality Studies

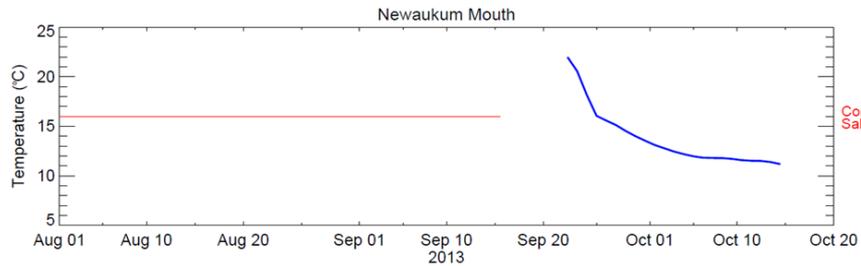
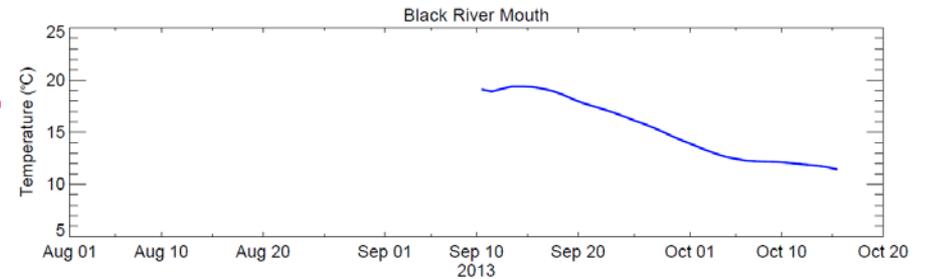
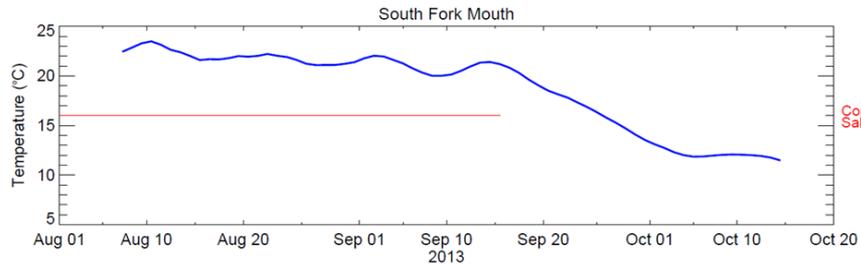
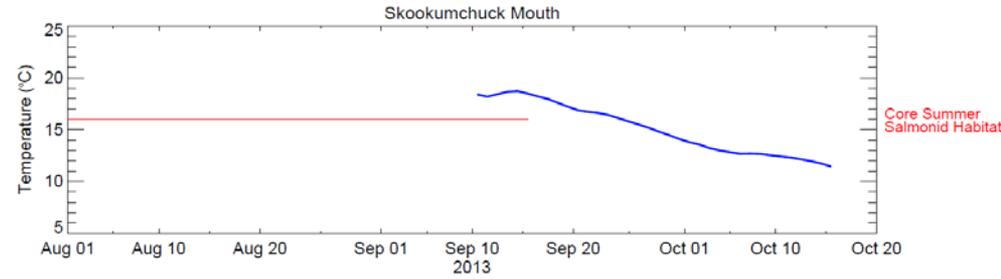
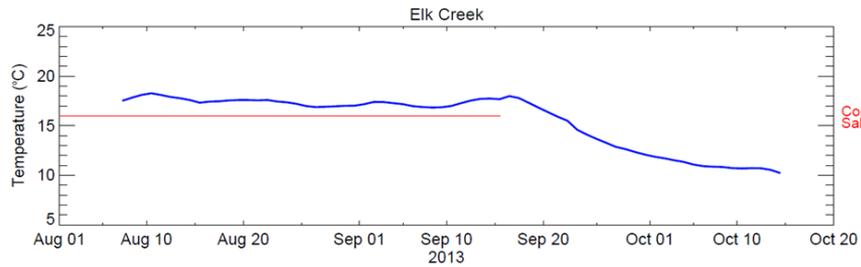
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7-Day Average of Daily Maximum (7-DADmax) Temperature: Mainstem

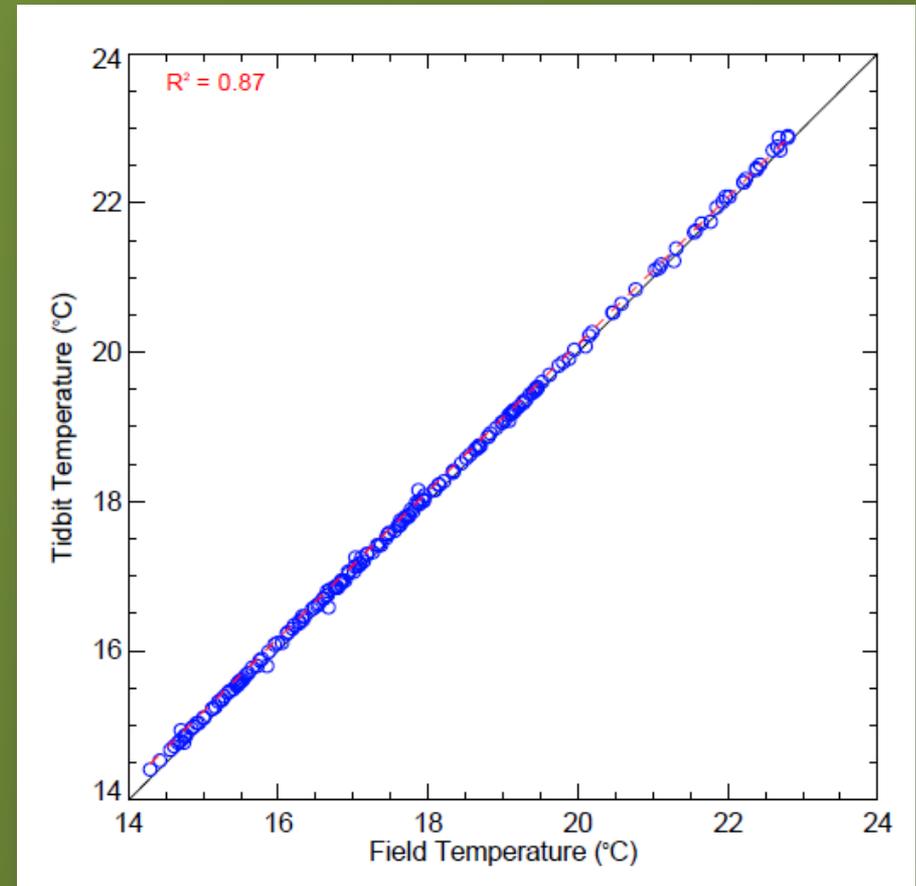


7-DADmax Temperature: Tributaries

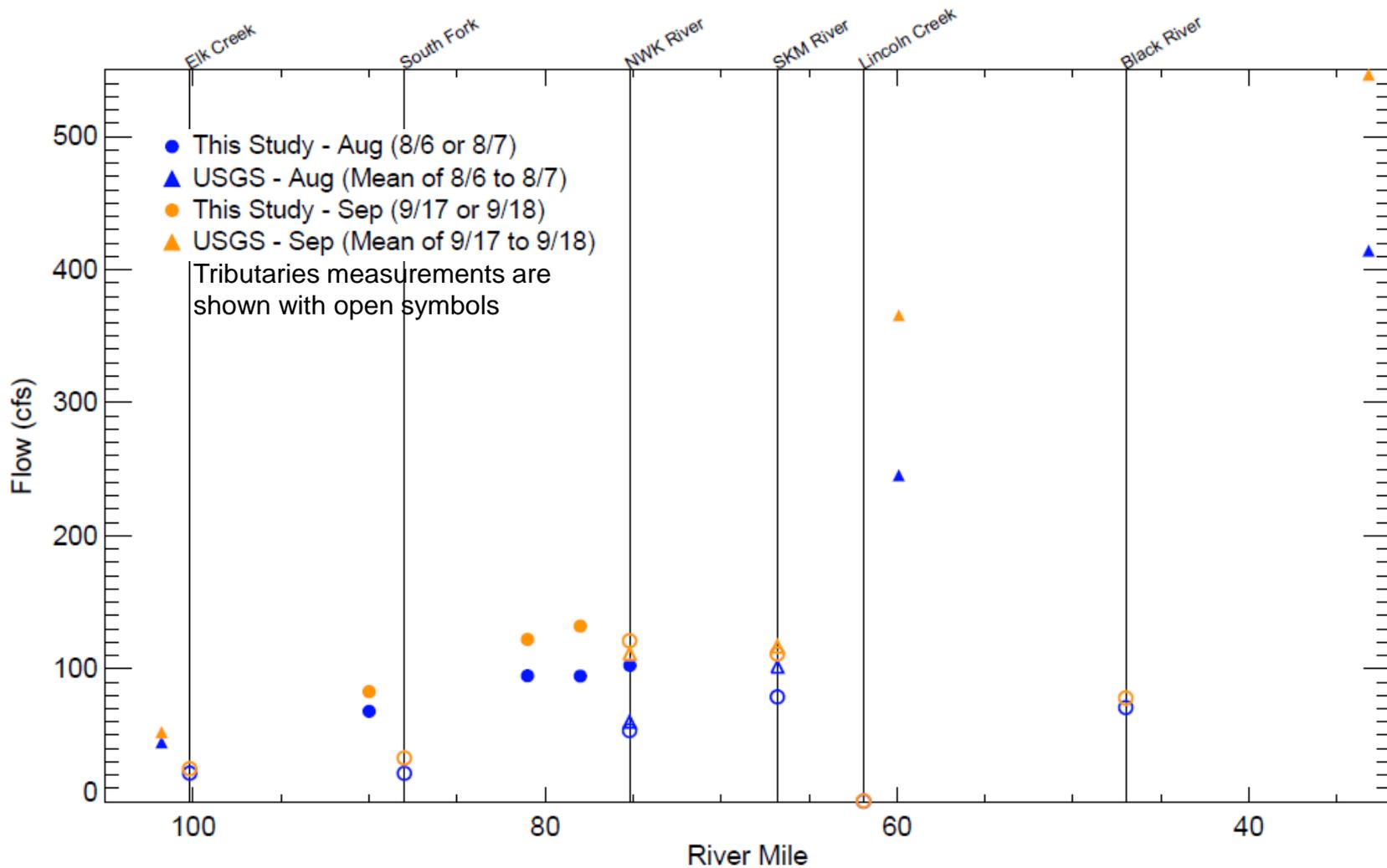


Verification of Temperature Tidbit Measurements

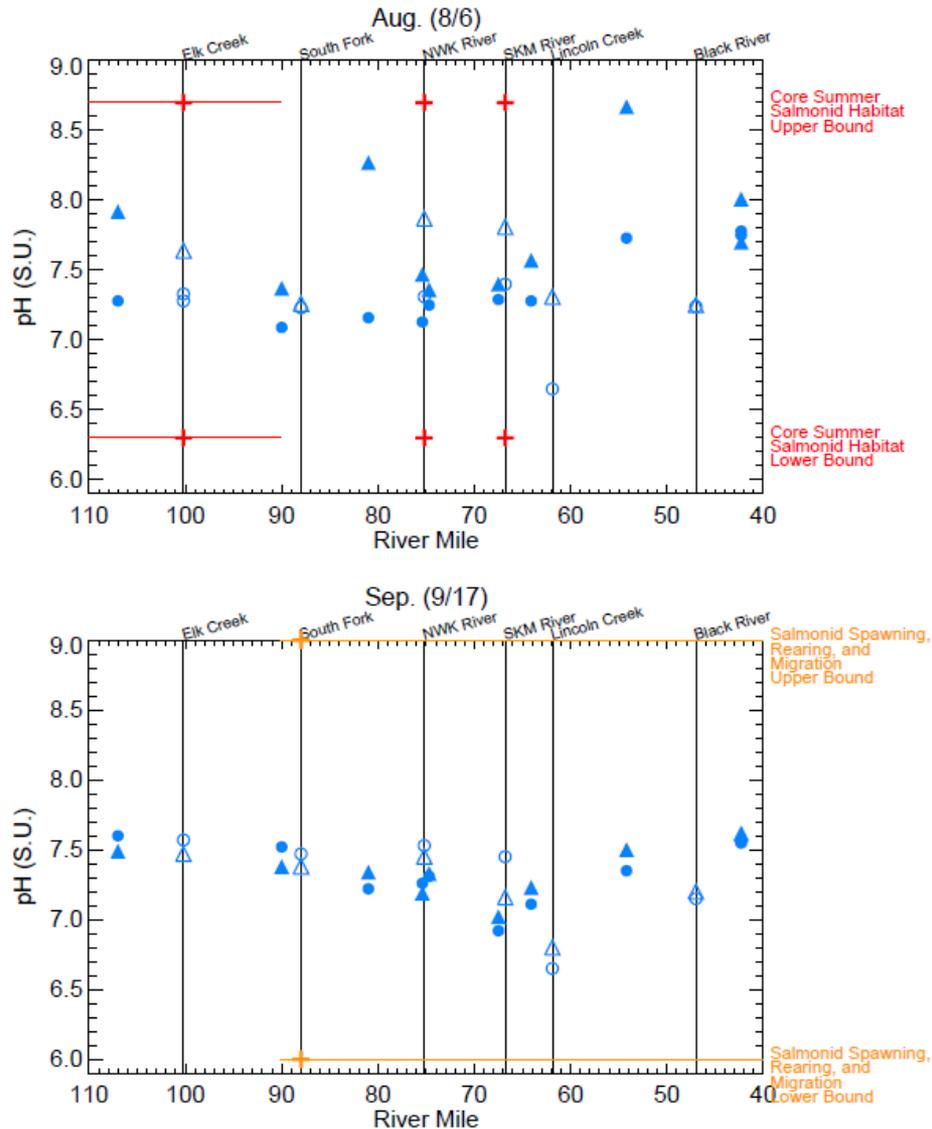
- Tidbit measurements paired and compared against field measurements



Synoptic Surveys: Flow Measurements



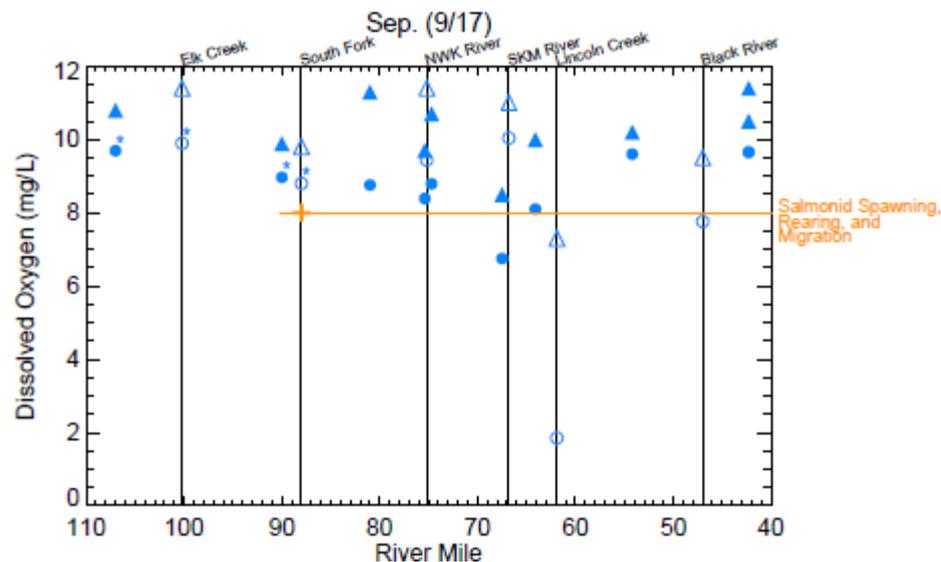
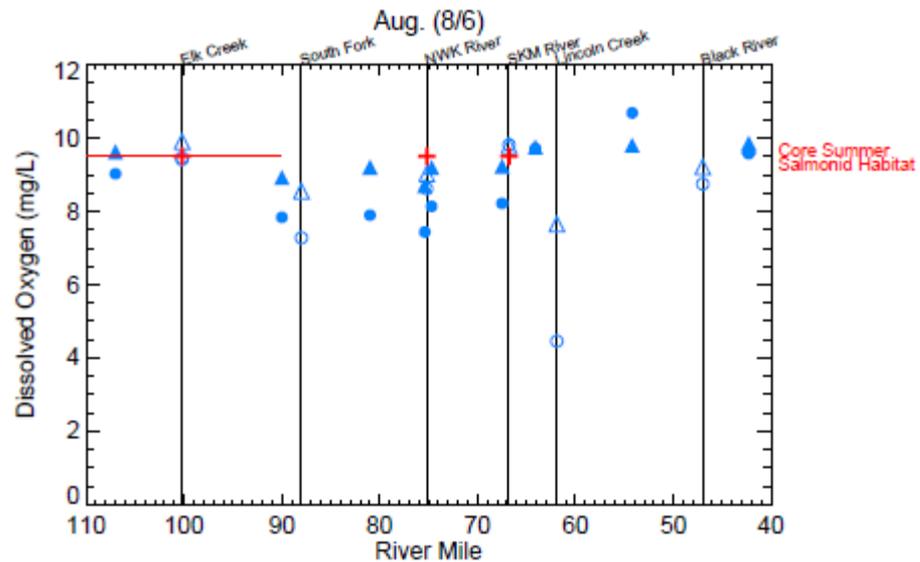
Synoptic Surveys: pH



● Field
▲ Lab

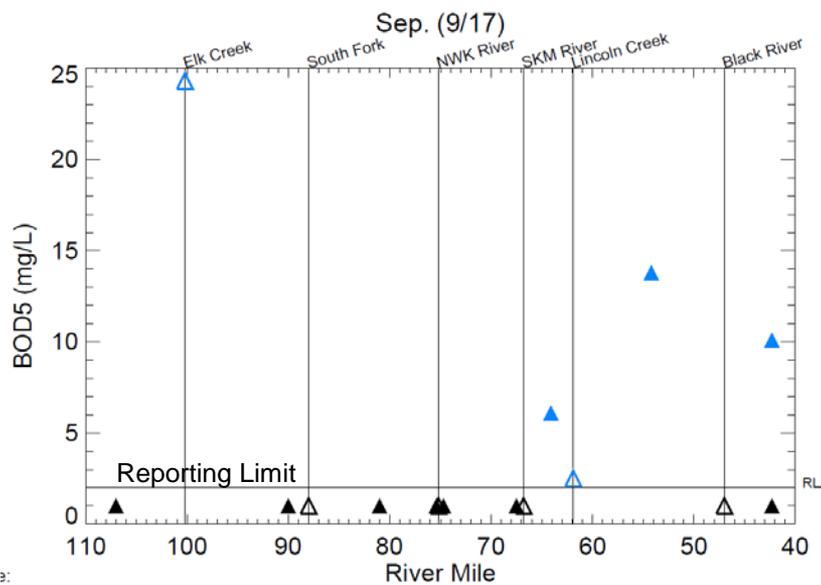
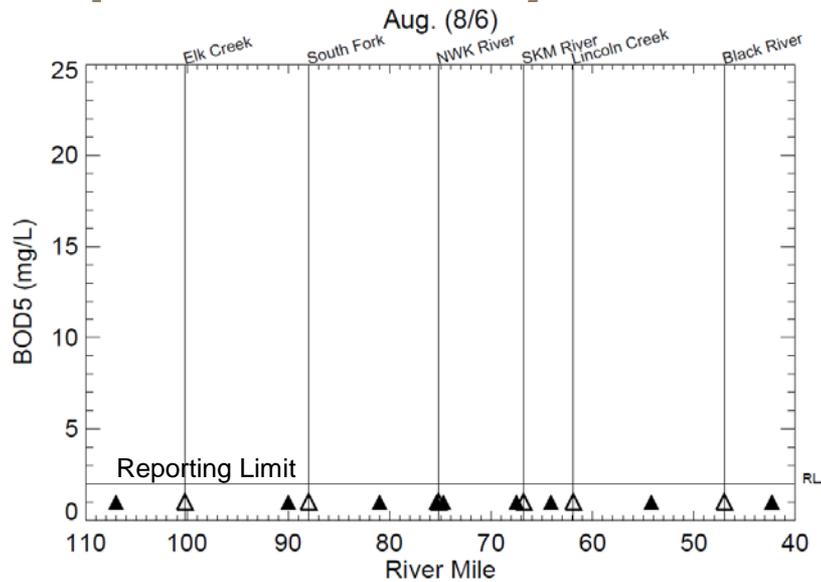
- Open symbols shown for tributaries
- Water quality criteria for tributary are shown as crosses, where applicable

Synoptic Surveys: Dissolved Oxygen



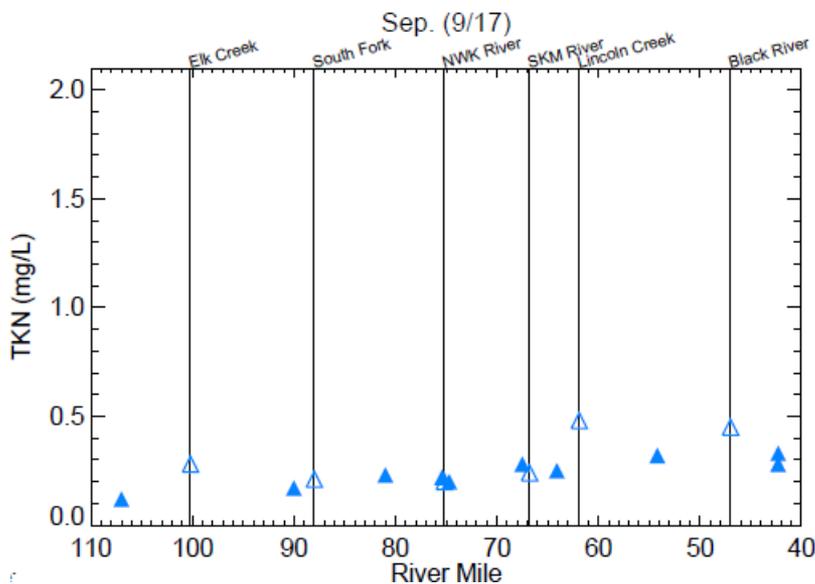
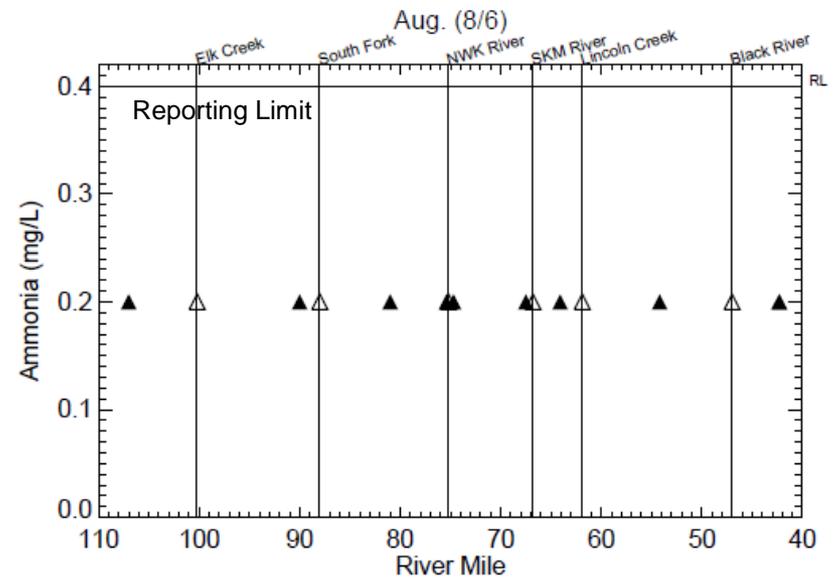
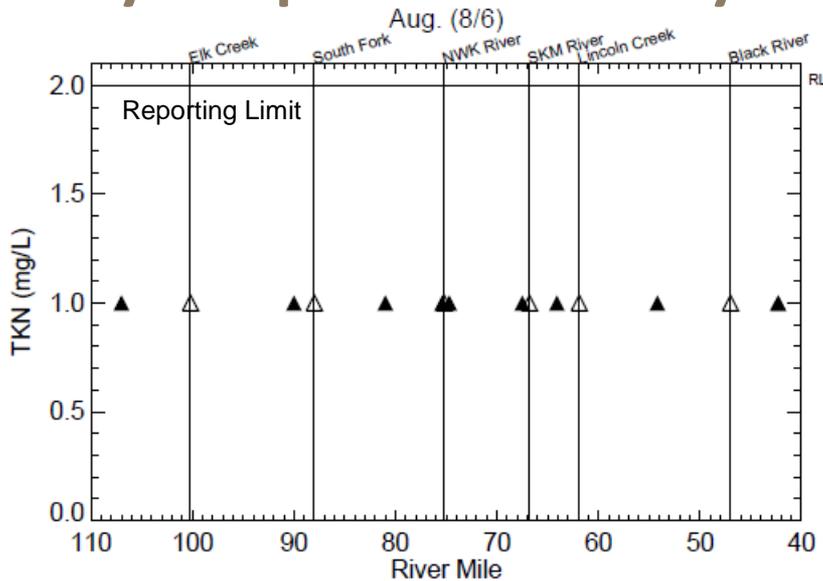
- Open symbols shown for tributaries
- Water quality criteria for tributary are shown as crosses, where applicable

Synoptic Surveys: BOD



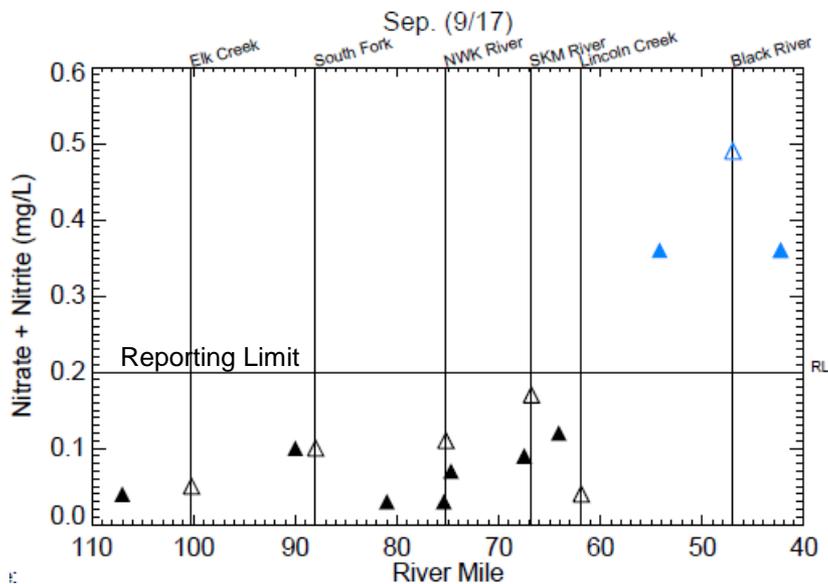
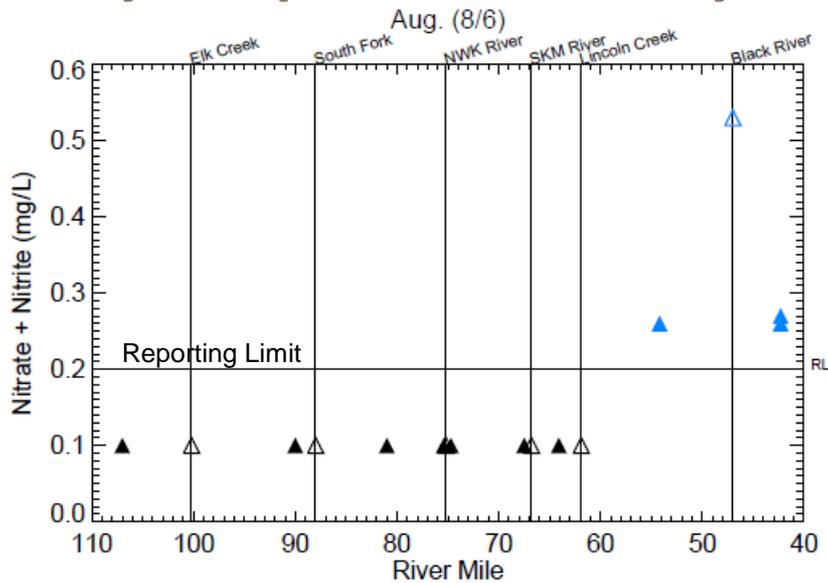
- Open symbols shown for tributaries
- Analytical values below reporting limit are shown in black

Synoptic Surveys: TKN and Ammonia



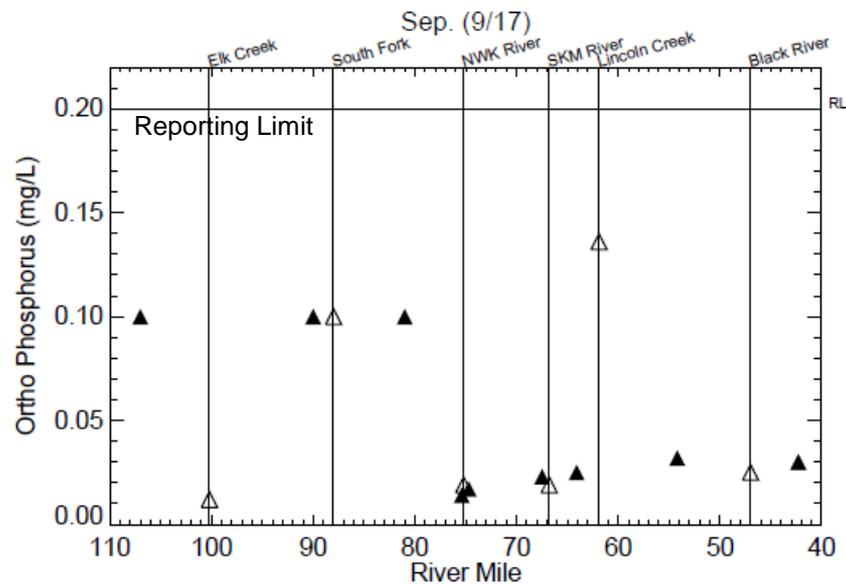
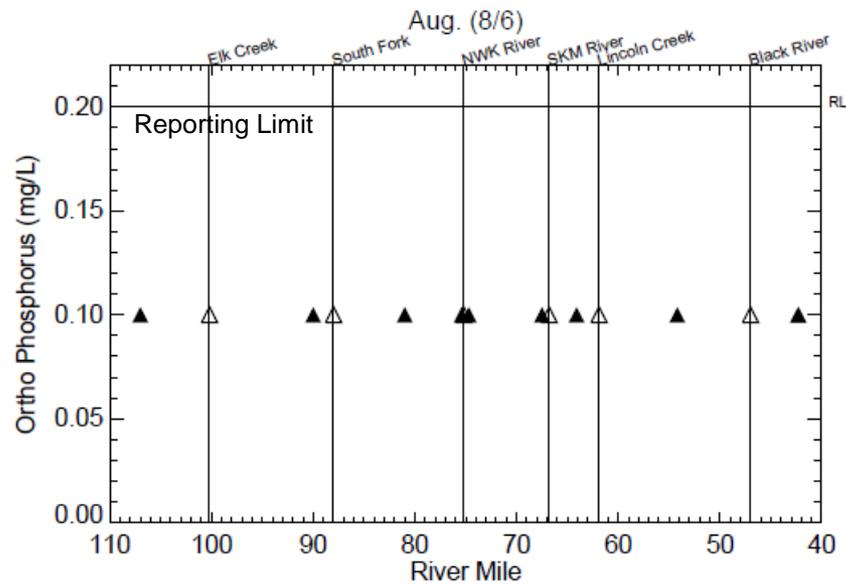
- Open symbols shown for tributaries
- Analytical values below reporting limit are shown in black
- September samples were analyzed at a lab that is authorized for lower reporting limits:
 - Range for ammonia: ND (RL=0.01 mg/L) to 0.518 mg/L

Synoptic Surveys: Nitrite + Nitrate



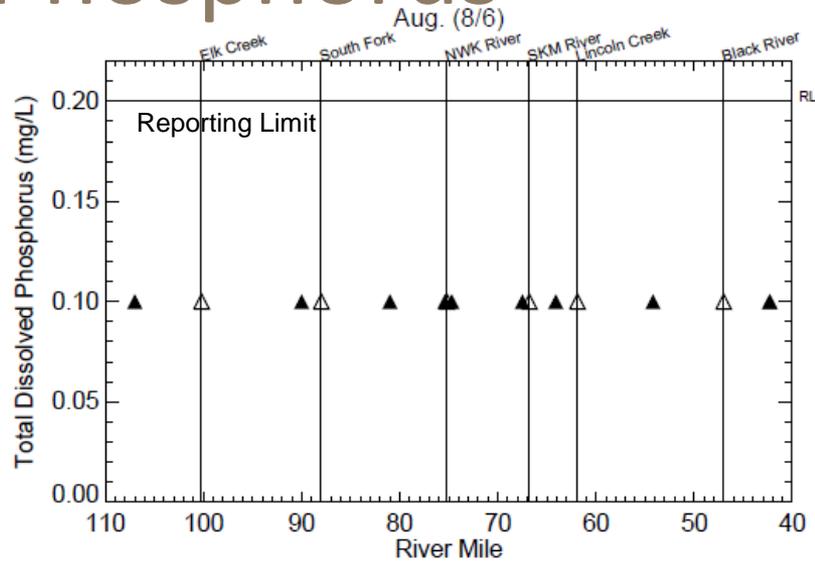
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- Analytical values below reporting limit are shown in black
- September samples were analyzed at a lab that is authorized for lower reporting limits:
 - Range for nitrite + nitrate: 0.012 mg/L to 0.591 mg/L

Synoptic Surveys: Orthophosphate

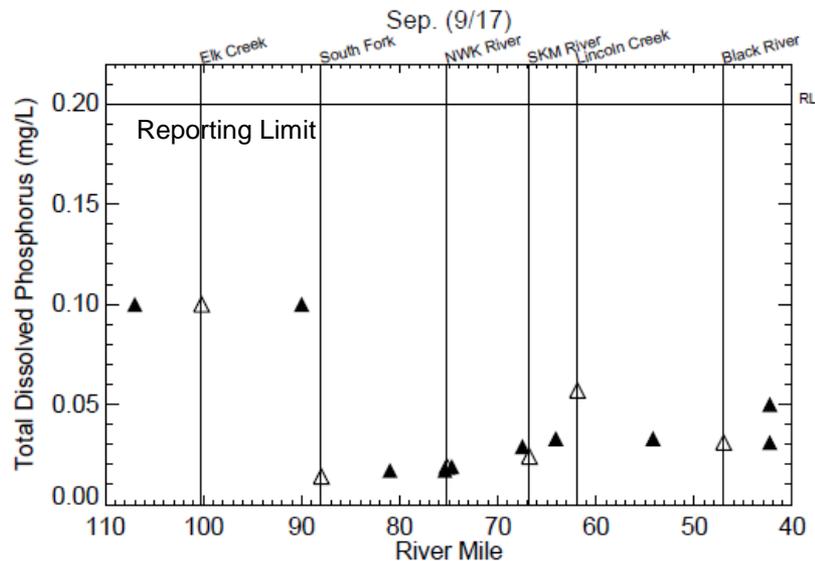


- Open symbols shown for tributaries
- Analytical values below reporting limit are shown in black

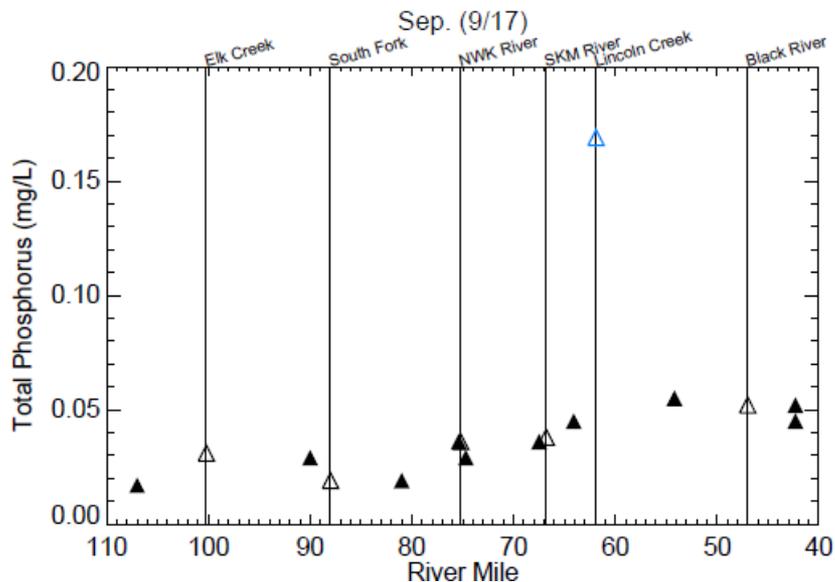
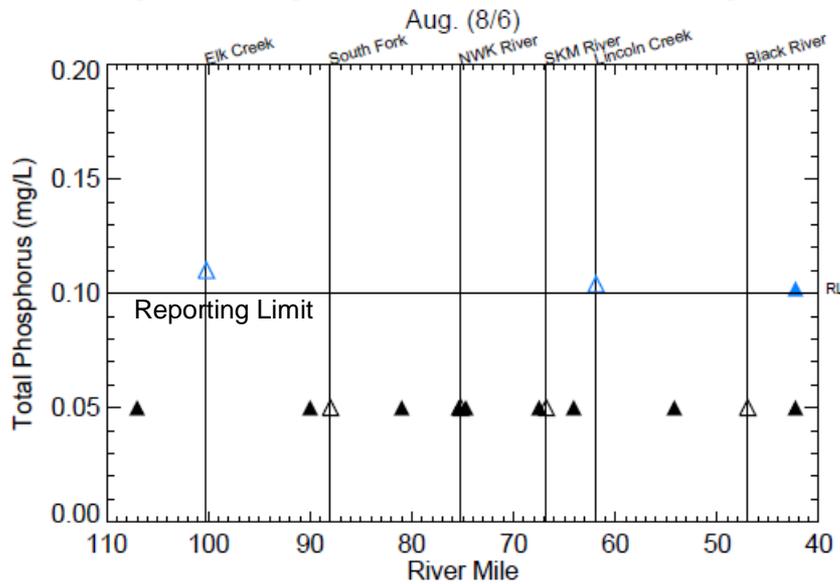
Synoptic Surveys: Total Dissolved Phosphorus



- Open symbols shown for tributaries
- Analytical values below reporting limit are shown in black

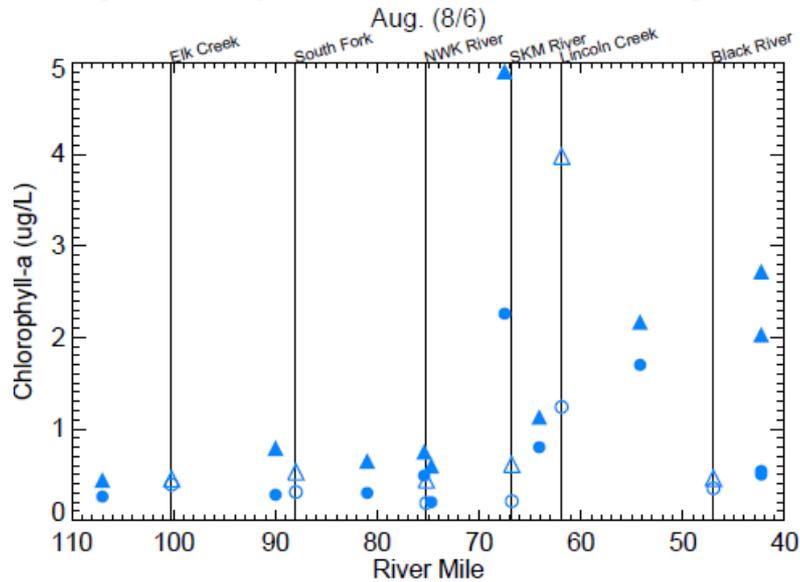


Synoptic Surveys: Total Phosphorus

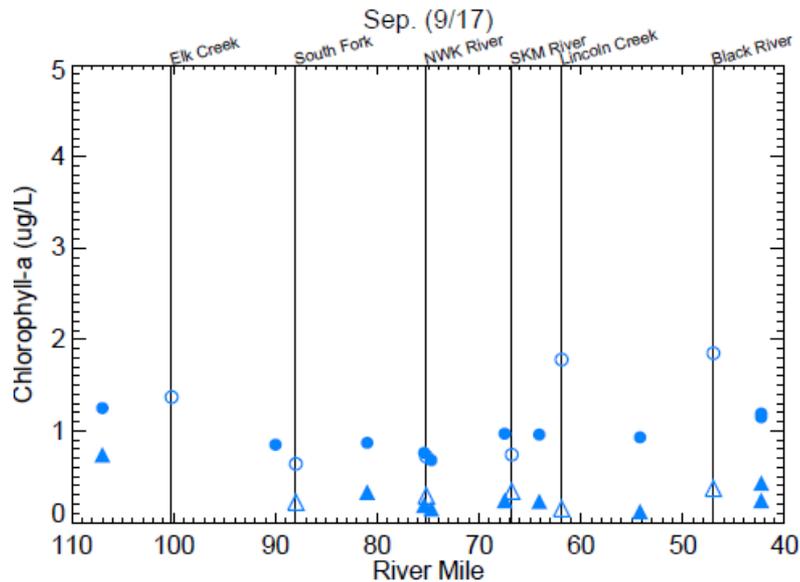


- Open symbols shown for tributaries
- Analytical values below reporting limit are shown in black
- September samples were analyzed at a lab that is authorized for lower reporting limits:
 - Range for total phosphorus: ND (RL=0.008 mg/L) to 0.21 mg/L

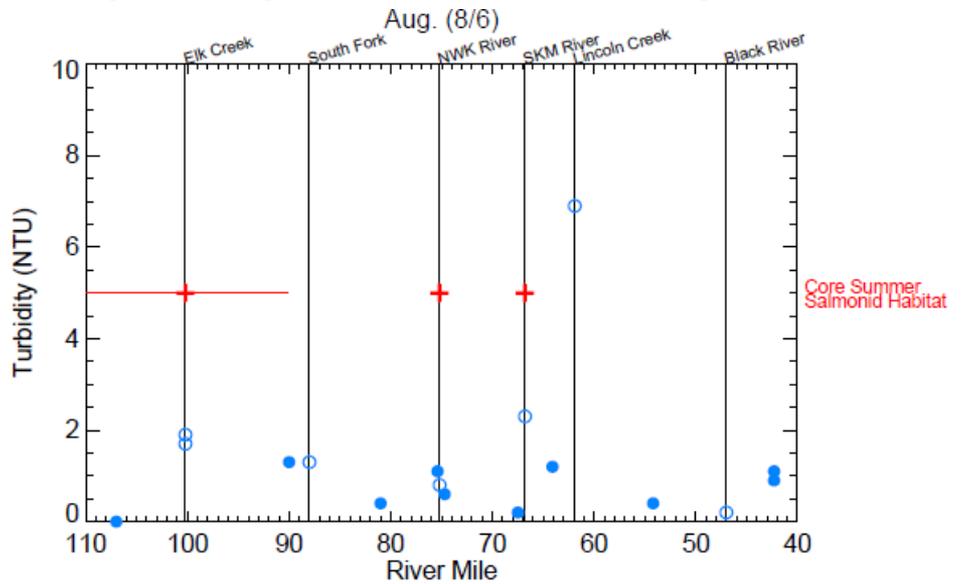
Synoptic Surveys: Chlorophyll-a



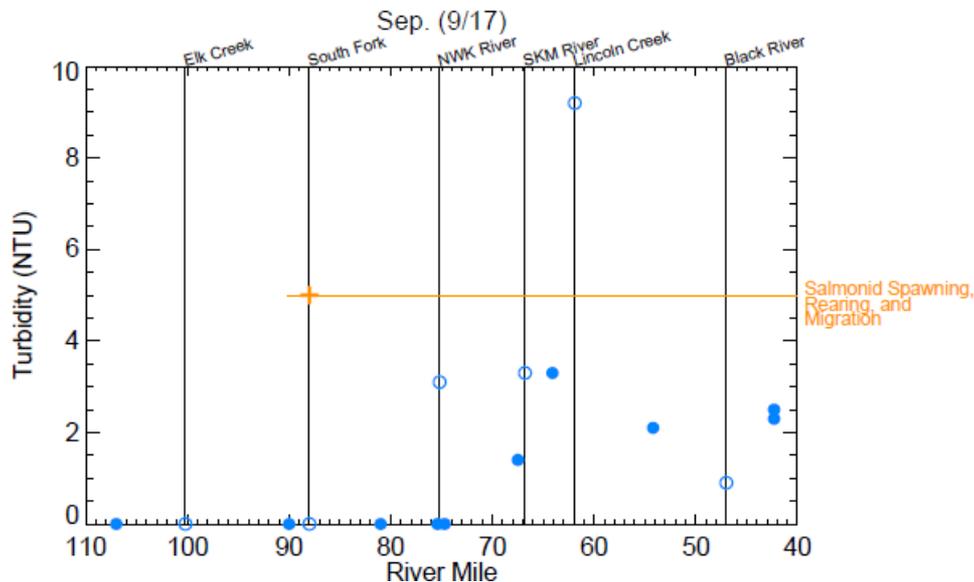
- Open symbols shown for tributaries



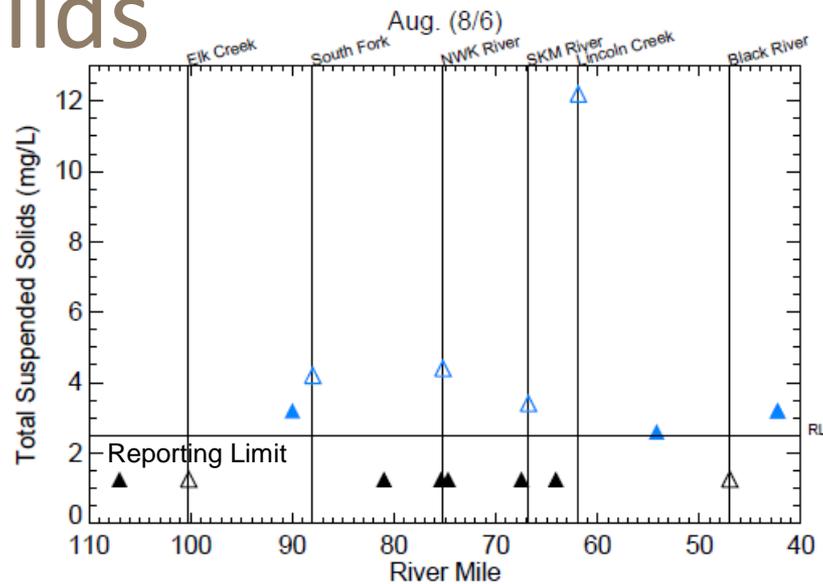
Synoptic Surveys: Turbidity



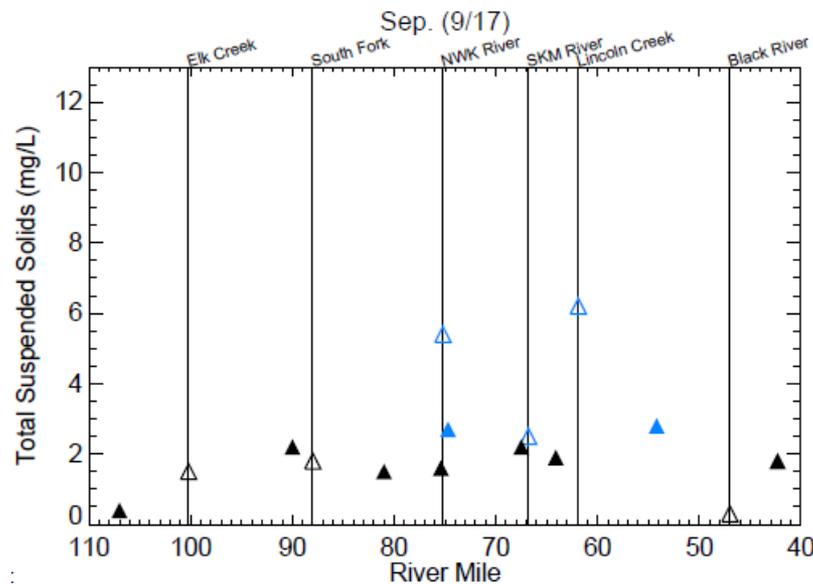
- Open symbols shown for tributaries
- Water quality criteria for tributary are shown as crosses, where applicable



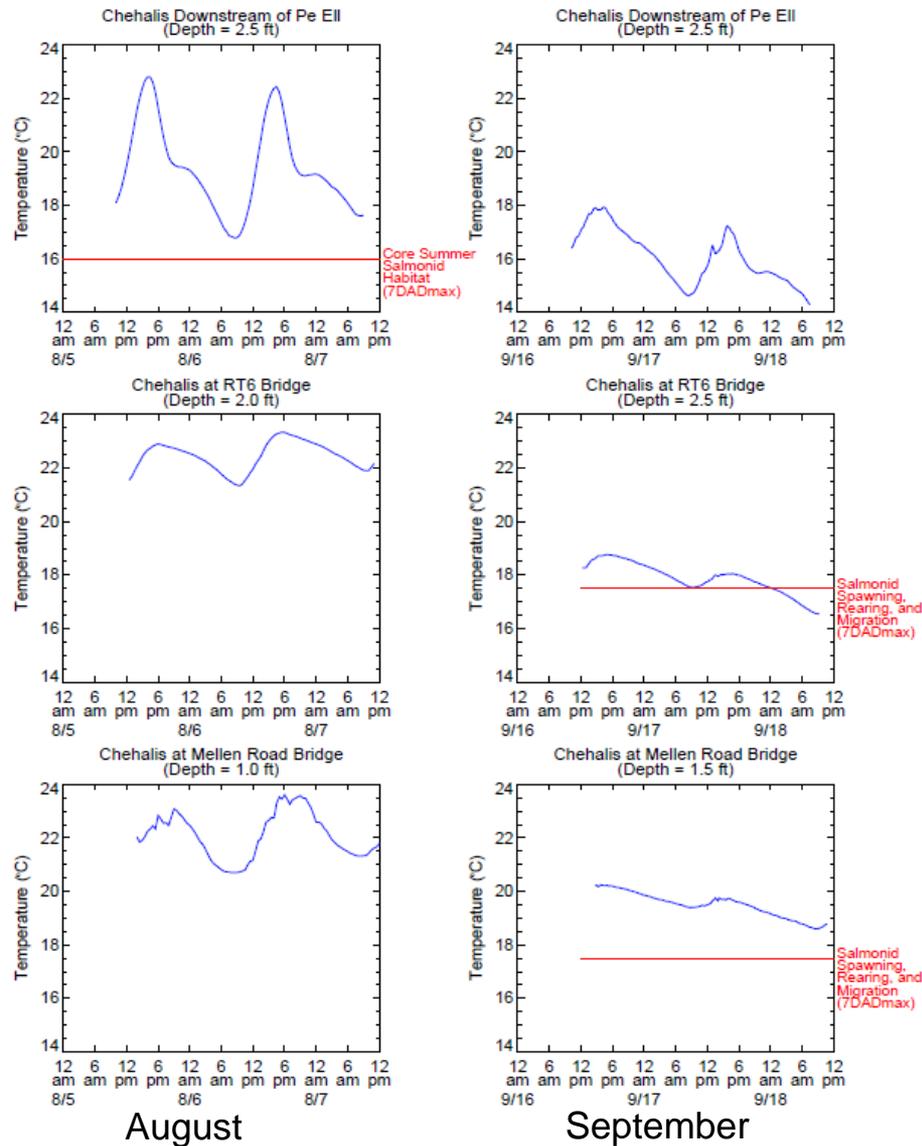
Synoptic Surveys: Total Suspended Solids



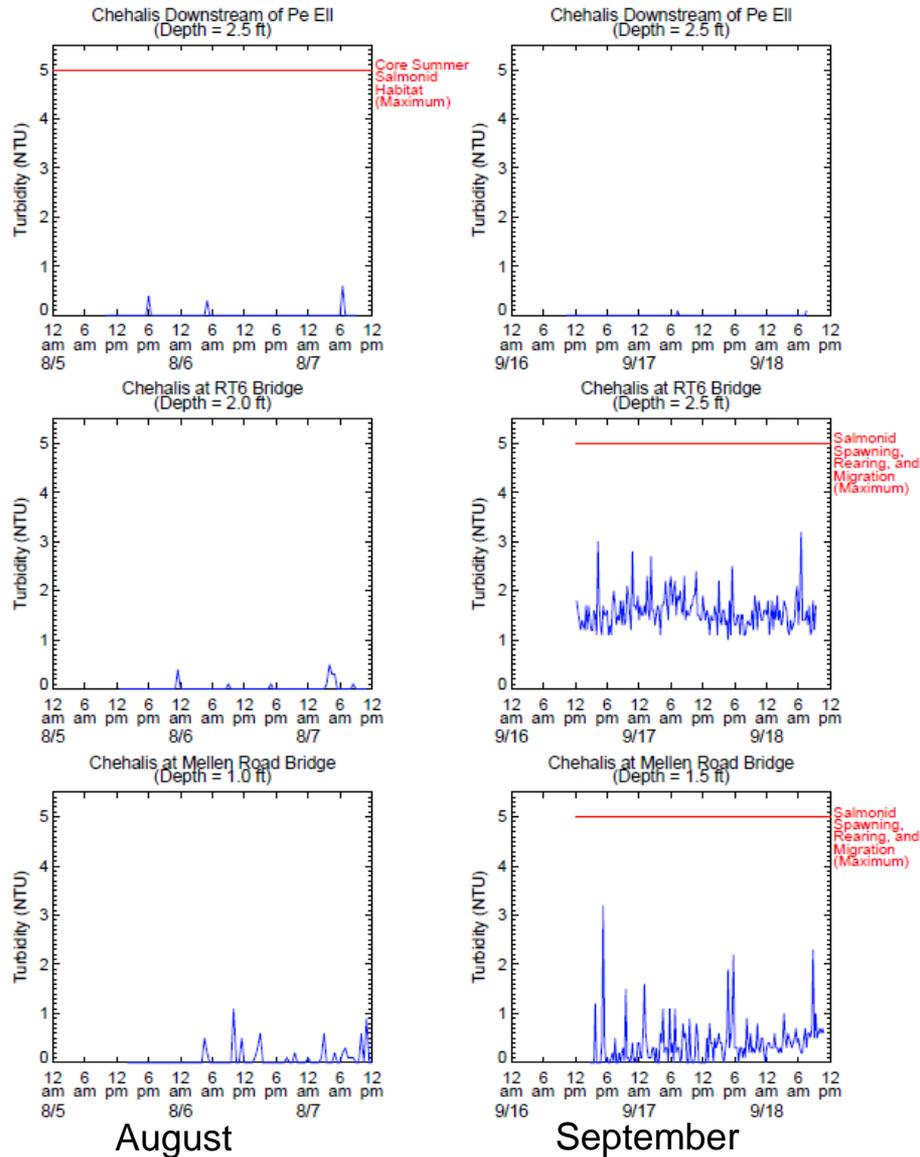
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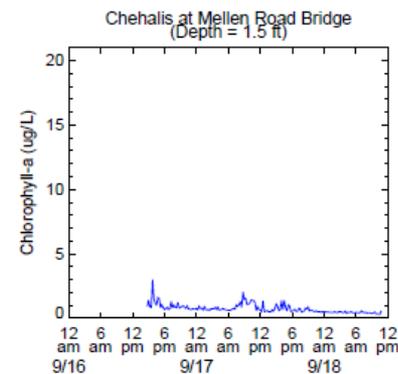
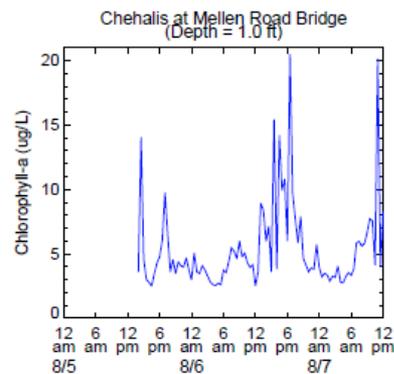
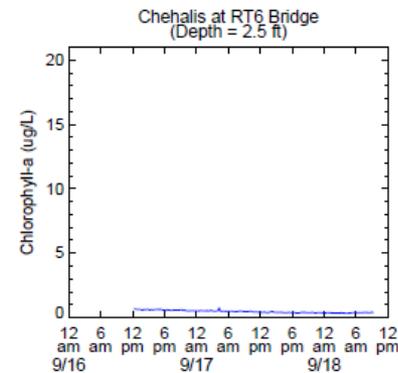
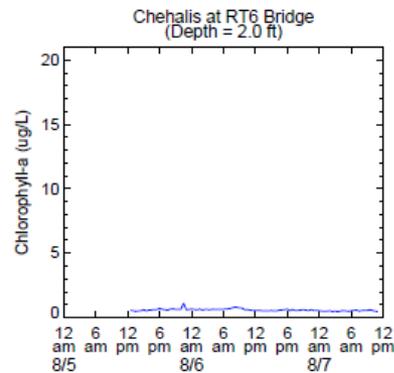
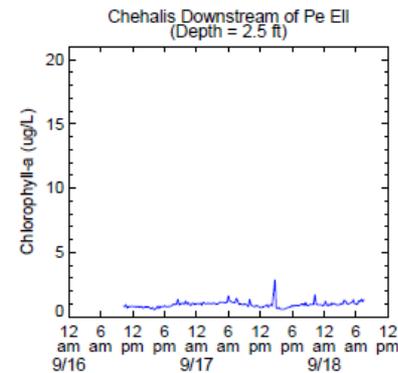
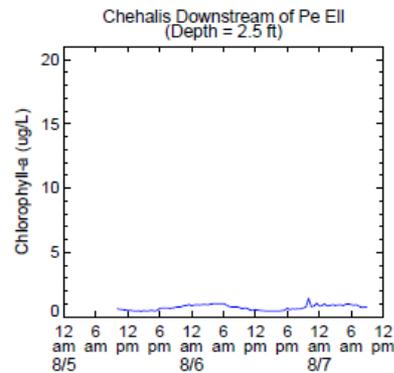
Diurnal Measurements: Temperature



Diurnal Measurements: Turbidity



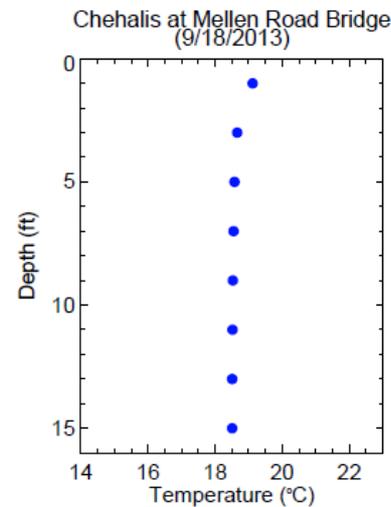
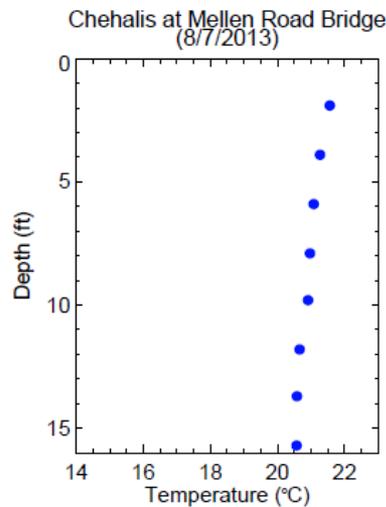
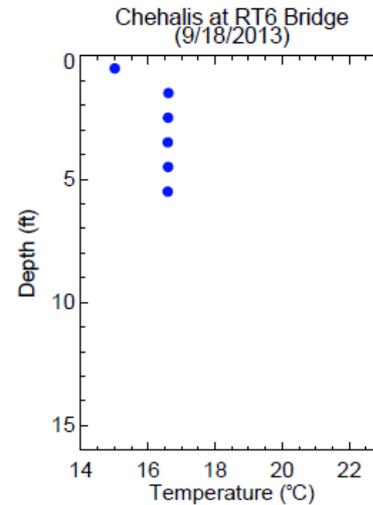
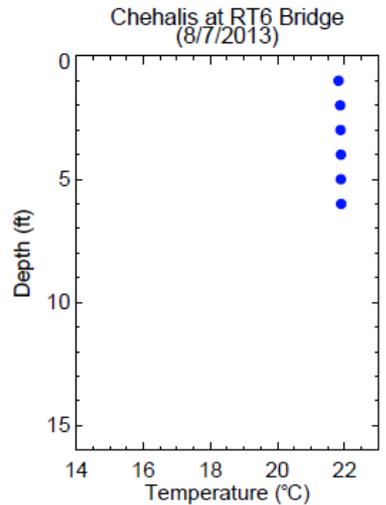
Diurnal Measurements: Chlorophyll-a



August

September

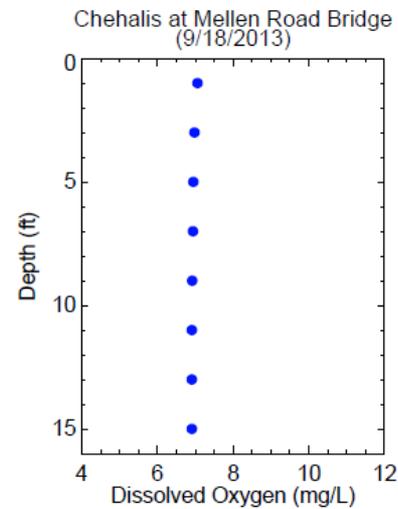
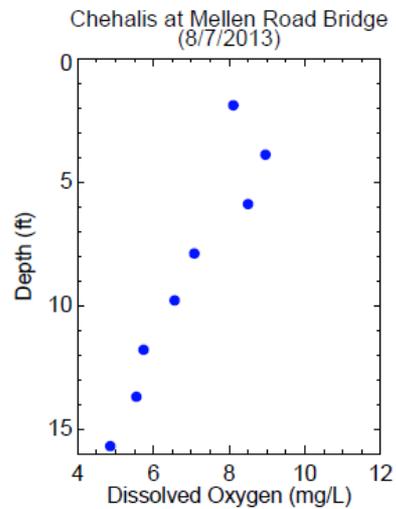
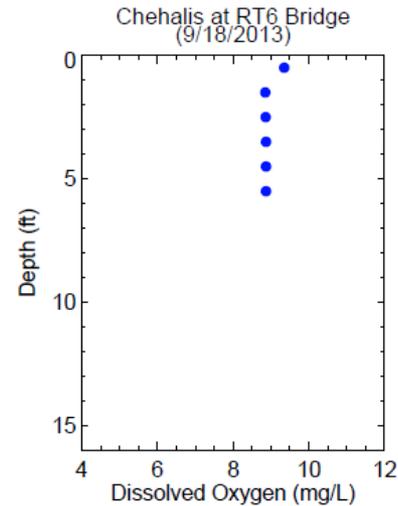
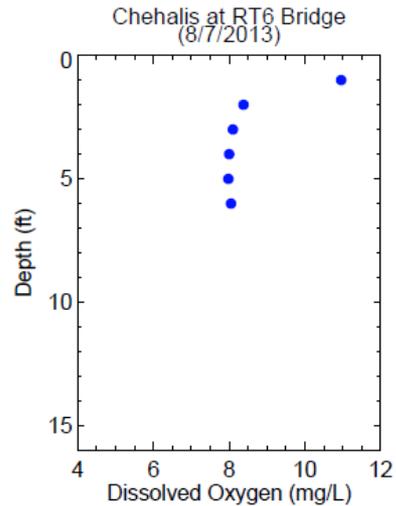
Depth Profiles in Centralia Reach: Temperature



August

September

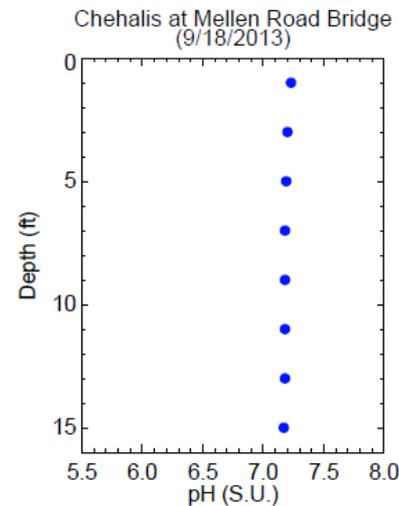
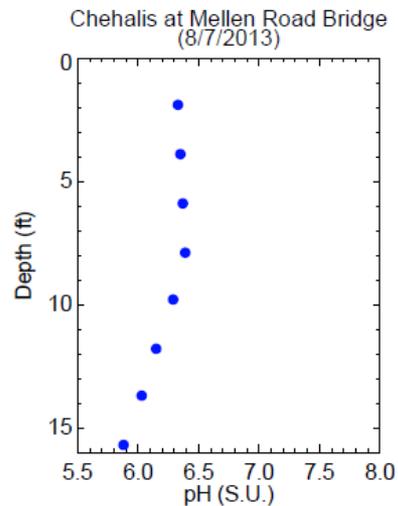
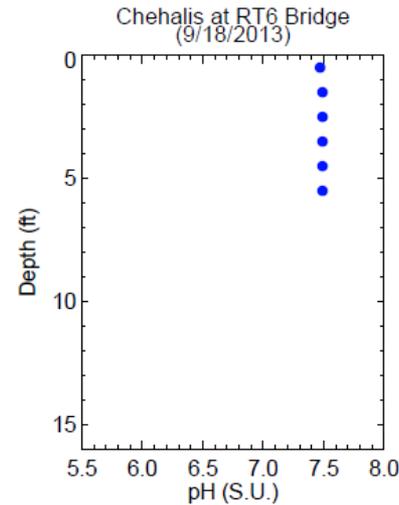
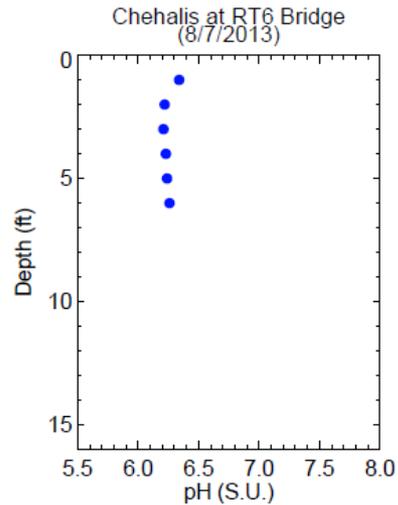
Depth Profiles in Centralia Reach: DO



August

September

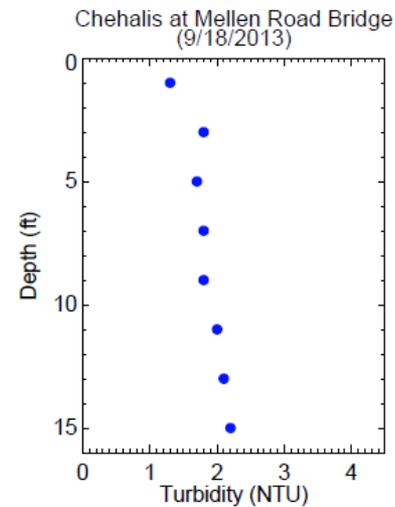
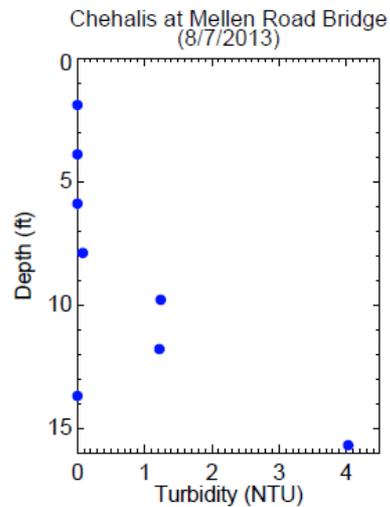
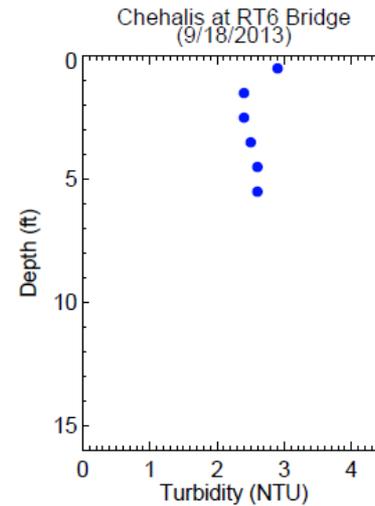
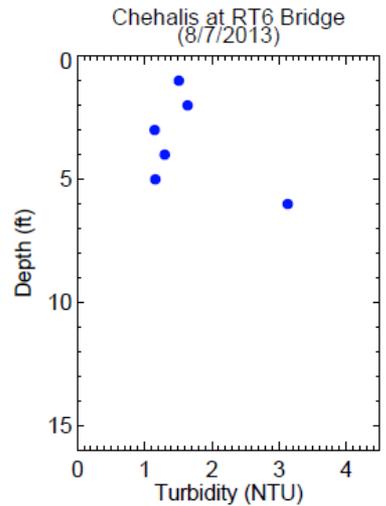
Depth Profiles in Centralia Reach: pH



August

September

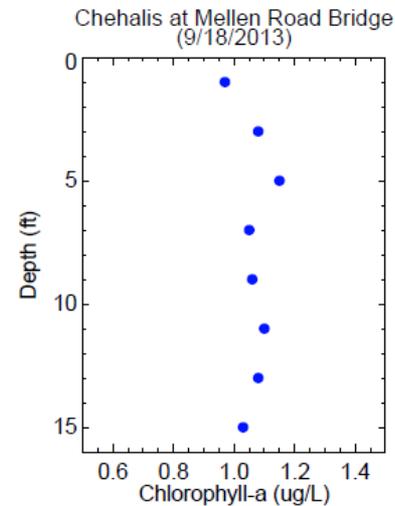
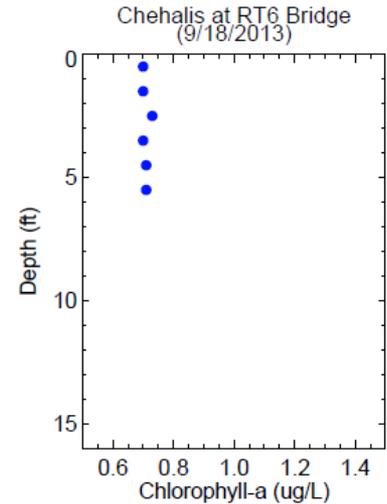
Depth Profiles in Centralia Reach: Turbidity



August

September

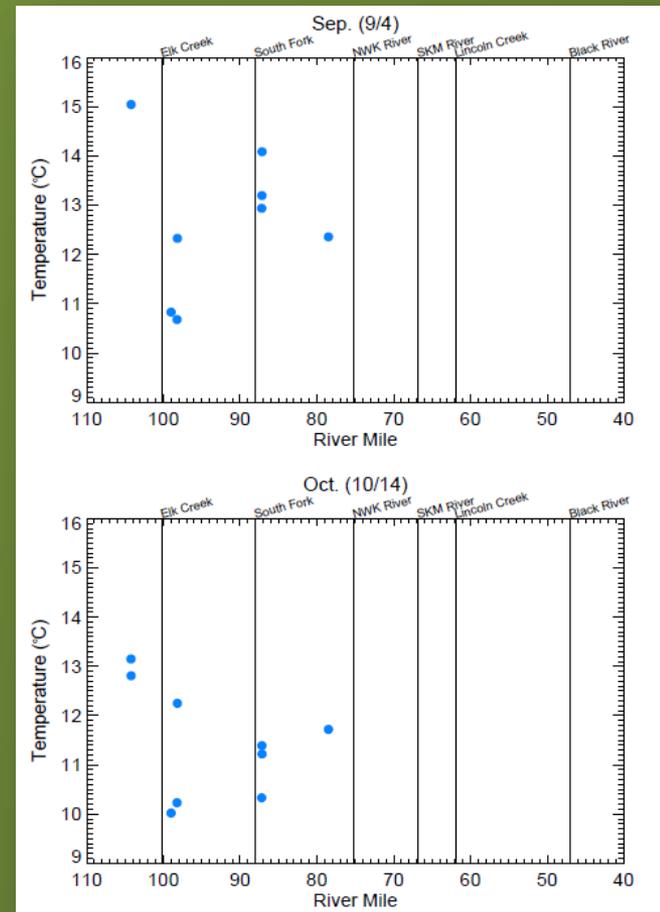
Depth Profiles in Centralia Reach: Chlorophyll-a



September

Groundwater Temperature

- Surveys conducted upstream of Newaukum River confluence
- Mostly domestic/agricultural water supply wells



Thermal Infrared Surveys

Water Quality Studies

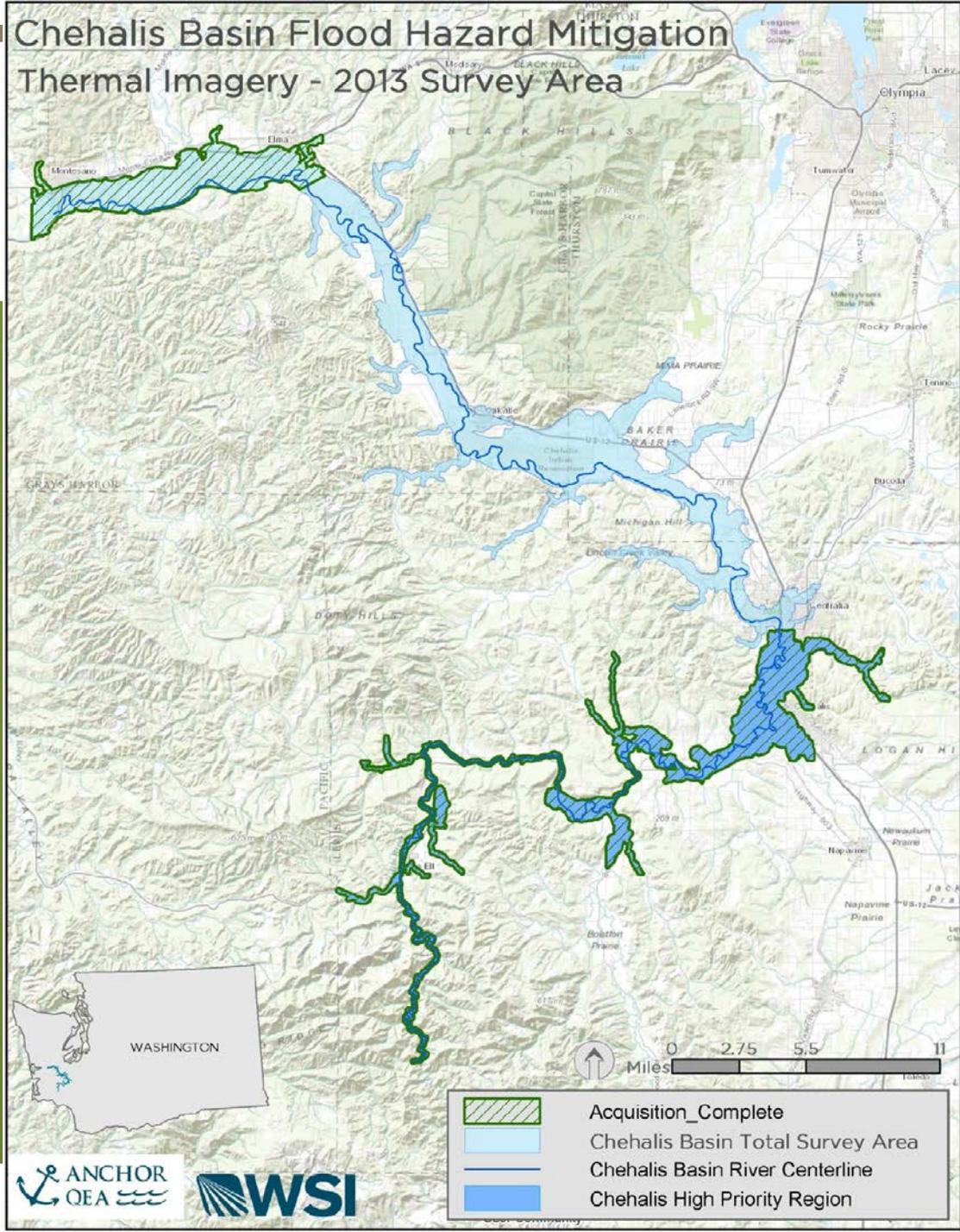
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FLIR Survey Design

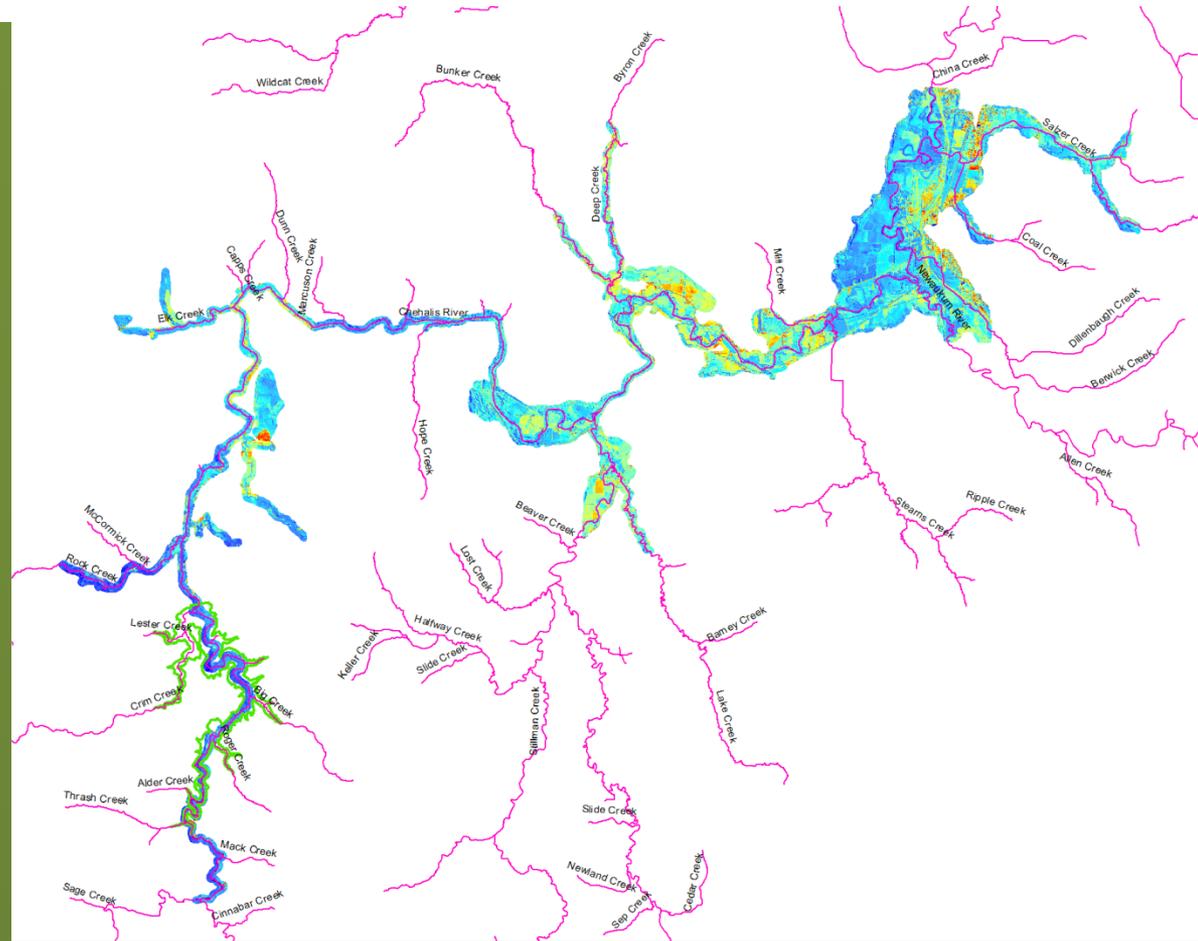
- Thermal imagery obtained through aerial survey using FLIR
- Useful for evaluating the distribution of water temperatures in the river and off-channel areas and prioritizing restoration opportunities
- Original scope called for acquisition of FLIR over 69,000 acres; to date 20,500 acres flown

FLIR Capture Area



Results

- Data provided to Environmental Technical Committee



Summary and Next Steps

Water Quality Studies

*Chehalis Basin Strategy: Reducing Flood Damage and
Enhancing Aquatic Species*



Summary of Preliminary Findings from Water Quality Studies

- 7-DADmax temperature above applicable criterion at all locations where tidbits were placed
 - Exceedances primarily in August and September
 - Generally below applicable criterion in October
- Dissolved oxygen mostly meets the applicable criterion
- No notable excursions over applicable criteria for pH and turbidity
- Higher reporting limits confounded interpretations of nutrients
 - 2014 surveys will use a lab with lower reporting limit
 - Low chlorophyll-a levels throughout suggest nutrients likely not an issue
- Depth profiles indicate mild stratification in Chehalis - Centralia Reach
 - Low DO levels recorded near sediments above confluence with Skookumchuck
- Groundwater temperature fairly constant between September and October surveys
 - Ranged from 10 to 15 °C

Upcoming Tasks

- Final summer low-flow synoptic survey in July 2014
- Riparian shade assessment
- FLIR flight survey
- Coordinate with fish biologists