Burnt Bridge Creek TMDL Update Meeting

Overview of Monitoring, Data Analysis, and Modeling

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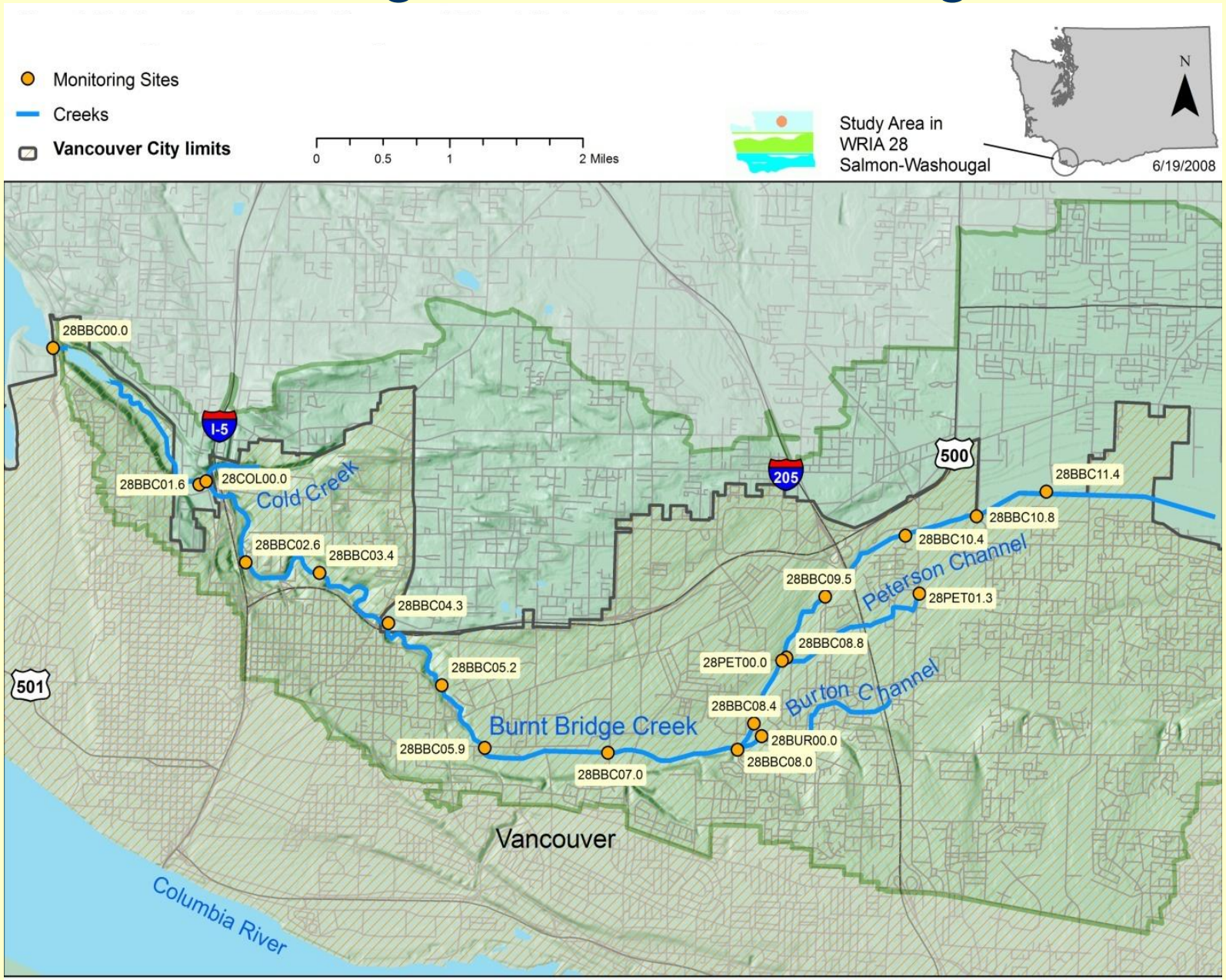
Purpose

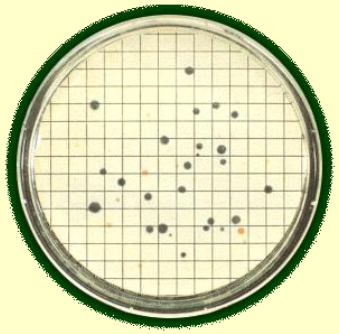
- Summary of Data Collection
  - Bacteria
  - Temperature
  - Dissolved Oxygen & pH
- Surface Water/Groundwater Data Analysis
  - Bacteria
  - Temperature
  - Dissolved Oxygen & pH
- Modeling
  - SHADE
- Next Steps

Burnt Bridge Creek Monitoring Sites



Summary of Data Collection

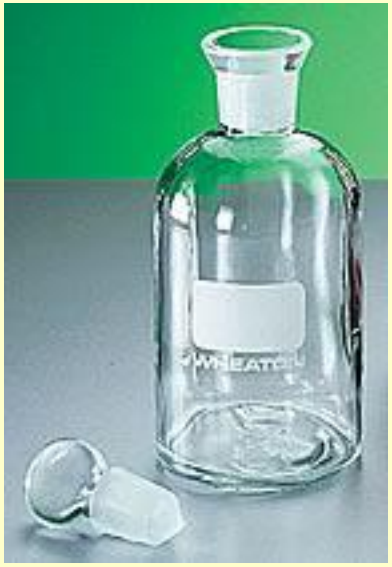
- Bacteria:
  - Sampled every 2 weeks from June 2008 through August 2009.
  - Flow measured at each site during each sampling run.

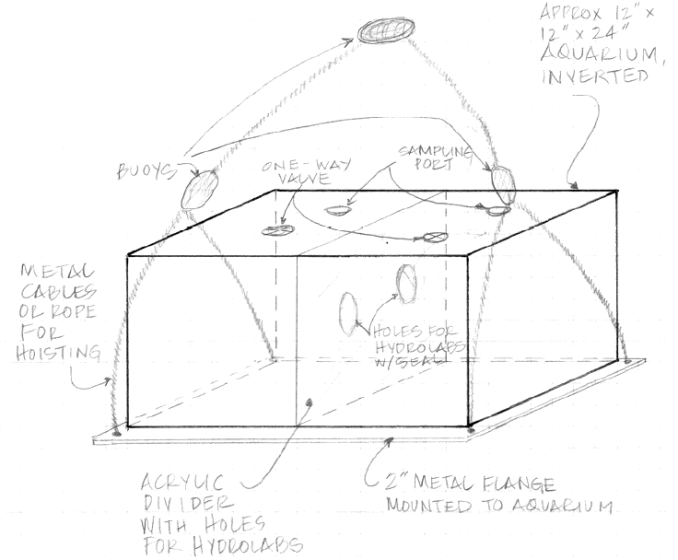


- Temperature:
  - Thermistors and piezometers collected data from May 2008 through September 2009.
  - Riparian vegetation assessment and stream channel survey performed at each site.

Summary of Data Collection, cont.

- Dissolved Oxygen & pH:
  - Periphyton sampled on July 29, 2008
  - Sediment Oxygen Demand Survey on July 28 and September 22, 2008
  - Instantaneous temperature, DO, pH, and conductivity measured during bi-weekly sampling runs
  - Winkler dissolved oxygen samples taken during bi-weekly sampling runs





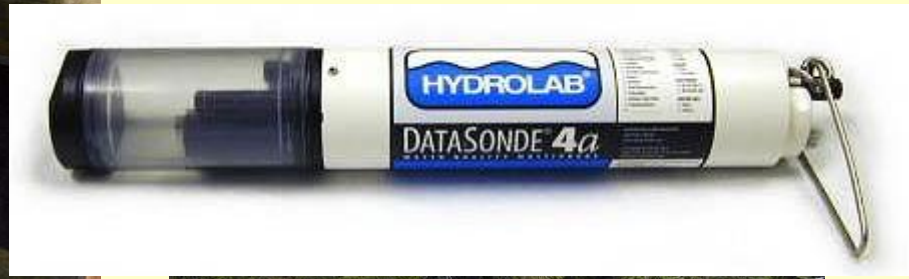
Summary of Data Collection, cont.

- Synoptic Surveys conducted on July 29 and September 23, 2008
  - Instantaneous flow measurements
  - Temperature, dissolved oxygen, pH, and conductivity
  - Grab samples collected in AM and PM of dissolved oxygen (Winkler's), bacteria, and nutrients
  - Groundwater samples collected at gaining piezometers once per survey (DO, bacteria, nutrients)

- Time of Travel conducted June 28 and September 22, 2008

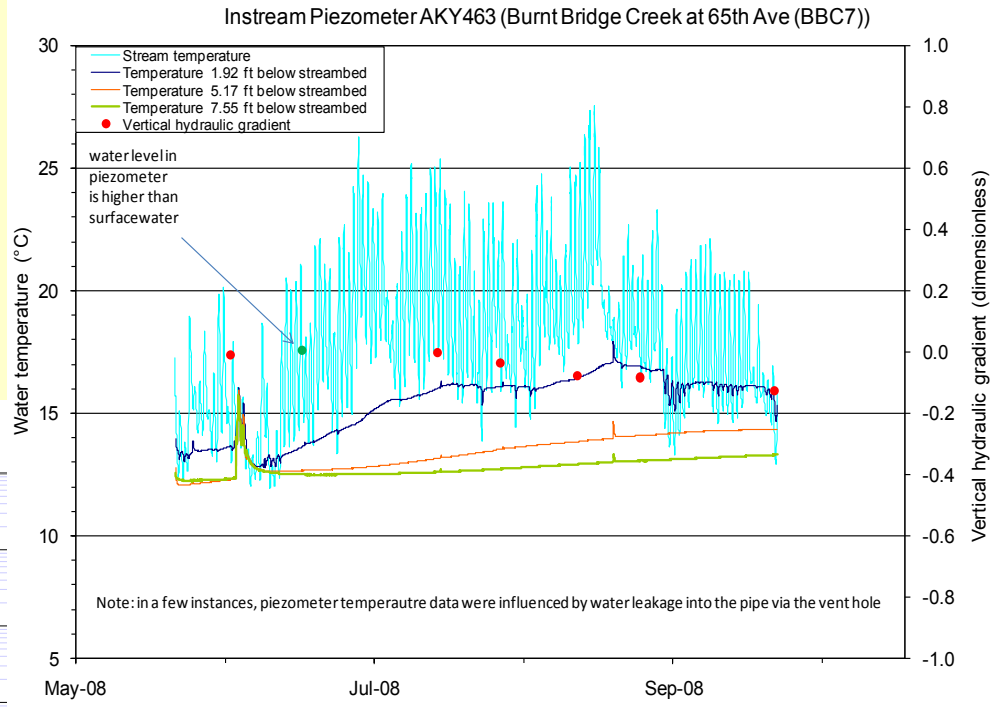
Summary of Data Collection, cont.

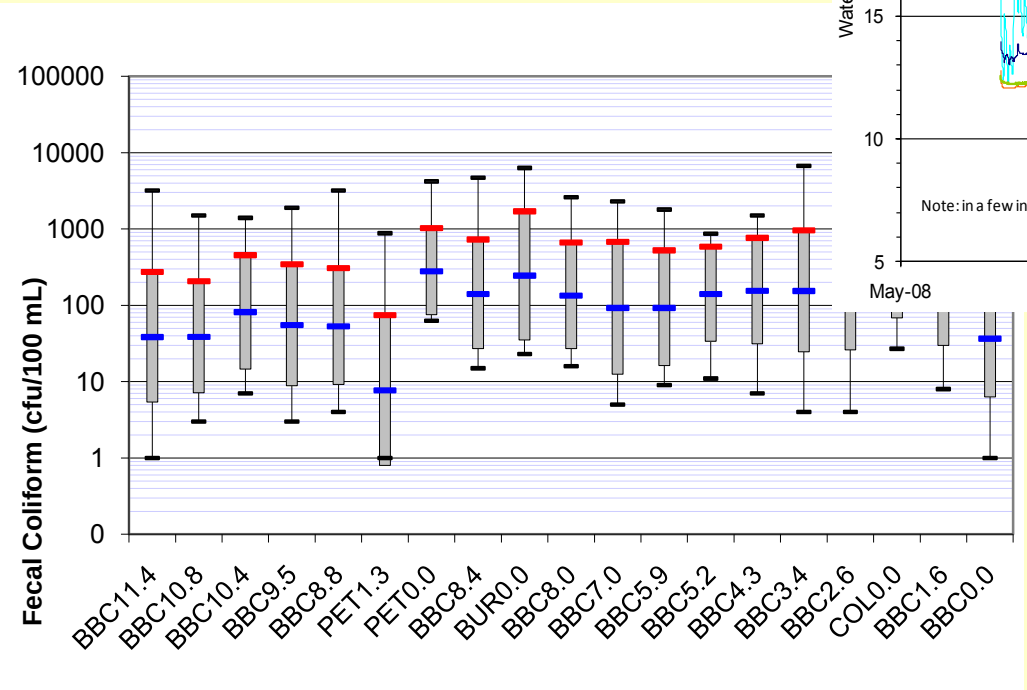
- Continuous Flow Monitoring at 3 locations operational from July 2008 through September 2009.



Surface Water/Groundwater Data Analysis

- Bacteria
- Temperature
- Dissolved Oxygen & pH
- Flow



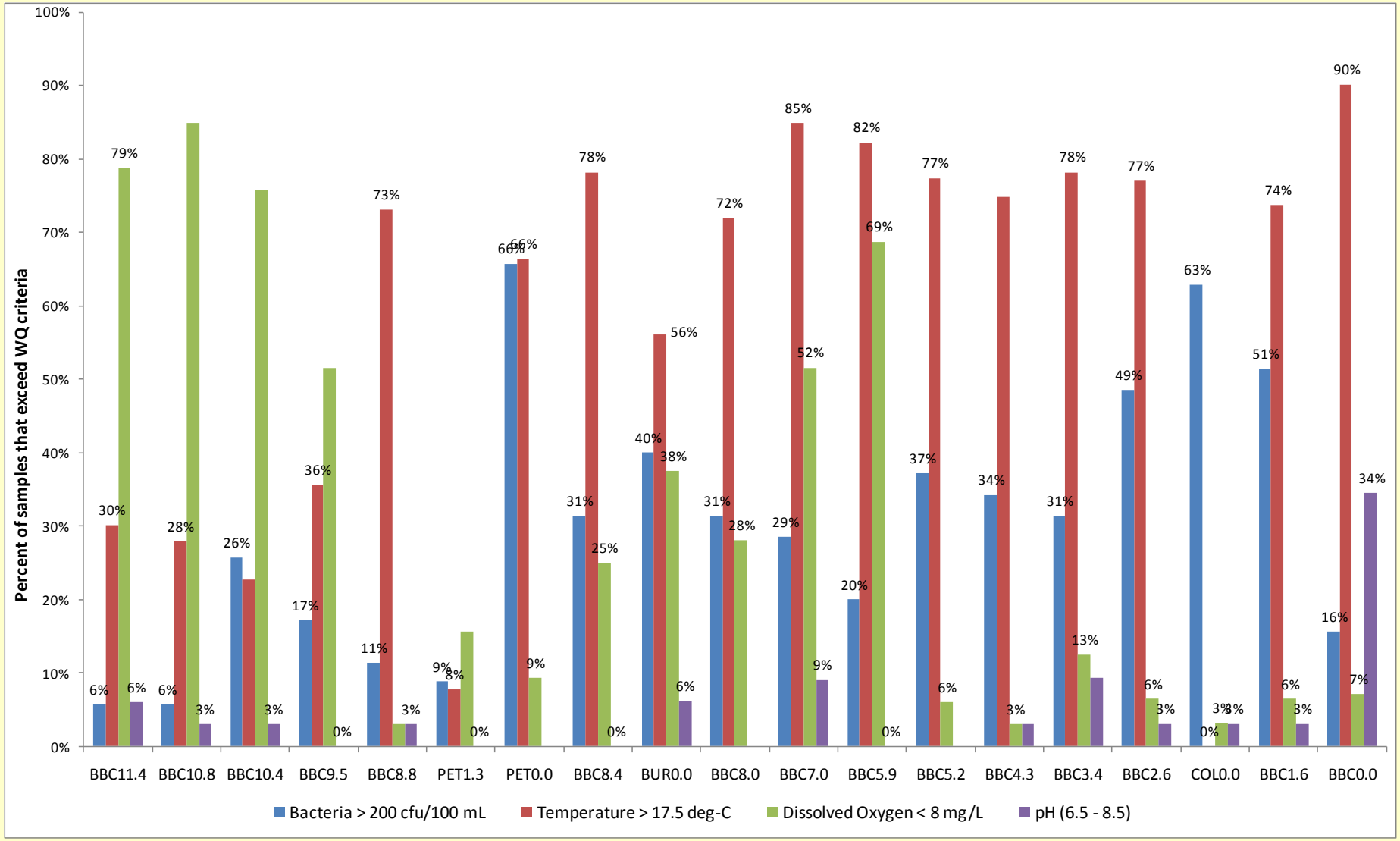


Data compared to Water Quality Criteria

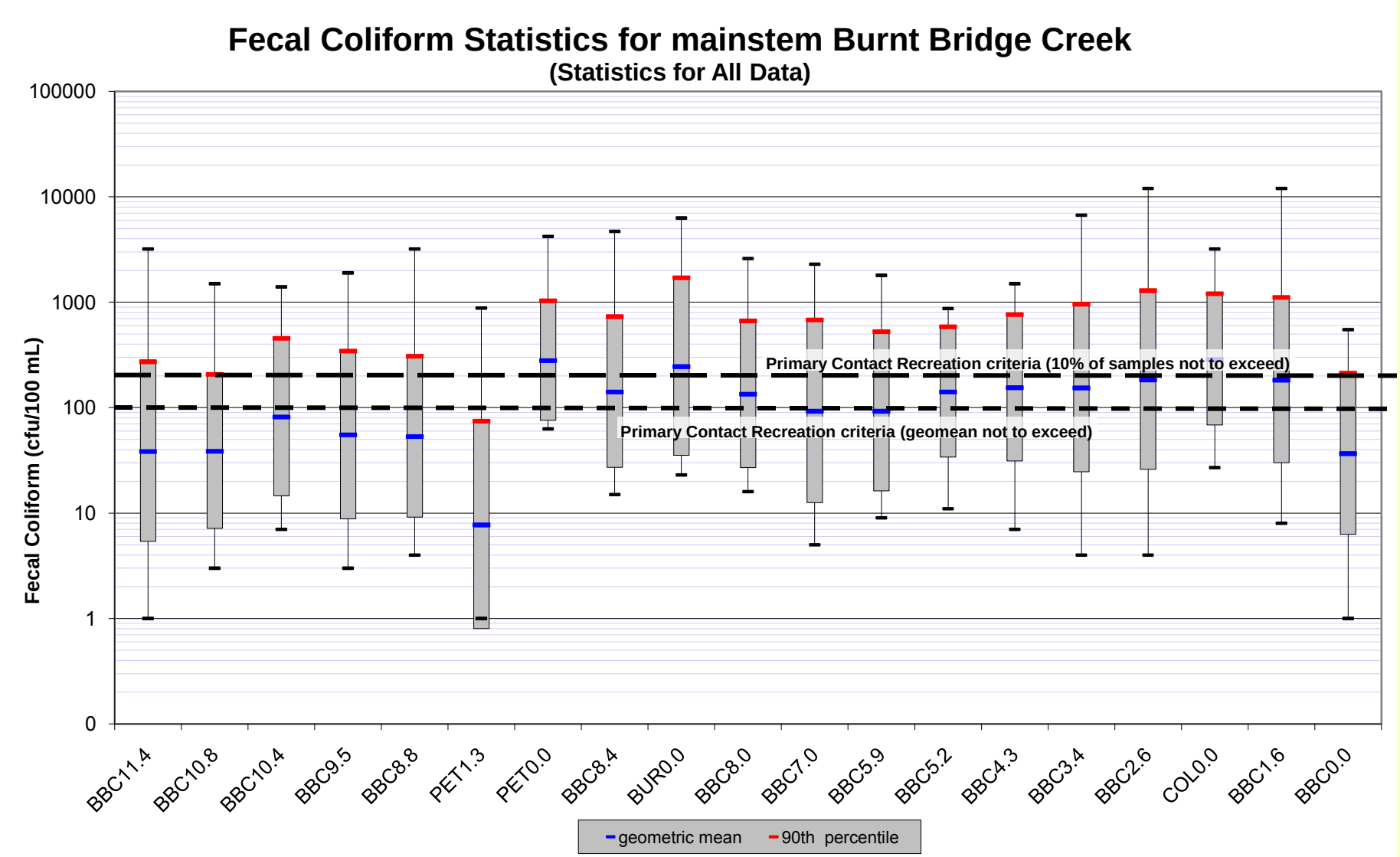
Site ID	Total number of days above water quality criteria							
	Bacteria > 200 cfu/100mL		Temperature > 17.5°C		Dissolved Oxygen < 8 mg/L		pH 6.5 - 8.5	
	# days	# samples	# days	# samples	# days	# samples	# days	# samples
BBC11.4	2	35	82	272	26	33	2	33
BBC10.8	2	35	76	272	28	33	1	33
BBC10.4	9	35	62	272	25	33	1	33
BBC9.5	6	35	97	272	17	33	0	33
BBC8.8	4	35	198	271	1	33	1	33
PET1.3	3	34	21	268	5	32	0	32
PET0.0	23	35	180	271	3	32	0	32
BBC8.4	11	35	212	271	8	32	0	32
BUR0.0	14	35	128	228	12	32	2	32
BBC8.0	11	35	95	132	9	32	0	32
BBC7.0	10	35	230	271	16	31	3	33
BBC5.9	7	35	222	270	22	32	0	32
BBC5.2	13	35	209	270	2	33	0	33
BBC4.3	12	35	202	270	1	33	1	33
BBC3.4	11	35	212	271	4	32	3	32
BBC2.6	17	35	211	274	2	31	1	32
COL0.0	22	35	0	270	1	31	1	32
BBC1.6	18	35	202	274	2	31	1	32
BBC0.0	5	32	191	212	2	28	10	29

[1] The highest annual running 7-day average of maximum temperatures.

Percent Exceedance of Water Quality Criteria

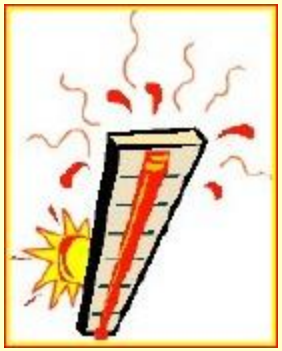


Bacteria Results



Weather Data

- Hazel Dell weather station
  - Latitude 45.68
  - Longitude -122.65
  - Elevation 232 feet
- Air temperature data compiled for July – August 1948 – 2009
- 2009 hottest 7DADM air temperatures on record for this station
- 2008 7DADM air temperatures in 60th percentile



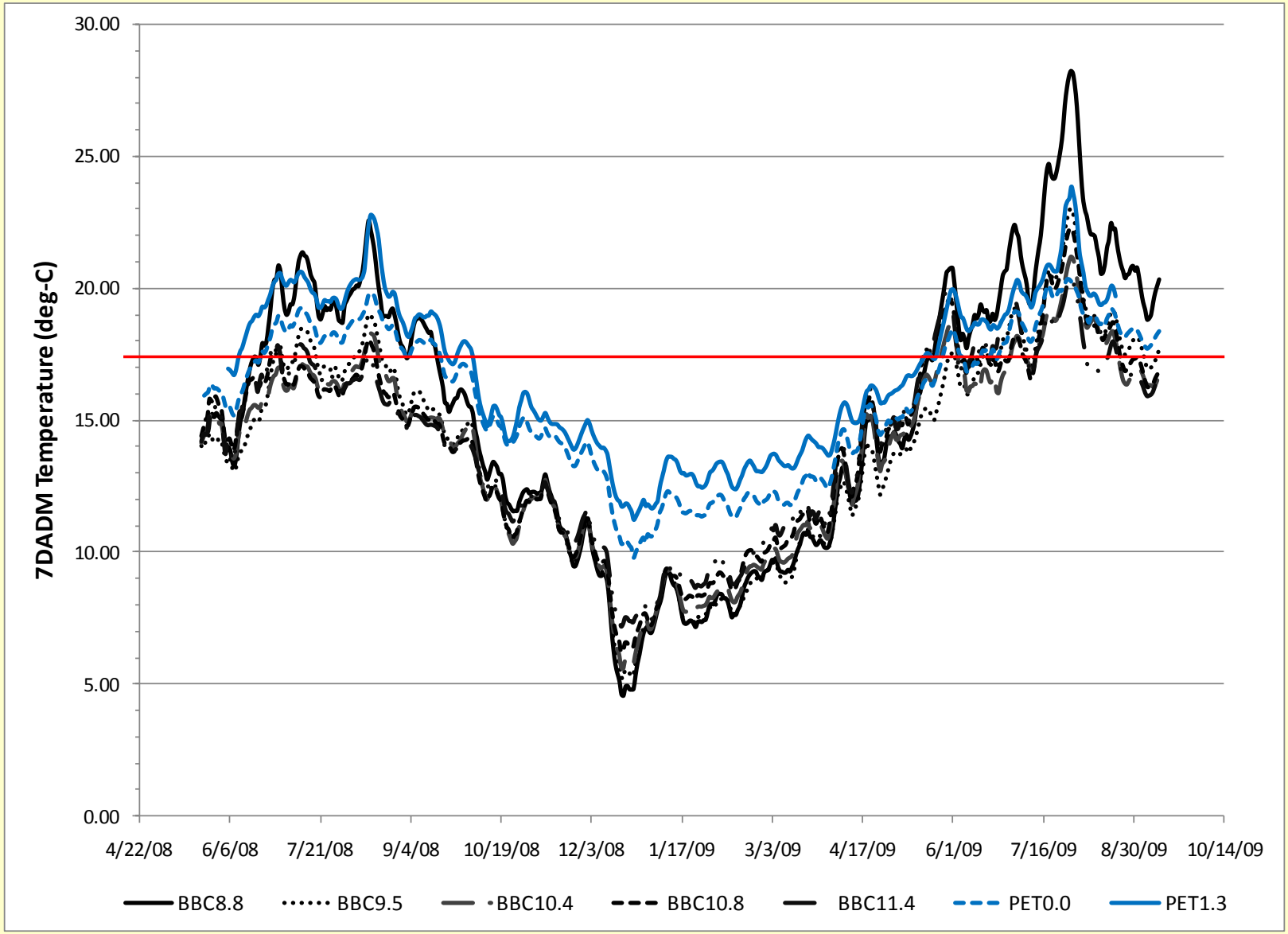
Temperature Results
(Critical Period – May to September 2008 and 2009)

Station	Days 7DADM above 17.5 deg-C	Number of Days on Record	% WQ Standard Violated
BBC11.4	82	272	30%
BBC10.8	76	272	28%
BBC10.4	62	272	23%
BBC9.5	97	272	36%
BBC8.8	198	271	73%
PET1.3*	21	268	8%
PET0.0	180	271	66%
BBC8.4	212	271	78%
BUR0.0	128	228	56%
BBC8.0	95	132	72%
BBC7.0	230	271	85%
BBC5.9	222	270	82%
BBC5.2	209	270	77%
BBC4.3	202	270	75%
BBC3.4	212	271	78%
BBC2.6	211	274	77%
COL0.0	0	270	0%
BBC1.6	202	274	74%
BBC0.0	191	212	90%

*PET1.3 compared to NPDES Permit Limit of 21 C

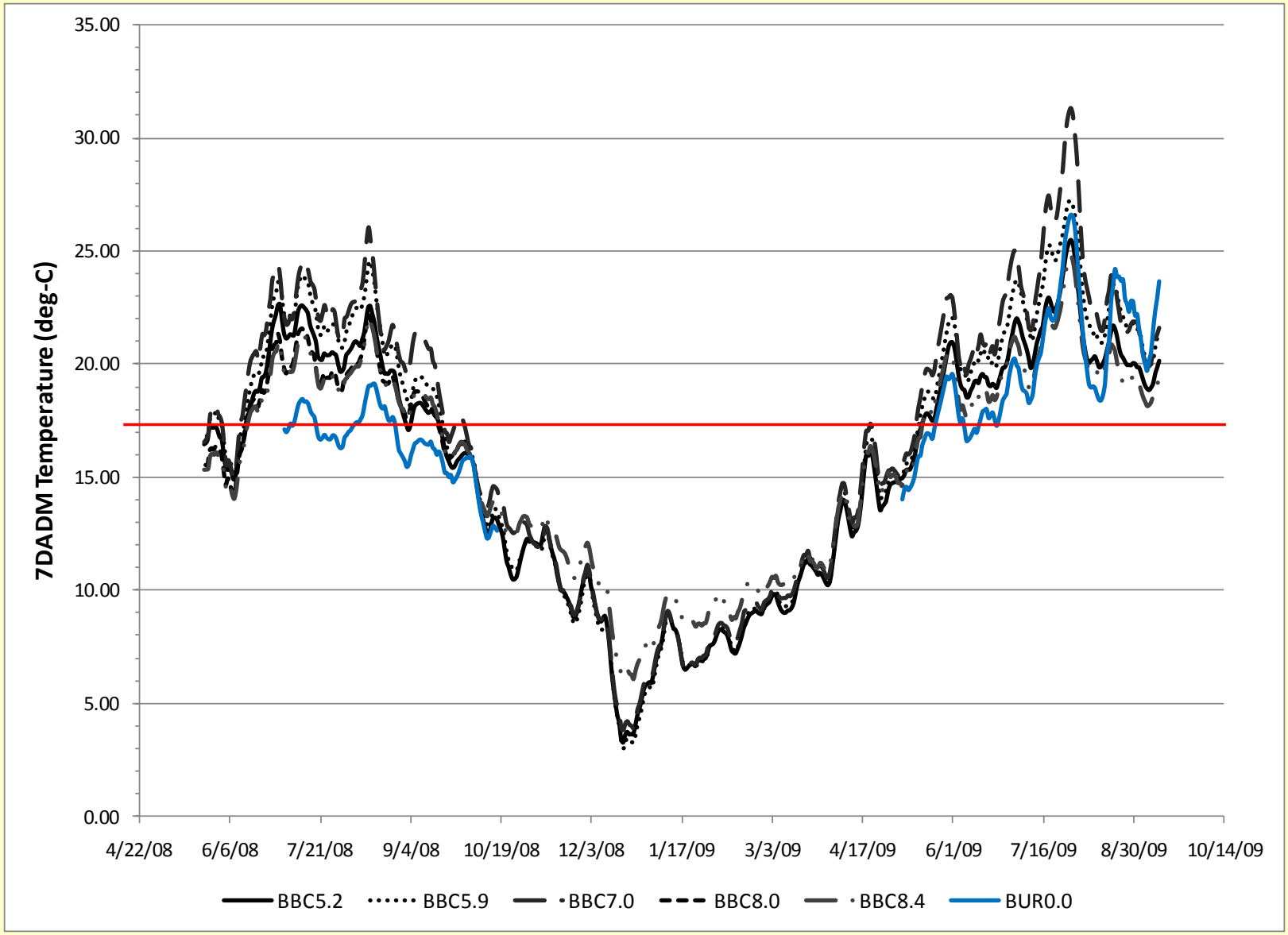
7DADM Temperatures

Upper Watershed Sites



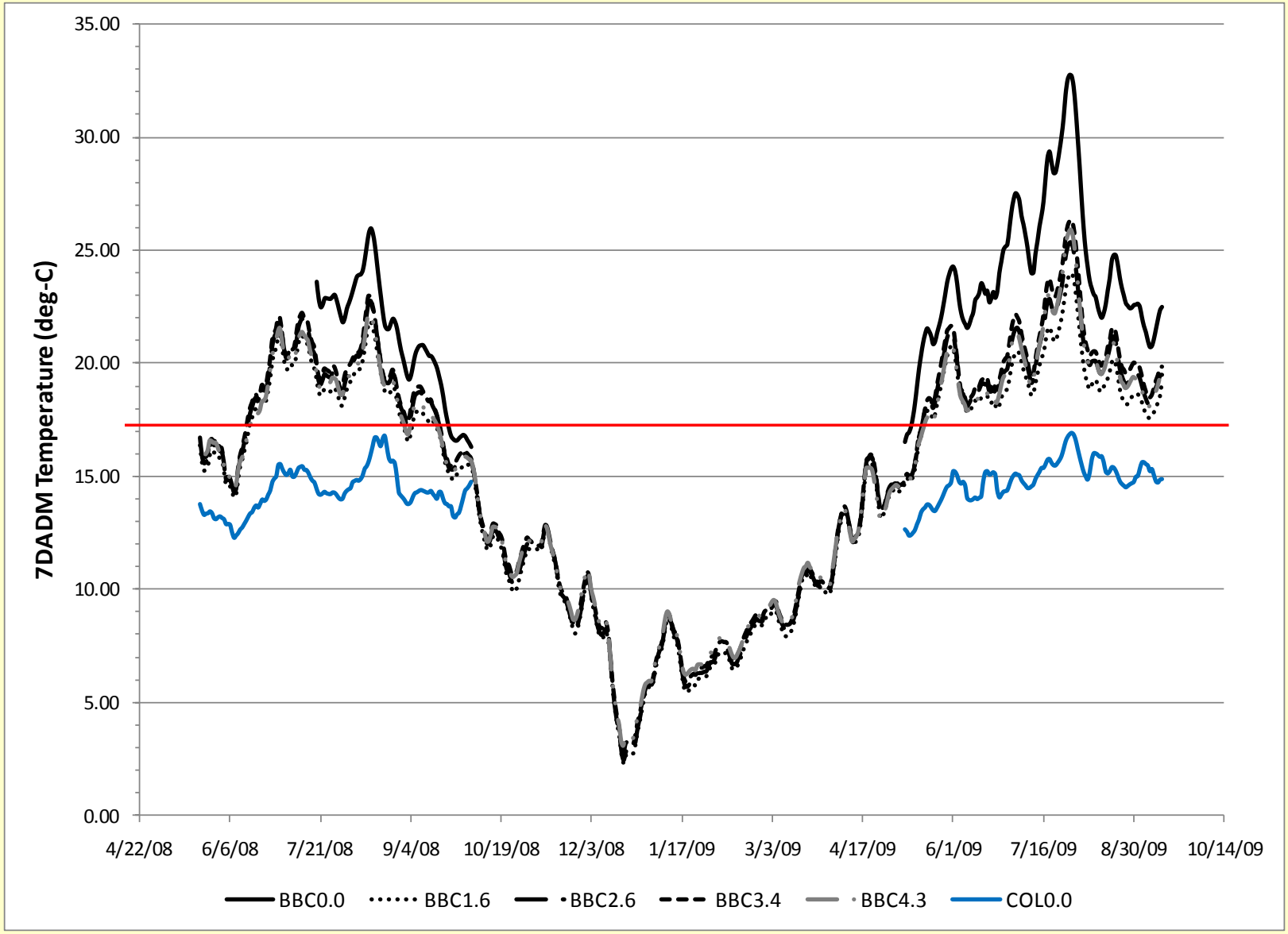
7DADM Temperatures

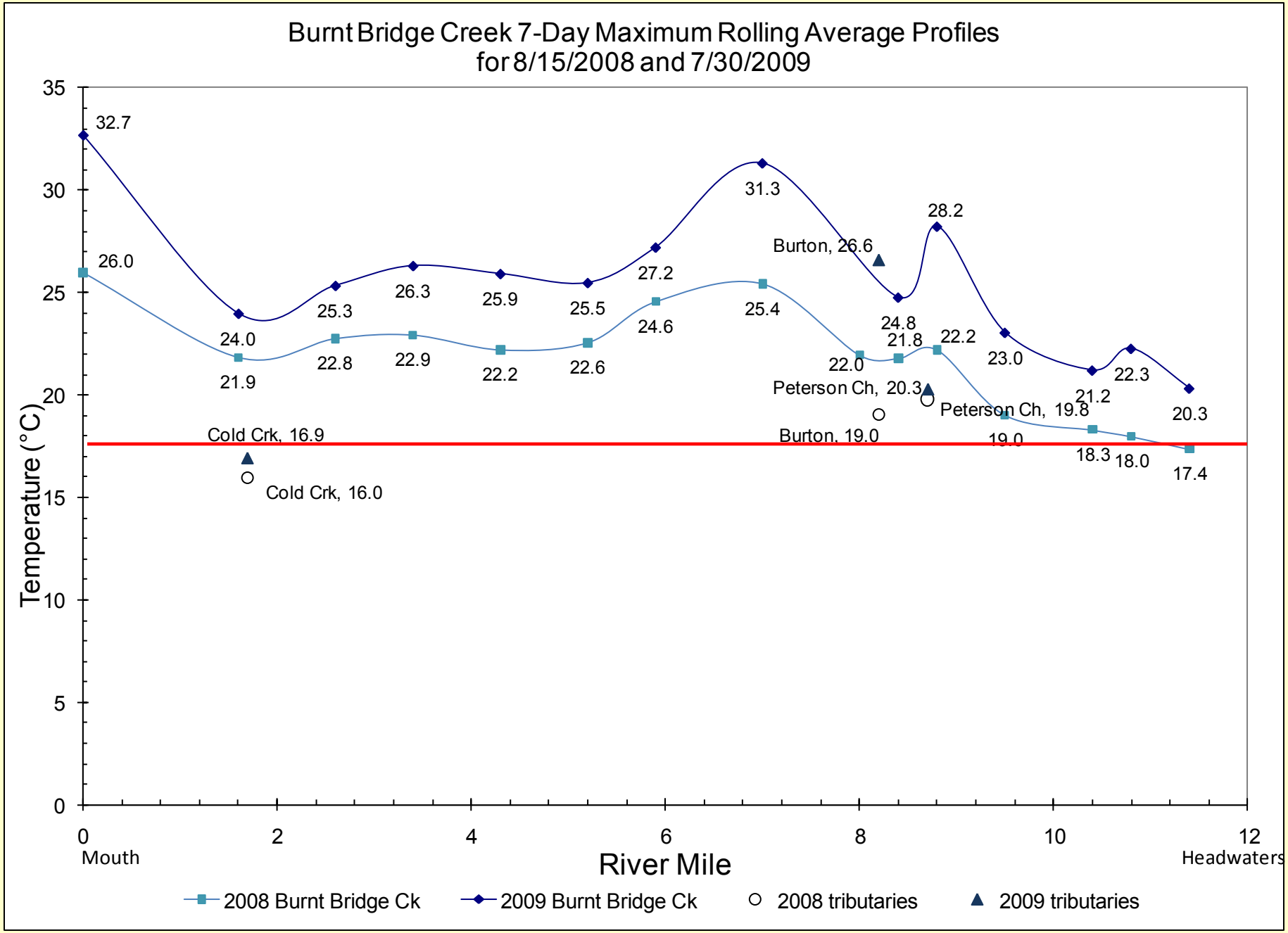
Middle Watershed Sites



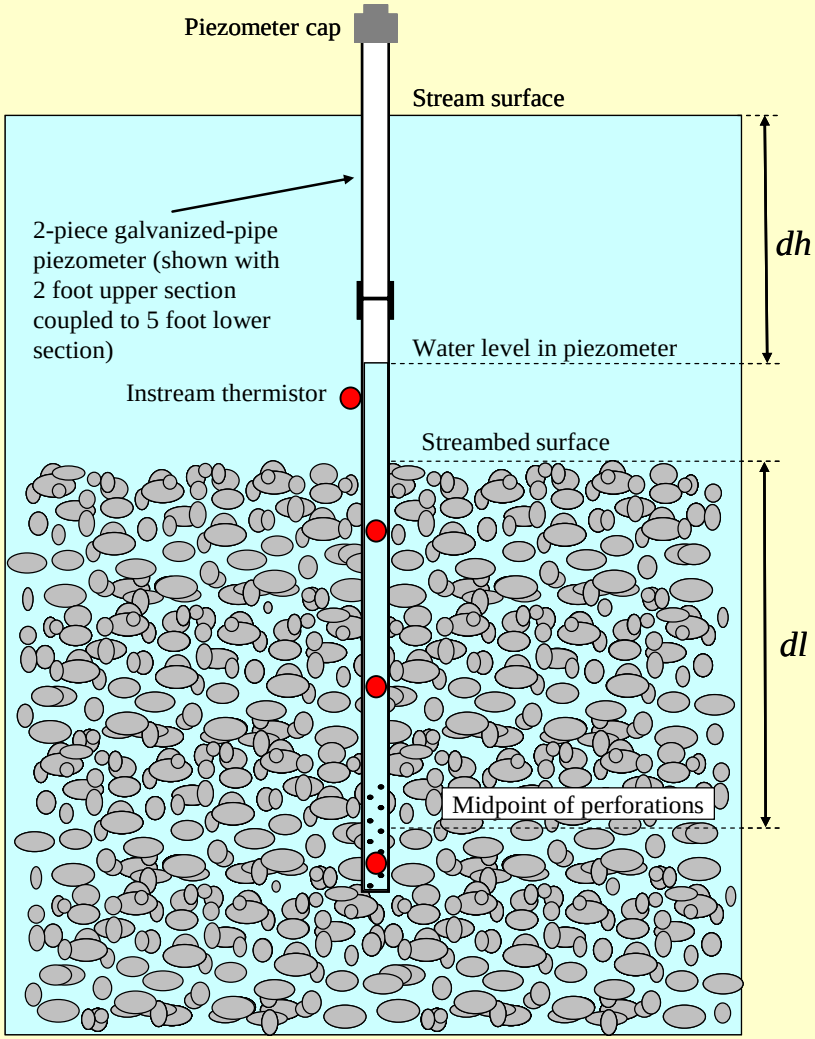
7DADM Temperatures

Lower Watershed Sites

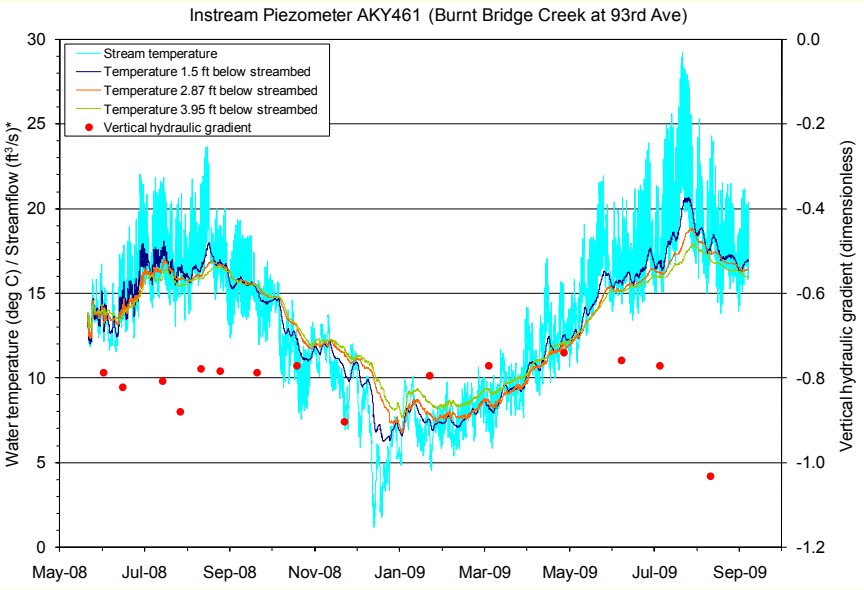


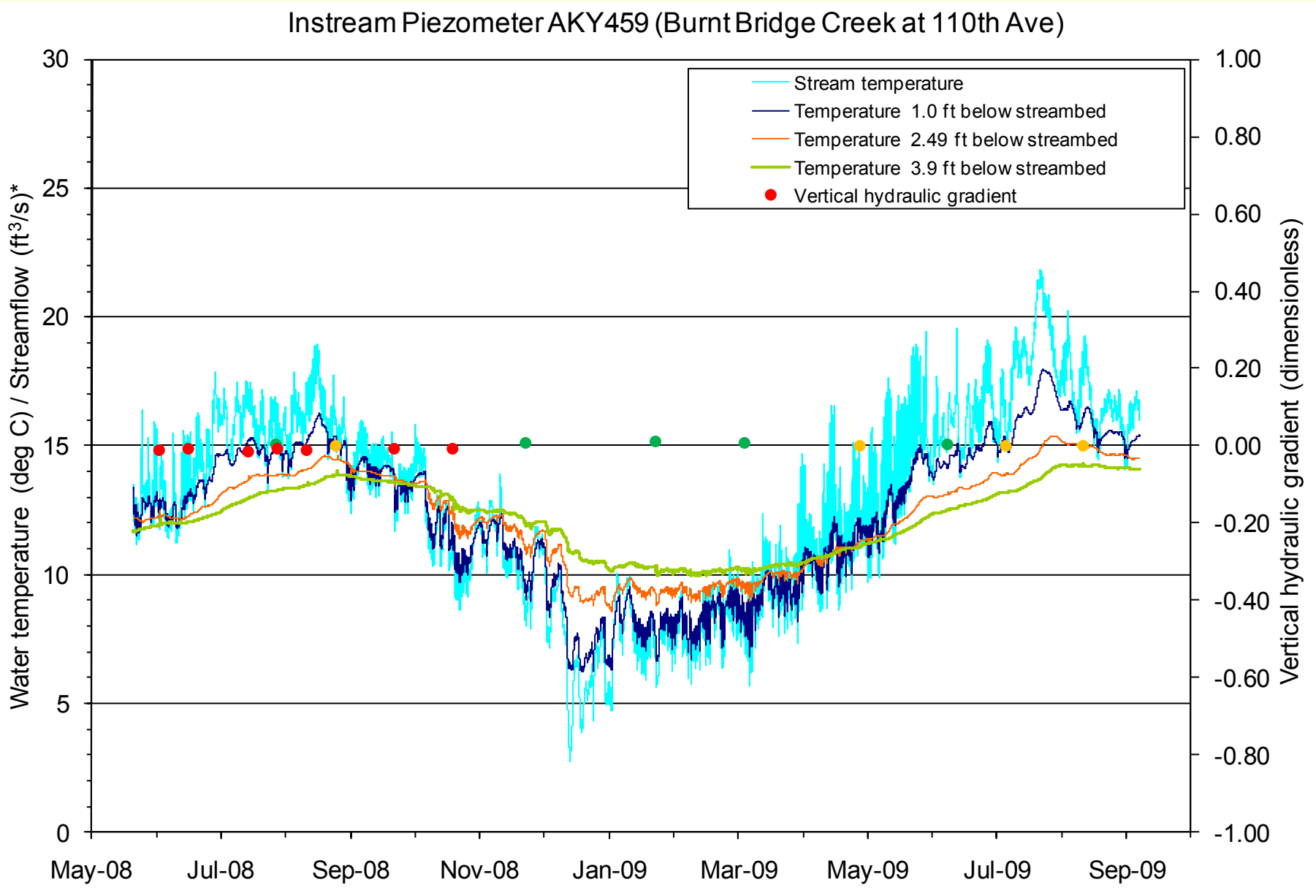

Burnt Bridge Creek 7-Day Maximum Rolling Average Profiles
for 8/15/2008 and 7/30/2009
Temperature (°C)
River Mile
Mouth
Headwaters
32.7
26.0
24.0
21.9
25.3
22.8
26.3
22.9
25.9
22.2
25.5
22.6
27.2
24.6
31.3
25.4
Burton, 26.6
22.0
Peterson Ch, 20.3
Burton, 19.0
24.8
21.8
28.2
22.2
Peterson Ch, 19.8
19.0
23.0
21.2
18.3
22.3
18.0
20.3
17.4
Cold Crk, 16.9
Cold Crk, 16.0
2008 Burnt Bridge Ck
2009 Burnt Bridge Ck
2008 tributaries
2009 tributaries

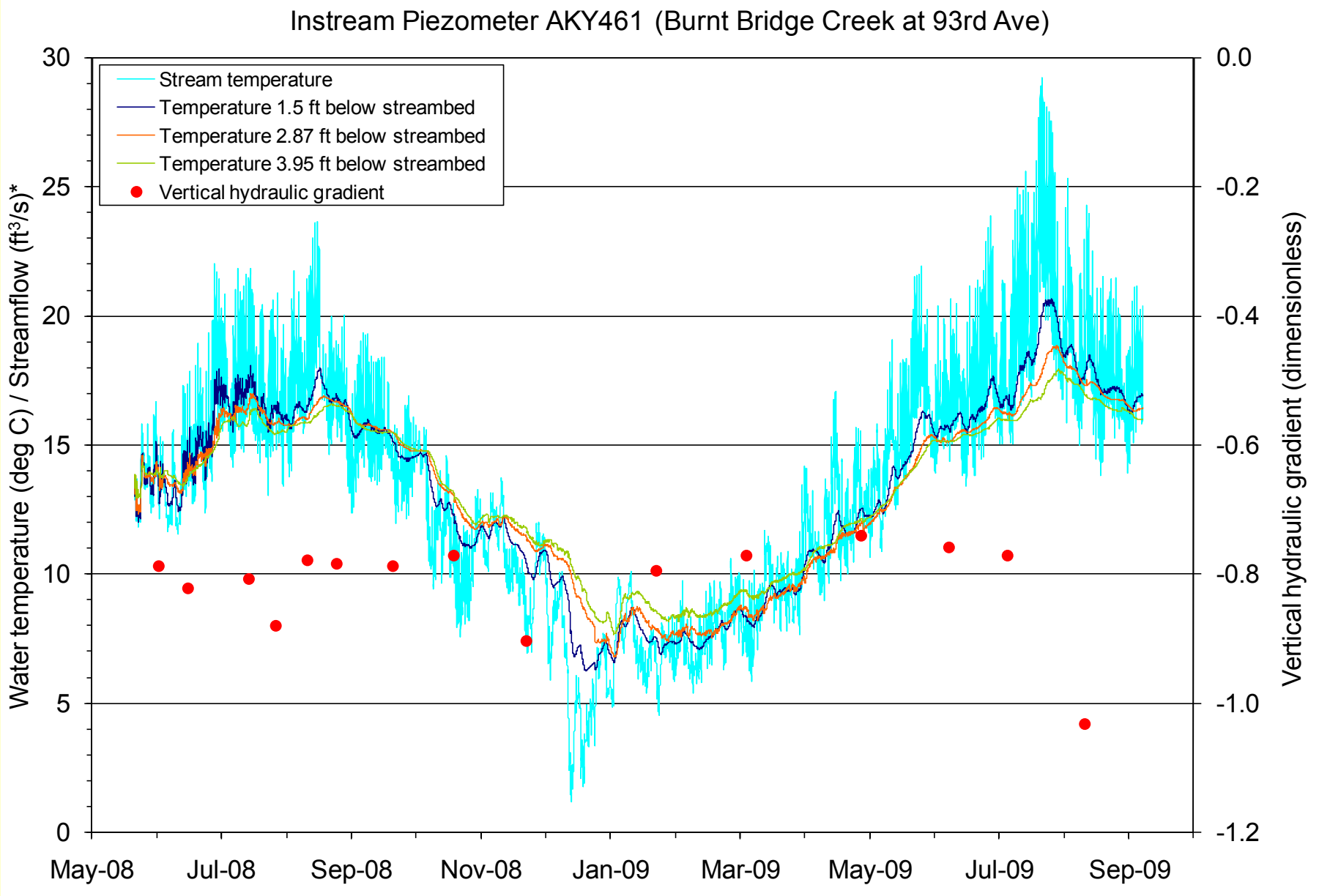
Piezometer Data



(diagram not to scale)

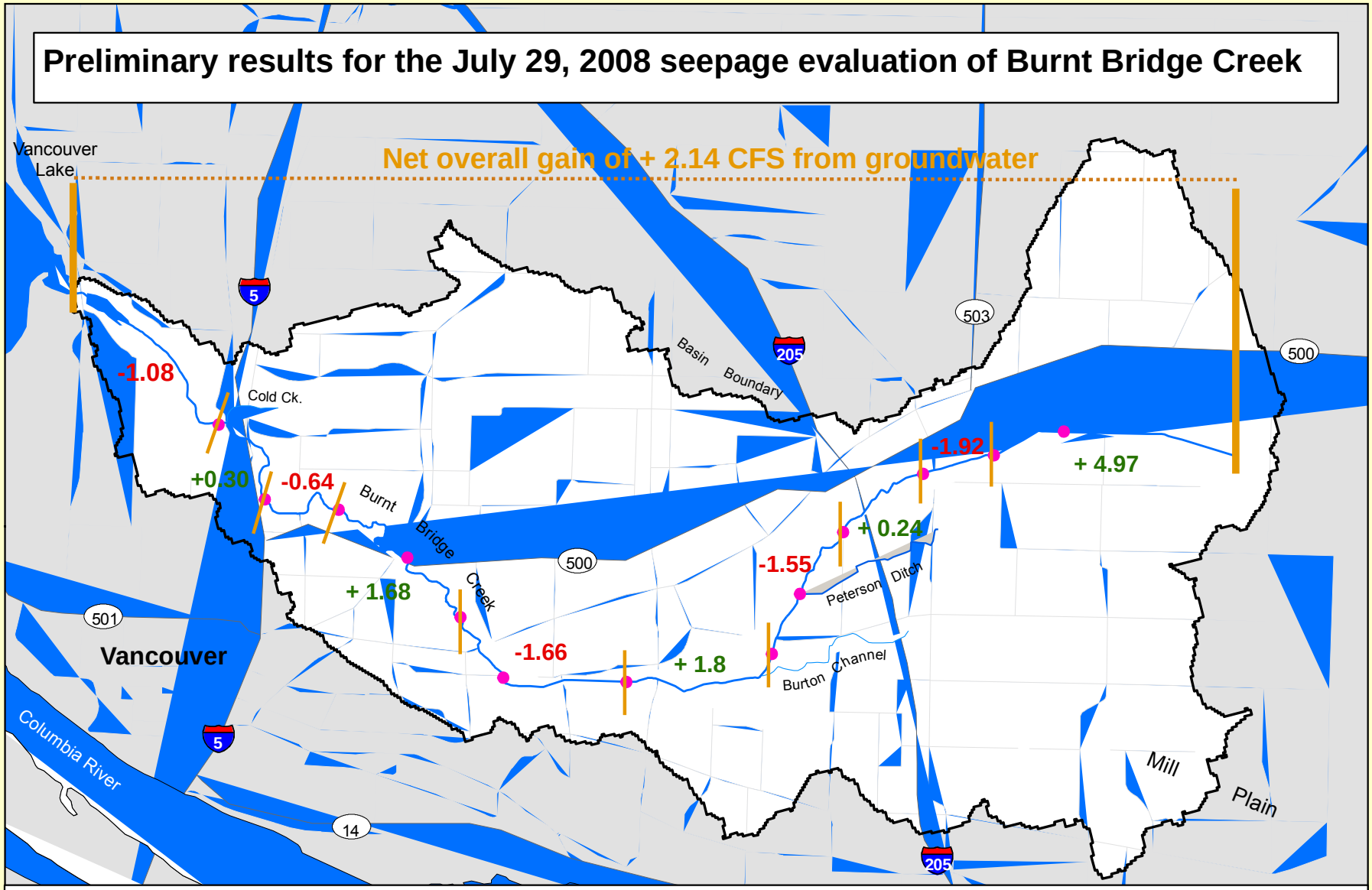



Instream Piezometer AKY459 (Burnt Bridge Creek at 110th Ave)
Stream temperature
Temperature 1.0 ft below streambed
Temperature 2.49 ft below streambed
Temperature 3.9 ft below streambed
Vertical hydraulic gradient
Water temperature (deg C) / Streamflow (ft3/s)*
Vertical hydraulic gradient (dimensionless)
30
25
20
15
10
5
0
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09


Instream Piezometer AKY461 (Burnt Bridge Creek at 93rd Ave)
Stream temperature
Temperature 1.5 ft below streambed
Temperature 2.87 ft below streambed
Temperature 3.95 ft below streambed
Vertical hydraulic gradient
Water temperature (deg C) / Streamflow (ft3/s)*
Vertical hydraulic gradient (dimensionless)
30
25
20
15
10
5
0
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09

Seepage Run and Time of Travel Results

Preliminary results for the July 29, 2008 seepage evaluation of Burnt Bridge Creek



EXPLANATION

+0.30 Seepage reach with net streamflow gain or loss

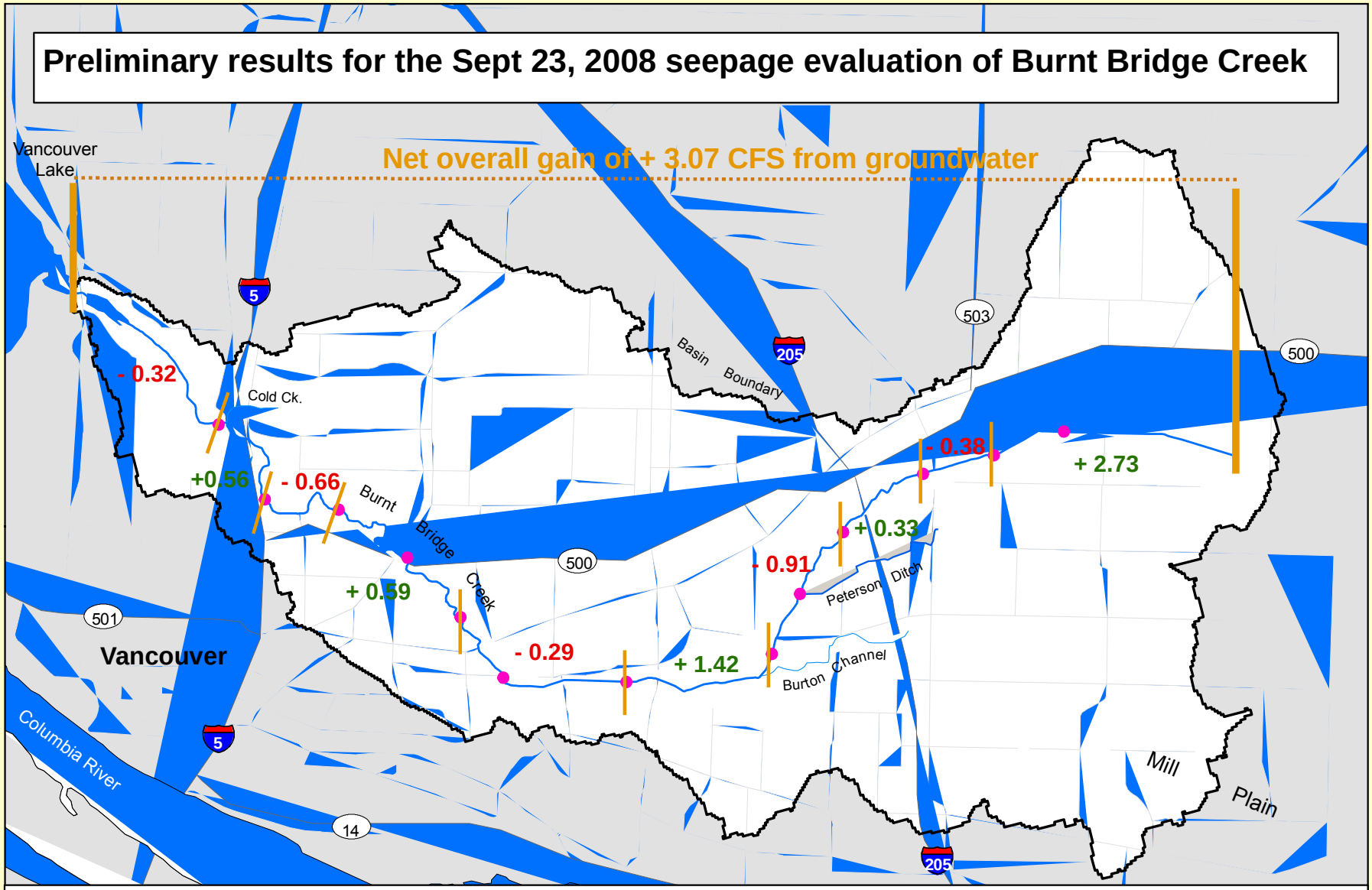
Instream Piezometer

N
W
E
S

0 0.5 1 Miles

0 0.5 1 2 Kilometers

Preliminary results for the Sept 23, 2008 seepage evaluation of Burnt Bridge Creek



EXPLANATION

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W
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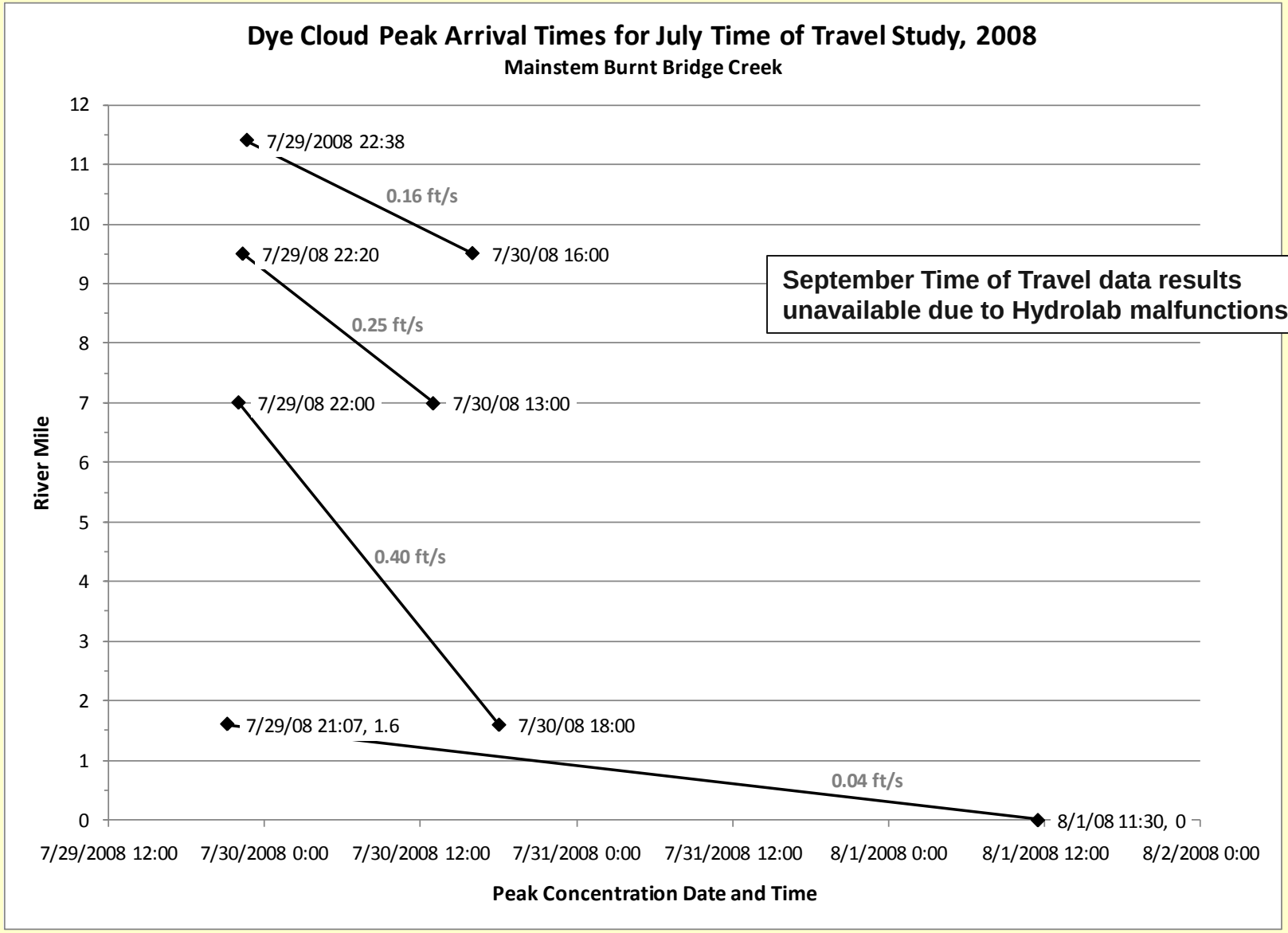
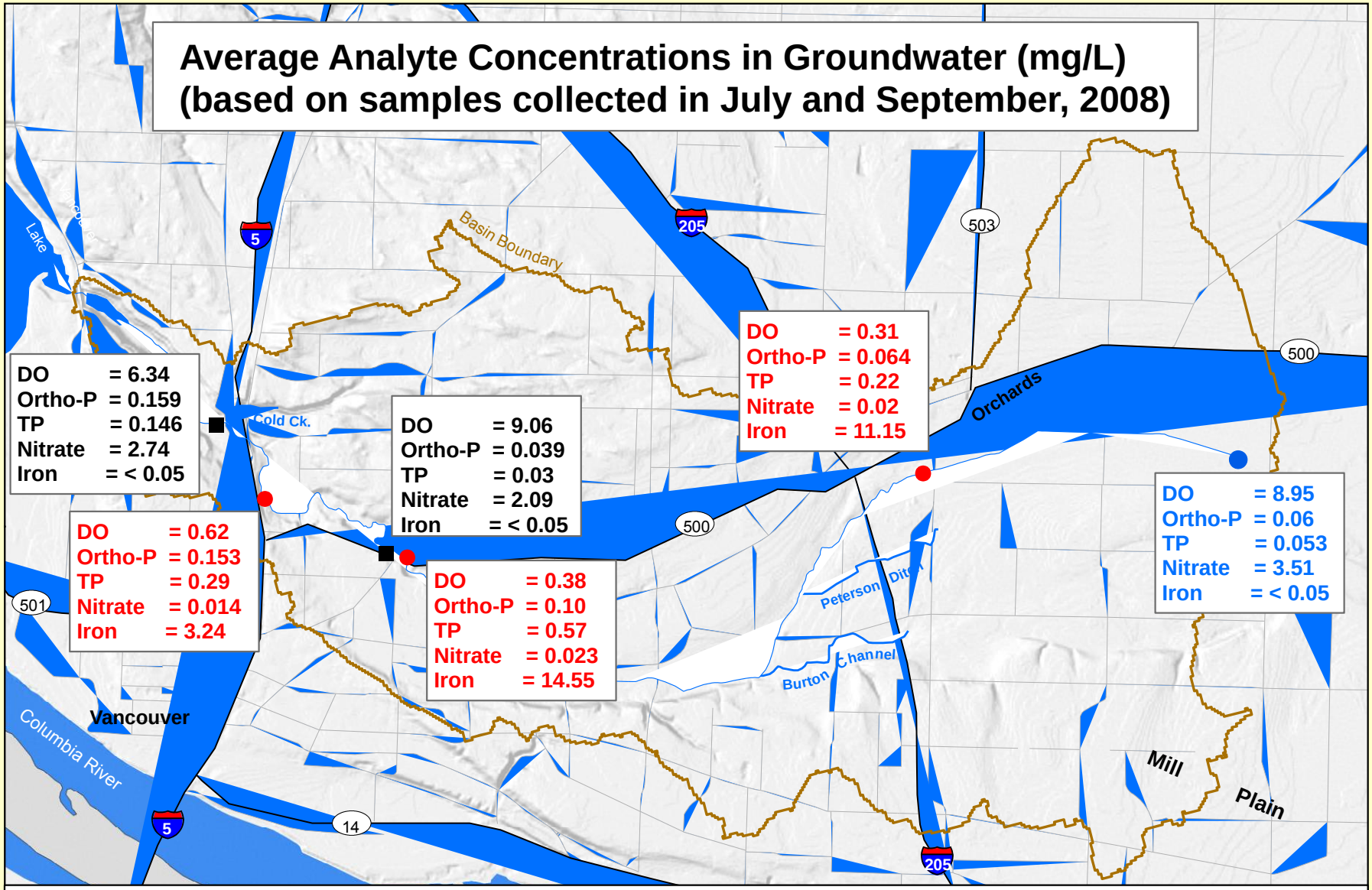
Time of Travel Results



Synoptic Survey Results

Average Analyte Concentrations in Groundwater (mg/L) (based on samples collected in July and September, 2008)



N
W E
S

Instream Piezometer

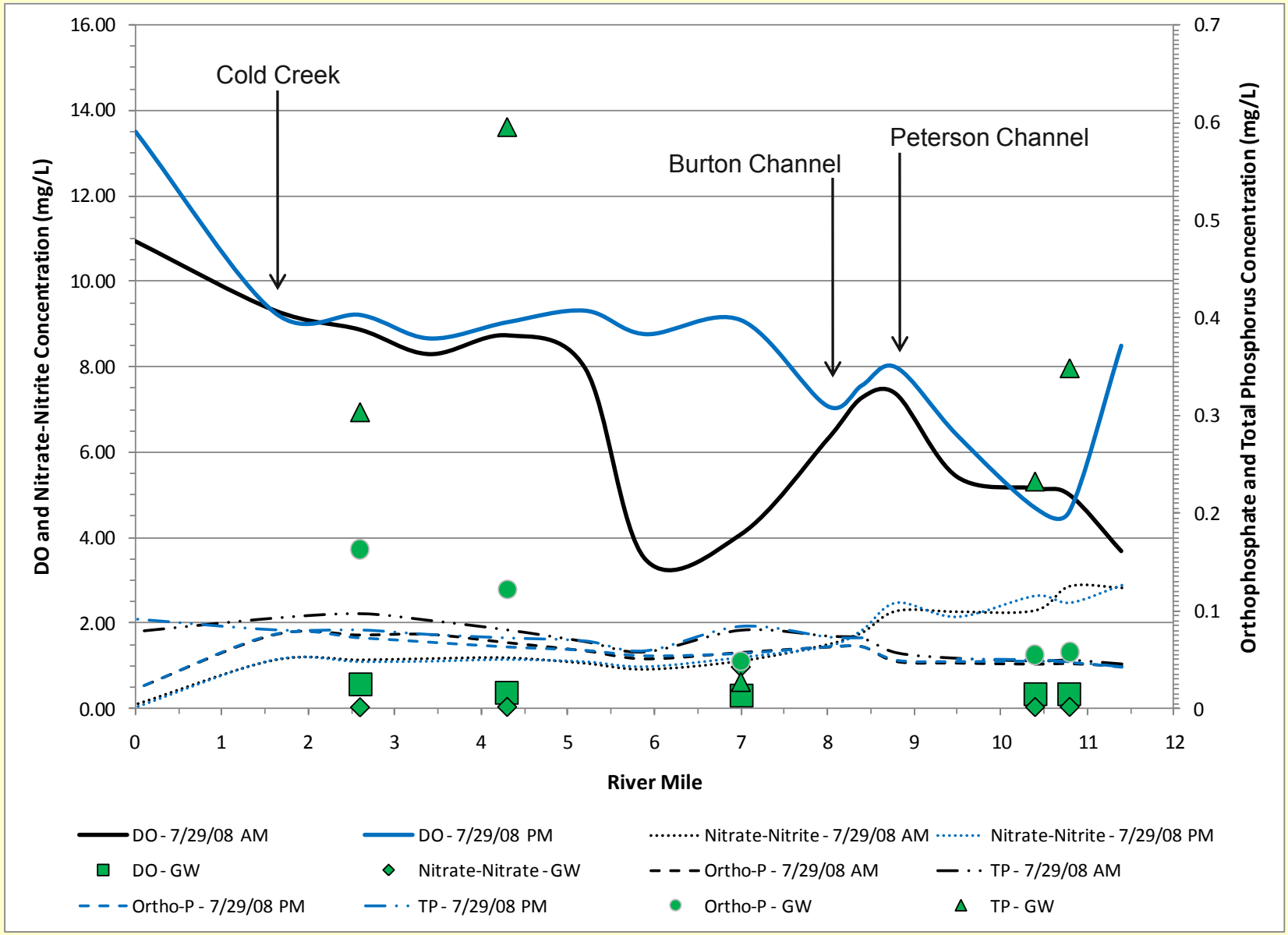
Headwater "Spring"

Off-stream Well

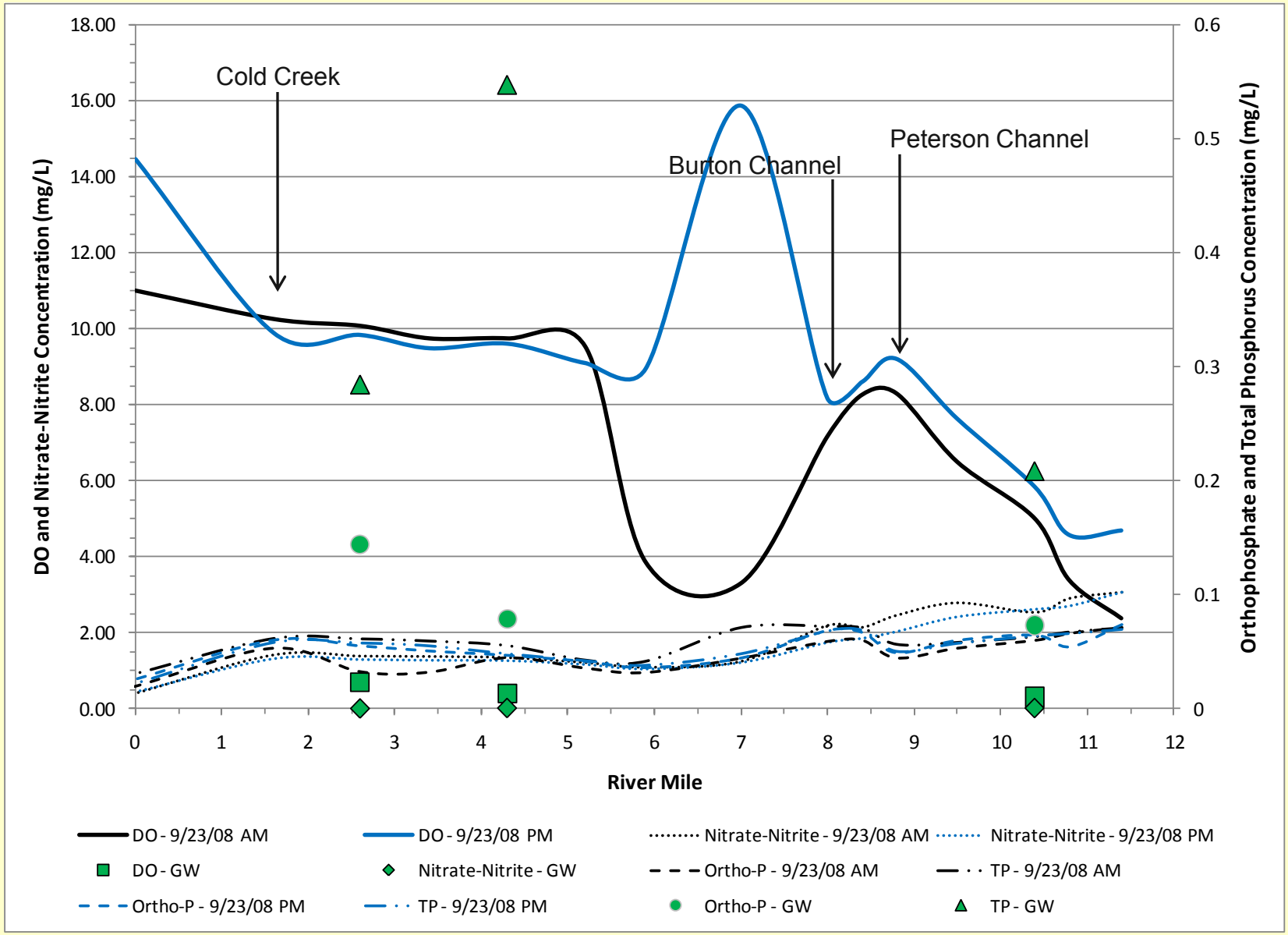
0 0.5 1 Miles

0 0.5 1 2 Kilometers

July Synoptic Survey – Nutrient and DO

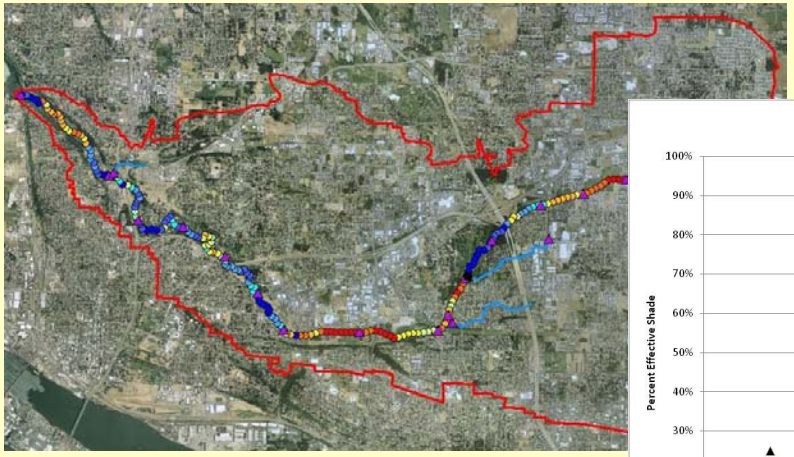


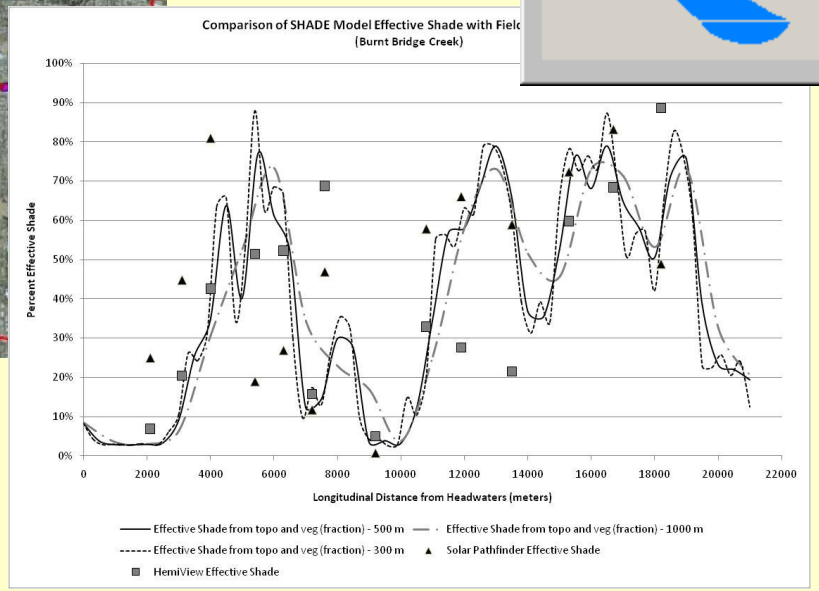
September Synoptic Survey – Nutrient and DO



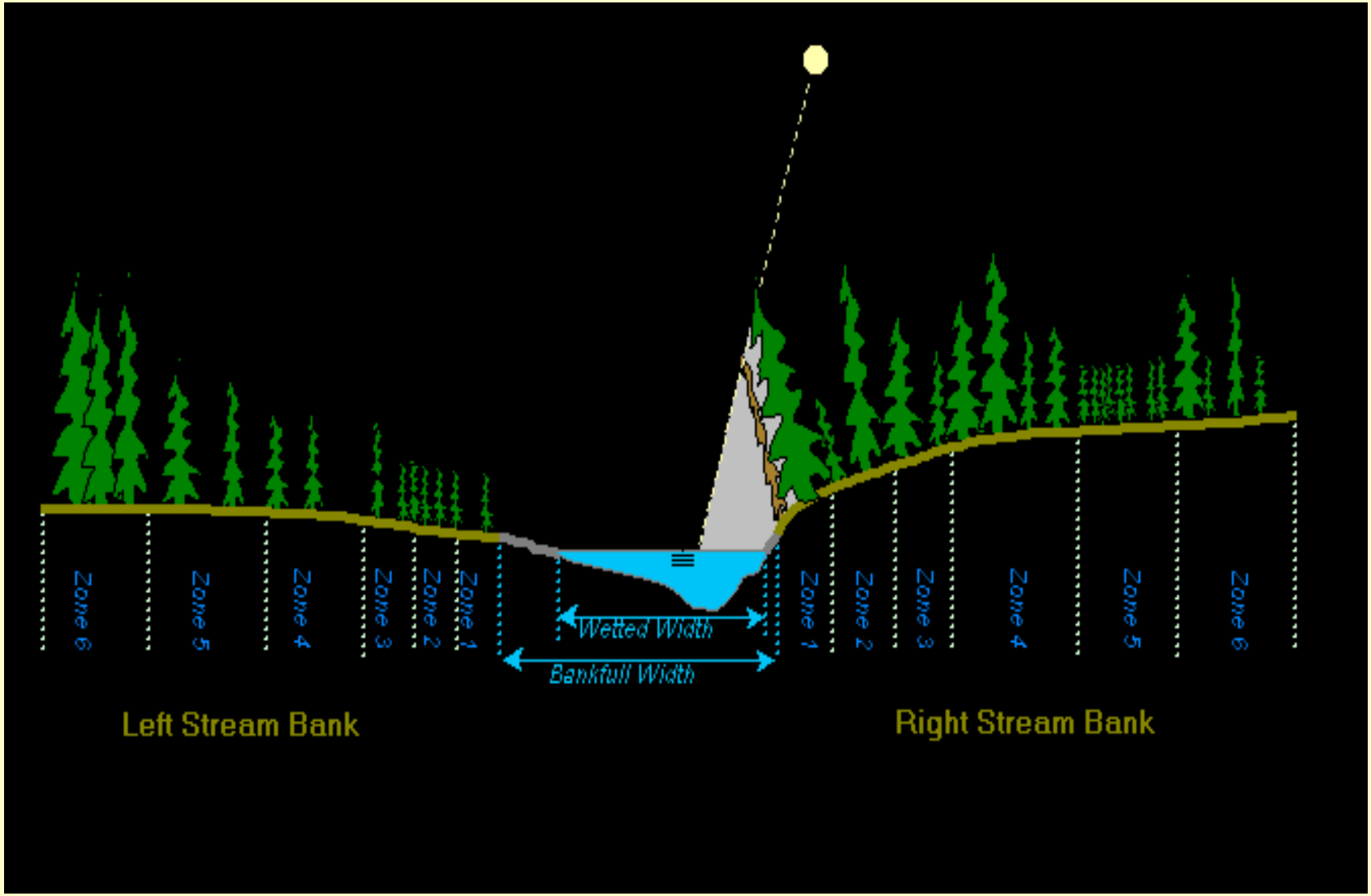
Modeling

- SHADE
  - Current condition vegetation
  - System potential vegetation
- Shade Deficit

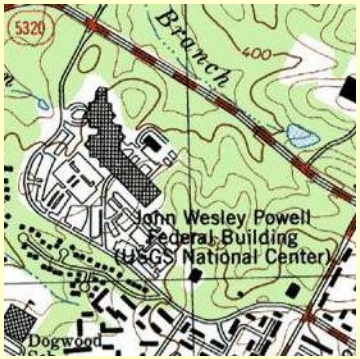




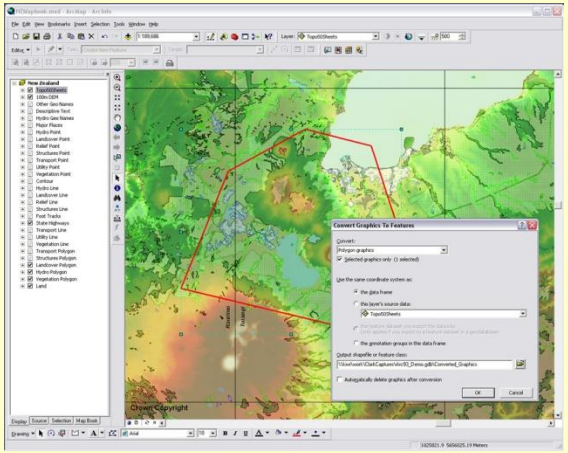
Shade Model Schematic



Shade Model Inputs

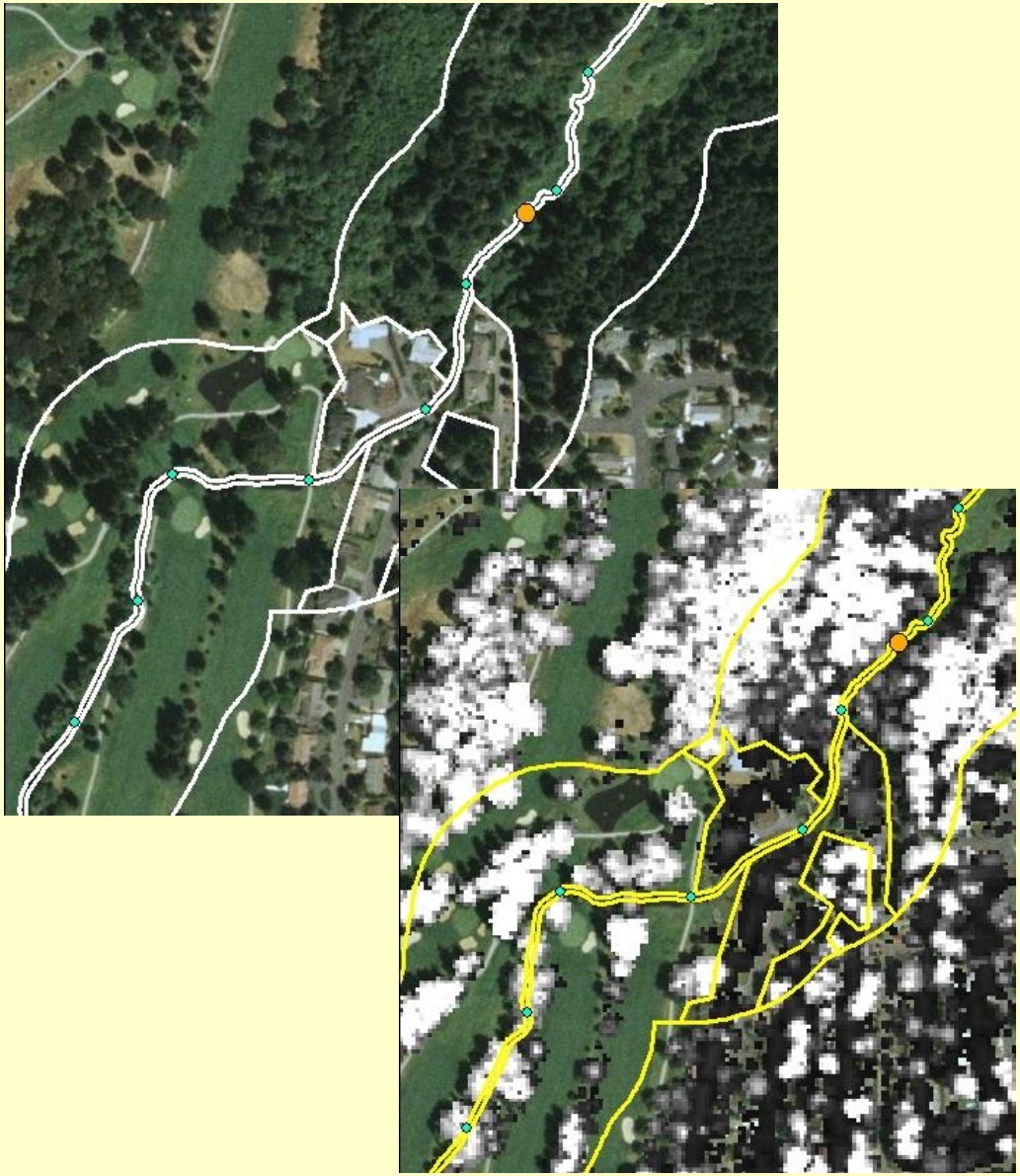


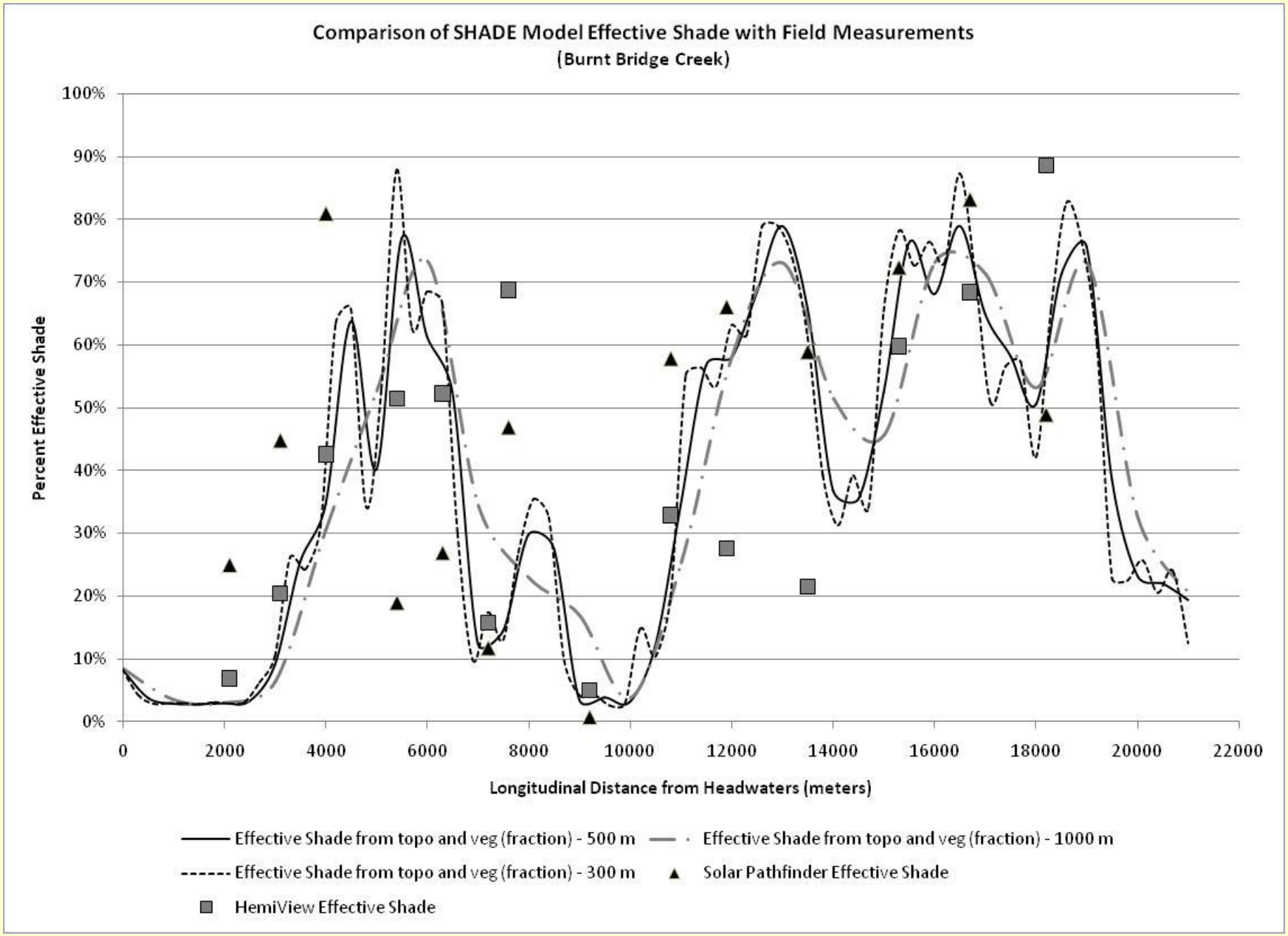
- Elevation (GIS)
- Aspect (GIS)
- Wetted Width (GIS and field measurements)
- Near Stream Disturbance Zone (NSDZ) (GIS & field measurements)
- Channel Incision (GIS and field measurements)
- Topographic Shade (GIS)
- Riparian Vegetation Characteristics (GIS & field measurements)
  - Height
  - Density
  - Overhang



Current Riparian Vegetation

- 300 foot buffer created around the stream
- Vegetation polygons delineated using GIS coverages
- Vegetation polygons are classified by species (i.e. deciduous, conifer, mixed), tree height (generated using LIDAR), and canopy density
- The vegetation map ground-truthed with field observations and measurements taken during habitat surveys



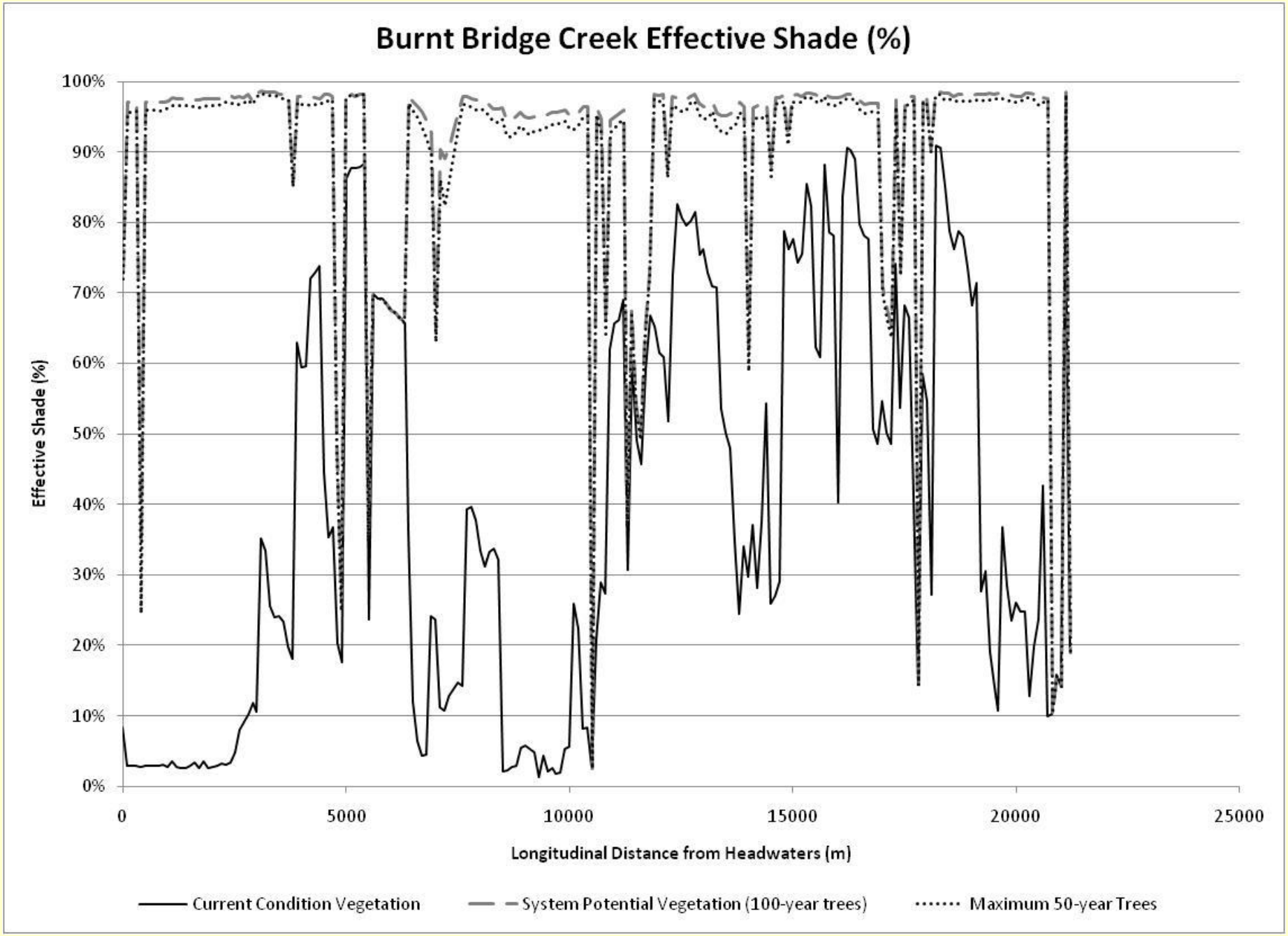

Comparison of SHADE Model Effective Shade with Field Measurements
(Burnt Bridge Creek)
Percent Effective Shade
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
Longitudinal Distance from Headwaters (meters)
Effective Shade from topo and veg (fraction) - 500 m
Effective Shade from topo and veg (fraction) - 1000 m
Effective Shade from topo and veg (fraction) - 300 m
Solar Pathfinder Effective Shade
HemiView Effective Shade

System Potential Vegetation

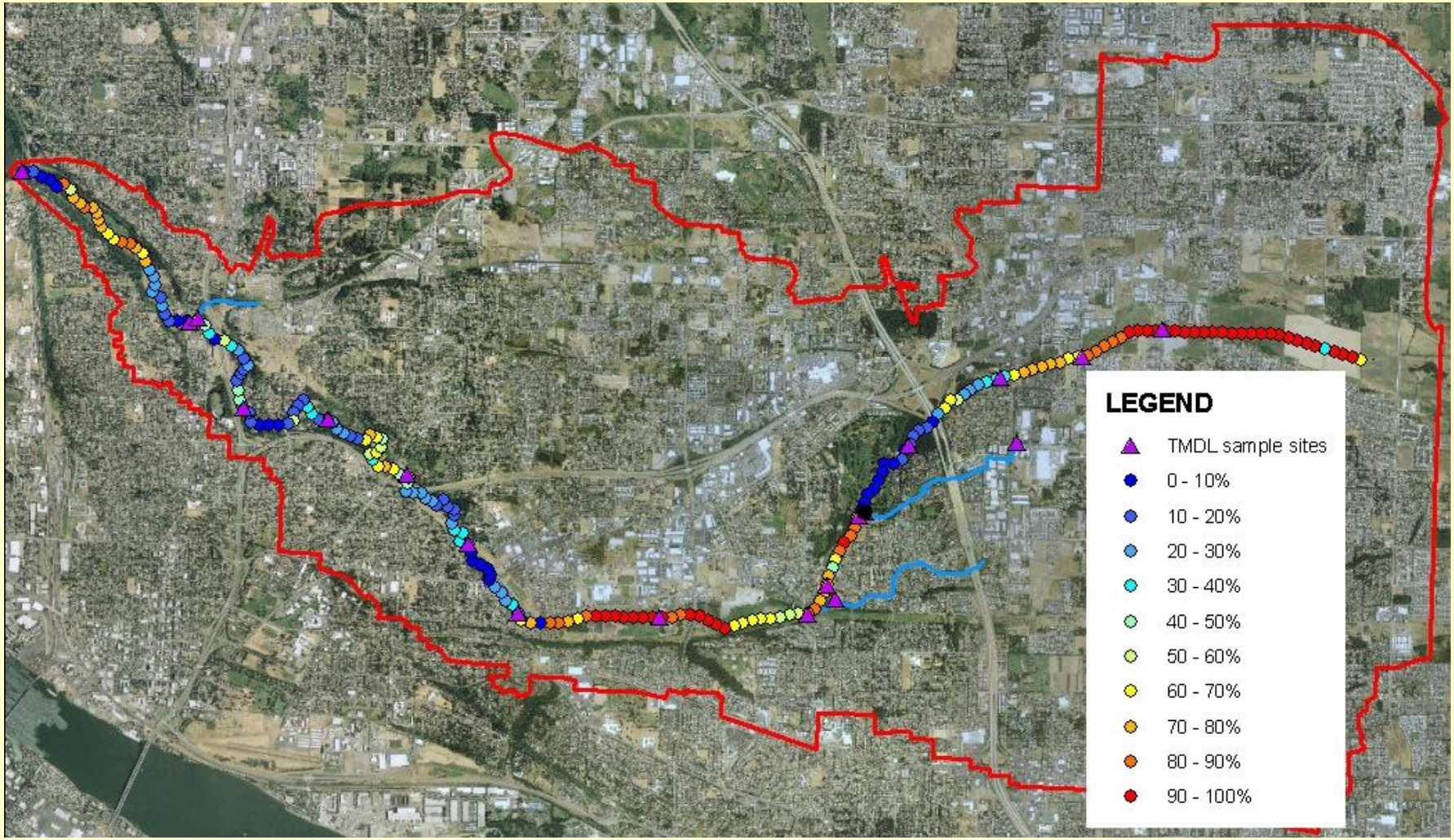
- Developed using SSURGO and DNR GIS coverages
- Confirmed with Interior Columbia Ecosystem Management Project data
- Salmon Creek (adjacent watershed) has similar species and height data

Species	SHADE model scenario	Height		Density	Overhang	
		(ft)	(m)	%	(ft)	(m)
Mixed (Douglas fir, grand fir, red cedar, hemlock, alder and maple)	Average system potential tree height*	133	41	85	13.3	4.1
	Maximum system potential tree height*	150	46	85	16	4.6
	Average 50-year SSURGO tree height	114	35	85	11.4	3.5
	Maximum 50-year SSURGO tree height	125	38	85	12.5	3.8

Height* is based on 100-year old tree heights from the SSURGO database

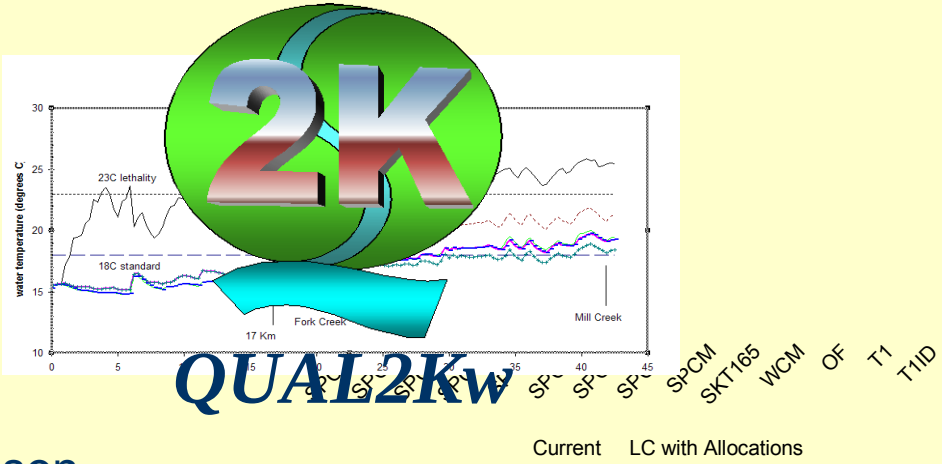

Burnt Bridge Creek Effective Shade (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Effective Shade (%)
0
5000
10000
15000
20000
25000
Longitudinal Distance from Headwaters (m)
Current Condition Vegetation
System Potential Vegetation (100-year trees)
Maximum 50-year Trees

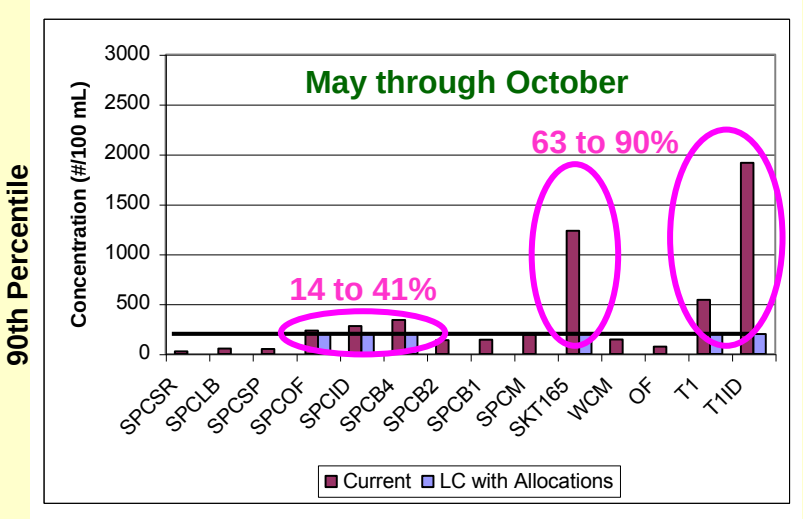
Burnt Bridge Creek Shade Deficit



Next steps…

- QUAL2Kw
  - Temperature
  - DO & pH
- Bacteria TMDL
  - Rollback Analysis
    - Annual, Wet & Dry Season
- Develop Load and Wasteload Allocations
  - Effective Shade
  - Bacteria
  - Stormwater
  - Nutrients?





Burnt Bridge Creek TMDL Process and Timeline

- Data collection completed September 2009
- September 2009 → Spring 2011 – Data analysis and model development
- Spring 2011 – TAC meeting to determine management scenarios that will be modeled
- Fall 2011 – Draft technical report available; begin holding TAC and AC meetings to develop a cleanup plan (who, what, when, where)
- Summer 2013 – Submit combined technical report/clean up plan to EPA
- 2014+ - Follow up to determine if strategy is working and make adjustments as needed

Thanks!

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Principle Investigator
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