King County Stream Monitoring Program

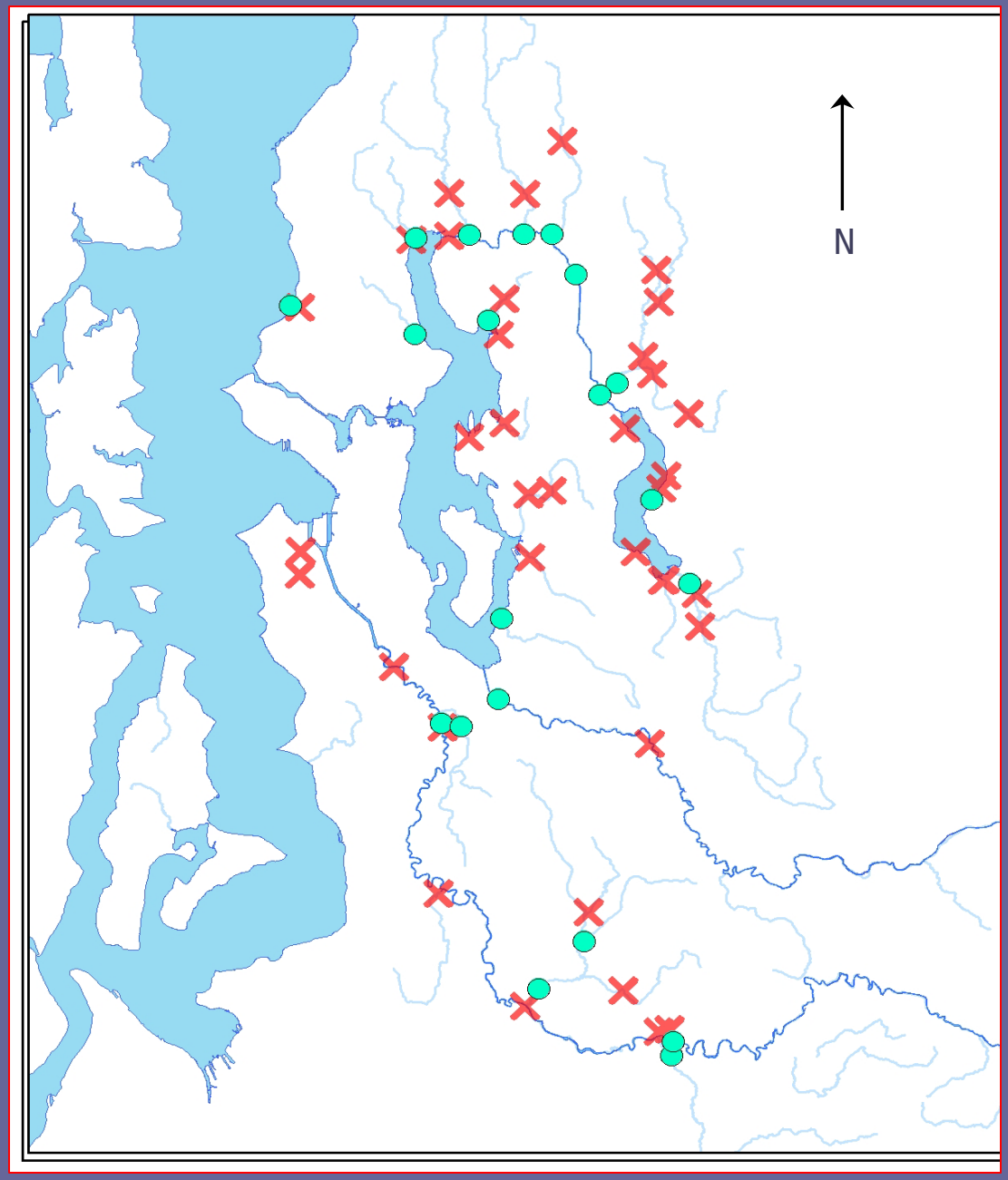
King County
Department of
Natural Resources and Parks
Water and Land Resources Division

Deb Lester
Spring 2010 - WLRD Science Seminar

Program Components

- Routine Stream Water Quality Monitoring
- Wet Weather Stream Water Quality Monitoring
- Stream Sediment Contaminant Monitoring
- Stream Benthic Macroinvertebrate Monitoring

Routine Ambient Stream Water Quality Monitoring Stations



Current Sampling Locations (20)

Pre-2009 Sampling Locations (56)

Stream Monitoring Questions

The stream monitoring program originally designed to answer four questions:

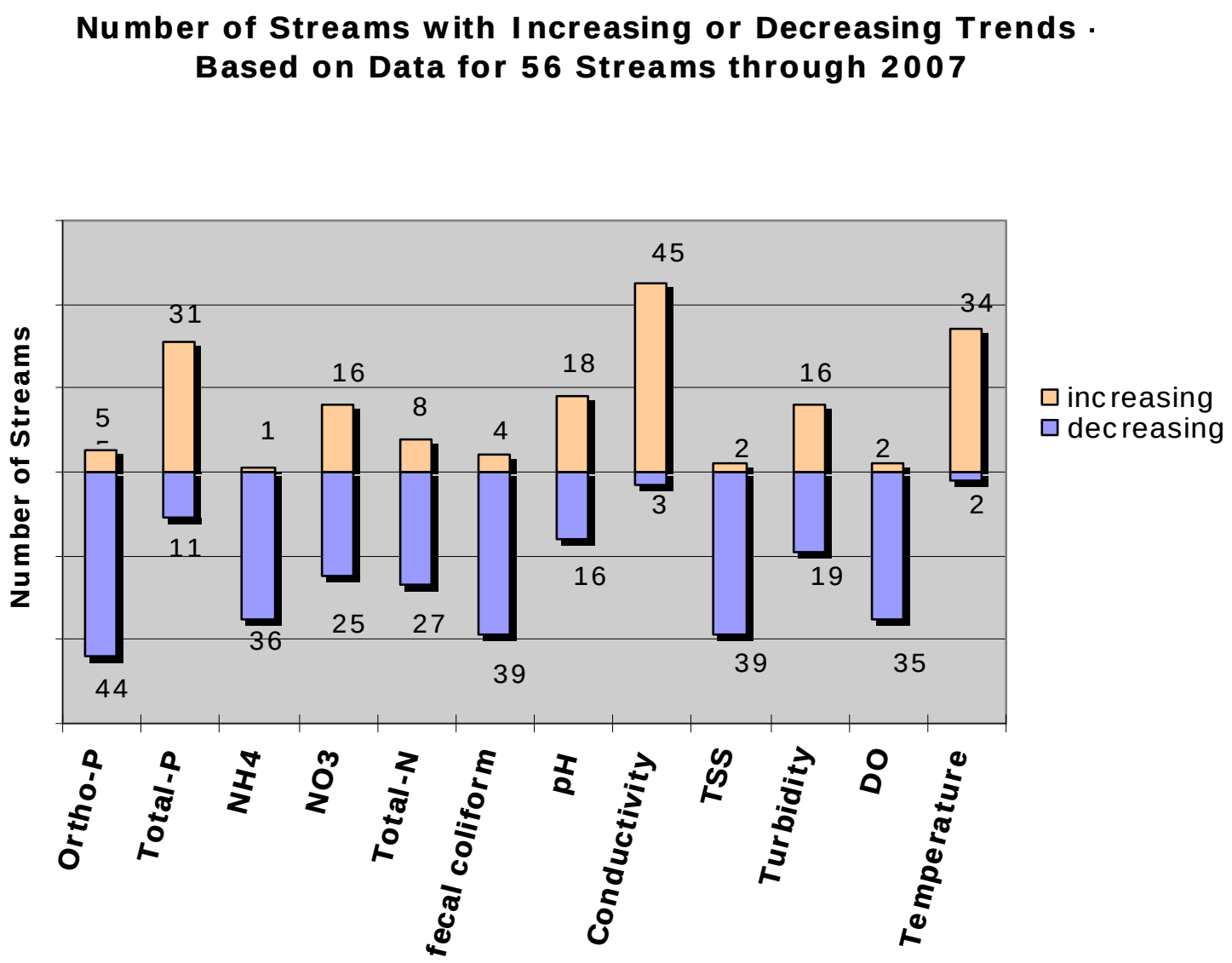
1. Has storm and/or base flow stream water quality changed over time?
2. Is there a spatial difference in storm and base flow water quality conditions?
3. What is the human health risk from stream water quality?
4. Do current (or future) King County facilities impact stream water quality?

Routine Ambient Stream Water Quality Monitoring – Analytical Parameters

20 sites sampled monthly (56 sites pre 2009)

- Bacteria (Fecal Coliform)
- Temperature
- Nutrients (OP, TP, TN, ammonia, nitrate+nitrite)
- Oxygen
- pH
- Turbidity
- Conductivity
- Total Dissolved Solids
- Eliminated quarterly metals, silica, TOC/DOC, turbidity, and *E. coli analysis* in 2009

Example of Water Quality Trend Analysis



Example of Water Quality Trend Analysis

	Locator	Period of Record	Trend Analysis years	ortho-P	Total P	NH_4^+	NO_3^-	Total N	fecal coliforms	pH	conductivity	total suspended solids	turbidity	dissolved oxygen	°C
Bear	0484	1971- 2007	37	↘	↘	↘	↘	↘	↘	↗	↗	↘			↗
Cedar River	X438	1996 - 2007	12		↗	↘					↗			↘	
Coal	0442	1972 - 2007	36	↘	↘				↘	↘		↘	↗	↘	↗
Crisp	0321	1972 - 2007	36		↗	↗		↘	↗	↗	↗	↘		↘	
Ebright	A685	1996 - 2007	12	↘	↗	↘		↗	↘		↗	↘			
Eden	A690	1987 - 2007	21	↗	↗		↗	↗	↗		↗			↘	
Evans	B484	1971 - 2007	37	↘	↘	↘	↘		↘	↘	↗	↘		↘	↗
Fairweather	0498	1975 - 2007	33	↘	↗		↘	↘	↘	↗		↘		↘	↗
Forbes	0456	1979 - 2007	29	↘	↗		↘	↘	↘	↘	↗	↘	↗	↘	↗
Green at Fort Dent Park	3106	1970 - 2007	38	↘	↘	↘			↘		↘	↘	↘	↘	↗
Idylwood	A620	1995 - 2007	13	↘	↗	↘	↘	↘	↘	↘	↗			↘	↗
Issaquah	0631	1972 - 2007	36	↘		↘		↘	↘	↗	↗	↘			↗
Juanita	0446	1975 - 2007	33	↘		↘	↘	↘	↘	↗	↗	↘	↘	↘	↗
Kelsey Creek	0444	1977 - 2007	31	↘	↗	↘	↘	↘	↘		↗	↘	↘	↘	↗
Lewis	A617	1995 - 2007	13	↘	↗	↘	↘	↘		↘	↗	↘			↘
Little Bear	0478	1971 - 2007	37	↘	↗	↘		↘	↘	↗	↗	↘	↗	↘	↗
Thornton	0434	1971 - 2007	37	↘	↗		↘	↘		↘	↗		↗	↘	↗
Longfellow	C370	1979 - 2007	29	↘	↗	↘	↘		↘	↘	↗	↘		↘	
Lyon	0430	1975 - 2007	33	↘		↘	↘	↘	↘		↗	↘	↘	↘	
May	0440	1972 - 2007	36	↗	↗	↘	↘	↘			↗	↘	↘	↘	↗

Water Quality Index (WQI)

- Integrates 8 water quality parameters into a single number (FC, temp, pH, DO, TN, TP, TSS, Turbidity)
- Developed by EPA, modified by Ecology and calibrated for Puget Lowland Streams.
- Unit less number 1-100 (>80 low concern; 80-40 marginal concern and <40 highest concern)
- WQI recently updated to reflect more stringent temperature WQC to protect salmon
- Some limitations to WQI- limited parameters, can over or underemphasize problems

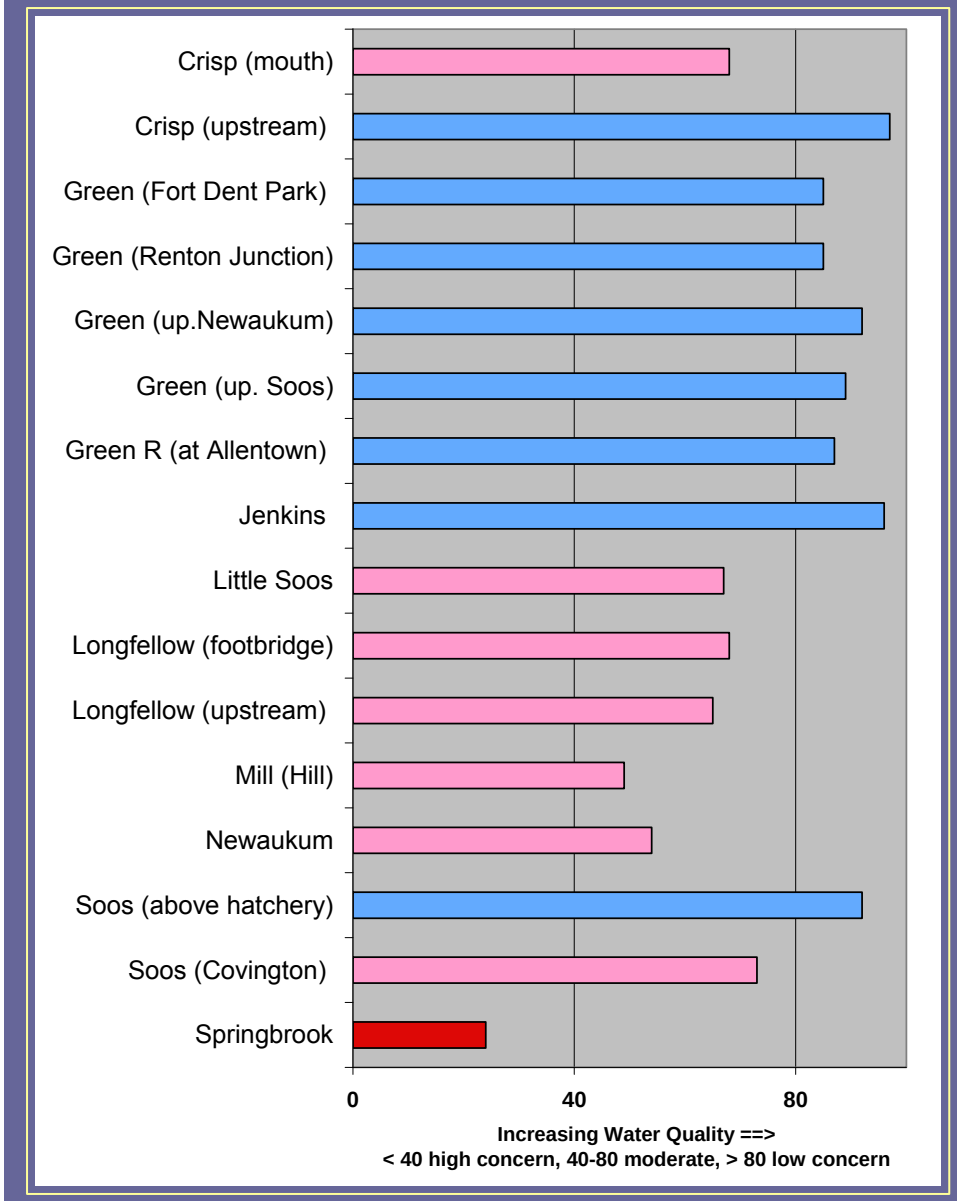
Stream Water Quality Index

2008-2009

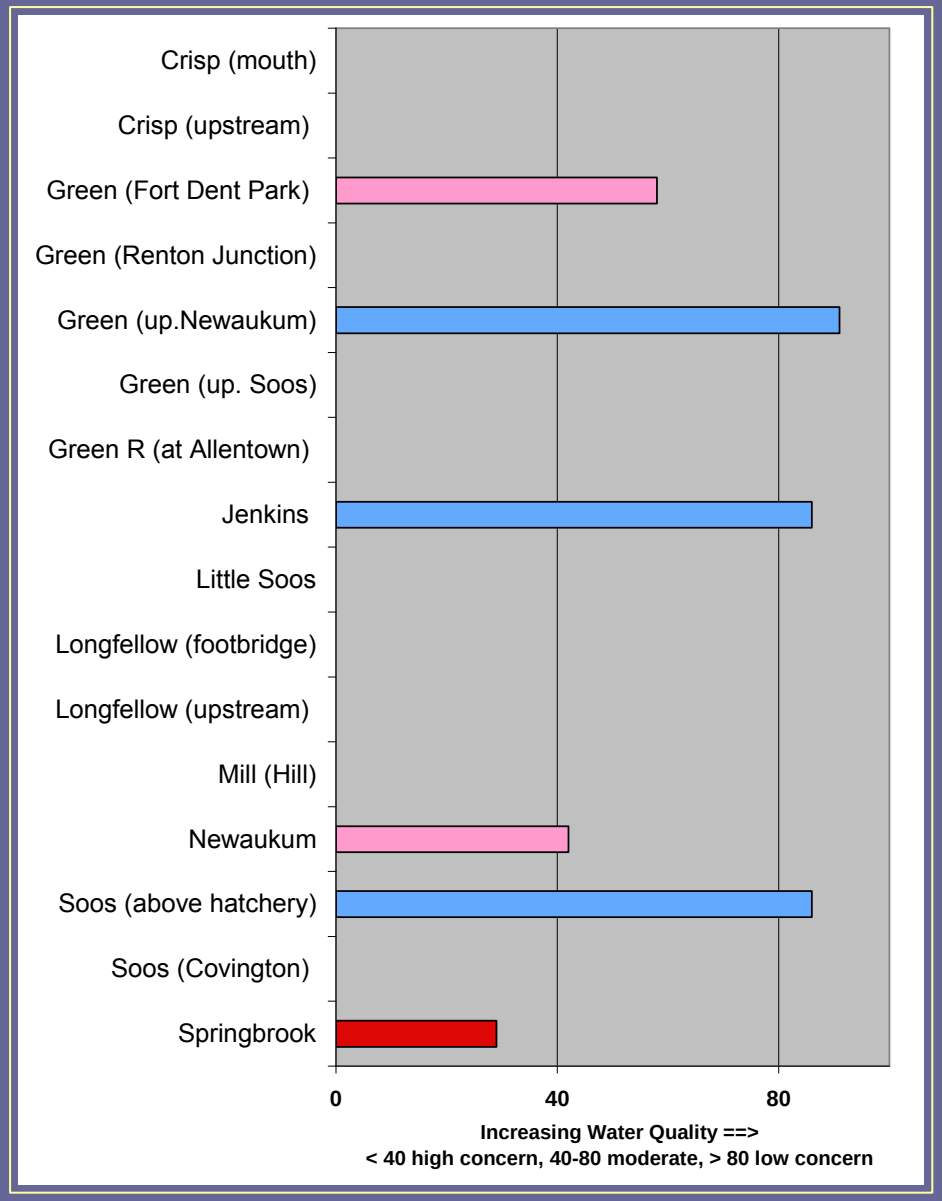
Low concern

Moderate or high concern

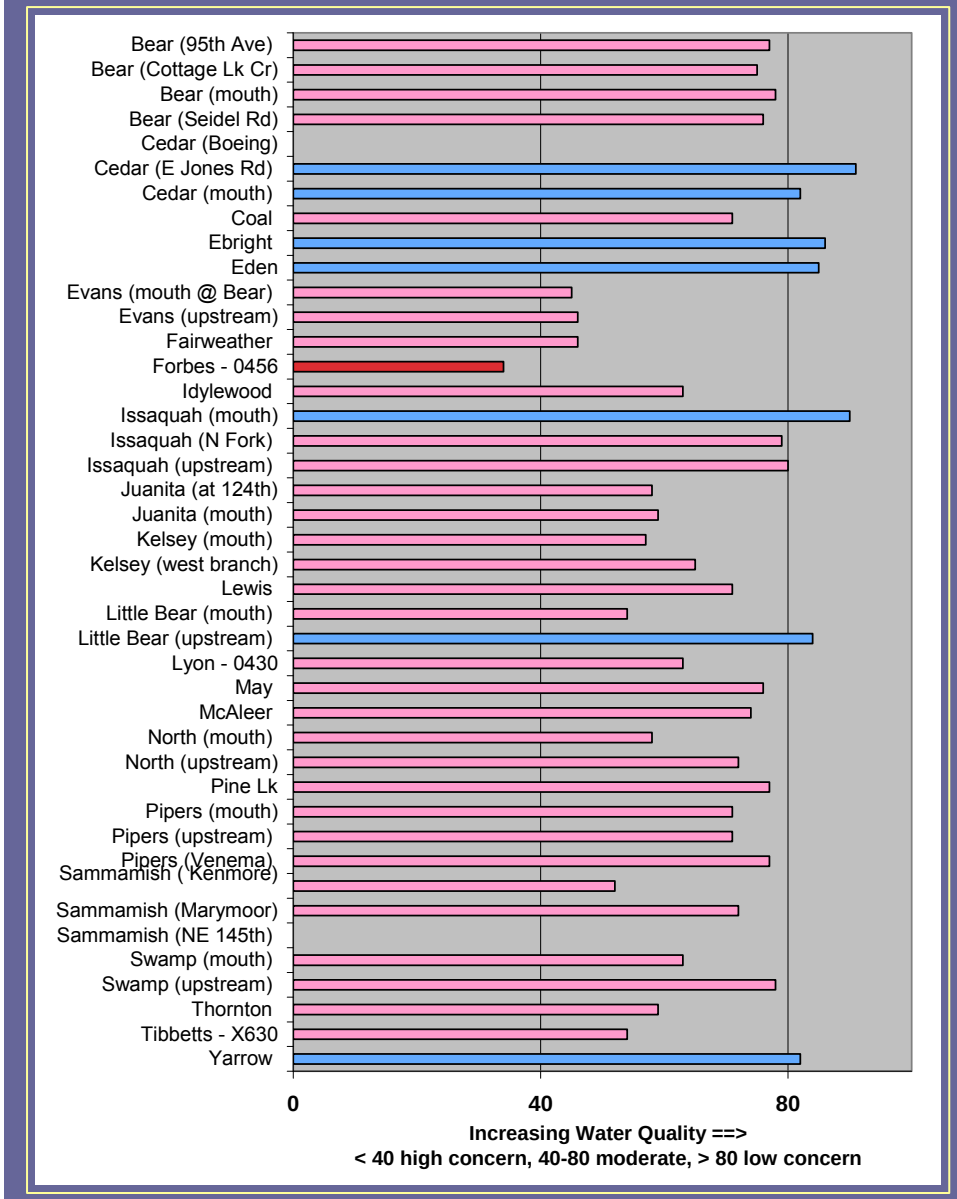
WRIA 9 - WQI 2007-2008



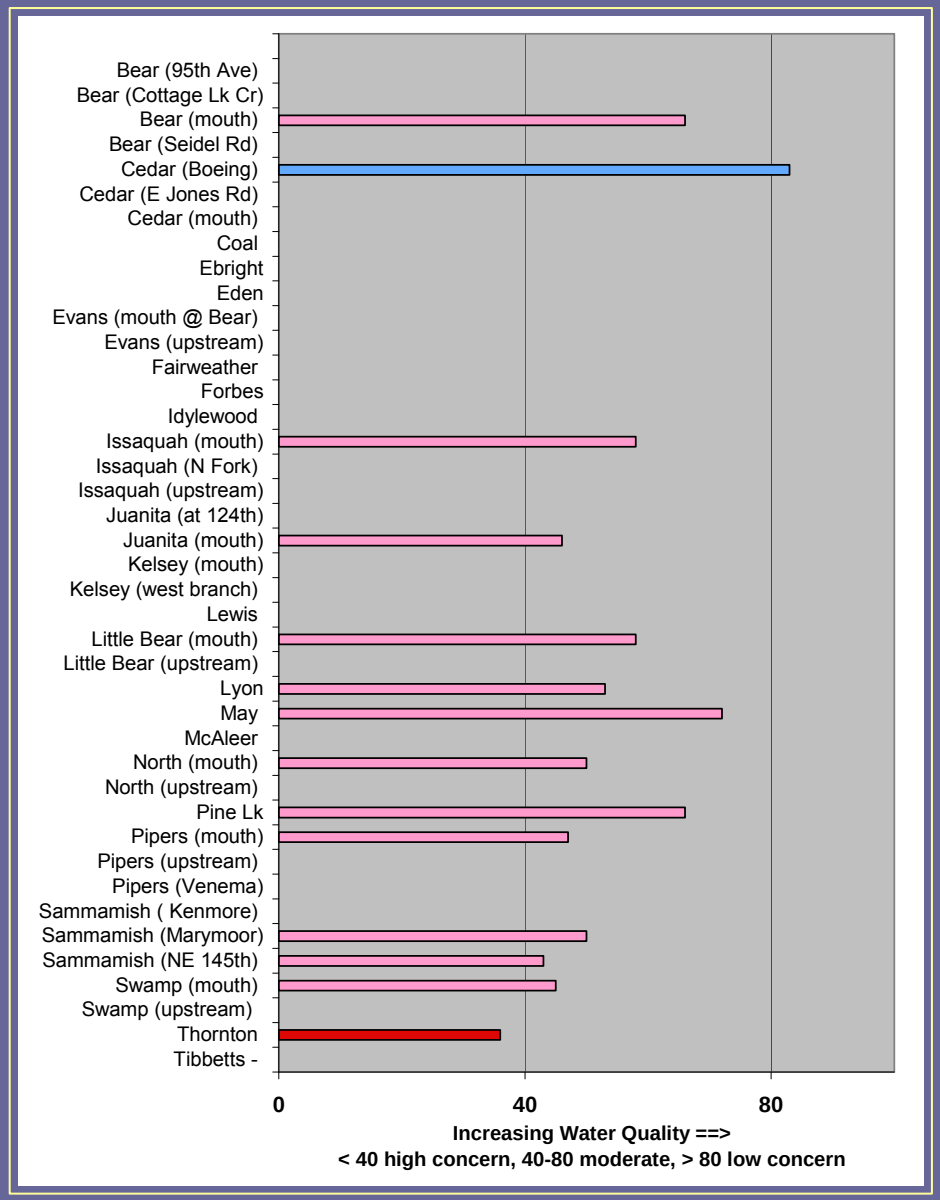
WRIA 9 - WQI 2008-2009



WRIA 8 - WQI 2007-2008

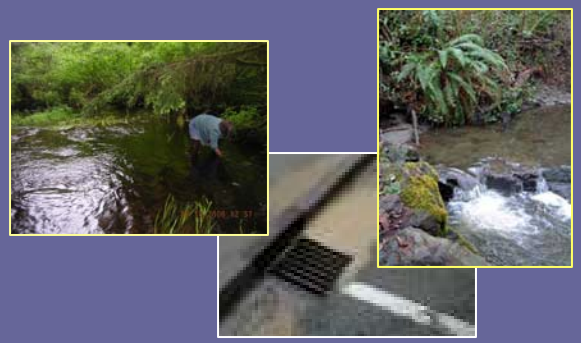


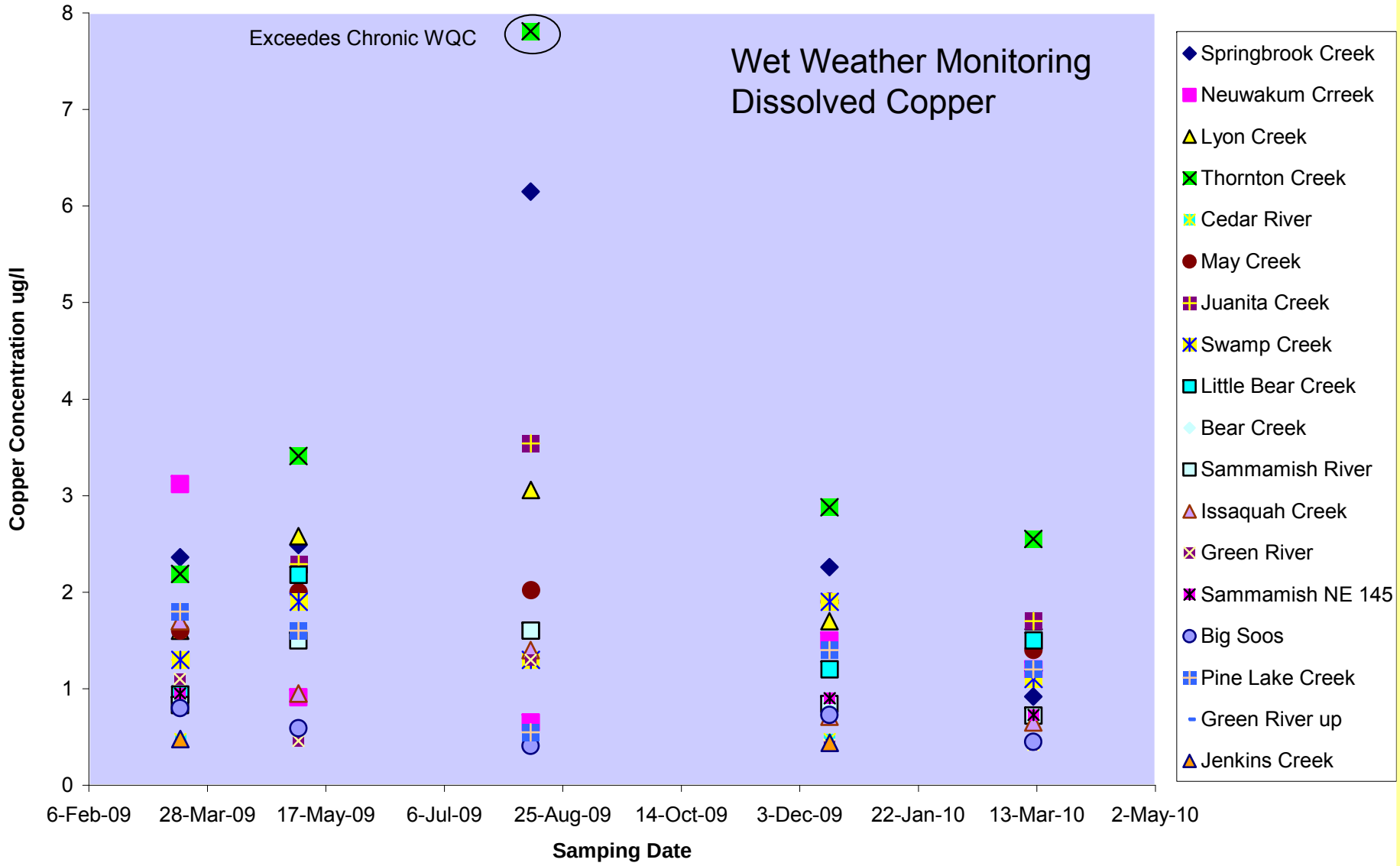
WRIA 8 - WQI 2008-2009

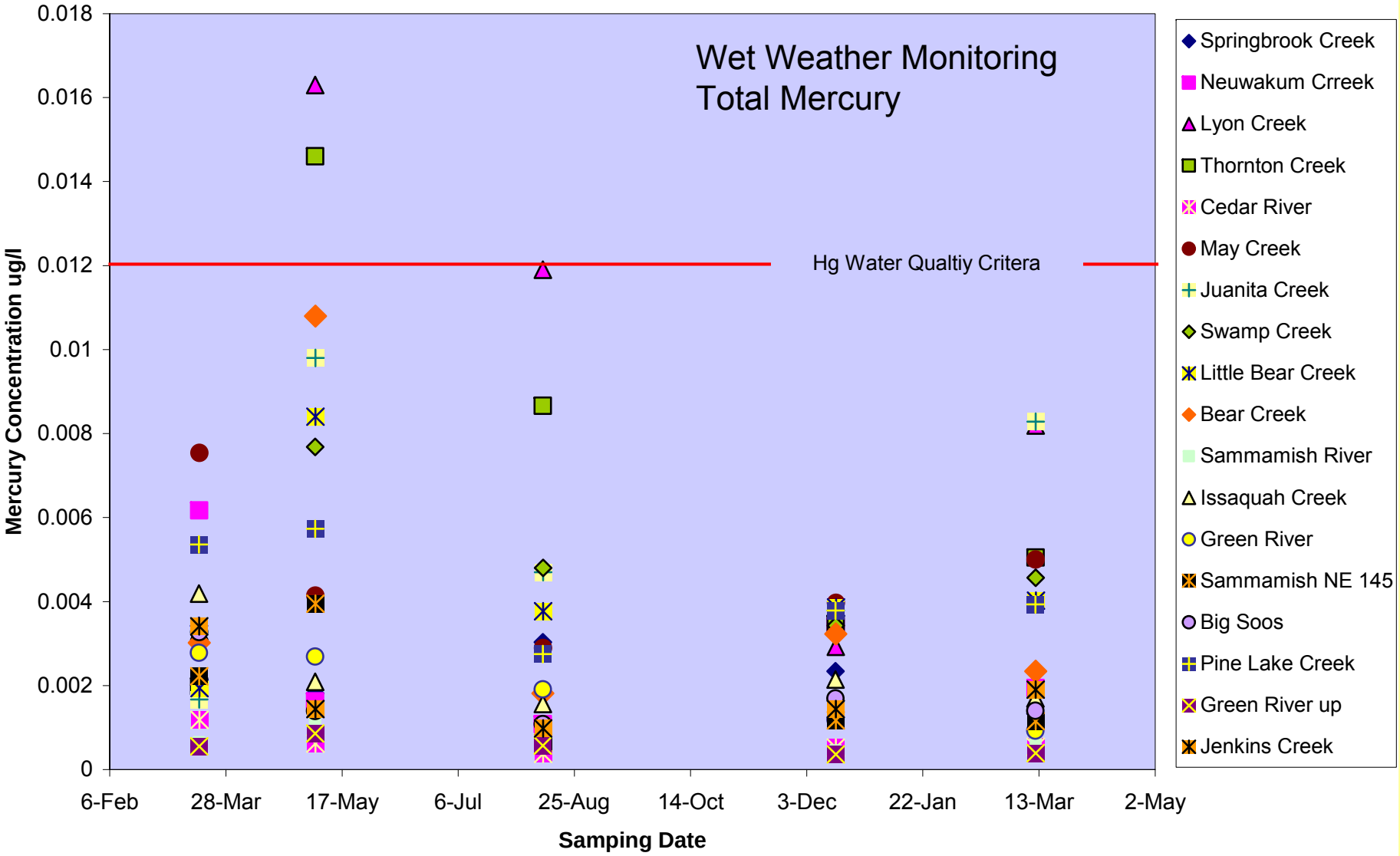


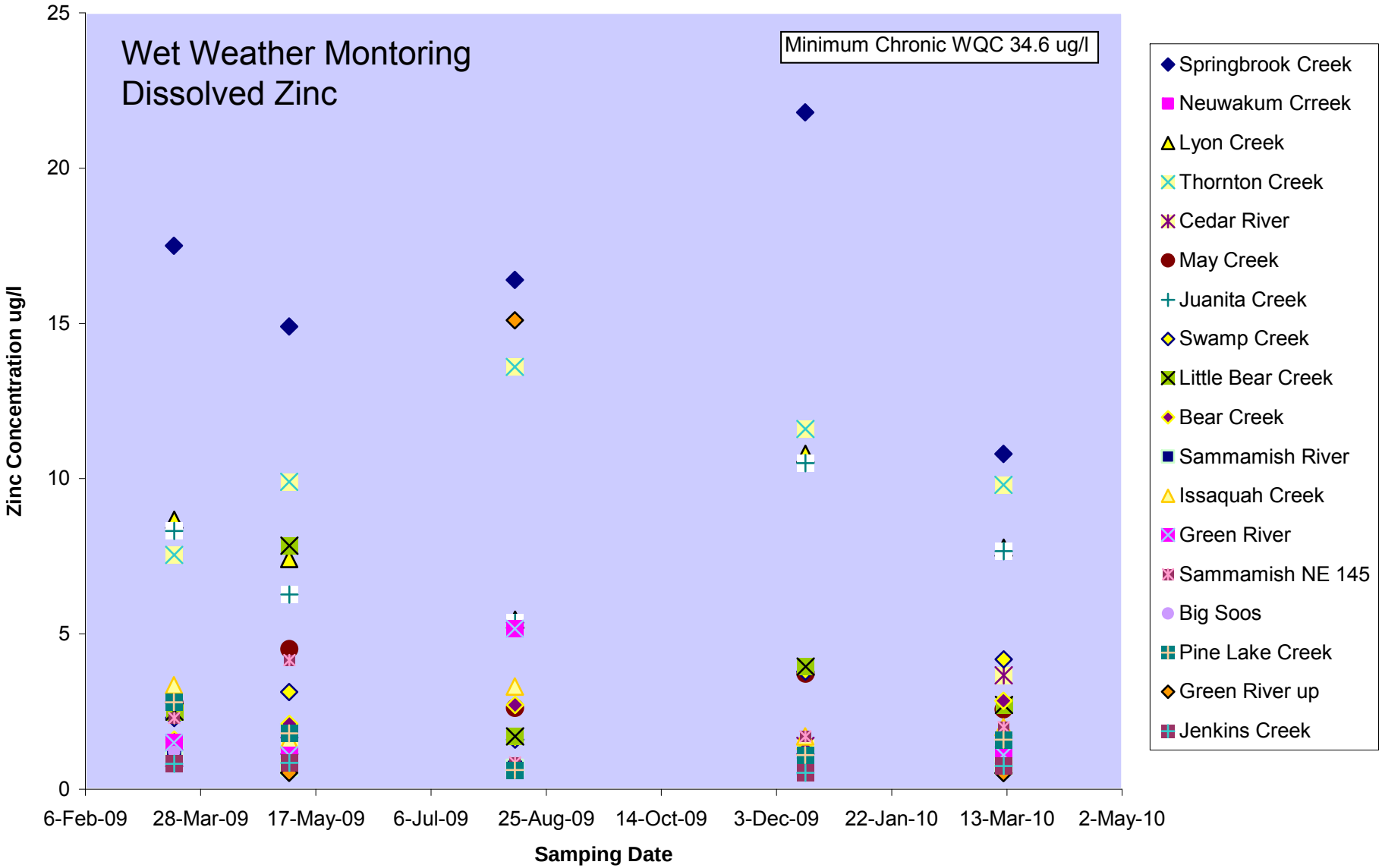
Stream Wet Weather Monitoring

- Sampling trigger - preferably ≥ 0.25″ rain with 24 hr antecedent dry period;
- Wet-weather samples collected from 20 streams;
- Target 4 events (2 Nov - Mar; 1 Apr - Jun; 1 Aug - Oct)
- Analysis includes all parameters measured during routine sampling, as well as low-level metals and organic compounds.




Wet Weather Monitoring
Dissolved Copper
Exceedes Chronic WQC
Copper Concentration ug/l
0
1
2
3
4
5
6
7
8
6-Feb-09
28-Mar-09
17-May-09
6-Jul-09
25-Aug-09
14-Oct-09
3-Dec-09
22-Jan-10
13-Mar-10
2-May-10
Samping Date
Springbrook Creek
Neuwakum Crreek
Lyon Creek
Thornton Creek
Cedar River
May Creek
Juanita Creek
Swamp Creek
Little Bear Creek
Bear Creek
Sammamish River
Issaquah Creek
Green River
Sammamish NE 145
Big Soos
Pine Lake Creek
Green River up
Jenkins Creek


Wet Weather Monitoring
Total Mercury
Hg Water Qualtiy Critera
Mercury Concentration ug/l
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
6-Feb
28-Mar
17-May
6-Jul
25-Aug
14-Oct
3-Dec
22-Jan
13-Mar
2-May
Samping Date
Springbrook Creek
Neuwakum Crreek
Lyon Creek
Thornton Creek
Cedar River
May Creek
Juanita Creek
Swamp Creek
Little Bear Creek
Bear Creek
Sammamish River
Issaquah Creek
Green River
Sammamish NE 145
Big Soos
Pine Lake Creek
Green River up
Jenkins Creek


Wet Weather Montoring
Dissolved Zinc
Minimum Chronic WQC 34.6 ug/l
Zinc Concentration ug/l
25
20
15
10
5
0
6-Feb-09
28-Mar-09
17-May-09
6-Jul-09
25-Aug-09
14-Oct-09
3-Dec-09
22-Jan-10
13-Mar-10
2-May-10
Samping Date
Springbrook Creek
Neuwakum Crreek
Lyon Creek
Thornton Creek
Cedar River
May Creek
Juanita Creek
Swamp Creek
Little Bear Creek
Bear Creek
Sammamish River
Issaquah Creek
Green River
Sammamish NE 145
Big Soos
Pine Lake Creek
Green River up
Jenkins Creek

Stream Sediment Contaminant Monitoring Program

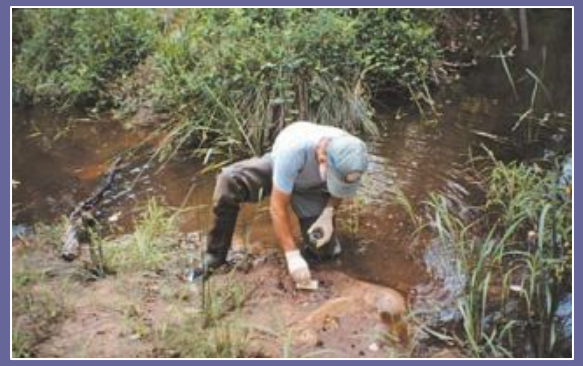
- Program initiated in 1987 – primarily measured metals at stream mouths
- 2003 trend analysis suggested program updates necessary
- 2004 - Program revised
  - Parameters added (organics, organic carbon, AVS/SEM)
  - 10 Trend Locations
  - 27 Rotating Basin Characterization Streams – sample approx. every river mile (approx. 20 samples yr 2004-08; 10 samples yr 2009)

Stream Sediment Monitoring Program Questions

- Do chemical concentrations in stream sediment exceed sediment quality guidelines or thresholds?
- How does sediment quality change over time?
- Does sediment quality differ within or between stream basins?

Stream Sediment Monitoring - Annual Trend Locations

- Little Bear Creek
- Big Bear Creek
- Thornton Creek
- Issaquah Creek
- McAleer Creek
- North Creek
- Newaukum Creek
- Soos Creek
- Springbrook Creek
- Mill Creek



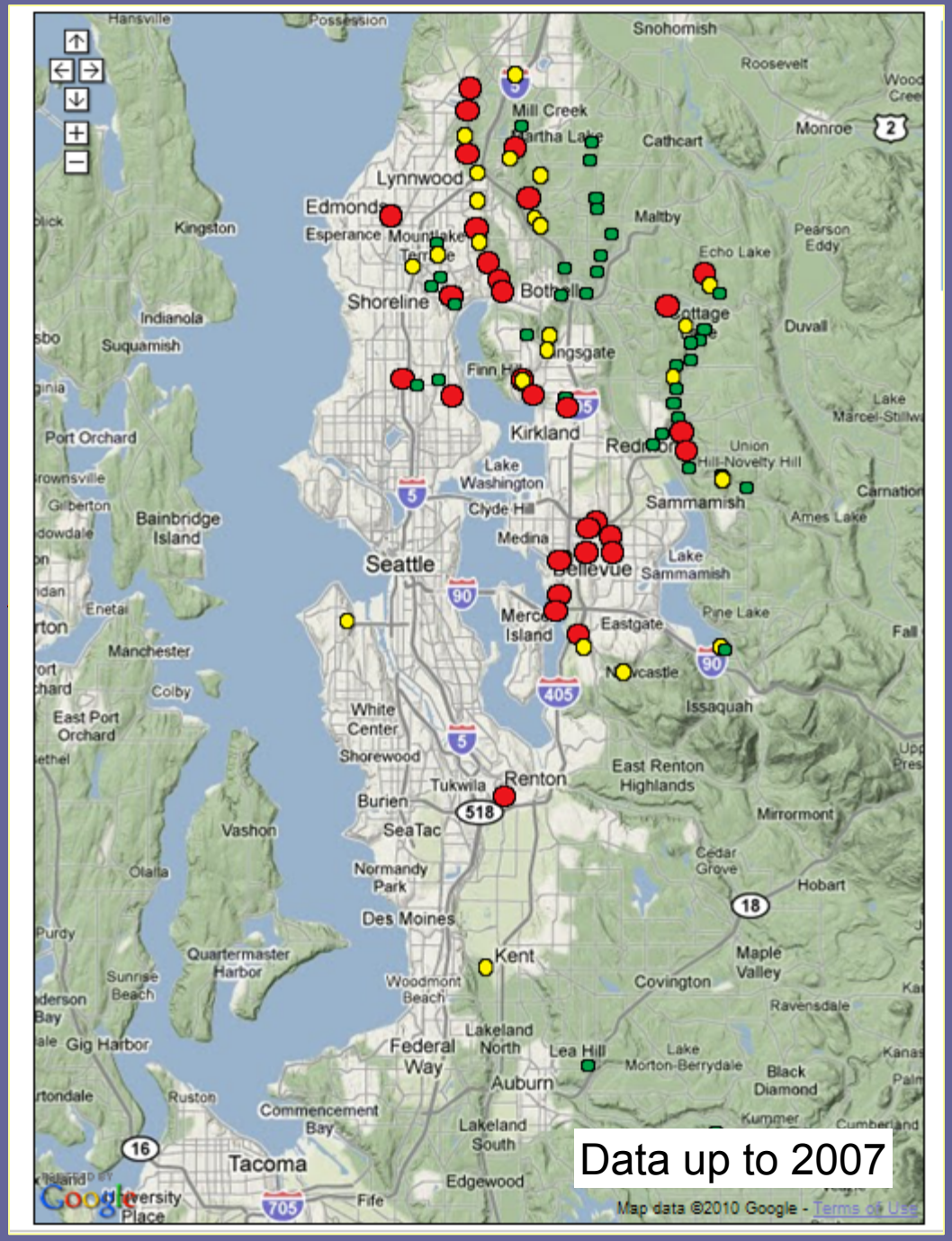
Sediment Basin Characterization Streams - Rotating Locations

- *Little Bear Creek*
- *Big Bear Creek*
- *Thornton Creek*
- *Issaquah Creek*
- *McAleer Creek*
- *North Creek*
- *Newaukum Creek*
- Soos Creek
- *Springbrook Creek*
- Mill Creek
- *Coal Creek* (Lake WA)
- *Forbes Creek*
- *Juanita Creek*
- *Lyon Creek*
- *May Creek*
- *Kelsey / Mercer*
- *Swamp Creek*
- Lewis Creek
- Pine Lake, Eden, Ebright Creeks
- Tibbets Creek
- *Taylor Creek* (Cedar River)
- Covington Creek
- *Des Moines Creek*
- Jenkins Creek
- Judd Creek
- Crisp Creek
- Longfellow Creek

Italics – completed basins

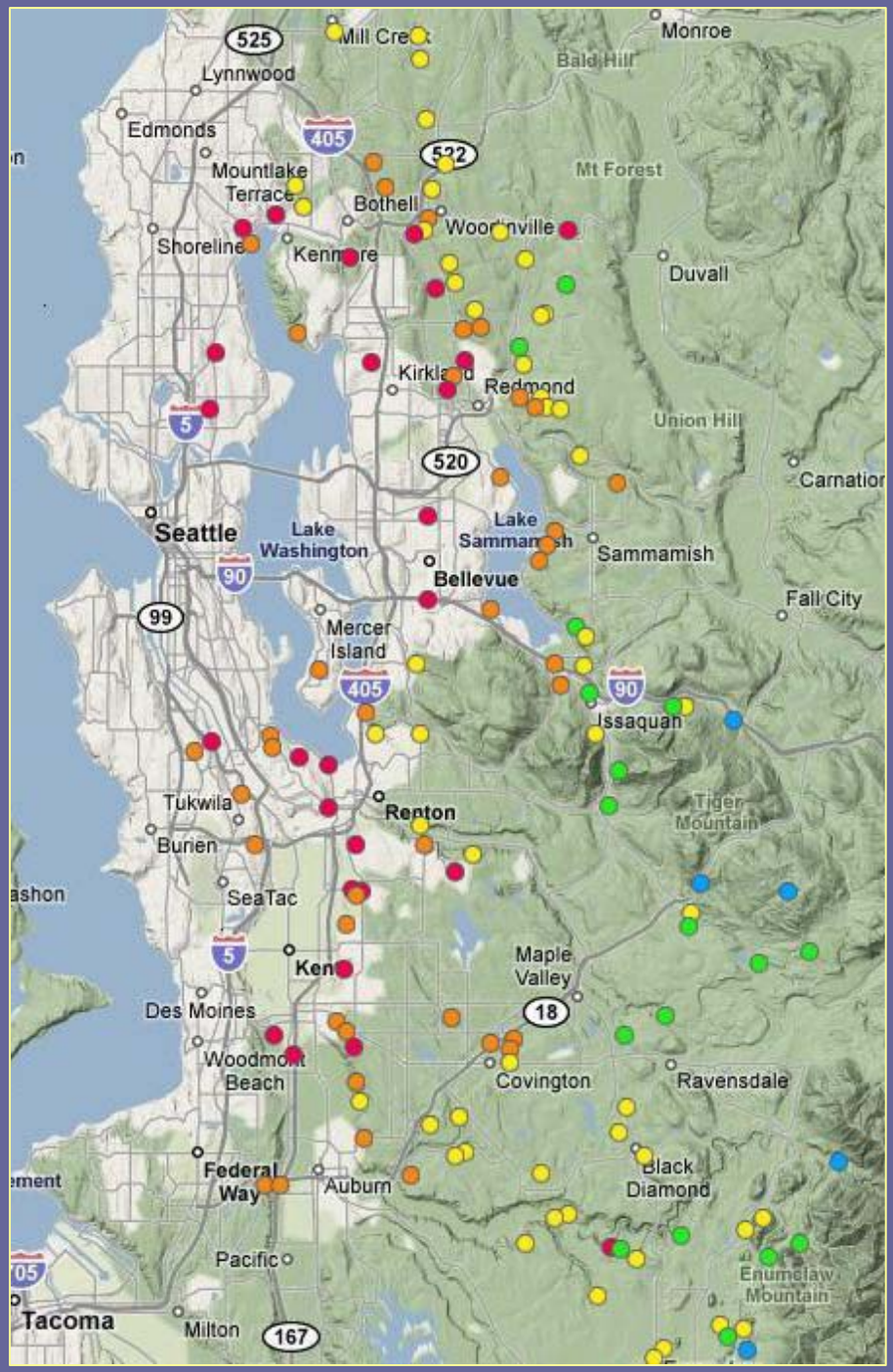
Stream Sediment Monitoring Sampling Locations

- Data compared to freshwater sediment guidelines



Data up to 2007

Map Legend	
	No effect
	Uncertain effect
	Probable effect



Benthic Macroinvertebrate Sampling Locations

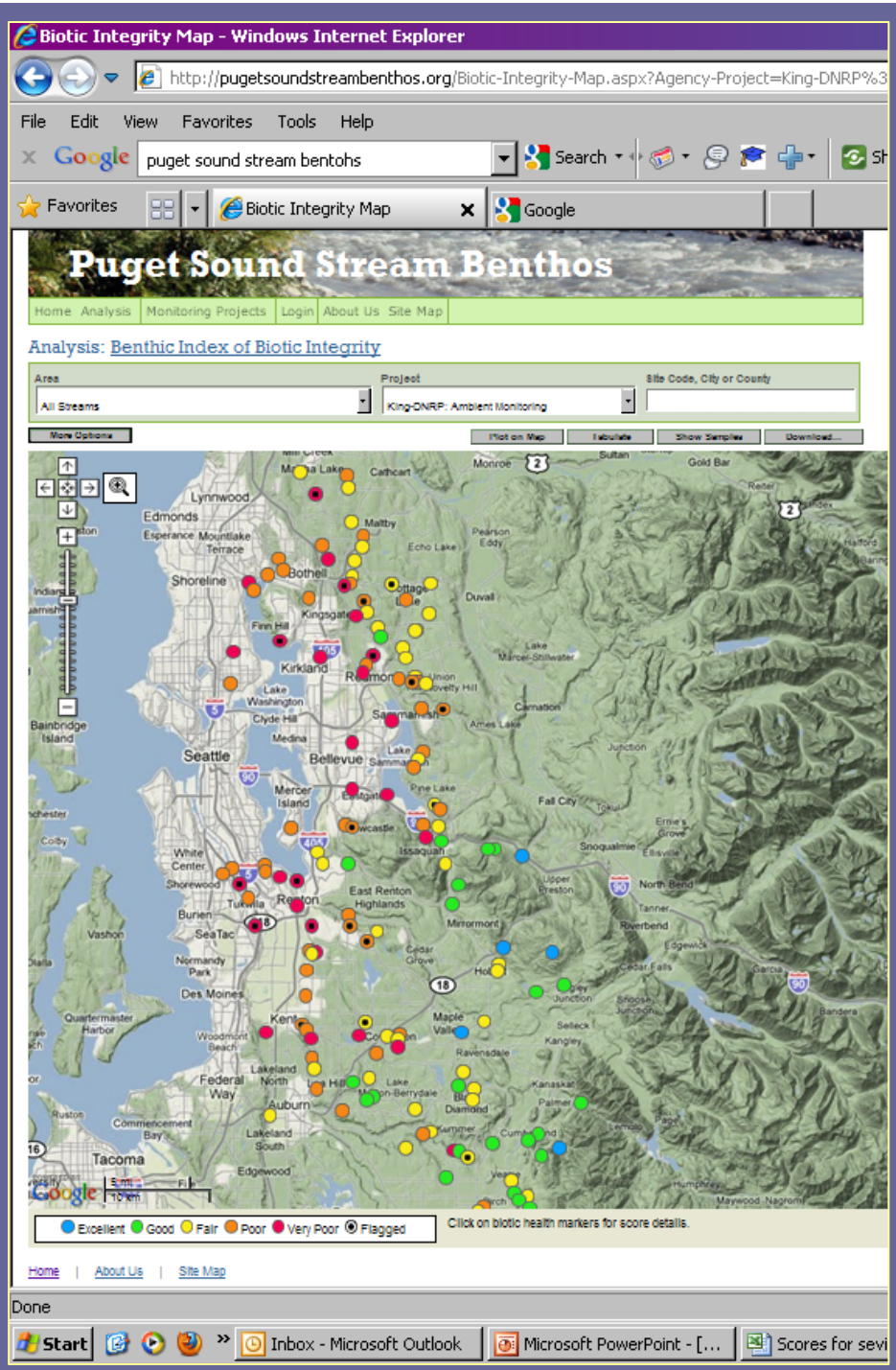
- ~ 140 Sampling locations;
- Samples collected annually from ~10 randomly-selected sites in each of 15 sub basins in WRIAs 8 and 9;
- Sampling initiated in 2002 - present (except 2004);
- Puget Lowland Benthic Index of Biotic Integrity (BIBI) used for primary data analysis tool;
- Data presented in Kingstat.

Benthic Macroinvertebrate Monitoring Questions

1. Do watershed sub-basins within the Greater Lake Washington Watershed (e.g. Bear Cr, Issaquah Cr, Lower Cedar Tribs etc.) and Greater Green-Duwamish (e.g. Soos Cr, Newaukum Cr, Jenkins/Covington Cr, etc.) differ in terms of biological condition?
2. Is the biological condition improving (or declining) over time? Is the trend significant?
3. Do land use patterns measured at the sub-basin level affect biological conditions differently within the watershed

Puget Sound Stream Benthos Website

- Multi-jurisdictional database
- Stores data and provides tools for analysis
- Full access to others, including the public
- Data are directly downloaded from the taxonomy labs



Biotic Integrity Scores - Windows Internet Explorer

http://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?Agency-Project=King-DNRP%3A%20Ambient%20Monitoring&minY=200

Puget Sound Stream Benthos

Home | Analysis | Monitoring Projects | Login | About Us | Site Map

Analysis: Benthic Index of Biotic Integrity

Area: All Streams

Project: King-DNRP: Ambient Monitoring

Site Code, City or County:

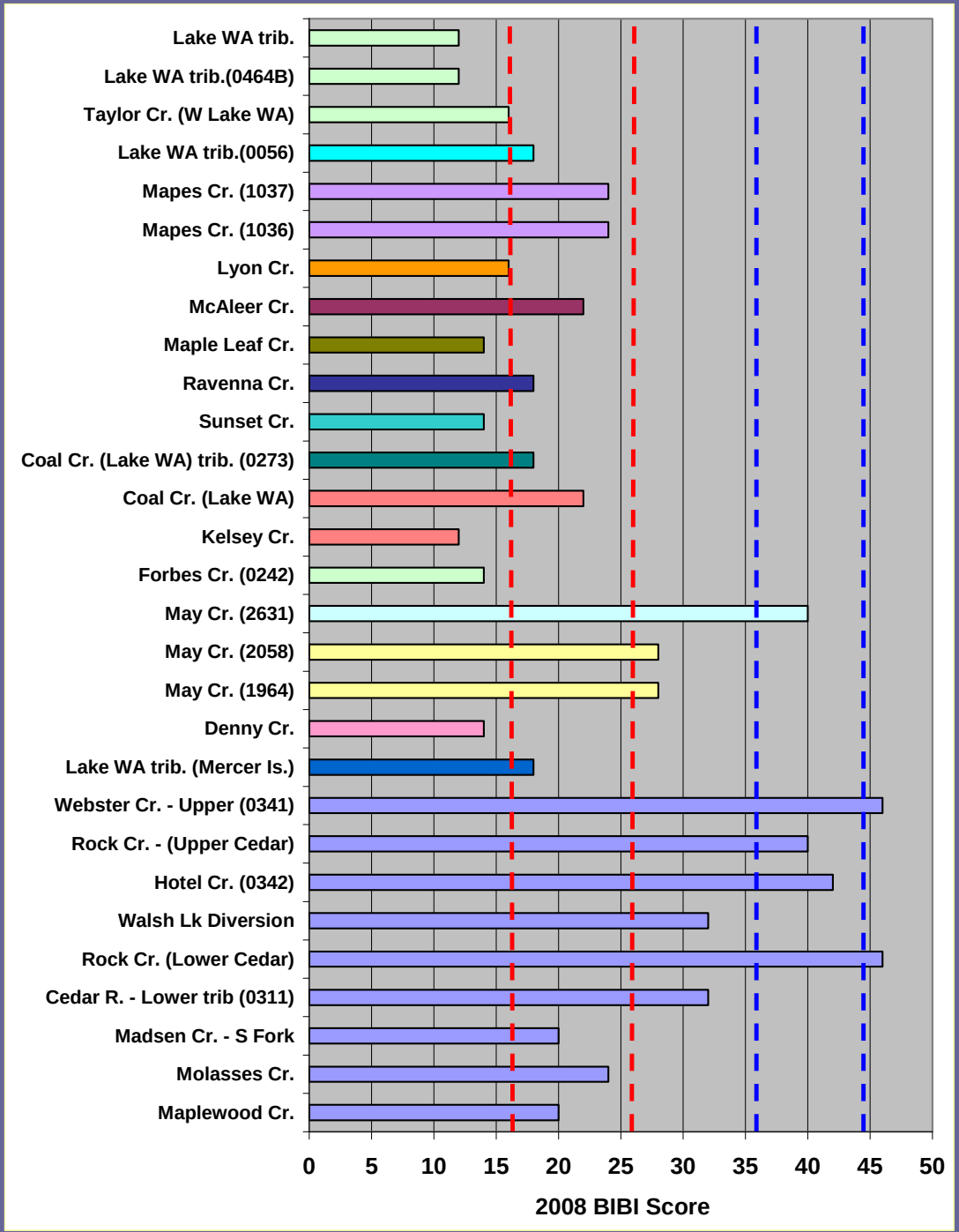
More Options | Plot on Map | Tabulate | Show Samples | Download...

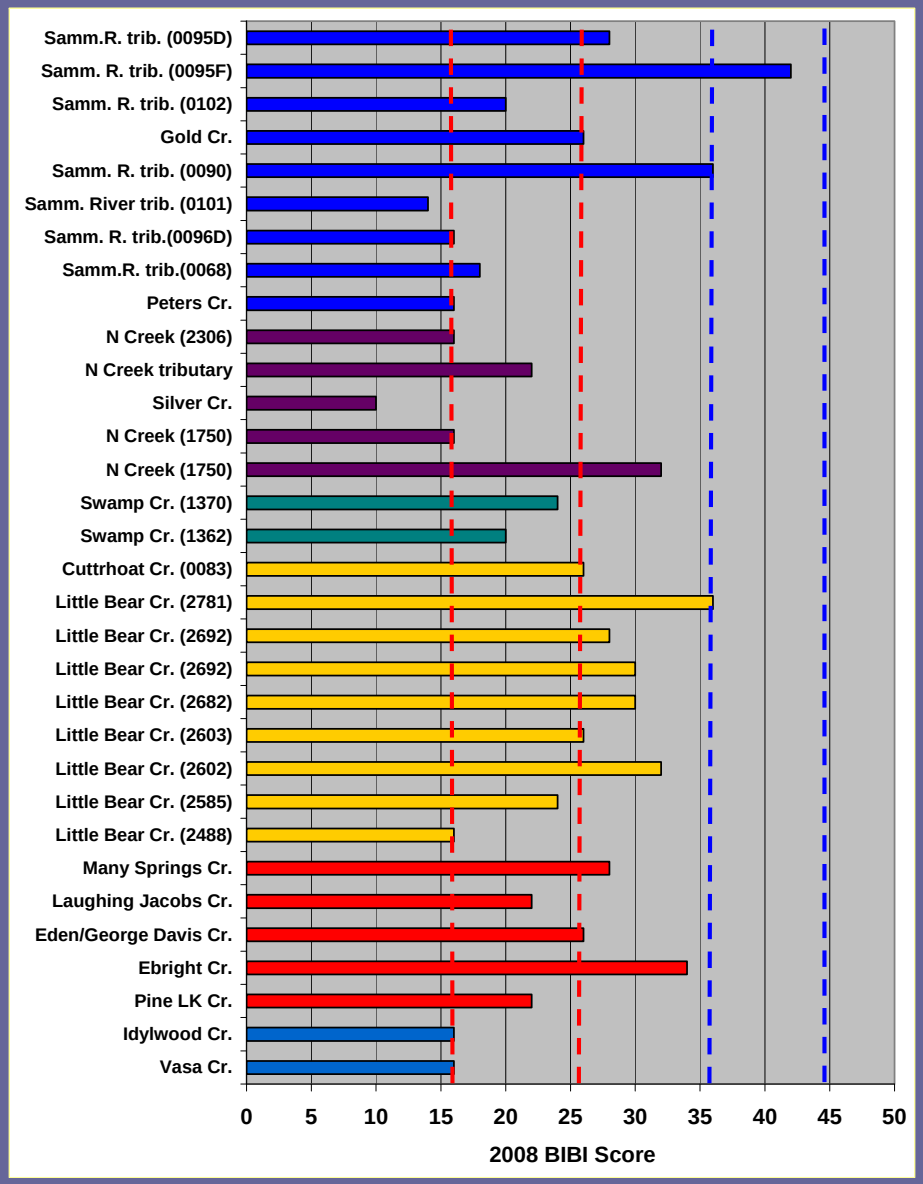
Row	Site Code, Location	Year, Project	Quantities											Scores											View Samples
			Taxa Richness	*Ephemeroptera Richness*	*Plecoptera Richness*	*Trichoptera Richness*	*Clinger Richness*	*Long-Lived Richness*	*Intolerant Richness*	*Dominance Percent*	*Predator Percent*	*Tolerant Percent*	*Organisms*	*Overall Score*	*Taxa Richness*	*Ephemeroptera Richness*	*Plecoptera Richness*	*Trichoptera Richness*	*Clinger Richness*	*Long-Lived Richness*	*Intolerant Richness*	*Dominance Percent*	*Predator Percent*	*Tolerant Percent*	
1	08EAS2446, ...	2008, Ambie...	19	2	4	3	10	4	0	72.6%	2.7%	42.0%	441	22	3	1	3	1	3	3	1	3	1	3	Details
2	08EAS2540, ...	2008, Ambie...	16	1	2	2	4	4	1	73.1%	5.2%	44.5%	134	18	3	1	1	1	1	3	1	3	1	3	Details
3	08WES1178, ...	2008, Ambie...	18	3	1	2	7	3	1	63.0%	0.4%	45.2%	554	18	3	1	1	1	1	3	1	3	1	3	Details
4	08EAS1536, ...	2008, Ambie...	14	2	2	1	6	2	0	66.3%	7.2%	47.1%	83	14	1	1	1	1	1	1	1	3	1	3	Details
5	08EAS2191, ...	2008, Ambie...	14	1	1	0	2	1	0	66.1%	1.2%	28.3%	501	14	1	1	1	1	1	1	1	3	1	3	Details
6	08EAS2272, ...	2008, Ambie...	14	1	2	2	3	1	0	66.3%	0.0%	59.3%	537	12	1	1	1	1	1	1	1	3	1	1	Details
7	08CED2898, ...	2008, Ambie...	29	4	6	2	9	3	3	43.5%	10.9%	5.9%	421	32	5	1	3	1	3	3	3	5	3	5	Details
8	08CED4975, ...	2008, Ambie...	40	6	6	10	20	7	4	61.2%	17.9%	2.4%	564	42	5	3	3	5	5	5	5	3	3	5	Details
9	08CED2711, ...	2008, Ambie...	16	1	3	2	5	3	1	69.3%	6.1%	7.9%	114	20	3	1	1	1	1	3	1	3	1	5	Details
10	08CED2433, ...	2008, Ambie...	23	2	5	4	10	2	2	79.0%	6.2%	35.8%	518	20	3	1	3	1	3	1	1	3	1	3	Details
11	08CED2518, ...	2008, Ambie...	22	2	4	3	12	4	0	72.7%	12.7%	22.7%	267	24	3	1	3	1	3	3	1	3	3	3	Details
12	08CED4192, ...	2008, Ambie...	42	7	8	12	25	7	5	34.1%	18.9%	14.8%	461	46	5	3	5	5	5	5	5	5	3	5	Details
13	08CED4479, ...	2008, Ambie...	38	4	7	8	18	6	1	40.2%	15.9%	25.8%	502	32	5	1	3	3	3	5	1	5	3	3	Details
14	08CED5046, ...	2008, Ambie...	37	8	8	9	20	5	8	45.6%	24.6%	7.3%	463	46	5	3	5	3	5	5	5	5	5	5	Details

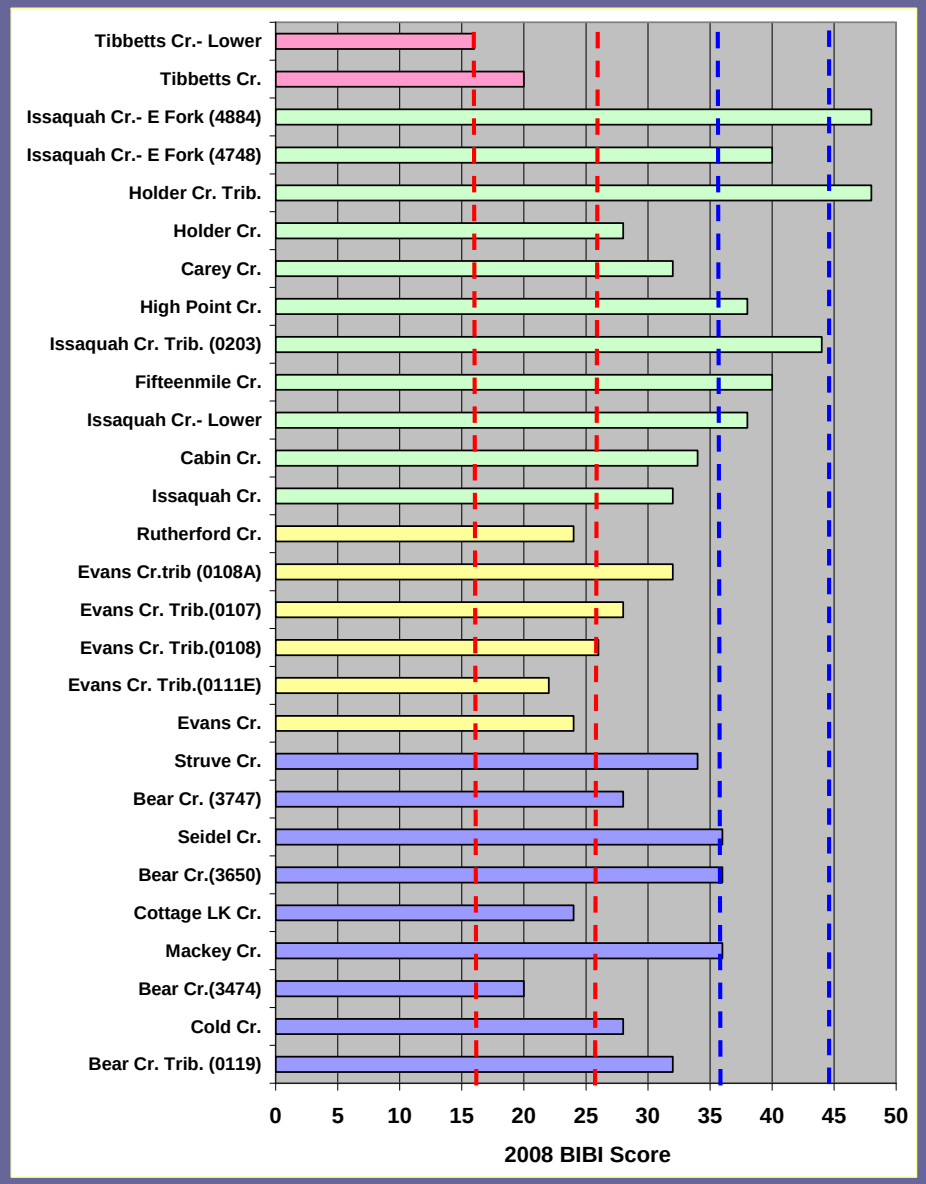
Done | Internet | 105%

Start | Inbox - Microsoft Outlook | Microsoft PowerPoint - [... | Scores for sevin.xls | Biotic Integrity Score... | 1:19 PM

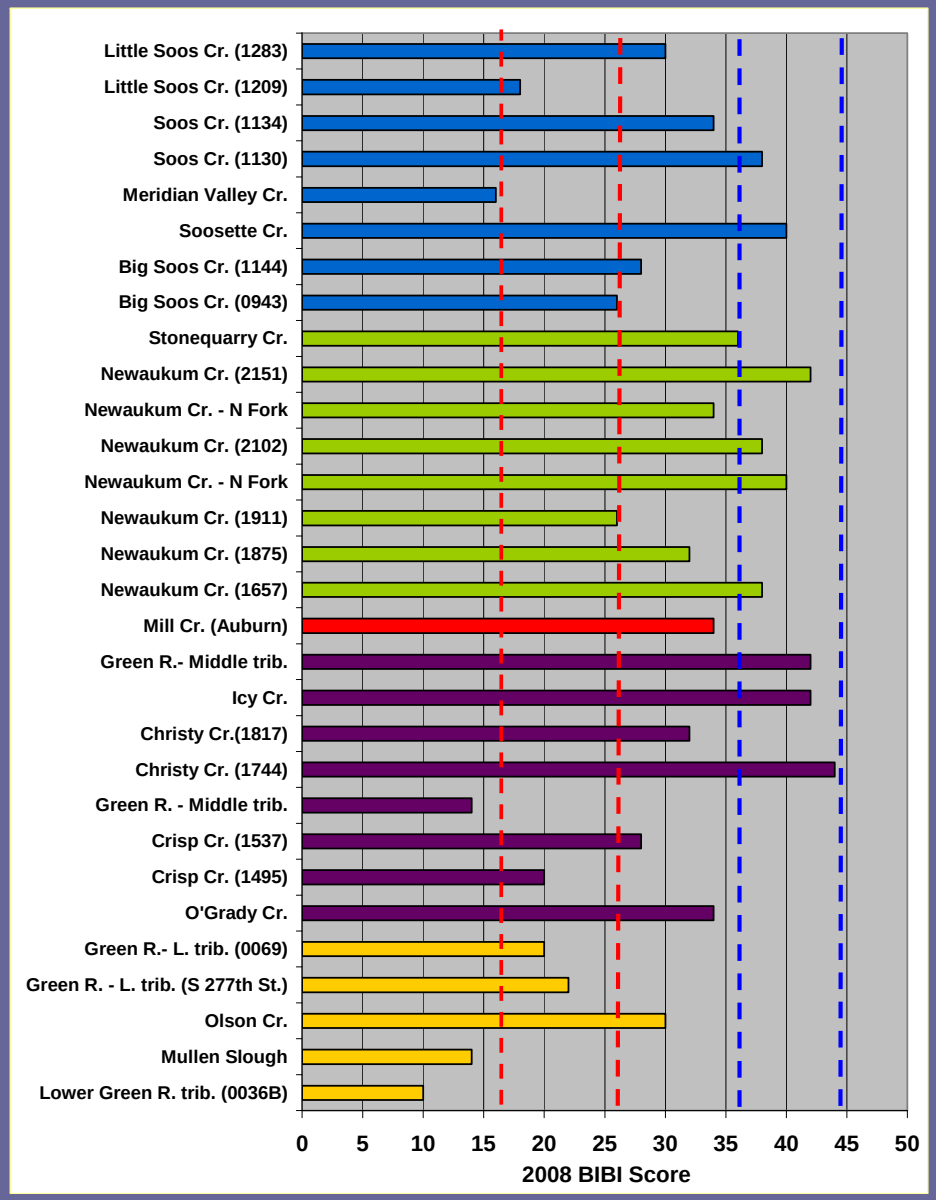
Cedar/Lake Washington Sub-basin 2009 BIBI Scores

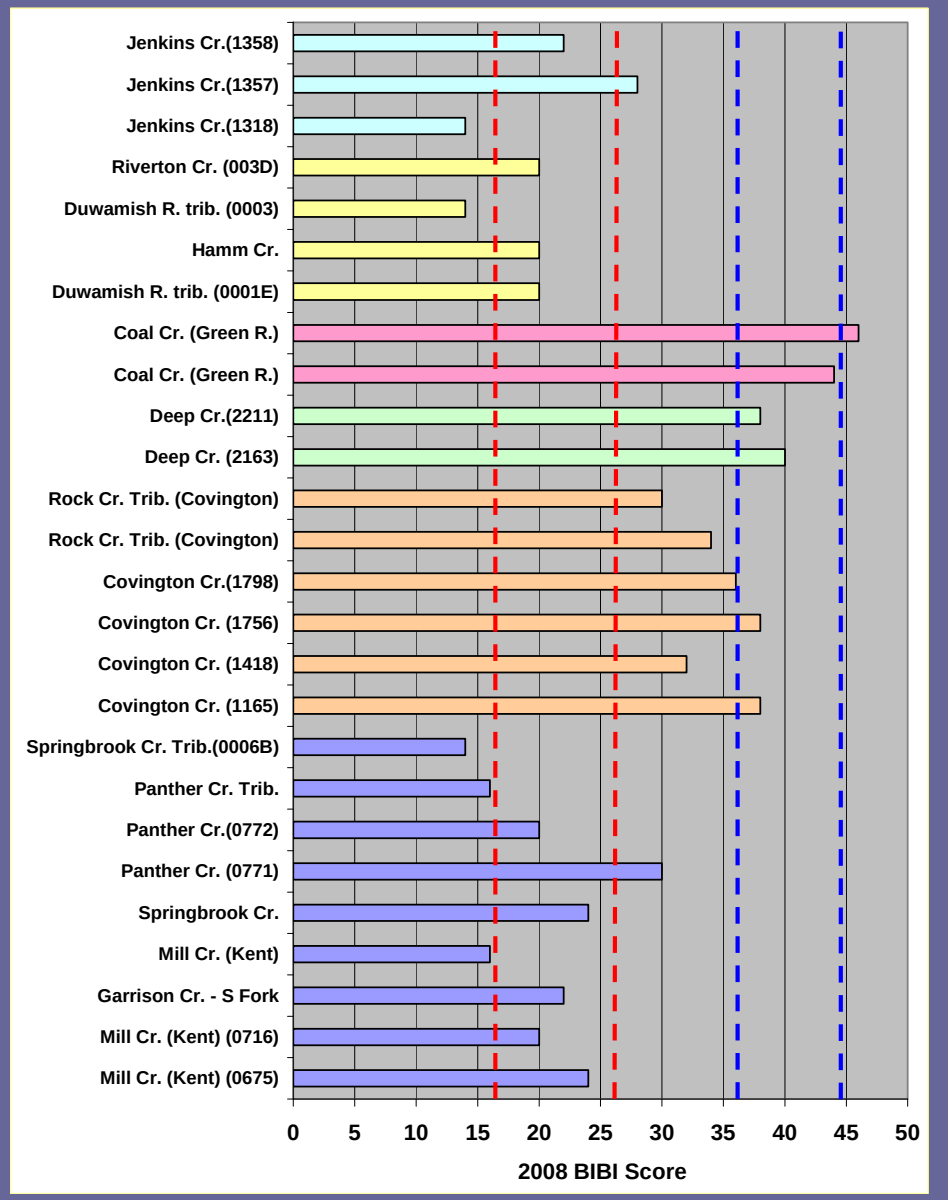






Sammamish River Basin – BIBI Scores 2008





Duwamish-Green Basin - BIBI Scores 2008

Acknowledgements!

Freshwater Stream Team

- Debra Bouchard
- Curtis Degasperi
- Sally Abella
- Dean Wilson
- Jo Wilhelm
- Numerous interns!

Environmental Lab Staff

- Jean Power
- Stephanie Hess
- Christopher Barnes
- Colin Elliott
- Katherine Bourbonnais
- Brian Prosch
- Diane McElhany
- Mike Doubrava
- Eric Thompson
- And MANY other KCEL staff!

Questions?