Estero Americano Watershed Sediment Reduction Project, Phase II, Sonoma and Marin Counties, CA

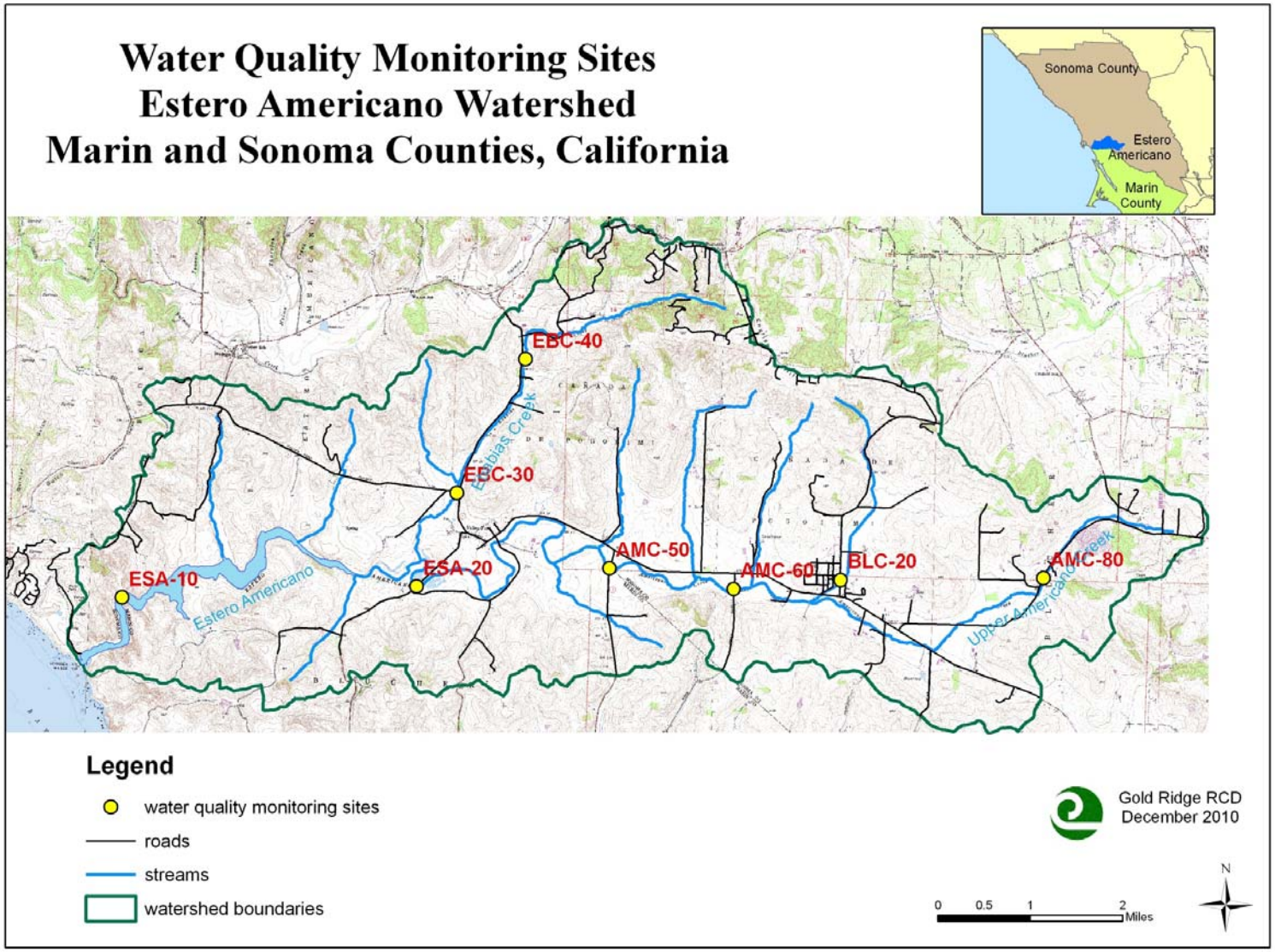
Draft Quarterly Monitoring Report
Item B.4.2

This quarterly report summarizes data collected from December 2012 through March 2013 under the SWRCB 319(h) funded Estero Americano Watershed Sediment Reduction Project, Phase II. The data period included three winter baseflow ambient sampling events on January 31, 2013, February 28, 2013 and March 29, 2013, as well as one storm sampling event which was conducted on December 21, 2012. The storm sampling event did not include sampling for nutrient or total suspended solids (TSS) analysis.

Since there are no public streamflow gauges deployed in the Estero Americano Watershed, the Salmon Creek streamflow gauge is used as a proxy for evaluating streamflow response to rainfall. Unfortunately, this gauge has been offline since September 2012 and no hydrograph data is available for the early 2012-13 water year storms.

All of the sampling sites had continuous surface flow during all sampling events during this data period, as would be expected of winter streamflow conditions.

Figure 3: Map of sampling locations throughout the Estero Americano Watershed.



Water Quality Objectives/Targets

As with previous GRRCD evaluations of water quality in the Estero Americano Watershed, the Water Quality Objectives or comparative thresholds are listed in the table below. The North Coast Regional Water Quality Control Board (NCRWQCB) has not set numeric standard water quality objectives for the Estero Americano Watershed, which falls into the "Bodega Bay" water body description (NCRWQCB, 1994). Statewide criteria set by the US Environmental Protection Agency (EPA), Region 9(US Environmental Protection Agency, 2000) and/or the objectives for the nearby Russian River water body by the North Coast Regional Water Quality Control Board (NCRWQCB, 1994) have been used as targets and are outlined in Table 2 below.

Table 2: Water Quality Objectives.

Parameter (reporting units)	Water Quality Objectives	Source of Objective
Dissolved Oxygen (mg/l or ppm)	Not lower than 7	North Coast Region Basin Plan Objective for Cold Water Fish
pH (pH units)	Not less than 6.5 or more than 8.5	General Basin Plan objective
Water Temperature (°C)	Not to exceed 21.1	USEPA (1999) 20-22 range, supported by Sullivan (2000)
Conductivity (uS)	None established	N/A
Nitrate as N (mg/l)	Not to exceed 1.0	
Ammonia-Nitrogen (mg N/l)	Not to exceed 0.5	USEPA (2009)
Orthophosphate (mg/l)	Not to exceed 0.10 (for streams and flowing waters not discharging into lakes or reservoirs)	USEPA(2000)
Turbidity	1. Not to exceed 55 NTUs during low flow; 2. not to exceed 150 NTUs during storm events	GRRCD selected thresholds, 1. Supported by Sigler (1984); 2. supported by Newcombe (2003)

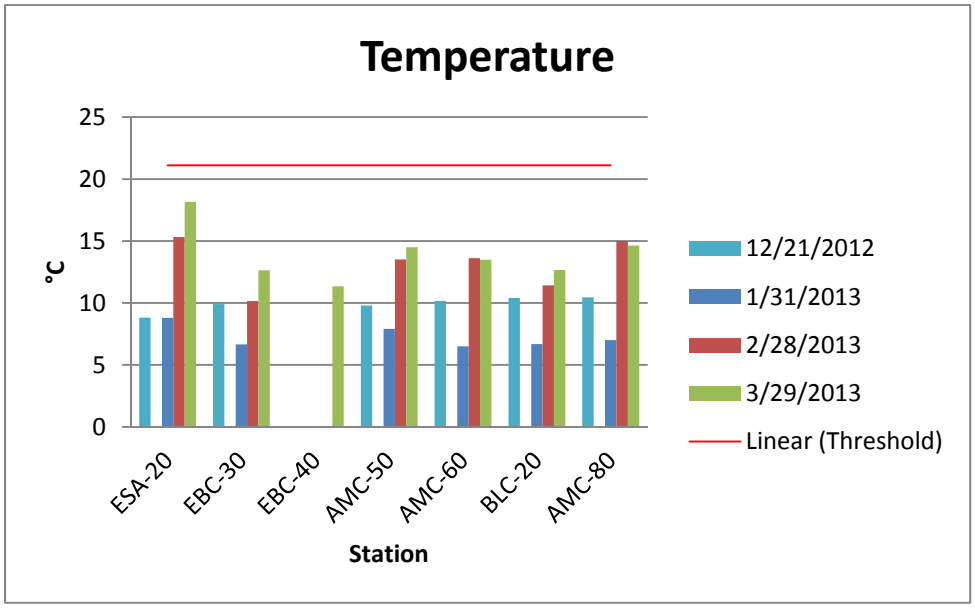
Results and Discussion

Temperature

Water temperature is important to fish and other aquatic species, as well as the function of the aquatic ecosystem. It influences the rate of metabolism for many organisms, including photosynthesis by algae and other aquatic plants, as well as the amount of dissolved oxygen that the water can hold.

Over the data period, temperature measurements were taken during each sampling event. Water temperature is not generally of concern during the winter months and all temperature from this data period met water quality objectives.

Figure 4: Temperature Measurements



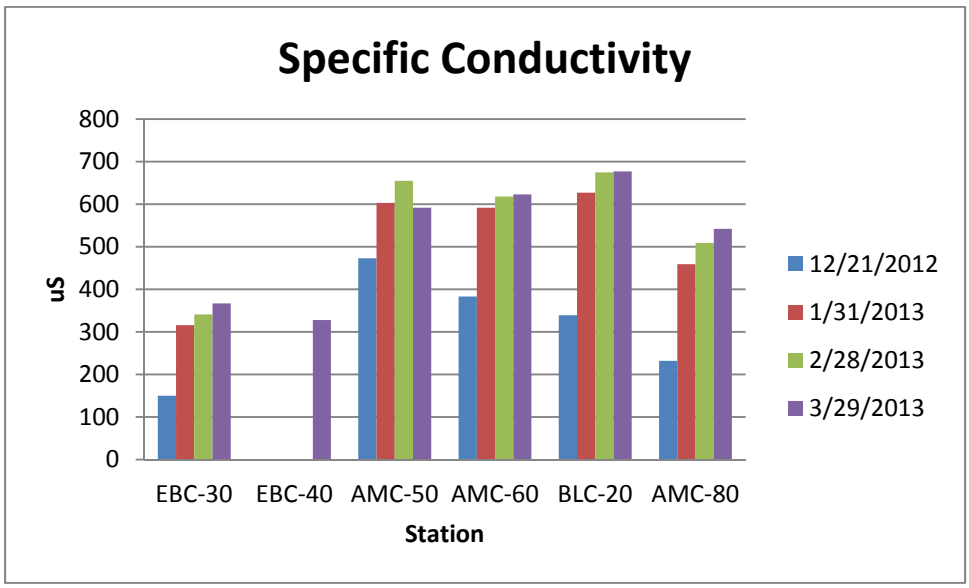
Conductivity

Conductivity is a measure of water's capacity for conducting electricity and is a measure of the ionic (dissolved) constituents present in the sample. While there is no specific water quality objective for conductivity, conductivity can be used as an indicator of pollutant levels.

The conductivity results from sampling station ESA-20 are not included in the graph below since high conductivity conditions are assumed to be a function of the tidal nature of this site, rather than an indicator of pollutant levels, and would have skewed the graph. As streamflow levels drop to baseflow conditions, specific conductivity results generally increase. There was very little rainfall in February and March. The highest conductivity result, 677 µS was observed at station BLC-20 during the March

29 sampling event. Specific conductivity results dropped during the 12/21/12 storm event sampling due to the dilution effect of the inflow of rainwater.

Figure 5: Specific Conductivity Measurements

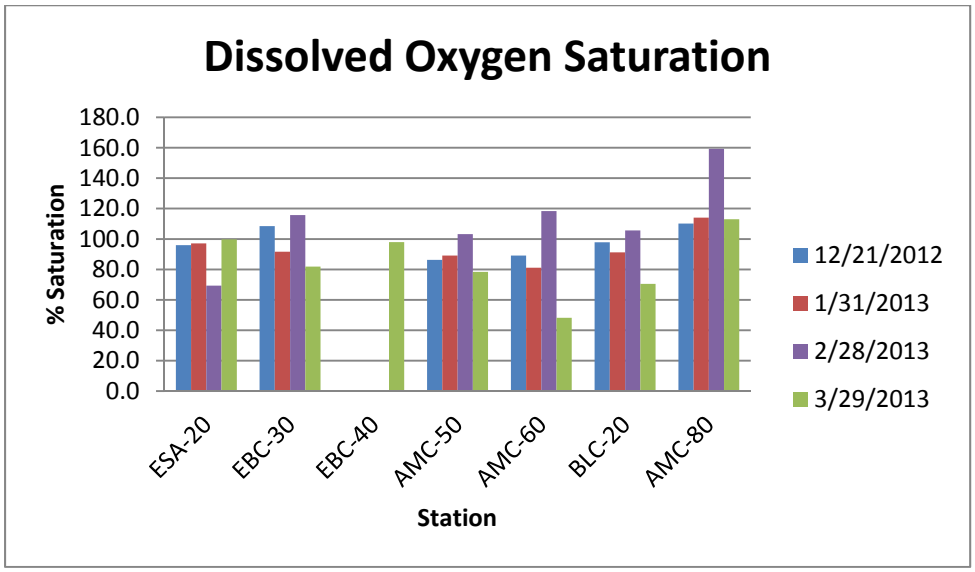


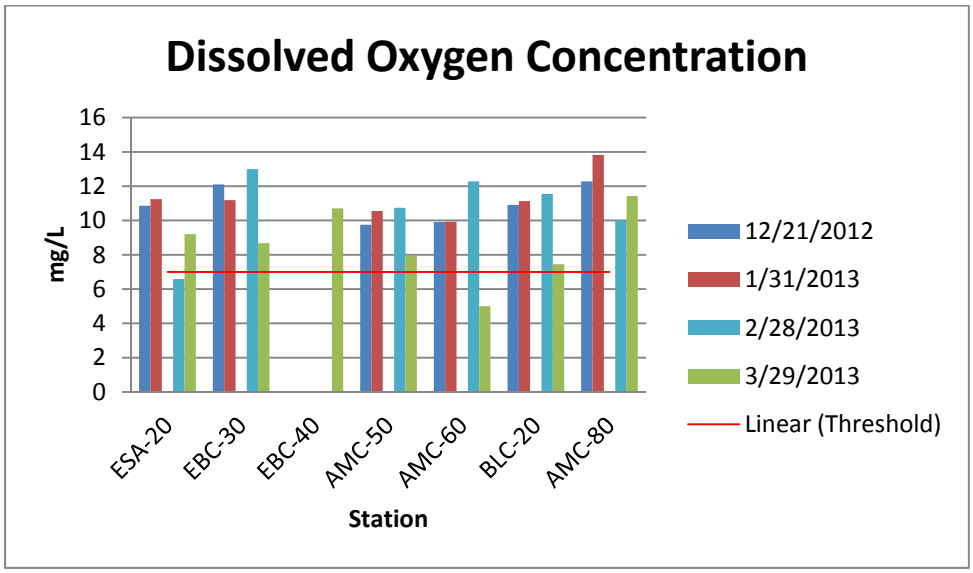
Dissolved oxygen

Dissolved oxygen (DO) refers to the amount of oxygen dissolved in water and available to aquatic organisms. Dissolved oxygen is added to water through diffusion from air, turbulence, and photosynthesis of aquatic plants, and removed through respiration of aquatic organisms, decomposition of organic material, and other chemical reactions that use oxygen.

Throughout the data period dissolved oxygen levels ranged from 48.2 to 159.3% saturation and 5.0 to 13.82 mg/l in Americano Creek and its freshwater tributaries. Several super-saturated DO conditions were observed during this sampling period, but since the presence of algae and aquatic plants isn't generally a concern during winter months, this may be attributed to winter flows. Since the collected measurements were grab samples, this information is not conclusive of the minimum dissolved oxygen conditions, a future monitoring recommendation would be to install continuous DO loggers to capture diurnal and seasonal variations.

Figures 6, 7: Dissolved Oxygen Measurements



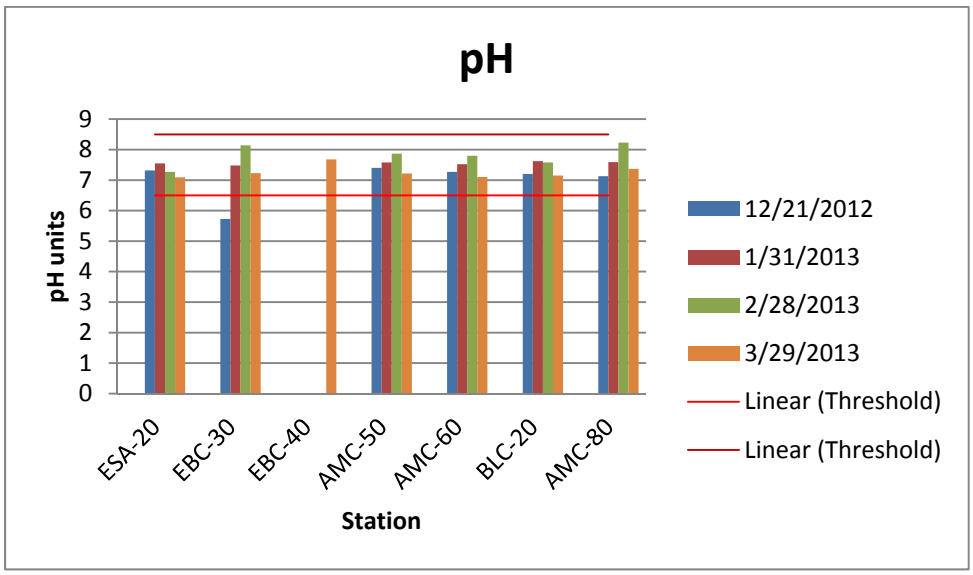


pH

pH refers to the concentration of hydrogen ions in water and determines the acidity or alkalinity of water. Natural pH levels are affected by geology, vegetation, and soil types in the streambed and surrounding the stream, and the availability of carbon dioxide. Changes in pH can have critical effects on water chemistry and the biological systems dependent on the aquatic environment. For example, the solubility and toxicity of metal compounds and nutrients changes greatly in relation with pH.

pH measurements ranged from 5.73 (at EBC-30) to 8.23 pH units (at AMC-80) for freshwater stations and 7.83 to 8.16 at the Estero station.

Figure 8: pH Measurements



Turbidity

Turbidity, which can make water appear cloudy or muddy, is caused by the presence of suspended and dissolved matter, such as clay, silt, finely divided organic matter, plankton and other microscopic organisms. Sources of turbidity include soil erosion, streambank erosion, animal waste, road and urban runoff, and excessive algal growth.

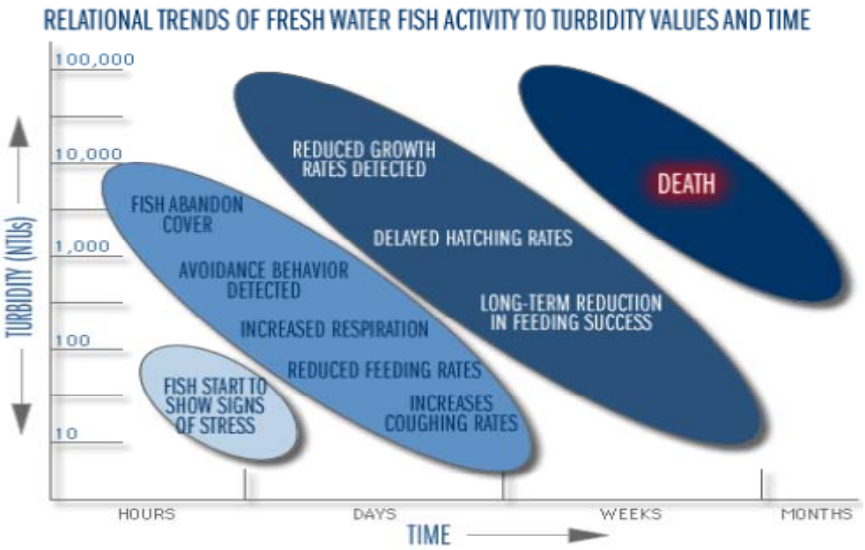
Excess turbidity reduces light, thereby reducing benthic organisms and ultimately fish populations. High turbidity level can increase water temperatures due to suspended particles absorbing heat. High turbidity levels also affect aquatic organisms by causing reduced feeding rates, reduced growth rates, damage to gills, and fatality.

Water quality objectives for turbidity and Total Suspended Solids (TSS) are not definitively established for the Estero Americano Watershed. While the North Coast Regional Water Quality Control Board mandates that turbidity levels not be increased more than

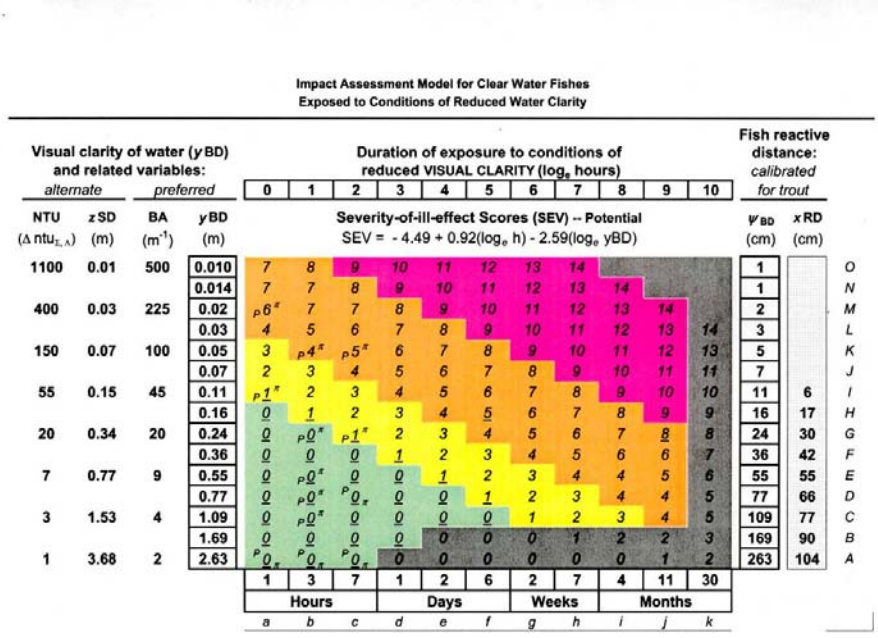
20% above naturally occurring background levels (NCRWQCB, 2007), when a background level has not been established (as is the case with the Estero), this objective is difficult to use. Since at least part of the watershed sustains anadromous fish, clear water fishery objectives have been employed as water quality targets. Newcombe (Newcombe, 2003) described the detrimental impacts to clear water fishes at several turbidity levels. Newcombe states that turbidity levels of 55 NTUs caused significant impairment to fish after one day and severe impairment after four months, while turbidity levels of 150 NTUs caused significant impairment after three hours and severe impairment after two weeks. For summer baseflow conditions, when turbidity is generally expected to be low, a threshold of 25 NTUs has been used.

No Nutrient or TSS sampling was conducted during this sampling interval.

Figures 9, 10: Representations of impairment relationships between turbidity and fresh water fish



"Figure 10: Idealized model of fish response to increased suspended sediments. Schematic source of above figure is unknown; it is a generic, un-calibrated impact assessment model based on Newcombe, C. P., and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. 16: 693-727. Reprinted, with permission, from: http://wow.nrri.umn.edu/wow/under/parameters/turbidity.html" (Berry, 2003).



Impact Assessment Model for Clear Water Fishes Exposed to Conditions of Reduced Water Clarity

Visual clarity of water (yBD) and related variables: *alternate* NTU ($\Delta ntu_{T,A}$)	*alternate* zSD (m)	*preferred* BA (m^{-1})	*preferred* yBD (m)	Duration of exposure to conditions of reduced VISUAL CLARITY ($\log_e$ hours): 0	1	2	3	4	5	6	7	8	9	10	Fish reactive distance: *calibrated for trout* Ψ_{BD} (cm)	xRD (cm)	
				Severity-of-ill-effect Scores (SEV) -- Potential: SEV = - 4.49 + 0.92($\log_e$ h) - 2.59($\log_e$ yBD)													
1100	0.01	500	0.010	7	8	9	10	11	12	13	14				1		O
			0.014	7	7	8	9	10	11	12	13	14			1		N
400	0.03	225	0.02	$_P6^*$	7	7	8	9	10	11	12	13	14		2		M
			0.03	4	5	6	7	8	9	10	11	12	13	14	3		L
150	0.07	100	0.05	3	$_P4^*$	$_P5^*$	6	7	8	9	10	11	12	13	5		K
			0.07	2	3	4	5	6	7	8	9	10	11	11	7		J
55	0.15	45	0.11	$_P1^*$	2	3	4	5	6	7	8	9	10	10	11	6	I
			0.16	0	1	2	3	4	5	6	7	8	9	9	16	17	H
20	0.34	20	0.24	0	$_P0^*$	$_P1^*$	2	3	4	5	6	7	8	8	24	30	G
			0.36	0	0	0	1	2	3	4	5	6	6	7	36	42	F
7	0.77	9	0.55	0	$_P0^*$	0	0	1	2	3	4	4	5	6	55	55	E
			0.77	0	$_P0^*$	$_P0_*$	0	0	1	2	3	4	4	5	77	66	D
3	1.53	4	1.09	0	$_P0^*$	0	0	0	0	1	2	3	4	5	109	77	C
			1.69	0	0	0	0	0	0	0	1	2	2	3	169	90	B
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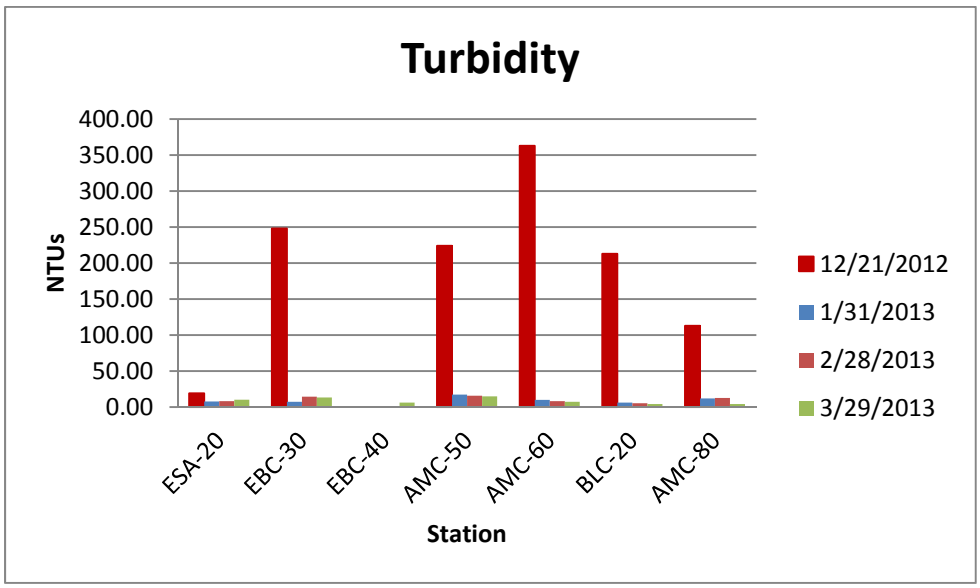
				1	3	7	1	2	6	2	7	4	11	30			
				Hours			Days			Weeks		Months					
				a	b	c	d	e	f	g	h	i	j	k			

"Figure 11: Matrix of impairment levels by turbidity level and duration. Yellow indicates slight impairment with changes in feeding and other behaviors, orange indicates significant impairment with altered fish growth and habitat quality, and red indicates severe impairment with physiological condition changes and habitat alienation (Newcombe 2001, 2003)" (Gold Ridge RCD, 2010).

The turbidity levels during the 12/21/12 storm sampling event showed the highest result at AMC-60, though turbid conditions were present throughout the watershed.

Figures 11: Turbidity Measurements



List of Works Cited

Berry, W. N. (2003). *The Biological Effects of Suspended and Bedded Sediment (SABS) in Aquatic Systems: A Reivew.* Narraganset, RI: US Environmental Protection Agency.

Gold Ridge RCD. (2010). *Salmon Creek Integrated Coastal Watershed Management Plan.* Occidental, California: Gold Ridge Resource Conservation District.

Newcombe, C. (2003). *Impact assessment model for clear water fishes exposed to excessively cloudy water.* Journal of the American Water Resources Association (JAWRA) 39(3):529-544.