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 2010 to February 2011 under the SWRCB 319(h) funded Estero Americano Watershed Sediment Reduction Project, Phase II. The data period included monthly sampling (December 6), the first storm sampling event (December 8), monthly sampling (January 26), and a second attempt at storm sampling (February 15) during which not enough rainfall was delivered to qualify as storm sampling.

The first significant rainfall event of water year 2011 occurred on October 23-24, 2010 and delivered between 5-8 inches of rainfall in the Estero Americano Watershed. Before that, only the Ebabias Creek (EBC-30 and EBC-40) and the upstream-most (AMC-80) and downstream-most (ESA-20) stations had sufficient surface flow to sample. After the first storm, all stations have remained wetted. An attempt to storm sample was made on 2/15/11. Despite being a dramatic storm event that followed a rainfall event two days earlier, the Project Manager and Technical Advisor concluded that during the sampling period there was not enough streamflow response to qualify as a storm sampling event. Since it was getting dark and there were high wind conditions due to the storm, sampling was ceased prior to stormflow conditions being attained. The 2/15/11 sampling event therefore qualified as a monthly sampling event. To date, the watershed has received approximately 32 inches of cumulative rainfall.

Estero Americano under high flow conditions

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. Below are the two hydrographs associated with the December 8, 2010 and February 15, 2011 storm events.

Figure 1: Hydrograph of Salmon Creek through the reporting period (December 6, 2010 through February 28, 2011)

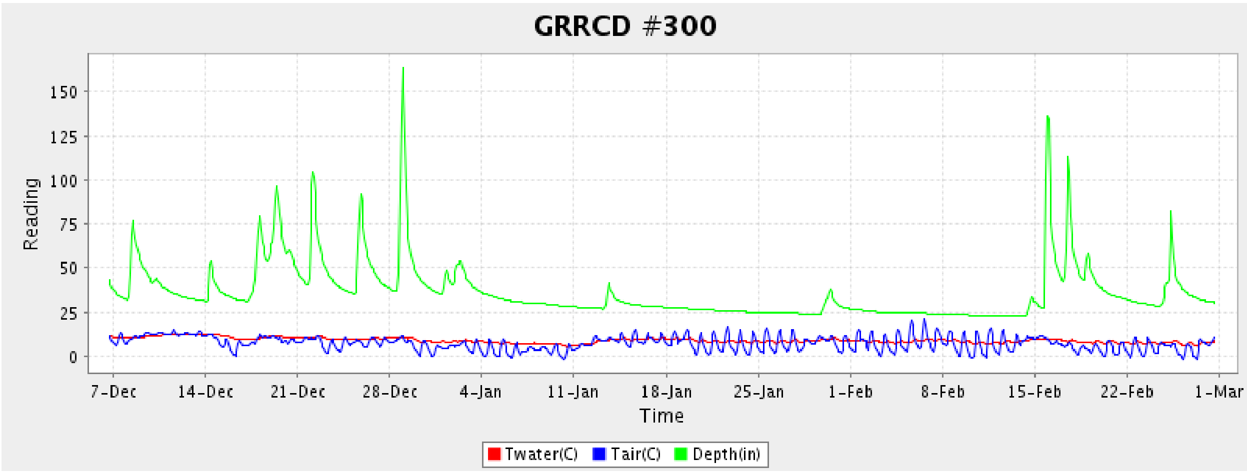
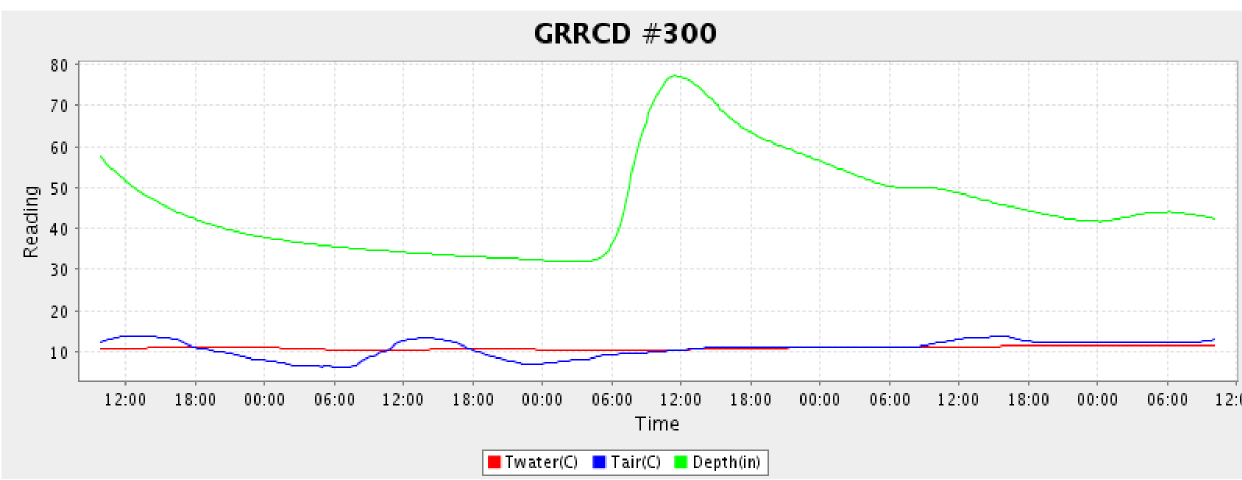


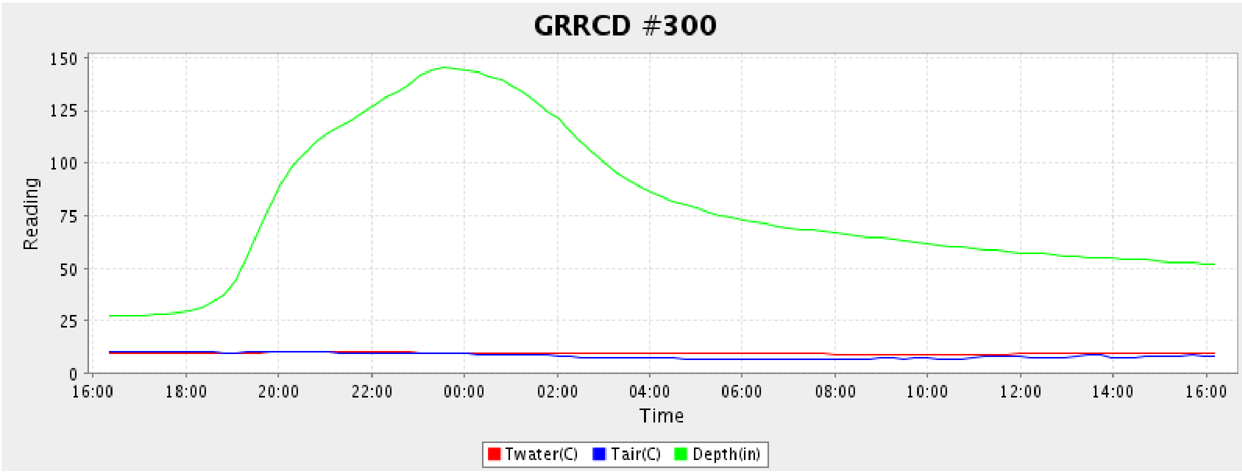
Figure 1 shows Salmon Creek streamflow throughout the reporting period. Note that the January 26, 2011 sampling event occurred during a relative dry spell, during which winter base flows conditions occurred. This period was coupled with several weeks of freezing temperatures at night and warm (~70°F) days (see blue line depiction of air Temperature).

Figure 2: Hydrograph of Salmon Creek from noon on December 16 to noon December 20, 2010



The hydrograph of the December 8, 2010 storm event illustrates the stream response to the rainfall and resulting runoff. Approximately 1.25” of rainfall occurred on 12/8/10 with a three day cumulative total of 2.7” from 12/6 to 12/8. Sampling occurred between 10:00 and 13:00 and captured peak flows.

Figure 3: Hydrograph of Salmon Creek from 16:00 on 2/15/11 to 16:00 on 2/16/11



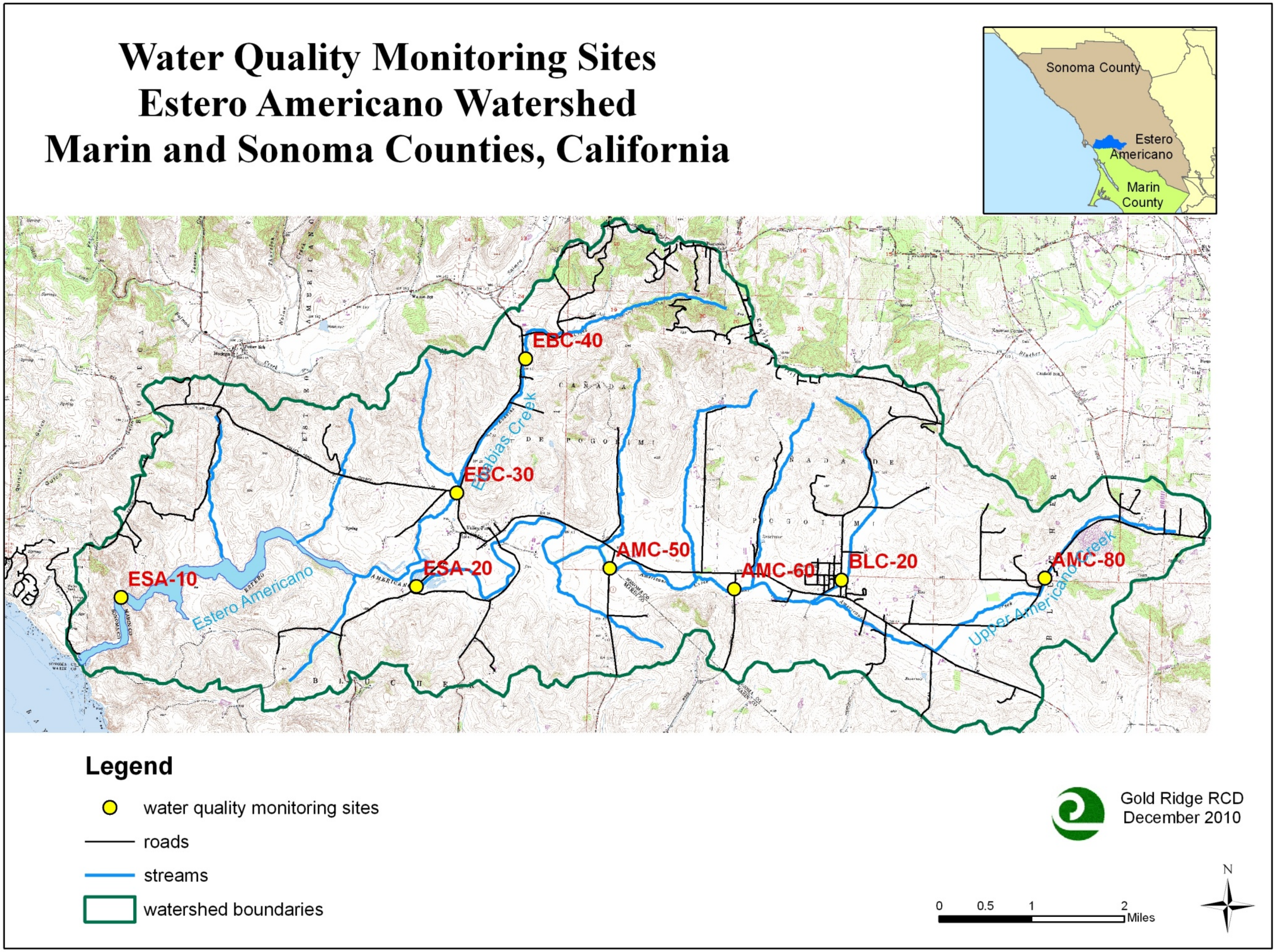
The hydrograph of the February 15-16 storm event illustrates that despite storm conditions, sampling conducted around 18:00 did not constitute a streamflow response and was therefore considered monthly sampling.

The sampling locations have been renamed to comply with SWRCB naming convention. See the table below and the associated attached map.

Table 1: Monitoring station IDs

New Station ID	Description
ESA-10	Estero Americano off of Estero Lane on private property; not currently sampled
ESA-20	Estero Americano at Marsh Road bridge
EBC-30	Ebabias Creek at Hwy. 1 bridge
EBC-40	Ebabias Creek off of Valley Ford Freestone Road
AMC-50	Americano Creek at Hwy. 1 bridge
AMC-60	Americano Creek at Gerike Road bridge
BLC-20	Bloomfield Creek at Bloomfield Road bridge
AMC-80	Americano Creek at Roblar Road bridge

Figure 4: 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.

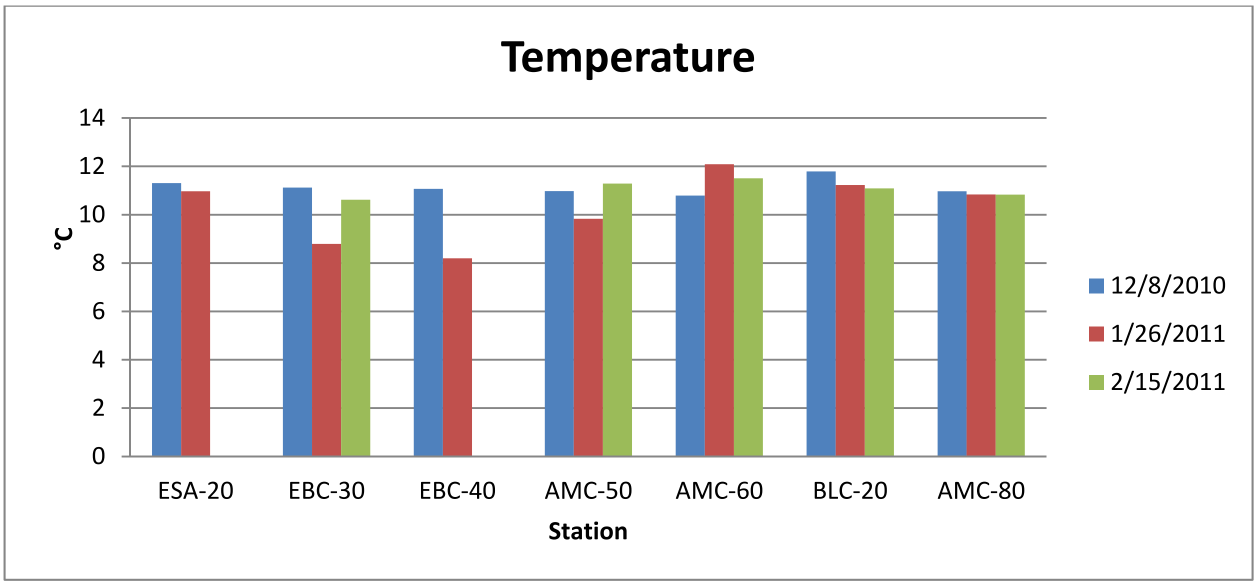
Parameter (reporting units)	**Water Quality Objectives**	**Source of Objective**
Dissolved Oxygen (mg/l or ppm)	Not lower than 7	North Coast Region Basin Plan Objective for Cold Water Fish
pH (pH units)	Not less than 6.5 or more than 8.5	General Basin Plan objective
Water Temperature (°C)	Not to exceed 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	USEPA(2000)
Turbidity	1. Not to exceed 25 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

Over the data period, temperature measurements varied from 8.20 to 12.09 °C, none of which exceeded the threshold of 21 °C. Since the collected measurements were grab samples, this information is not conclusive that the stream conditions never exceeded the water temperature objective, though considering the winter ambient air and high water volume conditions it isn't likely. The highest temperatures were observed during highest flow conditions during the December 8 storm sampling.

Figure 5: Temperature Measurements

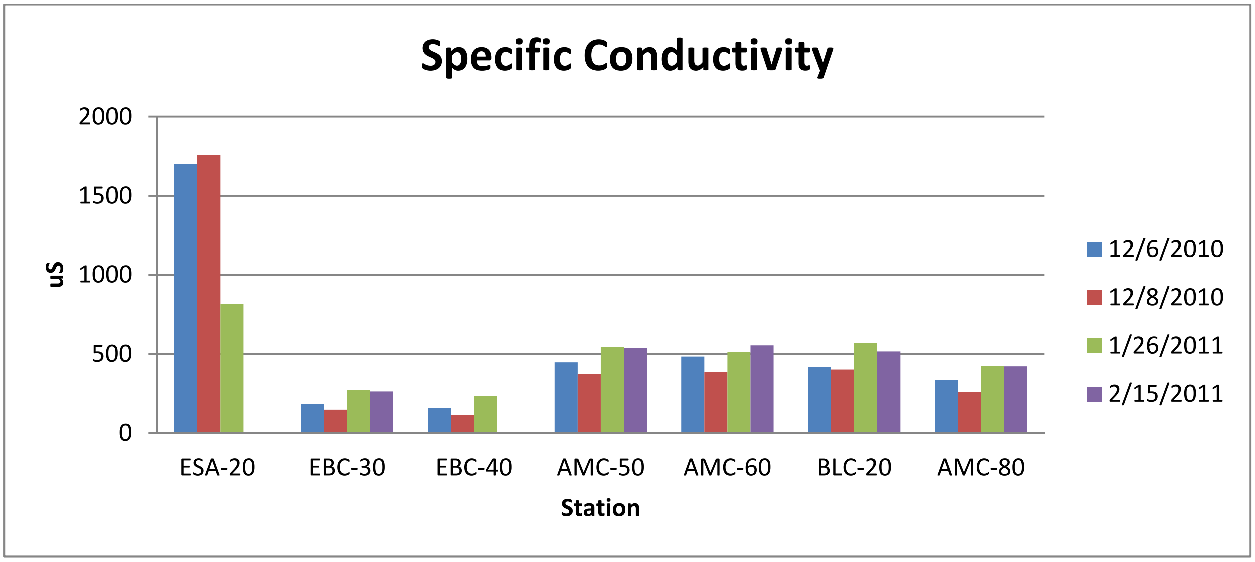


Conductivity

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.

Over the data period, specific conductivity measurements in Americano Creek ranged from 115 to 569 uS and from 815 to 1758 in the Estero Americano. As expected, specific conductivity levels dropped during the storm event in response to the influx of storm water. With the exception of Ebabias Creek stations (and excluding the tidal effects of salinity fluctuation at ESA-20), the conductivity results remained relatively high (>335 uS) for winter flow conditions throughout the sampling period.

Figure 6: Specific Conductivity Measurements

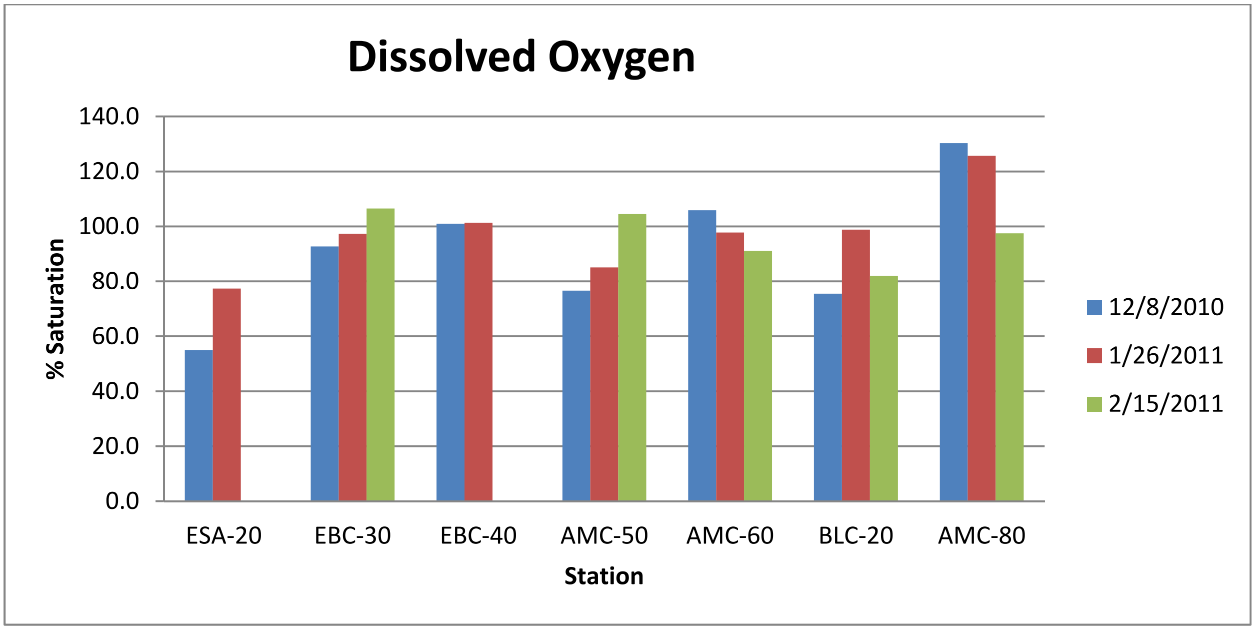


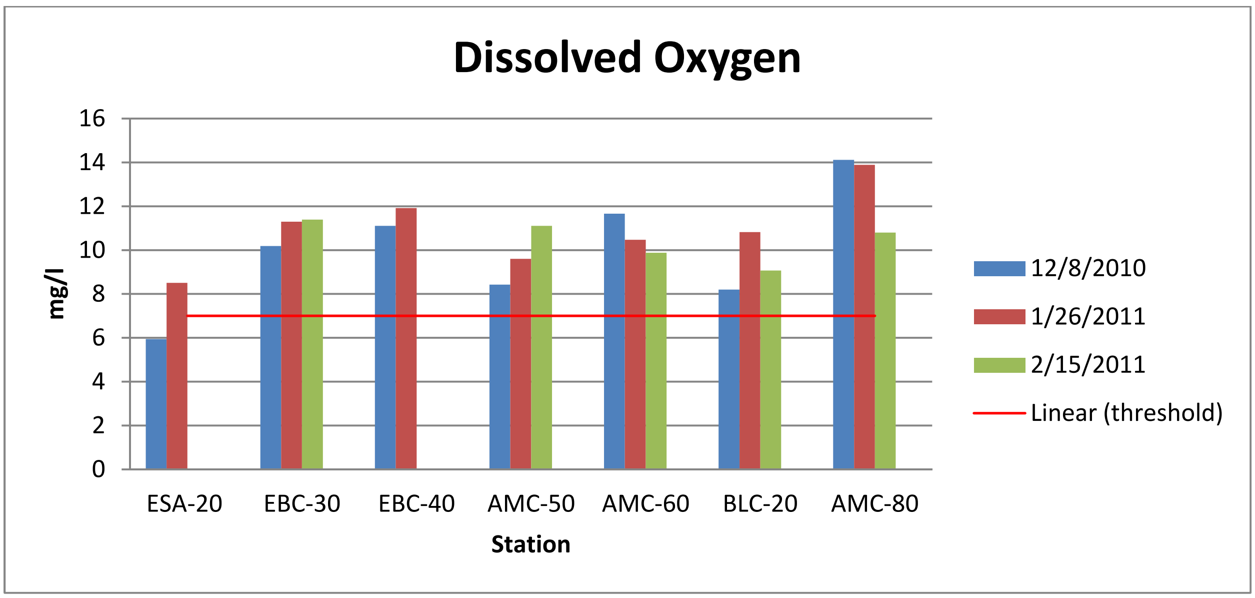
Dissolved oxygen

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.

As expected during winter flow conditions, dissolved oxygen levels met water quality objectives and remained high throughout the sampling period. Super-saturated conditions exceeding 100%, and ranging from 100% to 130%, were measured during the peak flows of the 12/8/10 storm event. Due to the high stream flow velocities the sonde probe was difficult to submerge, so it is not surprising that turbulent surface conditions measured well above 100% saturation.

Figures 7, 8: Dissolved Oxygen Measurements



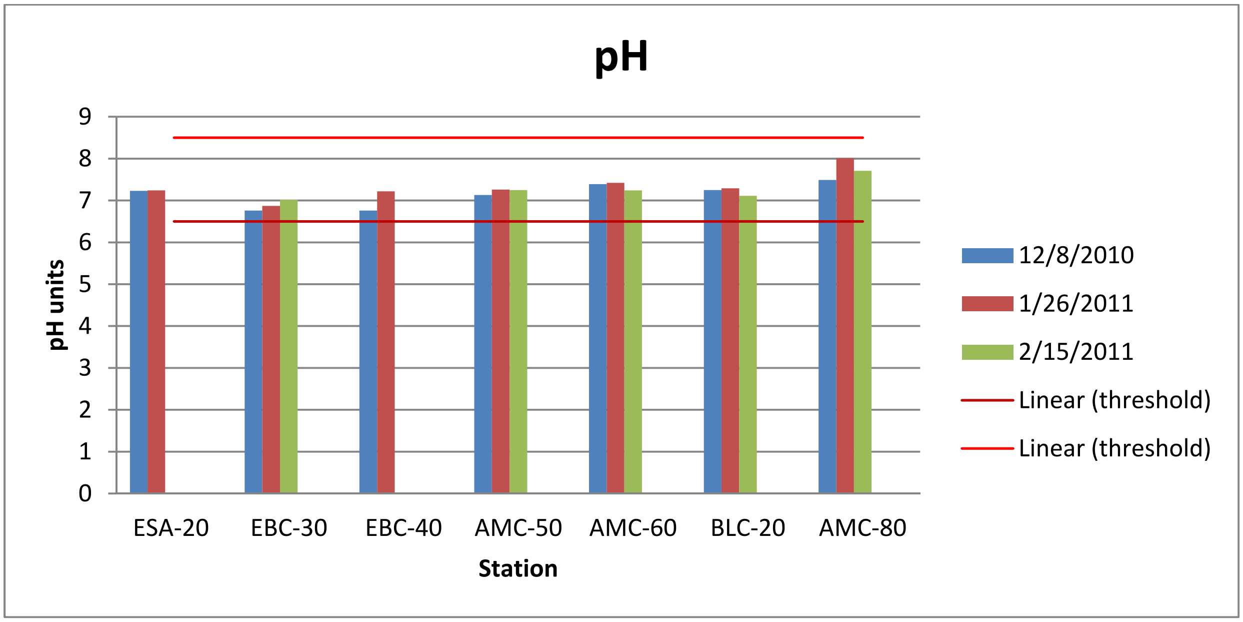


pH

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 with pH.

pH measurements ranged from 6.76 to 8.01 pH units, all of which feel within water quality objectives (WQOs).

Figure 9: pH Measurements



Nutrients

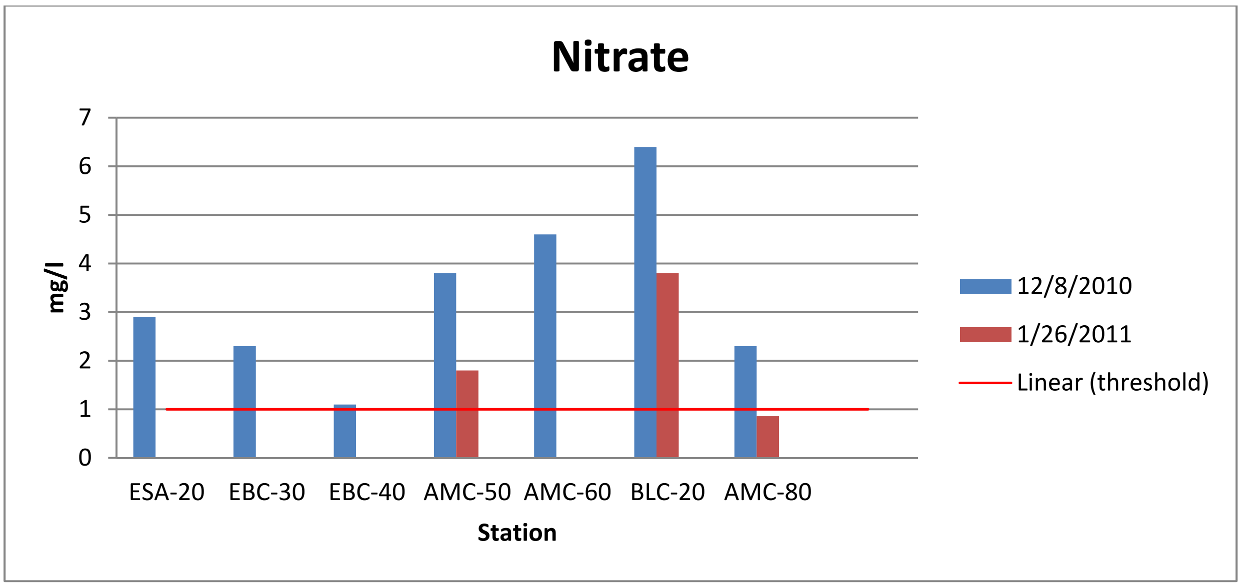
Nitrate-nitrogen, phosphate and phosphorous are not directly toxic to aquatic organisms but, where sunlight is available, these chemical nutrients act as biostimulatory substances that stimulate primary production. Excessive inputs of these nutrients, known as eutrophication, can result in abundant plant growth and resulting decay which depletes dissolved oxygen and can degrade habitat quality. While this effect is not generally of concern during winter flow conditions, the input and deposition of high nutrient sediments can exacerbate these conditions later in the year.

As per the Monitoring Plan for this project, nutrients are measured several times a year to characterize seasonal conditions when they may have water quality impacts. The conditions monitored during the course of this quarterly report include one storm sampling event on December 8, 2010. Due to a several high concentration nutrient results, selected stations were sampled for nutrients during the January 26, 2011 sampling event to investigate if these high nutrient concentrations persisted during winter base flow conditions.

Nitrate

Nitrate (NO_3) is an inorganic form of nitrogen that is soluble and therefore subject to leaching and biological uptake. Nitrate results ranged from 0.86 to 6.40 mg/l, with every station exceeding the 1.0 mg/l Water Quality Objective under stormflow conditions and concentrations remained high under winter base flow conditions, with the exception of AMC-80. Additional storm events should be sampled to show trends throughout the watershed under wet weather, surface runoff conditions.

Figure 10: Nitrate Measurements

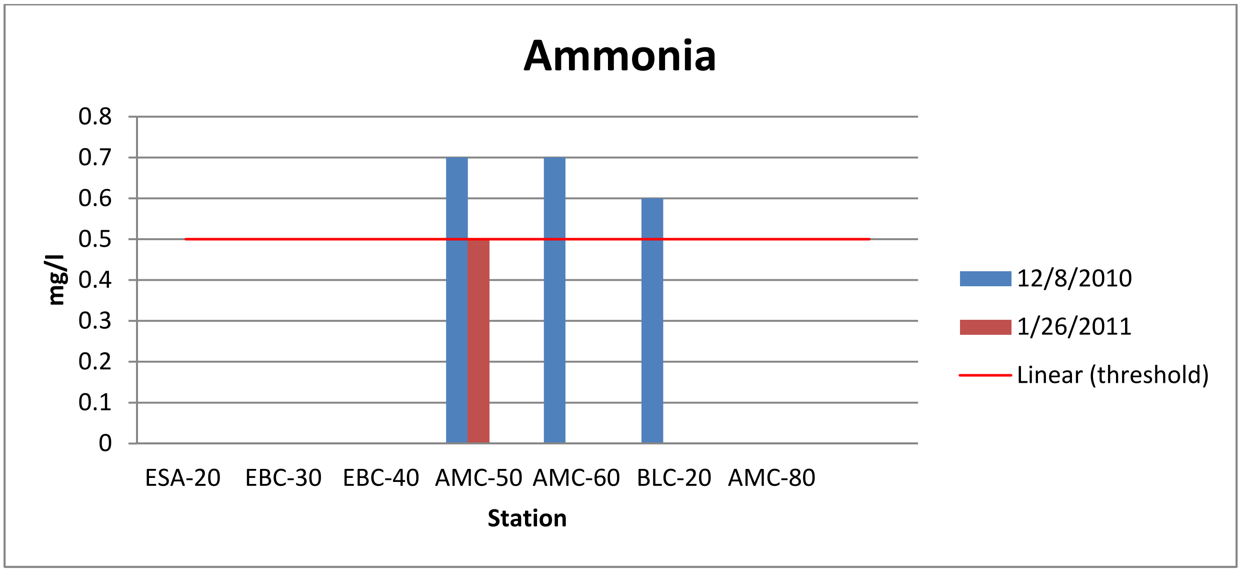


Ammonia

Total ammonia is composed of two forms; ionized ammonia (NH_4^+), and un-ionized ammonia (NH_3).Un-ionized ammonia, which primarily results from decomposition of manure and other organic debris by microbes, can be toxic to aquatic organisms in small concentrations. The percent of total ammonia in the harmful un-ionized form increase with higher temperatures and pH values.

Ammonia measurements were detected and slightly exceeded water quality objectives at stations AMC-50, AMC-60 and BLC-20 during the December 8, 2010 storm sampling event. Follow up Ammonia sampling during winter base flow conditions on 1/26/11, at AMC-50, BLC-20 and AMC-80 all met water quality objectives, with AMC-80 and BLC-20 not having detectible concentrations. This indicates that high Ammonia concentrations may not persist beyond the storm event and subsequent surface runoff. Additional storm events should be sampled to show trends throughout the watershed under wet weather, surface runoff conditions.

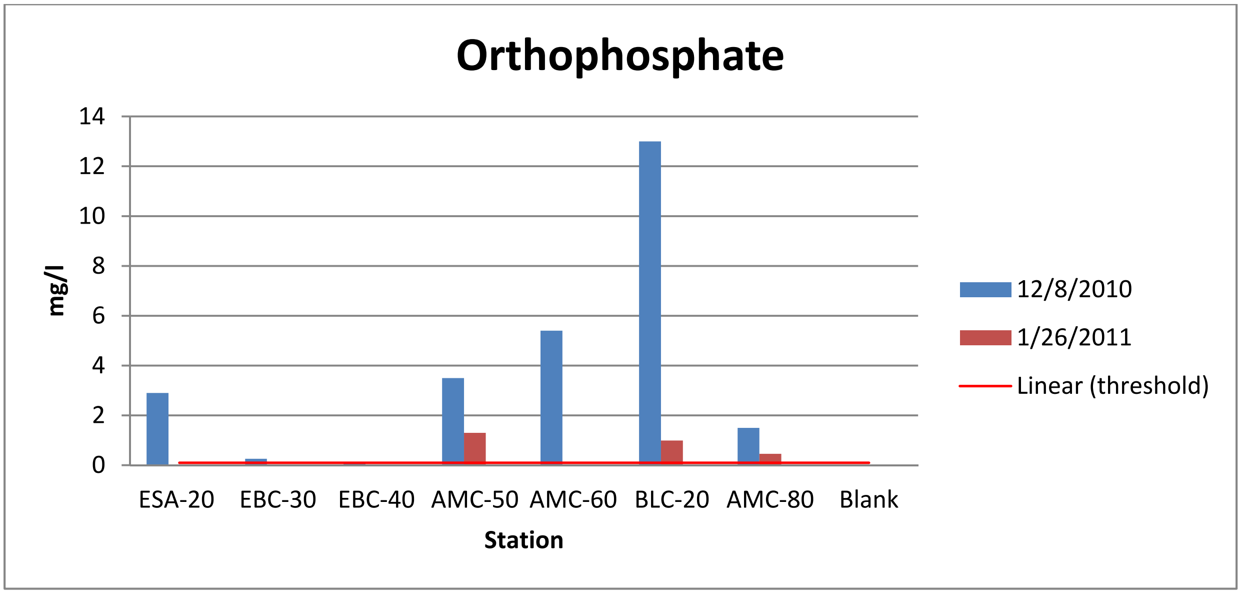
Figure 11: Ammonia Measurements



Orthophosphate

Orthophosphate results ranged from <0.13 to 13.0 mg/l. Detectable concentrations were measured at all of the stations during the 12/8/10 storm sampling event, all of which exceeded the 0.10 mg/l Water Quality Objective. The follow sampling on 1/26/11 during winter base flow conditions showed a significant drop in Orthophosphate concentration, though all three stations sampled still exceeded the WQO. Considering that there is not direct toxicity effect from elevated phosphate levels and under high flows and low water temperatures, algal growth is not a concern during winter months, additional storm events should be sampled to show trends throughout the watershed under wet weather, surface runoff conditions.

Figure 12: Orthophosphate Measurements



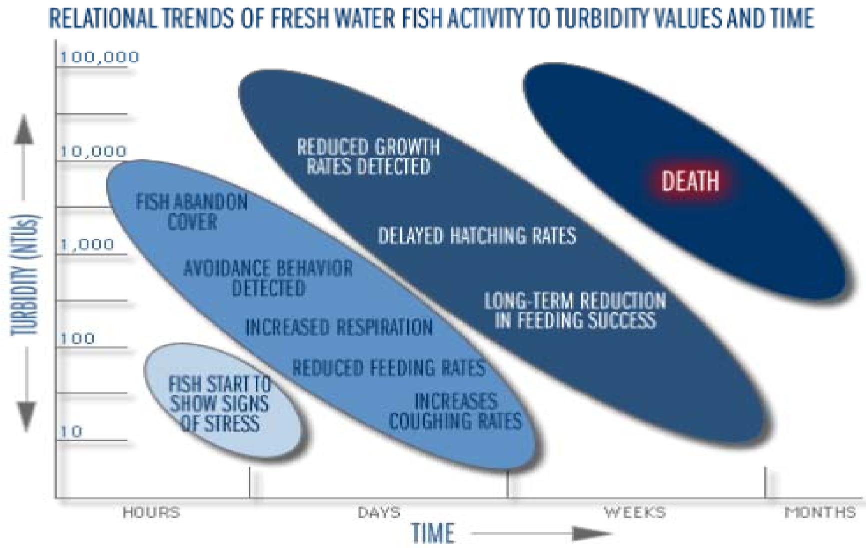
Turbidity and Total Suspended Solids

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.

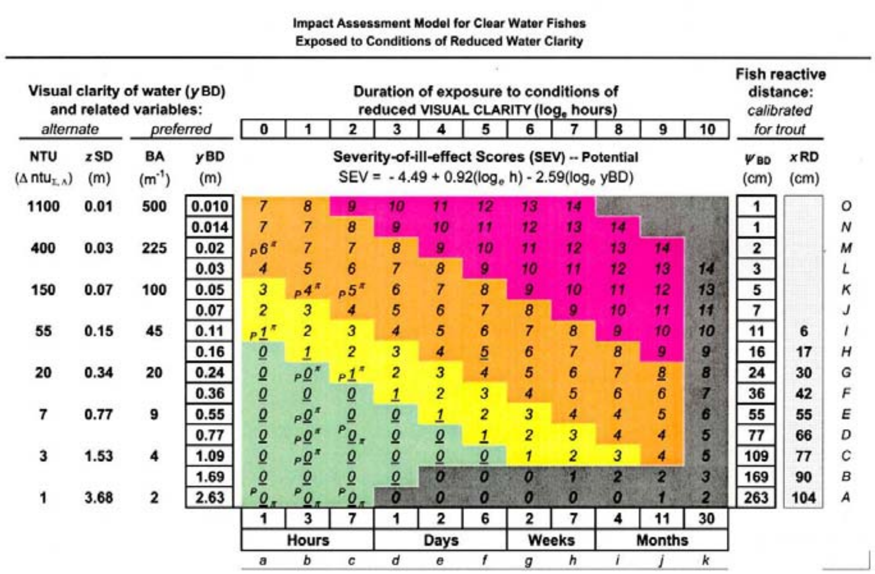
Excess turbidity reduces light, which decreases aquatic plant life, reducing benthic organisms and ultimately fish populations. High turbidity levels increase water temperatures due to suspended particles absorbing heat. High turbidity levels also affect aquatic organisms by causing reduced feeding rates, 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. Two turbidity thresholds are depicted on the graphs, 55 NTUs and 150 NTUs. 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.

Figures 13, 14: 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		preferred		Duration of exposure to conditions of reduced VISUAL CLARITY (log_e hours)											Fish reactive distance: calibrated for trout		
				0	1	2	3	4	5	6	7	8	9	10			
NTU ($\Delta ntu_{\Sigma,\Lambda}$)	zSD (m)	BA (m^{-1})	yBD (m)	Severity-of-ill-effect Scores (SEV) -- Potential; SEV = - 4.49 + 0.92(log_e h) - 2.59(log_e yBD)											ψ_{BD} (cm)	xRD (cm)	
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*	P0π	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
1	3.68	2	2.63	P0π	P0π	P0π	0	0	0	0	0	0	1	2	263	104	A
				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).

Turbidity conditions exceeded WQOs at a number locations during wet weather conditions (12/6 and 12/8/10). One condition to note is the highest Turbidity result of 432 NTUs at AMC-60 during the 2/15/11 sampling event. This may have been a sampling error, or there could have been a localized bank disturbance that resulted in this high reading. Unfortunately due to equipment failure, a sample was not taken at AMC-50 to see if the condition persisted downstream. Considering that the storm flow conditions on 12/8/10 were not excessively high at this station by watershed standards, this condition should be watched in the future, but may not be indicative of a chronic problem.

Figure 15: Turbidity Measurements

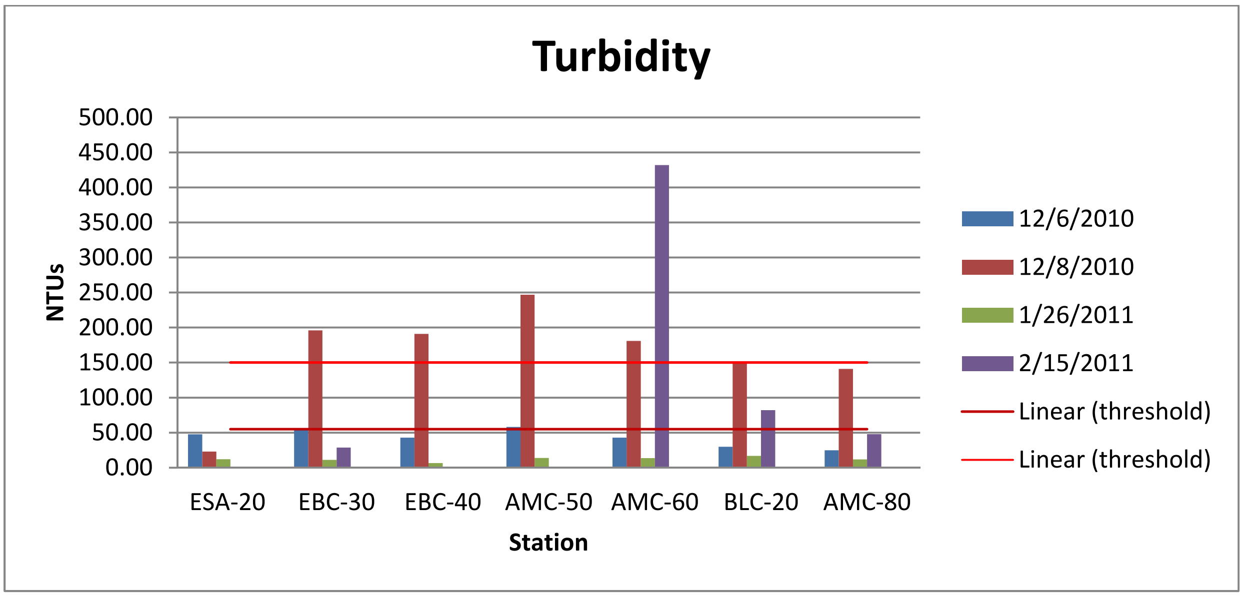
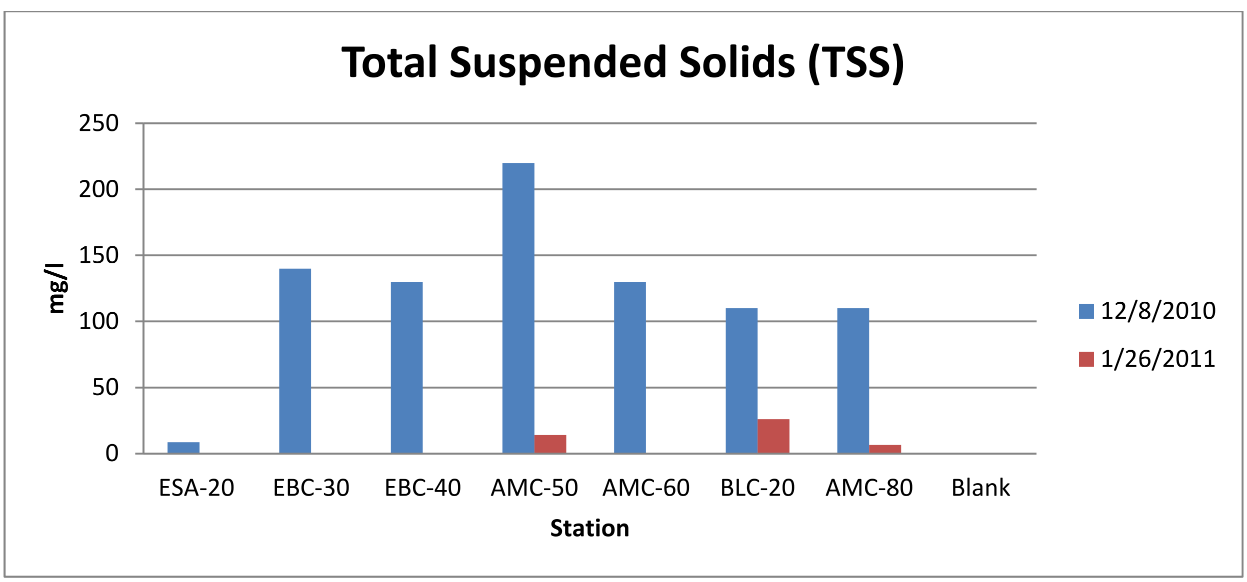


Figure 16: TSS Measurements



List of Works Cited

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