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FROM: Adona White
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DATE: April 3, 2013

SUBJECT: REVIEW OF 2012 INTEGRATED REPORT DATA AS SUBMITTED BY SALMON FOREVER FOR ELK RIVER AND FRESHWATER CREEK

On behalf of Staff of the North Coast Regional Water Quality Control Board (Staff of the Regional Water Board) I have reviewed the files submitted by Mr. Jesse Noell on behalf of Salmon Forever for consideration in the 2012 Integrated Report. These data were collected with support from a State Board Proposition 50 grant to Redwood Community Action Agency (Pin# 07-508-551). I am familiar with the submitted data as they were also used in the development of the draft Upper Elk River Sediment TMDL.
The data consist of two primary types:

1) Water quality: Turbidity, suspended sediment, stage and discharge, and rainfall data and resulting calculated suspended sediment loads.
2) Geomorphic: Stream cross-sections

The TMDL analyses evaluated conditions in Upper Elk with respect to beneficial uses and the water quality necessary to support them and prevent nuisance conditions. This memo describes how the conditions indicated by Salmon Forever data compare with those evaluated under the TMDL analyses.

Elk River Waterbody Delineation

Elk River is tributary to Humboldt Bay, Humboldt County, CA. Staff propose delineating the Elk River watershed into three distinct waterbodies as part of the 303(d) listing process and the Sediment TMDL development: (shown in Figure 1): Upper Little South Fork Elk River waterbody, Upper Elk River waterbody, and Lower Elk River and Martin Slough waterbody. Under TMDL development, conditions have been evaluated within twenty TMDL sub-basins covering the Elk River watershed. The TMDL subbasins were considered in the waterbody delineations which are based primarily on the location of landuse and beneficial use impairments.

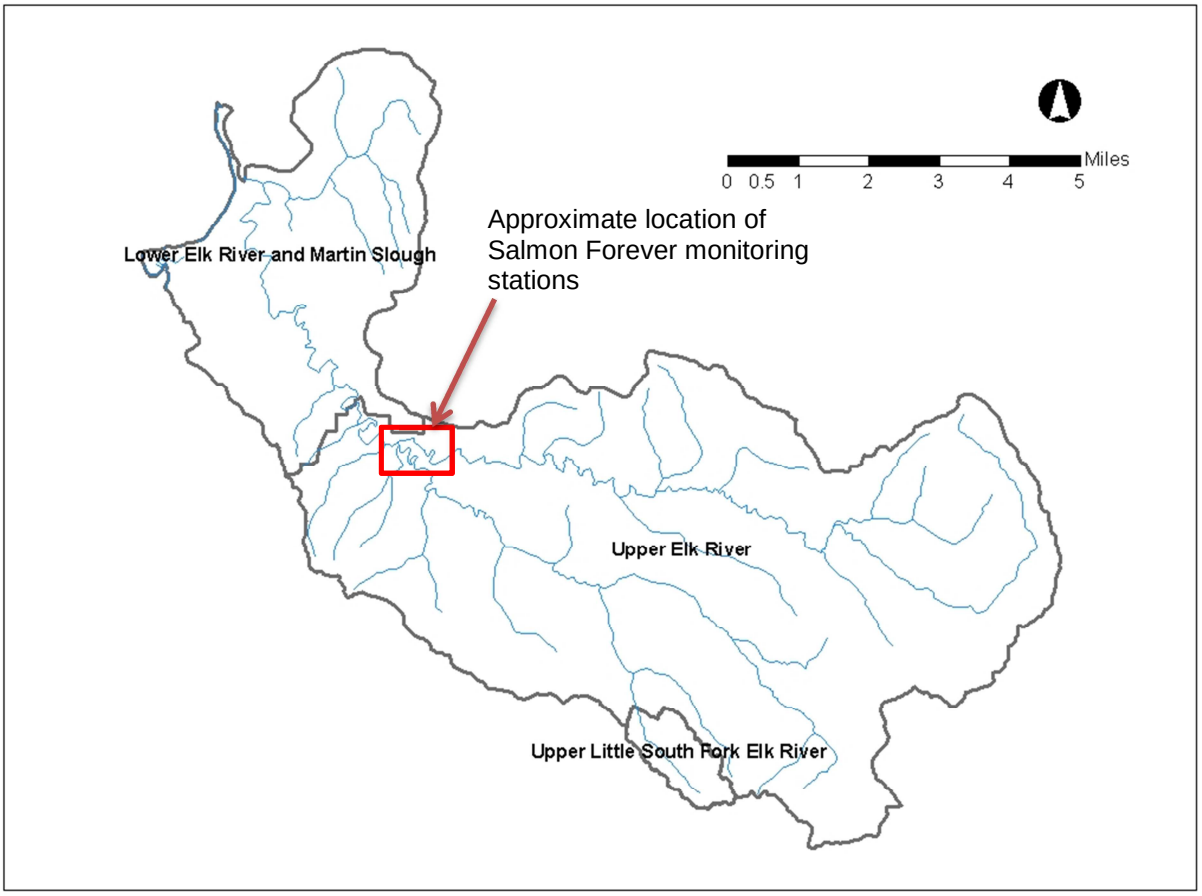

Figure 1. Proposed delineation of waterbodies in the Elk River watershed with approximate location of Salmon Forever monitoring stations.

The Upper Little South Fork Elk River waterbody is a reference portion of the Little South Fork sub-basin located within the Headwaters Forest Reserve and is comprised of unmanaged old-growth redwood forest. The sediment loading and instream conditions represent natural conditions.

The Upper Elk River waterbody includes sediment source areas and reaches of impaired beneficial uses and nuisance conditions. This waterbody is predominately forested and has historically been managed for industrial timber harvest production and light density rural residential uses in agricultural general zoning. The Regional Water Board has focused significant regulatory and non-regulatory efforts in the areas within the Upper Elk River Waterbody to control timber harvest-related discharges and address beneficial use impairment and nuisance flooding conditions. The Upper Elk River Waterbody was delineated to include all areas within the upper 17 subbasins where industrial timber harvesting is the dominant landuse. The downstream boundary of Upper Elk River waterbody was defined to include portions of the Lower Elk River subbasin that are managed for industrial timber harvest production, parcels which rely on Elk River for

domestic water supply, and parcels located within the 100-year floodplain[1] other than those zoned for agriculture exclusive.

The Lower Elk River waterbody is comprised of areas dominated by rural and urban residential and agricultural uses. Water supplies are generally served by either the Humboldt Community Services District or individual off-river systems. Fisheries habitat and utilization is not well documented in lower Elk River, nor are water quality conditions related to sediment. Changes in the frequency and magnitude of overbank flooding have not been documented as a result of discharge of waste, as in the Upper Elk River waterbody. Urban residential development within the city of Eureka sphere of influence is projected to increase in the Martin Slough and Lower Elk River West sub-basin in the near future[2]. Changing land uses can significantly affect municipal and industrial stormwater discharges which in turn affect sediment discharge. Staff of the Regional Water Board anticipate that these portion of the Elk River watershed will be incorporated into the Phase II Stormwater Program within the next three years. The dominant agricultural uses in the Lower Elk River waterbody include grazing and dairies. The Regional Water Board staff anticipates the development and implementation of a grazing program in the next five years.

In addition to the different landuses and impairments within the Lower Elk River waterbody, the topography and the geologic formations vary from the Upper Elk River waterbody. The lower most three sub-basins encompass the valleys along Mainstem Elk River and Martin Slough. They include the majority (76%) of lands with less than five percent hillslope gradient and a little less than half (42%) of the streams with less than one percent gradient. Over half (57%) of the Hookton Formation and related Quaternary terrace deposits (Qh-Qrt-Qmts) and more than three-quarters (79%) of the Quaternary alluvium, dune sand deposits (Q-Qds) present in the Elk River watershed are located in the lower three sub-basins. These formations may exhibit different patterns of erosion than the rates developed to represent the Upper Elk River and Upper Little South Fork Elk River waterbodies.

Staff is proceeding with technical TMDL development in the Upper Elk River and Upper Little South Fork Elk River waterbodies. Staff anticipates recommending the Upper Little South Fork Elk River waterbody be delisted because beneficial uses are not impaired and the sediment loading does not contribute to downstream impairments. Staff proposes to address impairments in the Lower Elk River and Martin Slough waterbody in one of two ways, either 1) Through TMDL development and implementation or 2) Implement programs to address stormwater and grazing-related discharges, categorize the waterbody as a 4b watershed, and demonstrate to EPA that the implementation programs can achieve beneficial use recovery.

[1] According to FEMA, 1987

[2] According to the Humboldt County General Plan and General Plan update

Water Quality Objectives

The Regional Water Board is responsible for establishing water quality objectives which, in the Board's judgment, are necessary for the reasonable protection of beneficial uses and for the prevention of nuisance conditions.[3] Water quality objectives form the basis for establishment of waste discharge requirements, waste discharge prohibitions, maximum acceptable cleanup standards and for other Regional Water Board actions, such as establishment of TMDLs.

The natural ambient condition of each waterbody is uniquely defined by a number of watershed characteristics, including but not limited to: geology, slope, climate, land cover, etc. Water quality objectives (objectives) are contained in Chapter 3 of the Basin Plan and define, in narrative or numeric form, the minimum ambient water quality conditions necessary to support beneficial uses. For example, the ambient water quality necessary to protect swimmers is based on human health studies and the potential for contaminants to be accidentally ingested. Similarly, the ambient water quality necessary to protect salmonids is based on aquatic life studies and the requirements of developing eggs and alevin for cold, clean, well-oxygenated water through the intergravel environment.

The Basin Plan contains four sediment-related water quality objectives. All of these objectives are applicable to the Upper Elk River. The sediment-related objectives are presented below in Table 1.

Table Error! No text of specified style in document.**. Sediment related water quality objectives (as identified in the Basin Plan)**

Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.
Suspended Sediment Load	The suspended sediment load and suspended sediment discharge rate of surface water shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Turbidity	Turbidity shall not be increased more than 20 percent above naturally occurring background levels. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.

[3] CWC § 13241.

Salmon Forever Elk River Data

Figure 2 and Table 2 provide the locations of Elk River monitoring data submitted by Salmon Forever.

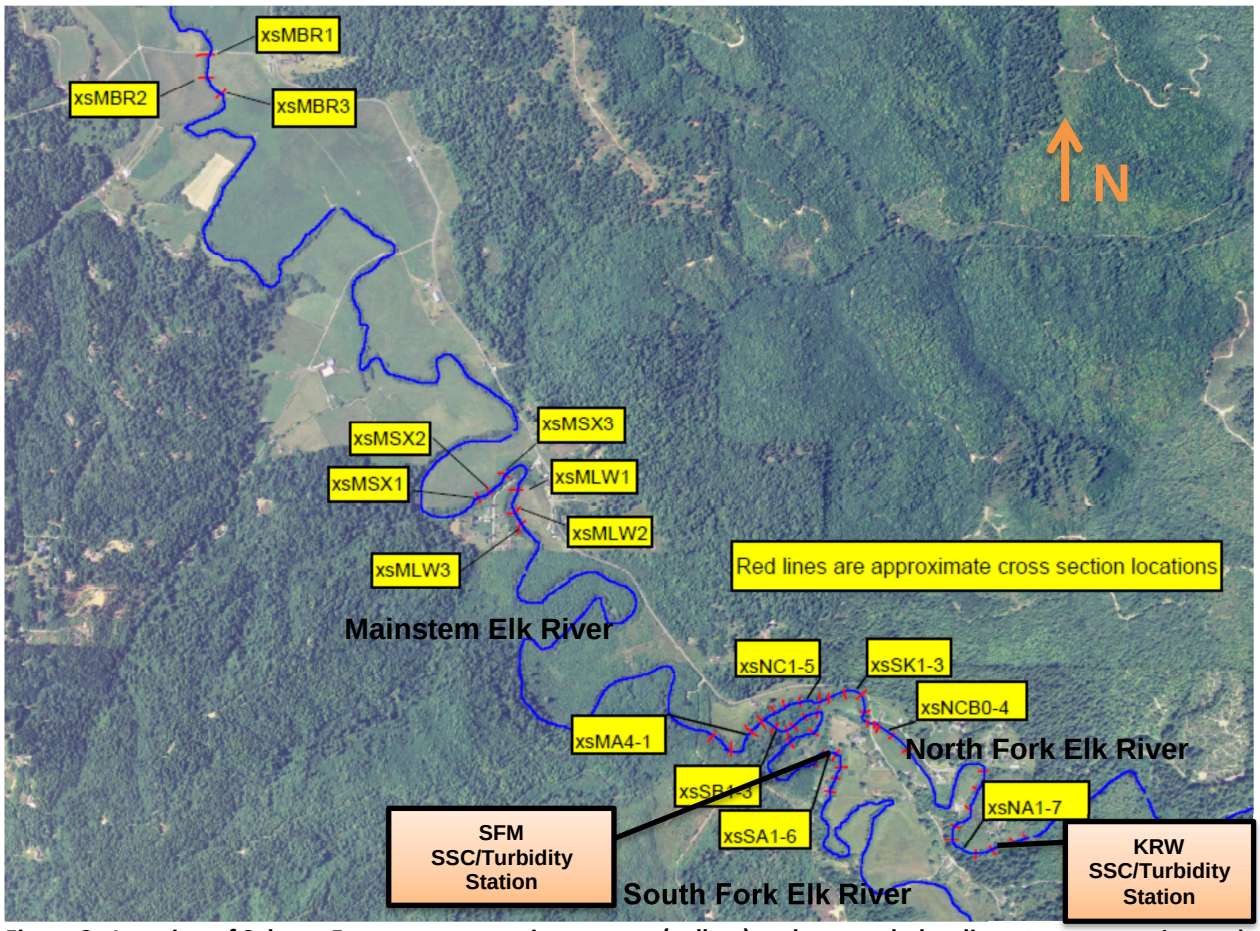

Figure 2. Location of Salmon Forever cross-section surveys (yellow) and suspended sediment concentration and turbidity sampling stations (orange) in Elk River.

Table Error! No text of specified style in document.**2. Latitude and longitude coordinates, drainage area, and sampling period for Salmon Forever suspended sediment, turbidity, and streamflow sampling stations.**

Station ID	Latitude	Longitude	Drainage Area	Sampling Period
KRW	40°41.909' N	124°08.513' W	19.30	2003-ongoing
SFM	40°42.077' N	124°08.936' W	22.19	2003-ongoing

The technique employed to collect the water quality data is known as turbidity threshold sampling (TTS). It is a reliable method for estimating suspended sediment loads developed by the USFS Southwestern Research Station Redwood Sciences Laboratory (RSL). Jack Lewis worked to develop the technique for RSL and, since his retirement, has been working as a consultant in data analysis. He serves as the primary data analyst and report writer on the project for Salmon Forever.

The turbidity data represent ambient turbidity at the stations with the probes being located on a boom in the river reading at 10-minute increments. An ISCO pump sampler is located at the station and is triggered to collect samples based upon an algorithm for TTS. The algorithm is designed to optimize the timing of sample pumping for correlating suspended sediment concentration of the sample to turbidity for the purposes of calculating suspended sediment load.

Suspended Material

Suspended sediment concentrations and duration appear to have significant effects on salmonid feeding and rearing patterns. Using a model developed by Newcombe and Jensen (1996), staff evaluated the monitoring data collected in Upper Elk River to develop predictions of the relative magnitude of ill effects on salmonids resulting from the measured suspended sediment and turbidity concentrations.

Using 80 studies documenting the effects of suspended sediment on fish, Newcombe and Jensen (1996) developed an empirical model which estimates the Severity of Ill Effects (SEV) Index. The SEV Index is a dose-response value that represents the biological impacts of suspended sediment to salmonids and other fish species. It is calculated by assessing the concentration of suspended sediment in the water column and the number of continuous hours that concentration is present per the following formula:

$$SEV = a + b \cdot \ln(\textit{Durantion(hr)}) + c \cdot \ln(\textit{Concentration(mg/L)})$$

Where:	SEV	=	Severity of Ill Effect
	a	=	intercept
	b,c	=	slope coefficients

This empirical model utilizes fisheries and suspended sediment research which correlate concentrations to an observed effect on the sampled population, such as salmonid avoidance of turbid waters, reduced feeding rates, reduced growth rates, or death. Newcombe and Jensen provides a useful means of evaluating if exposure to the measured suspended sediment concentrations and durations have an adverse effect on salmonid beneficial uses in the Elk River watershed. The SEV index provides a surrogate for interpreting the suspended sediment objective to determine if the COLD use is being supported. Table 3 describes the severity of ill effects indices as described by Newcombe and Jensen (1996).

Table 3. Severity of Ill Effects Index

	SEV	Description of Effect
Nill Effect	0	No behavioral effects
Behavioral Effects	1	Alarm reaction
	2	Abandonment of cover
	3	Avoidance response
Sublethal Effects	4	Short-term reduction in feeding rates; Short-term reduction in feeding success
	5	Minor physiological stress; Increase in rate of coughing; Increased respiration rate
	6	Moderate physiological stress
	7	Moderate habitat degradation
	8	Indications of major physiological stress; Long-term reduction in feeding rate; Long-term reduction in feeding success; Poor condition
Lethal and Paralethal Effects	9	Reduced growth rate; Delayed hatching; Reduced fish density
	10	0-20% mortality; Increased predation; Moderate to severe habitat degradation
	11	>20-40% mortality
	12	>40-60% mortality
	13	>60-80% mortality
	14	>80-100% mortality

Salmon Forever evaluated suspended sediment data from 2003-2008 collected at two locations in the Elk River. Data were compared to four, life-stage based SEV index models: adult and juvenile salmonids combined; adult salmonids only; juvenile salmonids only; salmonid eggs and larvae. The salmonid eggs and larvae life stage was selected as being the most sensitive to suspended sediment dose. Salmon Forever calculated the maximum continuous durations above specific concentrations for each life stage model and predicted the SEV.

Table 4 presents Salmon Forever data as the maximum number of continuous hours a specific suspended sediment concentration was exceeded at two separate Elk River sites from 2003 to 2008. For example, at SFM in 2003, the maximum length of continuous time in which the suspended sediment concentration was greater than 2,981 mg/L was 6.2 hours. Tables 5, 6, 7, and 8 translate these data into into SEVs according to the four salmonid life stage models.

Table 4: Maximum Duration at Suspended Sediment Concentrations for the Elk River

	Maximum Continuous Hours above specified SSC					
SSC Concentration	2981mg/L	1097mg/L	403mg/L	148mg/L	55mg/L	20mg/L
Site/Yr						
SFM/03	6.2 hr	41.5 hr	62.7 hr	174.2 hr	303.8 hr	1157.2 hr
KRW/03	0.0 hr	18.3 hr	46.0 hr	68.2 hr	154.8 hr	547.3 hr
SFM/04	0.0 hr	4.7 hr	29.5 hr	80.7 hr	110.0 hr	252.2 hr
KRW/04	0.0 hr	2.0 hr	27.3 hr	64.7 hr	91.3 hr	459.3 hr
SFM/05	0.0 hr	8.3 hr	27.7 hr	83.7 hr	215.8 hr	569.0 hr
KRW/05	0.0 hr	8.7 hr	18.0 hr	35.3 hr	163.0 hr	718.0 hr
SFM/06	0.3 hr	22.8 hr	111.2 hr	480.0 hr	1067.8 hr	1362.7 hr
KRW/06	0.0 hr	8.8 hr	37.0 hr	77.0 hr	337.0 hr	1311.3 hr
SFM/07	0.0 hr	13.8 hr	39.8 hr	76.7 hr	255.2 hr	518.2 hr
KRW/07	0.0 hr	2.0 hr	22.8 hr	46.2 hr	257.3 hr	391.0 hr
SFM/08	0.0 hr	15.0 hr	37.3 hr	114.8 hr	255.5 hr	1349.2 hr
KRW/08	0.0 hr	3.2 hr	16.7 hr	38.0 hr	211.5 hr	389.0 hr

Table 5: Severity of ill-effect scores for the Elk River from Newcombe and Jensen's model 1: adult and juvenile salmonids (0.5 – 250µ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
SFM/03	8.1	8.5	8	7.9	7.5	7.6
KRW/03	0.0	8.0	7.8	7.3	7.1	7.1
SFM/04	0.0	7.2	7.5	7.4	6.9	6.6
KRW/04	0.0	6.7	7.5	7.3	6.8	7.0
SFM/05	0.0	7.5	7.5	7.4	7.3	7.1
KRW/05	0.0	7.5	7.2	6.9	7.1	7.3
SFM/06	6.3	8.1	8.4	8.5	8.3	7.7
KRW/06	0.0	7.6	7.7	7.4	7.6	7.6
SFM/07	0.0	7.8	7.7	7.4	7.4	7.1
KRW/07	0.0	6.7	7.4	7.1	7.4	6.9
SFM/08	0.0	7.9	7.7	7.6	7.4	7.6
KRW/08	0.0	6.9	7.2	7.0	7.3	6.9

Table 6: Severity of ill-effect scores for the Elk River from Newcombe and Jensen's model 2: adult salmonids only (0.5 – 250μ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
SFM/03	8.6	8.8	8.2	7.9	7.4	7.3
KRW/03	0.0	8.4	8.0	7.5	7.1	7.0
SFM/04	0.0	7.7	7.8	7.6	7.0	6.6
KRW/04	0.0	7.3	7.8	7.5	6.9	6.9
SFM/05	0.0	8.0	7.8	7.6	7.3	7.0
KRW/05	0.0	8.0	7.6	7.2	7.1	7.1
SFM/06	7.2	8.5	8.5	8.4	8.0	7.4
KRW/06	0.0	8.0	7.9	7.5	7.5	7.4
SFM/07	0.0	8.2	8.0	7.5	7.4	6.9
KRW/07	0.0	7.3	7.7	7.3	7.4	6.8
SFM/08	0.0	8.3	7.9	7.7	7.4	7.4
KRW/08	0.0	7.5	7.6	7.2	7.3	6.8

Table 7: Severity of ill-effect scores for the Elk River from Newcombe and Jensen's model 3: juvenile salmonids only (0.5 – 75μ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
SFM/03	7.7	8.3	7.9	7.9	7.6	7.8
KRW/03	0.0	7.8	7.7	7.3	7.1	7.3
SFM/04	0.0	6.8	7.4	7.4	6.9	6.8
KRW/04	0.0	6.2	7.3	7.2	6.8	7.2
SFM/05	0.0	7.2	7.3	7.4	7.4	7.3
KRW/05	0.0	7.2	7.0	6.8	7.2	7.5
SFM/06	5.7	7.9	8.3	8.6	8.5	7.9
KRW/06	0.0	7.3	7.6	7.4	7.7	7.9
SFM/07	0.0	7.6	7.6	7.3	7.5	7.3
KRW/07	0.0	6.2	7.2	7.0	7.5	7.1
SFM/08	0.0	7.6	7.6	7.6	7.5	7.9
KRW/08	0.0	6.5	7.0	6.9	7.4	7.1

Table 8: Severity of ill-effect scores for the Elk River from Newcombe and Jensen's model 4: salmonid eggs and larvae (0.5 – 75μ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
SFM/03	8.2	10.0	10.1	11.0	11.3	12.4
KRW/03	0.0	9.1	9.8	9.9	10.5	11.6
SFM/04	0.0	7.6	9.3	10.1	10.1	10.7
KRW/04	0.0	6.7	9.2	9.9	9.9	11.4
SFM/05	0.0	8.2	9.3	10.1	10.9	11.6
KRW/05	0.0	8.3	8.8	9.2	10.6	11.9
SFM/06	5.0	9.4	10.8	12.1	12.6	12.6
KRW/06	0.0	8.3	9.6	10.1	11.4	12.5
SFM/07	0.0	8.8	9.6	10.1	11.1	11.5
KRW/07	0.0	6.7	9.0	9.5	11.1	11.2
SFM/08	0.0	8.9	9.6	10.5	11.1	12.6
KRW/08	0.0	7.2	8.7	9.3	10.9	11.2

The results indicate that under the water quality conditions measured in the vicinity of the Salmon Forever stations, juvenile salmonids are predicted to be experiencing major physiologic stress, long-term reduction in feeding rate and success, and poor condition. Salmon Forever predicts that eggs and larvae experience lethal and paralethal effects for all years analyzed, indicating major impairment of the COLD beneficial use.

While the SEV index is but one measure of potential impacts to cold water fisheries in the Upper Elk River waterbody, the data indicate that salmonids are predicted to be experiencing sublethal effects much of the time, as well as lethal and paralethal effects due to the suspended sediment concentrations and durations occurring in Upper Elk River. The predicted impacts to salmonids indicate that water quality conditions are not supportive of the cold water fishery, in violation of the suspended sediment load objective.

These same water quality conditions affect water supplies as well. The majority of Upper Elk River waterbody residents rely on the North Fork, South Fork, and Mainstem Elk River as their primary source of domestic and agricultural supply. The turbidity and suspended sediment concentrations in the winter time make it difficult to pump without damaging equipment. The time to clear between storms leaves little opportunity to pump water. The impacts to water supplies indicate that the MUN beneficial use in not supported, in violation of the suspended sediment load objective.

Turbidity

The Upper Elk River TMDL analyses evaluated sediment loads to ensure attainment of the water quality objective for turbidity. In order to estimate the sediment loading capacity in Upper Elk River (as a percentage of natural loading) that would ensure attainment of the Basin Plan turbidity objective, staff evaluated turbidity and suspended sediment concentration data from the reference watershed in Upper Elk River (Upper Little South

Fork Elk River) to determine natural sediment loading). Staff's analyses calculated and compared suspended sediment loads consistent with 1) naturally occurring background turbidity levels and 2) turbidity levels which are 20% greater than naturally occurring turbidity levels. Table 9 presents the comparison sediment loads and the estimated percentage of natural suspended sediment loading that would ensure attainment of the turbidity objective for 2004-2007, as well as the mean of those years.

As shown in Table 9, the percentage above natural suspended sediment background loading from 2004 to 2007 ranges from 115% to 132%, with a mean of 124%. Similar to the USEPA (2005) analysis in the Mad River TMDLs, staff recommends that to ensure an implicit margin of safety, 120% of natural suspended sediment loading be deemed in conformance with the turbidity objective over a range of streamflows and turbidity levels. Suspended sediment load is a portion of the total load.

Table 9. Comparison of 2004 to 2007 sediment loads and the estimated percentage of natural suspended sediment loading that would ensure attainment of the turbidity objective, as well as percentages of natural suspended sediment concentrations measured by Salmon Forever at SFM and KRW.

Year	Estimated Annual Suspended Sediment Load Based upon Naturally Occurring Background Turbidity in Reference Watershed ***(SSL Background Turbidity)*** ($yd^3/mi^2/yr$)	Estimated Annual Suspended Sediment Load Based upon 120% of Naturally Occurring Background Turbidity ***(SSL 120% Background Turbidity)*** ($yd^3/mi^2/yr$)	Percentage of Natural Suspended Sediment Loading in Conformance with Turbidity Objective	Percentage of Natural Suspended Sediment Load as measured by Salmon Forever at Station SFM	Percentage of Natural Suspended Sediment Load as measured by Salmon Forever at Station KRW
2004	11.64	14.36	123%	2470%	1887%
2005	22.32	28.23	126%	1320%	821%
2006	33.06	38.13	115%	1551%	1032%
2007	10.74	14.15	132%	1911%	1259%
Mean	19.44	23.72	124%	1813%	1250%

In the case of Upper Elk River, where the geologic formations produce primarily fined grained material, it is expected that the majority of the sediment loading is suspended. For any given change in total sediment load, a corresponding similar change in suspended sediment load is expected. Salmon Forever measurements indicate that suspended sediment loads at SFM and KRW exceed natural loading by approximately 800% - 2500%. Turbidity levels at these sites far exceed the Basin Plan's turbidity objective.

Settleable Material

Under the same RCAA grant, Northern Hydrology and Engineering and Stillwater Sciences used Salmon Forever's Elk River flow and concentration data in *Elk River Hydrodynamic and Sediment Transport Modeling Pilot Project* (June 2012). They found the concentrations to be very reliable. Additionally, they found that suspended sediment concentrations were

high enough in 2003-2008 to result in deposition of material. The ongoing deposition observed in the area around the confluence of North Fork and South Fork Elk River contributes to flooding due to reduced channel capacity from stored sediment as well as impairing cold water fisheries (COLD) and water supply (MUN). The flooding constitutes a nuisance condition according to Porter-Cologne Water Quality Control Act. The deposition of sediment resulting from the suspended sediment concentrations is in violation of the water quality objective for settleable material.

In 2002, Salmon Forever established a network of stream cross-section stations in the vicinity of the confluence of North Fork and South Fork of Elk River (Figure 3). It should be noted that the cross-section identification codes were altered slightly for use under the TMDL, as compared to those provided by Salmon Forever and shown in Figure 2. The cumulative change in cross-sectional area of the active channel for Mainstem, North Fork, and South Fork Elk River are shown in Figures 4, 5, and 6, respectively (negative values indicate filling, positive values indicate scour). The Salmon Forever cross-sections demonstrate a general pattern of channel filling between 2001 and 2008 (Salmon Forever, 2011). Additionally, staff evaluated the Salmon Forever cross-sections to determine the depth of sediment deposition and scour on the channel bed, banks, and floodplain areas (Figure 7). I have visited many of these cross-sections and observed the ongoing deposition on the channel bed, banks, and floodplain. The deposited material is fine sediment comprised primarily of silt and very fine sand.

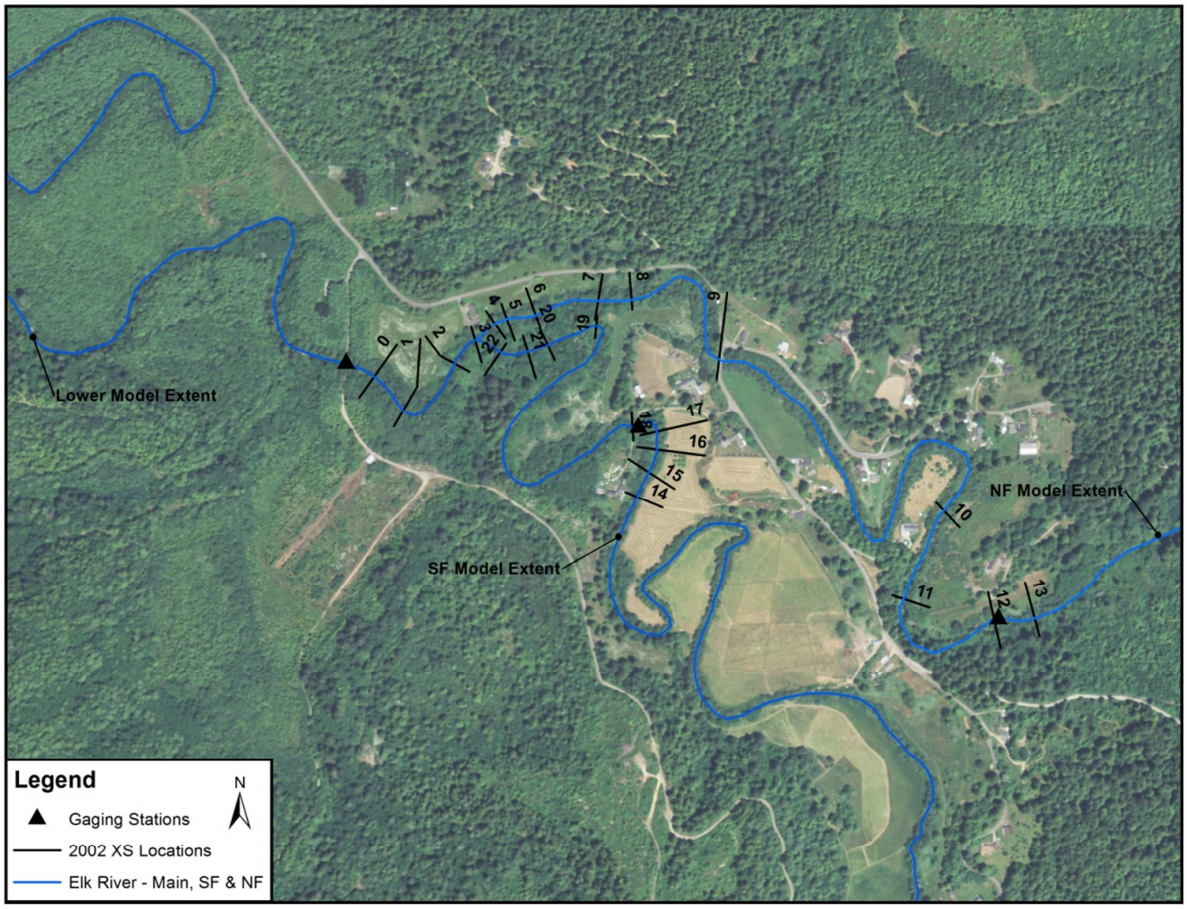

Figure 3. Location of Salmon Forever cross-sections near the confluence of the North and South Forks of the Elk River (NHE, 2012).

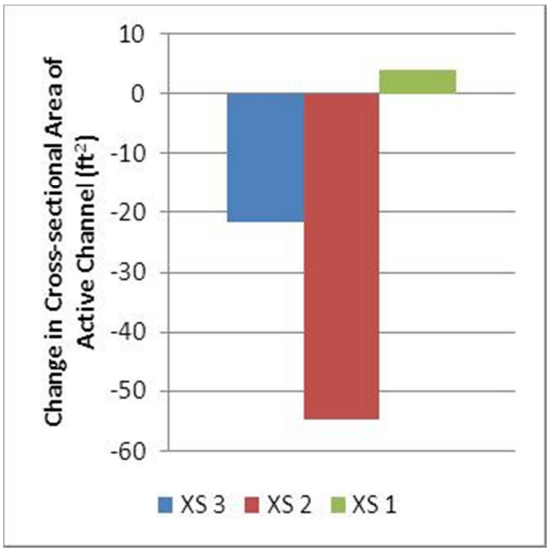

Figure 4. Cumulative change in cross-sectional area of active channel on Mainstem Elk River (Salmon Forever, 2001-2008). Negative values indicate filling, positive values indicate scour.

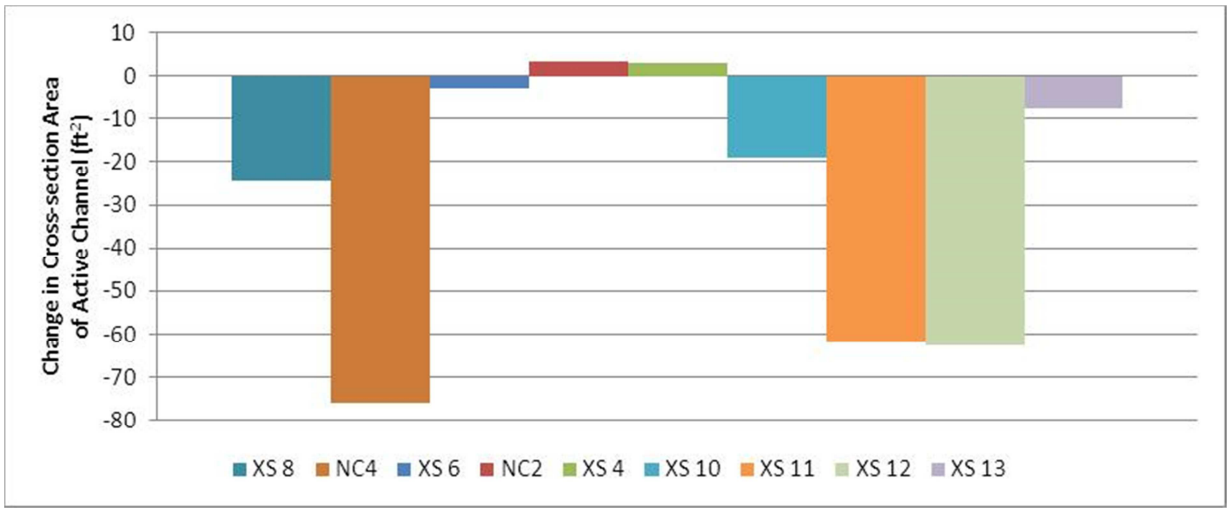

Figure 5. Cumulative change in cross-sectional area of active channel on North Fork Elk River (Salmon Forever, 2001-2008). Negative values indicate filling, positive values indicate scour.

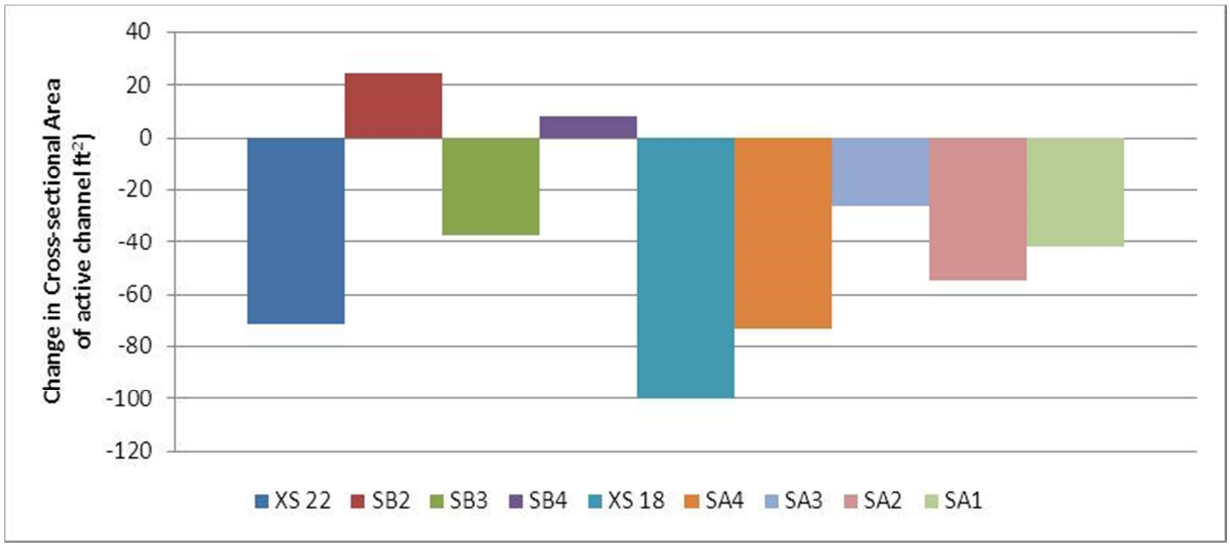

Figure 6. Cumulative change in cross-sectional area of active channel on South Fork Elk River (Salmon Forever, 2001-2008). Negative values indicate filling, positive values indicate scour.

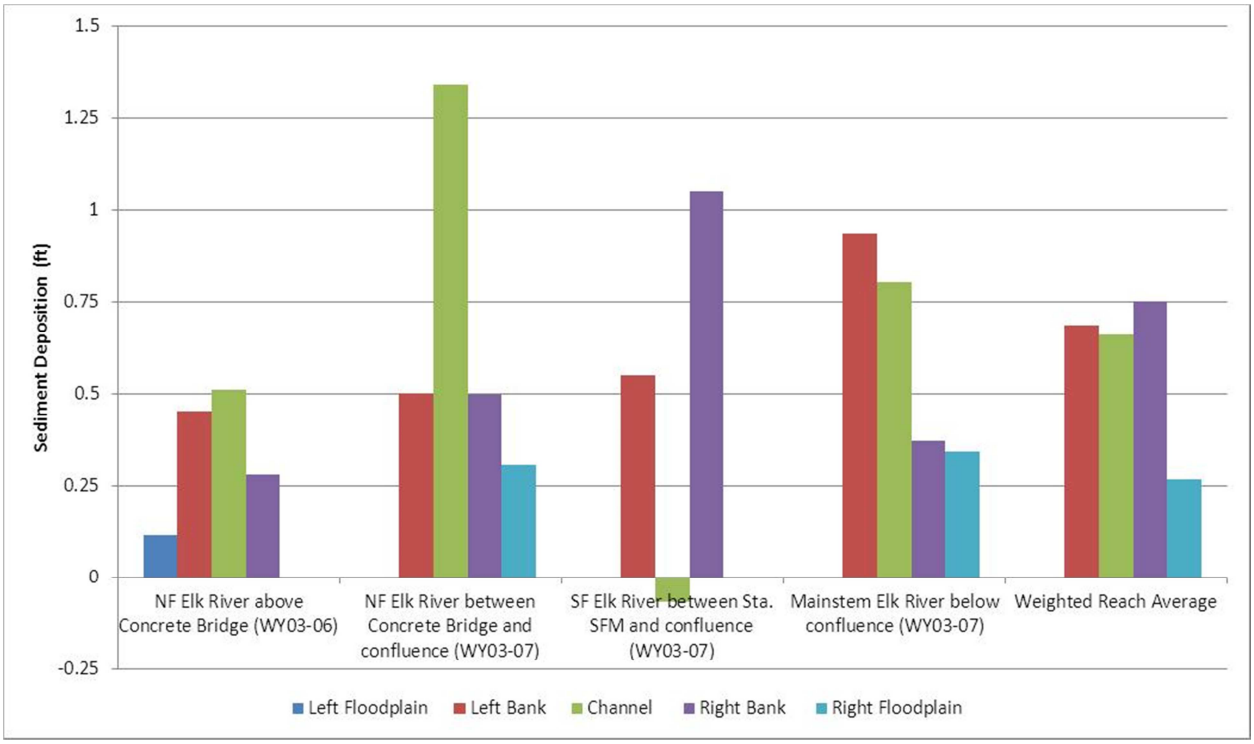

Figure 7. Measured deposition at cross-sections on right and left floodplain and banks (left as observed facing downstream) and channel bed (Salmon Forever 2003-2007). Positive values indicate filling, negative values indicate scour.

I have found that the Salmon Forever data are generally consistent with other similar monitoring data from the basin, including Humboldt Redwood Company (formerly Pacific Lumber Company) and Green Diamond Resources Company (formerly Simpson Timber Company).

In summary, I find the Salmon Forever data to be generally reliable and indicate that the Upper Elk River waterbody continues to be impaired by fine sediment, with beneficial uses not fully supported and water quality objectives not achieved.

Salmon Forever Freshwater Creek Data

A quick review of the Salmon Forever data in Freshwater Creek indicates the following:

1. From 2003-2008, suspended sediment concentrations and durations are predicted to have resulted in sublethal, lethal and paralethal effects on salmonids, similar to Elk River conditions. These results indicate that water quality conditions are not supportive of the COLD and MUN beneficial uses, in violation of the Basin Plan water quality objective for suspended sediment.

Table 10 presents Salmon Forever data as the maximum number of continuous hours a specific suspended sediment concentration was exceeded at two separate Freshwater Creek sites from 2003 to 2008. Tables 11, 12, and 13 translate these data into into SEVs

according to three of the four salmonid life stage models (data on the juvenile and adult life stage, model 1, were not submitted).

Table 10: Maximum Duration at Suspended Sediment Concentrations for Freshwater Creek.

	Maximum Continuous Hours above specified SSC					
SSC Concentration	2981mg/L	1097mg/L	403mg/L	148mg/L	55mg/L	20mg/L
Site/Yr						
FTR/03	0.0hr	13.0hr	39.0hr	51.7hr	63.7hr	245.5hr
FTR/04	0.0hr	2.5hr	15.2hr	48.7hr	65.8hr	135.0hr
FTR/05	0.0hr	4.2hr	15.7hr	28.0hr	58.2hr	164.2hr
HHB/05	0.0hr	1.3hr	9.3hr	29.8hr	49.3hr	206.0hr
FTR/06	3.0hr	9.2hr	17.7hr	45.3hr	135.2hr	478.5hr
HHB/06	0.0hr	4.8hr	18.8hr	57.0hr	154.7hr	448.0hr
FTR/07	0.0hr	1.0hr	15.2hr	29.8hr	61.3hr	257.5hr
HHB/07	0.0hr	0.0hr	11.2hr	29.7hr	101.5hr	273.8hr
FTR/08	0.0hr	3.7hr	10.2hr	22.2hr	89.5hr	253.2hr
HHB/08	0.0hr	2.5hr	9.0hr	23.7hr	56.5hr	264.3hr

Table 11: Severity of ill-effect scores for Freshwater Creek from Newcombe and Jensen's model 2: adult salmonids only (0.5 – 250µ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
FTR/03	0.0	8.2	8.0	7.3	6.7	6.6
FTR/04	0.0	7.4	7.5	7.3	6.7	6.3
FTR/05	0.0	7.7	7.5	7.1	6.7	6.4
HHB/05	0.0	7.1	7.3	7.1	6.6	6.5
FTR/06	8.3	8.0	7.6	7.3	7.1	6.9
HHB/06	0.0	7.7	7.6	7.4	7.1	6.9
FTR/07	0.0	7.0	7.5	7.1	6.7	6.6
HHB/07	0.0	0.0	7.4	7.1	6.9	6.6
FTR/08	0.0	7.6	7.3	6.9	6.9	6.6
HHB/08	0.0	7.4	7.3	7.0	6.6	6.6

Table 12: Severity of ill-effect scores for Freshwater Creek from Newcombe and Jensen's model 3: juvenile salmonids only (0.5 – 75µ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
FTR/03	0.0	7.5	7.6	7.1	6.5	6.7
FTR/04	0.0	6.4	6.9	7.0	6.5	6.3
FTR/05	0.0	6.7	6.9	6.6	6.4	6.5
HHB/05	0.0	5.9	6.6	6.7	6.3	6.6
FTR/06	7.2	7.3	7.0	7.0	7.0	7.2
HHB/06	0.0	6.8	7.1	7.1	7.1	7.2

FTR/07	0.0	5.7	6.9	6.7	6.5	6.8
HHB/07	0.0	0.0	6.7	6.7	6.8	6.8
FTR/08	0.0	6.6	6.6	6.5	6.8	6.8
HHB/08	0.0	6.4	6.6	6.5	6.4	6.8

Table 13: Severity of ill-effect scores for Freshwater Creek from Newcombe and Jensen's model 4: salmonid eggs and larvae (0.5 – 75µ)

	Suspended Sediment Concentration (mg/L)					
	2981	1097	403	148	55	20
Site/Yr	Severity of ill-effects Score					
FTR/03	0.0	8.7	9.6	9.6	9.5	10.7
FTR/04	0.0	6.9	8.6	9.6	9.6	10.0
FTR/05	0.0	7.5	8.6	9.0	9.4	10.3
HHB/05	0.0	6.2	8.1	9.0	9.3	10.5
FTR/06	7.4	8.4	8.8	9.5	10.4	11.4
HHB/06	0.0	7.7	8.8	9.7	10.5	11.4
FTR/07	0.0	5.9	8.6	9.0	9.5	10.8
HHB/07	0.0	0.0	8.3	9.0	10.1	10.8
FTR/08	0.0	7.4	8.2	8.7	9.9	10.7
HHB/08	0.0	6.9	8.0	8.8	9.4	10.8

2. Comparing the measured suspended sediment loads at the two Freshwater Creeks sites with those predicted to be in conformance with the turbidity objective (to not exceed 120% of natural turbidity, suspended sediment loading should not exceed 120% of natural), Salmon Forever found that for 2003-2008, the suspended sediment loads were approximately 400-720% of natural at HHB and 585-1870% of natural at FTR. These results indicate the Basin Plan turbidity objective is exceeded by the water quality conditions measured in Freshwater Creek.

Please feel free to contact me any time regarding this topic at 707-576-2672 and Adona.White@waterboards.ca.gov.

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