Kamman Hydrology & Engineering, Inc.
7 Mt. Lassen Drive, Suite B250, San Rafael, CA 94903
Telephone: (415) 491-9600
Facsimile: (415) 680-1538
E-mail: Greg@KHE-Inc.com

August 6, 2015

Cal Fire - Forest Practice Program Manager
135 Ridgeway Ave,
Santa Rosa, California 95401
santarosapubliccomment@calfire.ca.gov

Subject: THP 1-15-042 SON (Gualala Redwoods Inc. "Dogwood" THP)
THP 1-15-033 SON (Gualala Redwoods Inc. "Apple" THP)

Dear CAL FIRE:

I am a hydrologist with over twenty five years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology services in California since 1991 and routinely manage projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work is located in the Coast Range watersheds of California, including the Central and Northern California Counties. My areas of expertise include: characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I co-own and operate the hydrology and engineering consulting firm Kamman Hydrology & Engineering, Inc. in San Rafael, California (established in 1997). I earned a Master of Science in Geology, specializing in Sedimentology and Hydrogeology as well as an A.B. in Geology from Miami University, Oxford, Ohio. I am a state Certified Hydrogeologist (CHg) and a state registered Professional Geologist (PG).

I am very familiar with surface and groundwater conditions within the Gualala River watershed as I have completed numerous hydrology, hydrogeology, geomorphology and ecology studies within the watershed since 2002. A list of documents that I've authored as part of this work are provided in Attachment A.

I have reviewed the THPs and an associated report entitled, "Hydrologic Assessment of Water Withdrawal for Dust Control Use", prepared for Gulalala Redwoods, Inc. by O'Connor Environmental, Inc. (OEI) and dated June 11, 2010. The OEI report concludes that surface water drafting from the South Fork Gualala River for dust control purposes will not adversely impact summer rearing habitat for steelhead. Based on my review, I believe the OEI analysis is flawed and grossly underestimates the potential impacts on steelhead summer rearing habitat in the river due to surface water drafting. I don't believe the OEI study has correctly evaluated potential impacts on steelhead and other aquatic resources and therefore I do not agree with the conclusion that THP water drafting will not have a significant impact on flow, pool levels, anadromous fish and other aquatic biota in the South Fork Gualala River. The rationale for my opinion is as follows.

1. Inflated Baseflow Estimates
   The average baseflow (summer low flow) estimates presented in the OEI report represent the average daily flow rate for the July through September period for each year analyzed. However, based on analysis of USGS streamflow records from within the watershed, it is important to point out that there is typically a continuous decrease in summer baseflow rates during the July through September dry season. Thus, an average flow rate for the July through September period is higher that a large percentage of the actual flow rates that occur during the latter portion of the summer period.

   Table 1 demonstrates the typical seasonal pattern in descending river flow rates observed on the Gualala River during the summer. Table 1 presents average monthly flow rates measured by the USGS[1] at four (4) stream flow gauges in the watershed for 35 water years between 1951 and 2014. USGS flow data comes from gauges located at: 1) South Fork (SF) Gualala River above the confluence with the Wheatfield Fork; 2) Wheatfield Fork Gulalala River above the confluence with SF; 3) SF Gualala River near Annapolis; and 4) SF Gualala River near The Sea Ranch. Apart for 1957 and 1959 (years which experienced early wet season rains during the month of September), these data indicate descending flow rates through the summer period with highest flows in July and lowest flows in September (see columns A-C, Table 1).

   In order to compare flow rates between USGS and OEI gauges, unit area flow estimates were derived by dividing each monthly average flow rate by the contributing drainage to each gauge site (columns D-F, Table 1). This is the same data normalization technique used by OEI to derive average discharge rates expressed on a watershed area basis. The USGS unit area flow rates for the July through September period were then averaged and presented in column G of Table 1.

   The remainder of the columns (H-K) presented in Table 1 are scaled (by drainage area) baseflow estimates for a water drafting pumping site located downstream of the confluence of the South and Wheatfield Forks of the Gualala River. The scaled average monthly flows are presented in columns H-J while the full summer period (July-September) average flow rate is presented in column K.

[1] These data were obtained at the USGS website: http://waterdata.usgs.gov/ca/nwis/sw.

TABLE 1: Normalized and scaled measured USGS flow rates on Gualala River.

	A	B	C	D	E	F	G	H	I	J	K
SF Gualala R AB Wheatfield Fk nr Annapolis CA (DA=48.2 sq. mi.)											
YEAR	USGS Mean Mo. Flow in ft3/s			Mean Unit Area Flow (cfs/mi^2)				Q est. DA=161 sq.mi. (cfs)			
	Jul	Aug	Sep	Jul	Aug	Sep	Jul-Sep	Jul	Aug	Sep	Jul-Sep
2001	1.66	0.09	0.00	0.035	0.002	0.000	0.012	5.6	0.3	0.0	2.0
2003											
2004	1.56	0.51	0.00	0.033	0.011	0.000	0.014	5.2	1.7	0.0	2.3
2005	11.10	4.35	2.10	0.231	0.091	0.044	0.122	37.2	14.6	7.0	19.6

Wheatfield Fk Gualala R AB SF nr Annapolis, Ca (DA=111 sq. mi)											
YEAR	USGS Mean Mo. Flow in ft3/s			Mean Unit Area Flow (cfs/mi^2)				Q est. DA=161 sq.mi. (cfs)			
	Jul	Aug	Sep	Jul	Aug	Sep	Jul-Sep	Jul	Aug	Sep	Jul-Sep
2001	2.59	0.47	0.03	0.023	0.004	0.000	0.009	3.8	0.7	0.0	1.5
2002	2.77	1.12	0.76	0.025	0.010	0.007	0.014	4.0	1.6	1.1	2.2
2004											
2005	26.00	9.40	4.75	0.234	0.085	0.043	0.121	37.7	13.6	6.9	19.4
2006											
2007	1.21	0.27	0.01	0.011	0.002	0.000	0.004	1.8	0.4	0.0	0.7

SF Gualala R nr Annapolis, CA (DA=161 sq.mi.)											
YEAR	USGS Mean Mo. Flow in ft3/s			Mean Unit Area Flow (cfs/mi^2)				Q est. DA=161 sq.mi. (cfs)			
	Jul	Aug	Sep	Jul	Aug	Sep	Jul-Sep	Jul	Aug	Sep	Jul-Sep
1951	12.40	3.88	1.70	0.077	0.024	0.011	0.037	12.4	3.9	1.7	6.0
1952	16.80	6.63	3.69	0.104	0.041	0.023	0.056	16.8	6.6	3.7	9.0
1953	18.70	8.74	6.78	0.116	0.054	0.042	0.071	18.7	8.7	6.8	11.4
1954	14.30	24.50	10.80	0.089	0.152	0.067	0.103	14.3	24.5	10.8	16.5
1955	13.00	5.43	3.88	0.081	0.034	0.024	0.046	13.0	5.4	3.9	7.4
1956	11.10	5.16	4.93	0.069	0.032	0.031	0.044	11.1	5.2	4.9	7.1
1957	23.90	9.36	90.00	0.148	0.058	0.559	0.255	23.9	9.4	90.0	41.1
1958	20.00	9.21	5.79	0.124	0.057	0.036	0.072	20.0	9.2	5.8	11.7
1959	4.15	2.51	35.70	0.026	0.016	0.222	0.088	4.2	2.5	35.7	14.1
1960	13.00	5.92	5.44	0.081	0.037	0.034	0.050	13.0	5.9	5.4	8.1
1961	8.79	5.32	4.27	0.055	0.033	0.027	0.038	8.8	5.3	4.3	6.1
1962	11.10	5.07	5.52	0.069	0.031	0.034	0.045	11.1	5.1	5.5	7.2
1963	21.50	10.60	6.70	0.134	0.066	0.042	0.080	21.5	10.6	6.7	12.9
1964	7.61	3.63	2.88	0.047	0.023	0.018	0.029	7.6	3.6	2.9	4.7
1965	17.80	9.66	6.24	0.111	0.060	0.039	0.070	17.8	9.7	6.2	11.2
1966	12.20	5.97	2.12	0.076	0.037	0.013	0.042	12.2	6.0	2.1	6.8
1967	21.00	8.06	5.35	0.130	0.050	0.033	0.071	21.0	8.1	5.4	11.5
1968	9.14	9.27	7.03	0.057	0.058	0.044	0.053	9.1	9.3	7.0	8.5
1969	12.10	4.95	3.78	0.075	0.031	0.023	0.043	12.1	5.0	3.8	6.9
1970	2.85	1.72	1.68	0.018	0.011	0.010	0.013	2.9	1.7	1.7	2.1
1971	10.70	4.72	4.35	0.066	0.029	0.027	0.041	10.7	4.7	4.4	6.6
1991	5.14	1.82	1.50	0.032	0.011	0.009	0.018	5.1	1.8	1.5	2.8
1992	11.30	2.92	1.55	0.070	0.018	0.010	0.033	11.3	2.9	1.6	5.3
1993	42.40	13.80	6.09	0.263	0.086	0.038	0.129	42.4	13.8	6.1	20.8

SF Gualala R nr The Sea Ranch, CA (DA=161 sq. mi.)											
YEAR	USGS Mean Mo. Flow in ft3/s			Mean Unit Area Flow (cfs/mi^2)				Q est. DA=161 sq.mi. (cfs)			
	Jul	Aug	Sep	Jul	Aug	Sep	Jul-Sep	Jul	Aug	Sep	Jul-Sep
1991	5.82	1.38	0.70	0.036	0.009	0.004	0.016	5.8	1.4	0.7	2.6
1992		2.16	0.92		0.013	0.006			2.2	0.9	
2007											
2008	3.49	0.87	0.07	0.022	0.005	0.000	0.009	3.5	0.9	0.1	1.5
2009	6.39	1.59	0.66	0.040	0.010	0.004	0.018	6.4	1.6	0.7	2.9
2010	21.70	8.55	4.54	0.135	0.053	0.028	0.072	21.7	8.6	4.5	11.6
2011	19.80	8.40	4.50	0.123	0.052	0.028	0.068	19.8	8.4	4.5	10.9
2012	7.40	2.21	1.01	0.046	0.014	0.006	0.022	7.4	2.2	1.0	3.5
2013	2.40	0.75	0.28	0.015	0.005	0.002	0.007	2.4	0.8	0.3	1.1
2014	1.59	0.53	0.17	0.010	0.003	0.001	0.005	1.6	0.5	0.2	0.8

When comparing the average flow rate for the full summer period (July-September) versus the average flow rate for each individual month, it can be seen that the July-September average flow rates (columns G [unit area] and K [scaled area]) are almost always greater than the individual average August and September flow rates (columns D-F [unit area] and H-J [scaled area]) during the vast majority of years analyzed. Thus, the use of a full summer (July-September) flow rate by OEI in their hydrologic analysis grossly overestimates the amount of water actually being delivered to the proposed water drafting site at the confluence of the South and Wheatfield Forks of the Gualala River during the August and September periods. Therefore, the baseflow rates used by OEI do not represent low flow conditions experienced during the majority of the summer period. In fact, if an analysis were completed on average daily flow data instead of monthly averages, it is likely that the minimum daily flow rate experienced during any given year would be even lower than the average monthly flow rate for coincident periods. The waning days of late summer, when flows are at their lowest and river pools becomes disconnected (esp. during dry years), represents the period of greatest potential pumping impacts to pool water levels and associated aquatic habitat.

It is important to note that the average September flow rates (column c, Table 1) observed on the SF Gualala River during dry years (1991, 1992, 2008, 2009, 2012, 2013 and 2014) are very near or lower than the typical water drafting pumping rates reported by OEI at 100-300 gpm or 0.22 to 0.67 cfs. Thus, their statement that withdrawals represent less than 0.1% of the total daily flow for one truckload and less than 0.5% for five truckloads is grossly inaccurate for dry year periods when pumping rates are near or greater than available surface flows. Pumping as these rates could dewater pools and river during dry and possibly other year types.

Therefore, a more appropriate and conservative baseflow rate should be used in the OEI analysis such as the minimum daily flow rate for the entire summer low flow period – a value that is likely orders of magnitude lower that the average July-September flow rate actually used in the 2010 OEI analysis. Particular emphasis should be placed on using more realistic flow rates in the analysis due to the current decline in summer baseflow rates occurring on the Gualala River. This decline is illustrated by plotting a chronology of the unit area flow rates on the SF Gualala River from column G of Table 1 (see Figure 1). Although discussion for the decline in summer baseflow rates is beyond the scope of this letter, these data clearly indicate a trend of decreasing summer water supply that is adversely impacting summer rearing habitat for salmonids in the Gualala River.

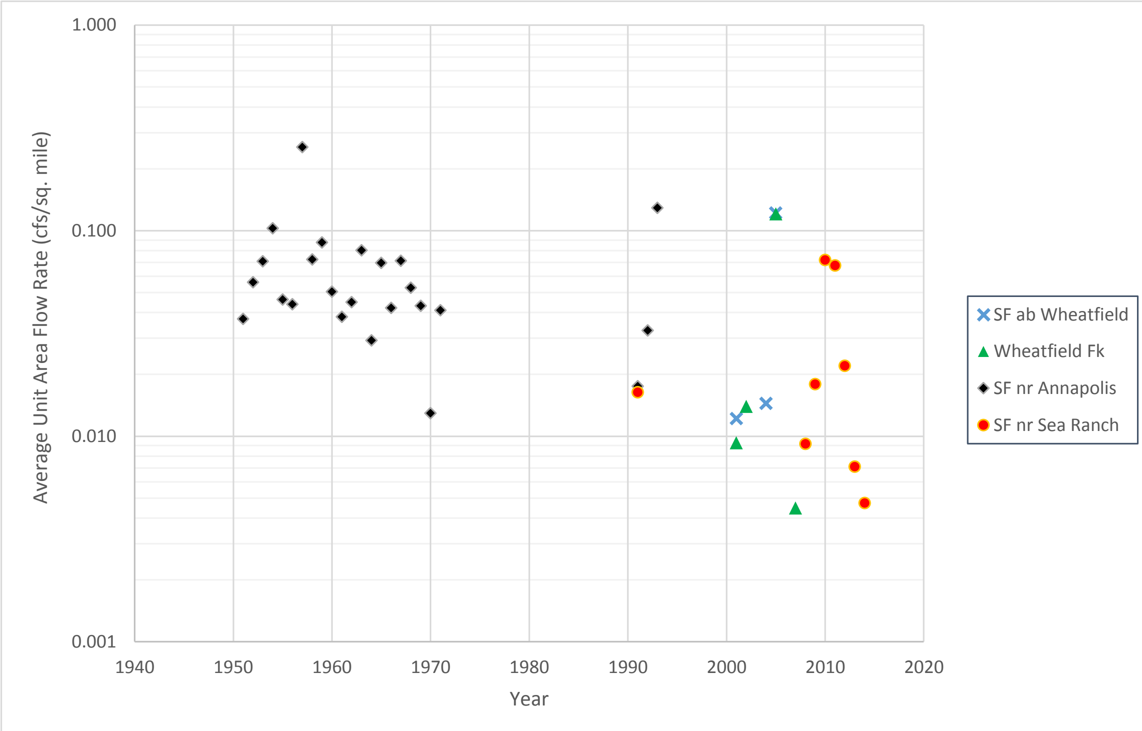


FIGURE 1: Chronology of average unit area discharge rates for the July through September period derived from USGS flow monitoring data. Discharge expressed in cubic feet per second (cfs) per square mile of drainage area.

2. Inaccurate Groundwater Modeling Assumptions

In addition to the inflated baseflow estimates revealed above, OEI also integrates the following inaccurate assumptions into their groundwater modeling analysis.

- OEI states that the character and thickness of alluvium is unknown in the vicinity of the water drafting pump location. However, County boring logs for test holes completed at the Annapolis Road bridge crossings of the SF and Wheatfield Forks from 1973 were obtained[2] and reviewed and provide detailed descriptions of alluvium content and thickness. These logs indicate notable clay and silt layers of variable thicknesses, interbedded with a matrix of sand and gravel. The presence of clay/silt layers will create groundwater flow heterogeneities leading to higher horizontal flow rates vs. vertical flow rates. Given the large percentage of silt and clay in the river valley alluvium, the uniform hydraulic conductivity value of 1,000 ft/day used by OEI should be reduced and modified in both the horizontal and vertical flow directions.

[2] Logs are contained in the report entitled, "Preliminary Geologic Report, Gualala River System, Sonoma and Mendocino Counties", prepared by Thomas E. Cochrane, Geologist, submitted to State Water Resources Control Board and dated September 27, 1989.

- OEI's discharge analysis generated baseflow estimates ranging from 8.4 to 14.9 cfs. However, I did not see reference in their report to what flow value was used in the groundwater model analysis. Regardless, as discussed above, these values grossly over-estimate the low summer baseflow rates during August and September.

- OEI applies a constant head boundary at both the upstream and downstream ends of their model. Flow/water level monitoring and field observations indicate that the summer water level in the Gualala River may drop several feet through the summer base flow period. Because the summer river levels are an expression of the groundwater table, this indicates that the alluvial water table is also fluctuating on the order of several feet. This magnitude of water level change is also similar to the typical summer pool depths in the river. Thus, as the water table declines through the summer, pool water depths get shallower and aquatic habitat is compromised not only by less water, but also by higher water temperatures, degraded water quality and reduced cover from predators. By maintaining a constant head boundary at the river bed level, their model in forces a static water level that does not mimic the natural seasonal water table decline and dewatering of pools. In short, the elevated static water level (constant head) likely maintains fully wetted pools before, during and after pumping – hardly a rigorous assessment of potential impacts to aquatic habitat for salmonids and other organisms.

- The OEI groundwater model assumes no loss of inflow via evaporation or evapotranspiration. Groundwater exchange with surrounding bedrock is not discussed.

- The OEI groundwater model incorporates a uniform hydraulic connection between river/pool bed and underlying alluvium. Based on model simulation results, OEI concludes that the relatively high "transmissivity" of the streambed alluvium (sand-gravel mix) is a primary factor why they don't observe dramatic changes in simulated river/pool water levels or impacts to fish.

  The Gualala River is included in the Clean Water Act 303(d) list for impairments associated with excessive sediment and high temperatures. A TMDL addressing sediment impairments was established by the U.S. Environmental Protection Agency (USEPA) in December 2001. The TMDL states that excessive fine sediment is accumulating in pools and has created an embedded[3] substrate in most other portions of the river bed. Fine sediment consists of clay and silt size material which display hydraulic conductivities orders of magnitude lower than a sand-gravel mix. Apart from decreasing the depth and habitat area within pools, the accumulation of fine sediment retards the exchange of surface and groundwater through the river bed. Thus, the OEI groundwater model assumption of uniform and high hydraulic conductivity, representative of an unconsolidated

[3] Embeddedness is the packing of fine grained sediment into the interstices or voids between large sediment particles such as gravel and cobble.

sand-gravel mix grossly exaggerates the rate of water exchange between stream and underlying alluvium.

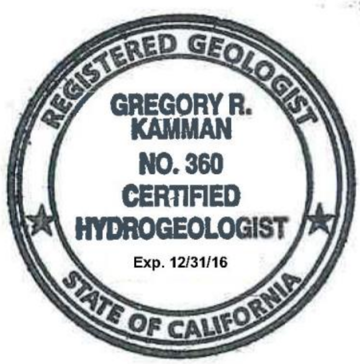
As indicted above, the hydraulic conductivity of the fine grained veneer currently covering and filling the bed and pools of the Gualala River is likely orders of magnitude less (slower) than the uniform and high value used by OEI. In fact, the actual water exchange through the fine sediment accumulated in pools may be slow enough to permit the complete or near-complete dewatering of pools when pumped at the rates anticipated for water drafting. It would take only one such dewatering event under slow recharge conditions to decimate the aquatic habitat residing in such a pool.

When considering all the critiques described above, there is no doubt in my mind that the OEI analysis is not a realistic or accurate assessment of potential pumping-induced impacts to aquatic habitats in the SF Gualala River. Given that salmonids in the watershed are already severely impacted by a decreased summer water supply (see Figure 1) and excessive fine sediment loads, State resources agencies should not approve the Dogwood and Apple THP's until it can correctly demonstrated that water drafting will not impact aquatic species and associated habitats.

Please feel free to contact me by phone (415-491-9600) or email (greg@khe-inc.com) if you have any questions or would like to discuss this letter further.

Sincerely,

Greg Kamman
Principal Hydrologist



ATTACHMENT A
List of Kamman's Gualala River Study Reports, Declarations and Presentations

Bowen, M., Kamman, G.R., Kaye, R. and Keegan, T., 2007, Gualala River Estuary assessment and enhancement plan. Estuarine Research Federation, California Estuarine Research Society 2007 Annual Meeting, 18-20 March, Bodega Marine Lab (UC Davis), Bodega Bay, CA

Ecorp Consulting, Inc and Kamman Hydrology & Engineering, Inc., 2004, Draft Gualala Estuary and Lower River Enhancement Plan: Results of 2002 and 2003 Physical and Biological Surveys. Prepared for: Sotoyome Resource Conservation District and California Coastal Conservancy, June 10.

Kamman, G.R., 2012, Adequacy of Applicant Responses to Comments on FEIR, Fairfax Conversion Project (SCH# 2004082094). Memorandum prepared for Friends of the Friends of the Gualala River, May 31, 3p.

Kamman, G.R., 2012, Review of Mitigated Negative Declaration, Ratna Ling Buddhist Retreat Master Plan, File No.: PLP08-0021. Professional declaration prepared for Friends of the Gualala River, April 4, 5p.

Kamman, G.R., 2009, Fairfax Conversion Project Environmental Impact Report (SCH# 2004082094). Professional declaration prepared for Friends of the Gualala River, July 27, 15p.

Kamman, G.R., 2007, Negative Declaration for File No. UPE04-0040, Gualala Instream. Professional declaration prepared for Friends of the Gualala River, October 21, 2p.

Kamman, G.R., 2004, Evaluation of potential impacts on hydrology and water supply, THP No. 1-04-055 SON and Proposed Mitigated Negative Declaration TCP No. 04-533, Roessler/Zapar Inc. THP/Conversion, Annapolis, CA. Professional declaration prepared for Friends of the Gualala River, August 13, 11p.

Kamman, G.R., 2004, Evaluation of potential hydrologic effects, THP No. 1-04-059 SON and Proposed Mitigated Negative Declaration TCP No. 04-531, Sleepy Hollow (Martin) THP/Conversion, Annapolis, CA. Professional declaration prepared for Friends of the Gualala River, July 17, 9p.

Kamman, G.R., 2003, Evaluation of potential hydrologic effects, Negative Declaration for THP/Vineyard Conversion, No. 1-01-171 SON, Artesa Vineyards, Annapolis, CA. Professional declaration prepared for Friends of the Gualala River, May 19, 9p.

Kamman, G.R., 2002, Flow Monitoring and Analysis of Baseflows on the North Fork Gualala River. Study completed on behalf of the California Coastal Conservancy.