Burke, James@Waterboards

From:	St.John, Matt@Waterboards
Sent:	Tuesday, January 19, 2016 9:25 AM
To:	Burke, James@Waterboards
Cc:	Olson, Samantha@Waterboards
Subject:	FW: Partial history of biased decisions that led to excessively impaired conditions if Elk River
Attachments:	WQ-02-01-02-2.pdf; 5_ELKpeakflow.pdf; Appendix B-2.xls

From: Jesse Noell [mailto:noelljesse@gmail.com]
Sent: Sunday, January 17, 2016 11:25 PM
To: St.John, Matt@Waterboards; Blatt, Fred@Waterboards; Mangelsdorf, Alydda@Waterboards; cafferata@CalFire.ca.gov
Subject: Partial history of biased decisions that led to excessively impaired conditions if Elk River

Matt St.John, Fred Blatt, and Board Members: this is a comment regarding the proposed WDRs for Green Diamond and Humboldt Redwood Company.

Please study Figure 1 of WQ-02-01--02-2.pdf and I think you will see how the present flooding legacy has manifested from WQ's and CDF's inept planning decisions.

Note how aggradation compounds this legacy. Figures 2, 3, 4. Perhaps 15% of the increased flooding that residents suffer today is due to peak flow increase; while the remaining 85% is due to aggradation and loss of channel conveyance capacity. Presently (2015) the channel has aggraded more than a foot in South Fork and 2/3rds of a foot in North Fork since 2002, and the bias inherent in your Board's poor decisions has come home to roost. Why was CDF so arrogant as to completely ignore proper evaluation of sediment and aggradation in its mandatory decisions of significance--this legacy really points to CDF's lead agency incompetence. But, despite CDF incompetence, WQ has the authority and duty to prohibit discharge, and failing that-- to clean it up and abate the consequences!

If you study Figure 6, and compare this with the rapid channel infill that is ongoing, you will be faced with just how terrible WQ's decisions have been, and how egregious the present and proposed WDR's are. Peakflow increase has been maintained, and flooding has certainly not abated to the levels predicted by the FEMA delineations that are the thresholds for protection of public health and safety under CEQA. Ongoing aggradation is much worse than predicted by WQ's Orders.

The net effect is that flooding is far worse and far more frequent than identified in the "faith based" agency decisions---decisions that were certified and must now be enforced.

So, what is the proper thing to do? Ignore the prior certifications and underscore the mounting evidence that the past CEQA process by Board Members is a sham and fraud? Or stop the harvest that manifests the harm and threats to health and safety?

Or will WQ follow CEQA and issue "overriding considerations", begin takings procedures; provide just compensation and due process? When will WQ admit that it lacks authority to single out Elk River families forcing them to bear an undue burden?

Where is the "margin of safety" for human beings that is required by law?

WQ controls the valve that creates flooding by its actions permitting discharge--thus your name "Water Quality Control Board". When will you live up to your name?

Please deny Waste Discharge Permits in Elk River until the river recovers.

Jesse Noell

State of California | **The Resources Agency**

Memorandum

To: Dean Lucke
Assistant Deputy Director, Forest Practice
California Department of Forestry
and Fire Protection
135 Ridgway Avenue
Santa Rosa, CA 95401

Date: January 14, 2001

Telephone: (916)653-5843

From: **Department of Forestry and Fire Protection**

Subject: Elk River Peak Flow Analysis

The effects of past harvesting and an annual harvest of 600 clearcut equivalent acres on peak flows in the Elk River watershed are summarized in attached Tables 1, 2, and 3. These peak flow changes were determined using Equation 1 in Lisle et al. (2000). Factors considered in this approach are limited to canopy removal, watershed wetness, flow return periods, and number of years since harvest. Attached Table 4 provides an example of the spreadsheets that were used to calculate changes in flow.

Canopy removal values were based on harvesting levels included in past, recently approved, and currently proposed Elk River watershed THPs, as summarized in Table 5, with adjustments for different silvicultural treatments based on coefficients given in Lisle et al (2000).

Overall, these results support the general conclusion that canopy removal rates of up to 600 acres per year do not result in an increase in peak flow over current conditions.

<u>References</u>

Lisle, T., L. Reid, and R. Ziemer. 2000. Addendum: Review of Freshwater Flooding Analysis Summary. Report prepared by the USDA, Forest Service, Pacific Southwest Research Station in Arcata for the California Department of Forestry and Fire Protection, Sacramento, CA. 16 p.

Lewis, Jack, S. R. Mori, E. T. Keppeler, and R.R. Ziemer. 2001. Impacts of logging on storm peak flows, flow volumes and suspended sediment loads in Caspar Creek, California. *In:* Mark S. Wigmosta and Steven J. Burges (eds.) Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forested Areas. Water Science and Application Volume 2, American Geophysical Union, Washington, D.C., p. 85-125.

John R. Munn
Soil Erosion Studies
Project Manager

cc: Jerry Ahlstrom
Pete Cafferata
Clay Brandow
Bill Snyder
Ron Pape

ELK RIVER PEAK FLOW SUMMARY
January 14, 2002

Table 1: PRIOR YEARS PEAK FLOW INCREASE

Harvest Year	Retun Period (yrs)	Wetness Rating	Wetness Value	Peak Flow Increase (%)
1999	2	Average	304	4.66
2000	2	Average	304	4.02
2001	2	Average	304	3.67

Table 2: FUTURE YEARS PEAK FLOW ALTERNATIVES

Harvest Year	Retun Period (yrs)	Wetness Rating	Wetness Value	Harvest Area (CCE ac.)	Peak Flow Increase (%)
2002	2	Average	304	600	3.54
2003	2	Average	304	600	3.45
2004	2	Average	304	600	3.39

Table 3: RETURN PERIOD AND WETNESS EFFECTS ON PEAK FLOWS

Return Period (yrs)	Wetness Rating	Wetness Value	Peak Flow Increase (%) 2001 w/ no harvest	Peak Flow Increase (%) 2002 w/ 600 ac CCE
2	Dry	50	10.25	9.88
2	Average	304	3.67	3.56
2	Wet	400	2.67	2.58
15	Dry	50	9.24	8.91
15	Average	304	2.67	2.57
15	Wet	400	1.67	1.61

Table 4:
ELK RIVER PEAK FLOW CALCULATION FOR 600 CLEARCUT EQUIVALENT ACRES IN 2002 AND AVERAGE WATERSHED WETNESS

January 14, 2002

Recurrance Interval (yrs)	2
Index Logging Year	2002
Logging Recovery Coef. (B2)	-0.0771
Constant (B4)	1.1030
Storm Size Coef. (B5)	-0.0963
Watershed Wetness Coef. (B6)	-0.2343
Watershed Wetness Index (w)	304
Control Peak Flow (ynfc)	0.0091
Expected Control Pk. Flow (yc)	0.0073
Watershed Size (ac)	29376

Year	**Clearcut Equiv. (ac.)**	**ST/SW Equiv. (ac.)**	**Selection Equiv. (ac.)**	Canopy Equiv. (ac.)	Proportion Wtrshd. Logged (c)	Summers Since Logged (t)	Observed/ Expected Peak Flow Ratio	Annual Peak Flow Change (%)
1989	137.0	644.1	555.7	897.9	0.03057	13	1.00054	0.054
1990	33.0	1617.3	55.7	1273.8	0.04336	12	1.00156	0.156
1991	132.7	0.0	829.4	547.4	0.01863	11	1.00101	0.101
1992	575.3	225.1	68.9	778.6	0.02650	10	1.00193	0.193
1993	358.5	552.6	396.5	971.2	0.03306	9	1.00301	0.301
1994	425.8	910.9	434.6	1326.3	0.04515	8	1.00494	0.494
1995	302.8	988.4	1064.9	1576.6	0.05367	7	1.00686	0.686
1996	308.8	341.7	843.7	986.9	0.03360	6	1.00491	0.491
1997	89.9	138.6	286.3	337.0	0.01147	5	1.00188	0.188
1998	11.7	0.0	193.4	108.4	0.00369	4	1.00067	0.067
1999	0.0	0.0	41.5	20.8	0.00071	3	1.00014	0.014
2000	6.2	0.0	0.0	6.2	0.00021	2	1.00005	0.005
2001	0.0	84.0	522.8	324.4	0.01104	1	1.00262	0.262
2002	600.0	0.0	0.0	600.0	0.02042	0	1.00523	0.523
Sum								3.536

Table 5: Elk River Combined Canopy Equivalent Acres
January 14, 2002

Treatments within	Acres Harvested																Pending
Watersheds	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
North Fork Elk River																	
Clearcut Equiv.	0.0	0.0	2.4	133.0	24.2	83.3	63.1	261.3	406.3	294.4	75.5	89.9	0.0	0.0	6.2	6.2	757.7
ST/SW Equiv.	0.0	0.0	1288.4	116.6	793.6	0.0	93.5	355.4	221.6	988.4	216.2	138.6	0.0	0.0	0.0	0.0	158.7
Selection Equiv.	0.0	0.0	0.0	476.1	55.4	775.6	10.5	356.3	311.0	1042.6	503.8	30.9	159.3	41.5	0.0	0.0	648.4
South Fork Elk River																	
Clearcut Equiv.	3.5	0.0	0.0	4.0	8.8	0.6	274.7	97.3	0.0	0.0	233.3	0.0	0.0	0.0	0.0	0.0	63.4
ST/SW Equiv.	0.0	0.0	508.1	93.6	810.0	0.0	131.7	197.2	678.2	0.0	0.0	0.0	0.0	0.0	0.0	84.0	0.0
Selection Equiv.	0.0	0.0	56.1	79.6	0.3	0.1	18.7	0.0	100.3	0.0	324.5	0.0	0.0	0.0	0.0	522.8	672.6
Lower Elk River																	
Clearcut Equiv.	0.0	0.0	0.0	0.0	0.0	48.8	237.5	0.0	19.6	8.4	0.0	0.0	11.7	0.0	0.0	0.0	0.0
ST/SW Equiv.	0.0	0.0	0.0	434.0	13.7	0.0	0.0	0.0	11.0	0.0	125.6	0.0	0.0	0.0	0.0	0.0	0.0
Selection Equiv.	0.0	0.0	1.6	0.0	0.0	53.8	39.7	40.2	23.2	22.3	15.5	255.5	34.1	0.0	0.0	0.0	0.0
Elk River Sum																	
Clearcut Equiv.	3.5	0.0	2.4	137.0	33.0	132.7	575.3	358.5	425.8	302.8	308.8	89.9	11.7	0.0	6.2	6.2	821.0
ST/SW Equiv.	0.0	0.0	1796.5	644.1	1617.3	0.0	225.1	552.6	910.9	988.4	341.7	222.6	0.0	0.0	0.0	84.0	158.7
Selection Equiv.	0.0	0.0	57.7	555.7	55.7	829.4	68.9	396.5	434.6	1064.9	843.7	809.1	193.4	41.5	0.0	522.8	1321.0

From: <Ron_Pape@fire.ca.gov>
To: <henrd@rb1.swrcb.ca.gov>, <whita@rb1.swrcb.ca.gov>, <msopher@dfg.ca.gov>, <wcondon@dfg.ca.gov>, <john.p.clancy@noaa.gov>, <dan.free@noaa.gov>, <Amedee_Brickey@fws.gov>, <John_Hunter@fws.gov>
Date: Tue, Jan 15, 2002 9:34 AM
Subject: FW: Elk River Peak Flow

Attached are several files that contain John Munn's final Elk River Peak Flow analysis. Please review these documents as soon as possible and forward any comments to Bill Snyder or Ron Pape at CDF's Santa Rosa office. It is CDF's intent to schedule the first Elk River THPs for second review on Friday, January 25, 2002. If you have any questions, please give me a call. Also for NMFS, due to the uncertainty of FWS's email system, could you make sure that they have or get them a copy of this information (thanks again).

Ron Pape
Division Chief, Forest Practice
Northern Region Headquarters
(707) 576-2942

> -----Original Message-----
> From: Munn, John
> Sent: Monday, January 14, 2002 3:47 PM
> To: Lucke, Dean; Snyder, Bill; Pape, Ron
> Subject: Elk River Peak Flow
>
> Attached is a memo (in Word) and related tables (in Excel) that that Dean
> requested this morning showing the effect of an annual harvest of 600
> acres in the Elk River watershed. The original and cc's should be in the
> mail tomorrow.
>
> JRM
>
> <<MM020114.DL2.doc>> <<ER Peak Sum Tables.xls>>
> <<ER_Example_Table.xls>> <<ER Harvest Sum Table.xls>>
>

CC: <Dean_Lucke@fire.ca.gov>, <John_Marshall@fire.ca.gov>, <Joe_Fassler@fire.ca.gov>, <Ron_Pape@fire.ca.gov>

60	2/1/2002	Regional Water Board internal memorandum Re: Elk River Peak Flow Analysis.

INTEROFFICE MEMORANDUM

TO: DIANA HENRIOULLE-HENRY, P.E., HEADWATERS UNIT SENIOR

FROM: ADONA WHITE, WATER RESOURCES CONTROL ENGINEER

SUBJECT: ELK RIVER PEAK FLOW ANALYSIS

DATE: FEBRUARY 1, 2002

INTRODUCTION

This memo provides additional discussion to the memo dated January 30, 2002. Please include this in the official files for Elk River THPs.

I have reviewed the peak flow analysis conducted by California Department of Forestry and Fire Protection (CDF) for both Freshwater and Elk River watershed. CDF has employed partial methodology as presented by Drs. Lisle, Reid, and Ziemer of Redwood Sciences Laboratory in their October 25, 2000 *Addendum: Review of Freshwater Flooding Analysis Summary* (Lisle et al., 2000).

Lisle et al. (2000) presents an explanation of the likely cumulative effect on increased flood frequency in Freshwater Creek resulting from past harvesting and various future harvesting scenarios. The cumulative effect results from the combination of hydrologic changes resulting from canopy removal and sediment inputs associated with the hydrologic changes (rilling, scour of low order channels, landsliding) and roads.

I have applied the model described in Lisle et al. (2000) to Elk River watershed conditions, as discussed and presented in this memo. I have attempted to be consistent in this memo by using the same terms as those used in Lisle et al. (2000). These are preliminary calculations and may change if errors or ways to validate or modify assumptions are discovered; consequently, additional conclusions may also result.

METHODOLOGY AND RESULTS

These analyses are based upon harvesting road construction between 1967 and 2015. The results presented herein demonstrate flood frequency changes between 1983 and 2015.

HYDROLOGIC CHANGES IN ELK RIVER WATERSHED

Removal of canopy results in reduced rainfall interception and reduced evapo-transpiration capacity. The combination of these effects results in increased runoff associated with peak flow events. The model estimating the increased peak flows was developed by Lewis et al. based on data from the Caspar Creek watershed, a coastal redwood watershed, not dissimilar to Elk River in terms of geology, vegetation, and rainfall patterns. The model offers information about the relative magnitudes of harvest-related peakflow changes relative to background conditions for the watershed being modeled.

This model is mathematically represented as:

$$E(r) = \exp\{[1 + B_2(t-1)]c[B_4 + B_5 \ln(y_c) + B_6 \ln(w)]\}$$

Where:

B_2	= Logging recovery coefficient
B_4	= constant
B_5	= storm size coefficient
B_6	= watershed wetness coefficient
RI	= recurrence interval
Y_{ncf}	= control peak flow
y_c	= expected peak flow
w	= wetness index
c	= portion of watershed canopy removed
t	= time since harvest that calculation is made

This equation estimates the expected increase in volume of water associated with a given recurrence interval peak flow. The effects of harvest are greatest immediately following harvest and follow an exponential decay after harvest (i.e., hydrological recovery).

Using the harvest history provided by CDF (Munn, 2002) and the Pacific Watershed Associates (PWA) report (1999), the peak flow increases, due to hydrologic changes only, were determined for the 2-year recurrence interval flow and are shown in Figure 1. It should be noted that similar percent increases were observed at Caspar Creek for the highest flows on record at the time the paper was written (i.e., up to the 8-year recurrence interval flow) (Lewis et al., 2000). Data indicate that up to the 8-year recurrence interval peak flow is affected by harvesting. The model shows increases in peak-flows for even greater return interval peak flows.

CDF Analysis

The methodology employed by CDF (Munn, 2002) is based solely upon increased peak flow. Their analyses does not also include the increase in flood frequency due to aggradation of sediment, a key factor in increase flood frequency. CDF determined that 600 clearcut equivalent acres would be acceptable in the Elk River watershed and would not worsen the existing flooding problem. However, this hydrologic component is but a portion of the flooding problem in the Elk River and Freshwater Creek watersheds, as the following analysis demonstrate.

Further, Figure 1 shows that CDF's proposed harvest scenario will, in fact, increase existing flood frequency in Elk River due solely to hydrologic changes, and that current flood frequency is greater than background levels. Figure 1 also demonstrates that if harvesting is deferred after 2001, the hydrologic changes due to canopy removal will stabilize in approximately 2015. This is because the modeled hydrologic effects due to harvesting approach zero after 14 years.

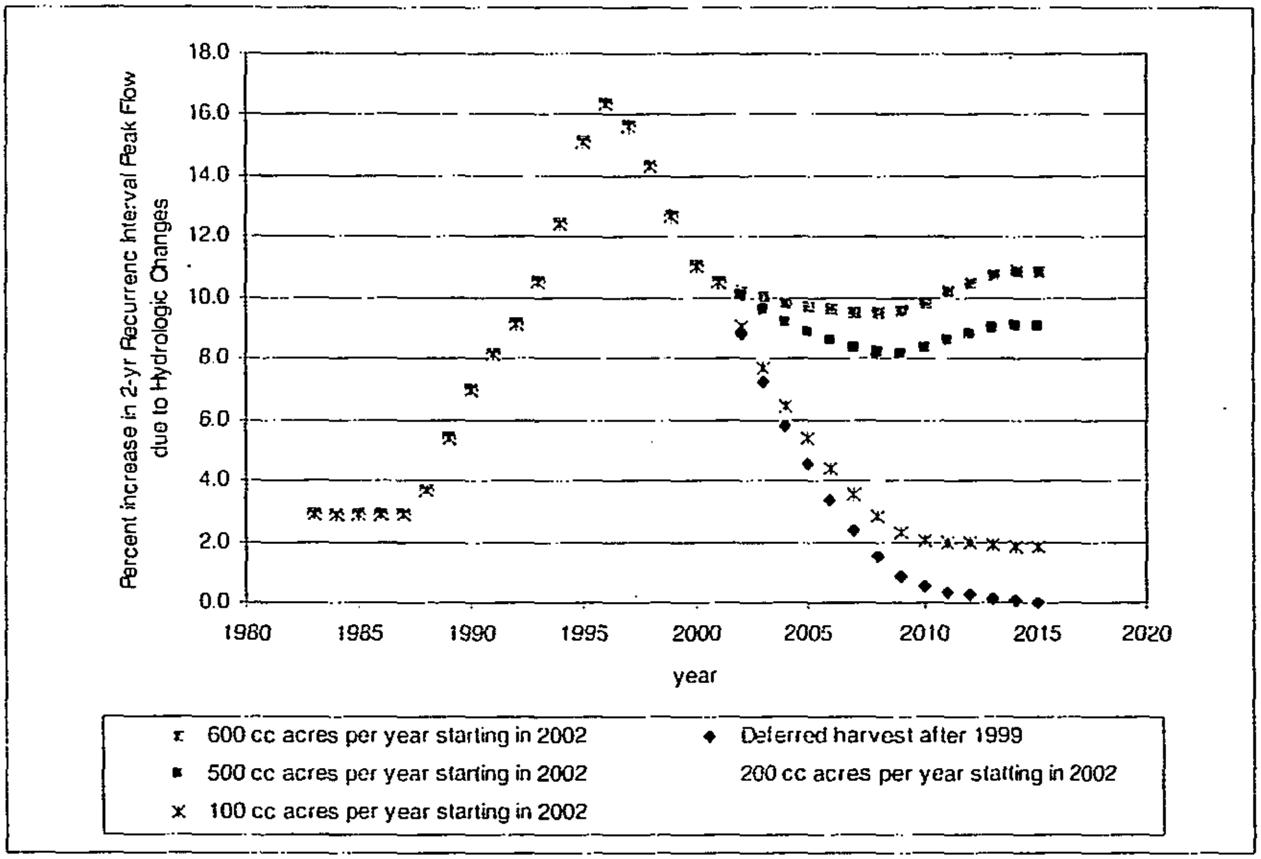

Figure 1. Estimated percentage increase in 2-year recurrence interval peak flow based upon one past harvesting and four future harvesting scenarios.

SEDIMENT INPUTS OVER BACKGROUND

Lisle et al. (2000) identify two types of sediment inputs which result due to the timber harvest and related activities: silviculturally-related and road-related sediment inputs. Both of these activities increase the sediment inputs above background levels. It should be noted that in this context increases above background levels are relative to those of the specific watershed being modeled.

Silviculturally Related Sediment Inputs

The increased peak flows not only result in increased runoff of water, but also result in increased sediment inputs by two primary mechanisms: silviculturally-related hillslope landsliding and rilling and scour of low order channels. These sediment inputs were modeled using the following equations, as presented by Lisle et al. (2000). The equations are based upon information contained in the PWA report (1998).

Pre-Pacific Lumber Company (PL) Habitat Conservation Plan (HCP) silviculturally-related landslide inputs are based upon data in the PWA report (1998) indicating a 1300% increase in landsliding on recently harvested areas in North Fork Elk River. Post-PL HCP sediment inputs are based on the assumption that the mass-wasting strategy is completely effective at preventing increased rates of landslides on all areas except planar slopes and breaks in slope. This assumption has not been validated. The landslide rates on harvested portions of the watershed are assumed to return to background levels 15 years after harvesting. This assumption has not been validated.

Hydrologically associated erosion inputs (i.e. rilling and scour of low order channels) are based upon Lewis et al. (1998) and are presented in Lisle et al. (2000). These inputs are the same for pre- and post-PL HCP conditions and are assumed to stabilize and decrease over time after harvest (as the canopy grows back), following the same recovery-rate as the hydrologic change recovery.

$$P = \sum_{i=1}^{15} C_i(1400 - 92.9i) \text{ (Pre-HCP conditions)}$$

$$P = \sum_{i=1}^{15} C_i(219 - 20.9i) \text{ (Post-HCP conditions)}$$

Where:

- $P =$ proportional increase in sediment input over background in a given year
- $C =$ portion of watershed canopy removed in a given year
- $i =$ number of years prior to the year of calculations that harvesting took place

Road Related Sediment Inputs

The presence of roads on the landscape results in sediment delivery via surface erosion and road-related landsliding. Lisle et al. (2000) estimate sediment inputs associated with non-storm-proofed roads in Freshwater as 20% over background for the roaded area. Sediment delivery from storm-proofed roads is assumed only 4% over background for the roaded area. This assumption may not be valid because storm proofing may not be as effective as indicated.

The area of the watershed comprised of roads was based upon road construction rates in the North Fork Elk River, as presented on Page 13 of the PWA report (1998). These same road construction rates are assumed for the South Fork Elk River watershed. Road widths are assumed to be 14 feet.

The rates of storm-proofing are based upon Table 1, on Page 3 of (Miller, 2000) which indicate that in the Elk River watershed 47.17 miles were storm-proofed by 2000. It was assumed that storm-proofing began in 1998 and continued at the same rate until all the roads were storm-proofed.

It should be noted that the results presented here do not include any additional road construction, though approximately 11 miles of new roads are proposed associated with pending timber harvest plans. Further analyses are necessary to model the inputs from the proposed roads.

Combined Sediment Inputs

The silviculturally-related and road-related sediment inputs are summed to estimate the total percent sediment inputs over background resulting from harvest-related activities. Figure 2 shows the modeled sediment inputs over background levels for two harvest scenarios (deferred harvest beginning in 2001 and 600 clearcut (CC) equivalent acres annually beginning in 2002, as proposed by CDF). Figure 2 also shows that modeled sediment inputs from harvest and roads reach a peak in 1996.

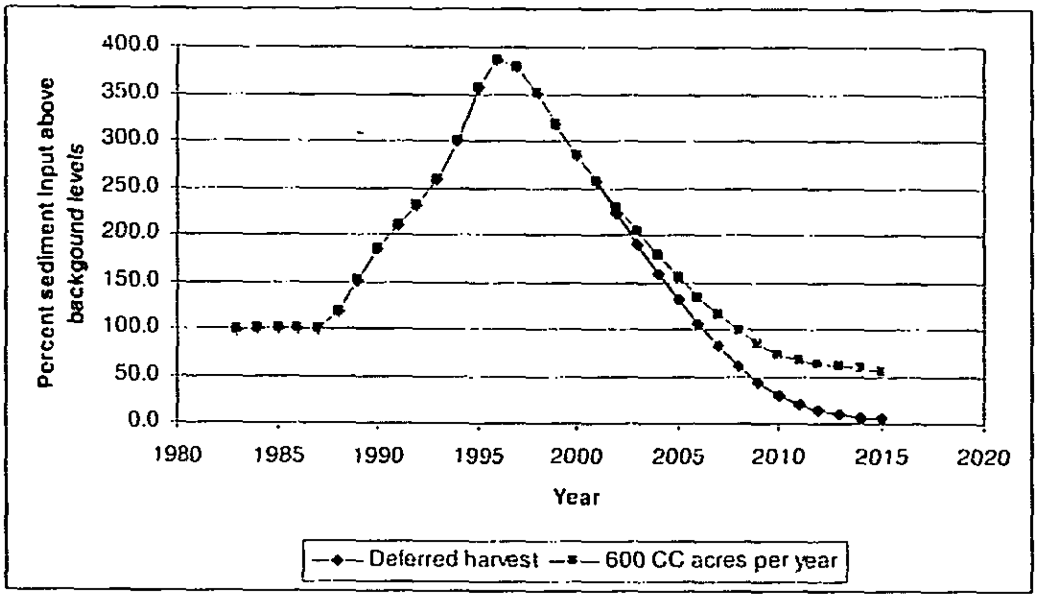

Figure 2. Annual percent sediment input over background for two harvest scenarios.

Aggradable Sediment

Both the silviculturally-related and road-related sediment deliveries increase the total deliveries over background sediment delivery levels. A stream has a certain capacity for sediment transport; once the capacity is exceeded by sediment inputs, aggradation occurs. Aggraded sediment may eventually be flushed out of the system if the inputs are abated. If inputs continue to exceed the threshold for aggradation, further aggradation will occur. The cumulative effect on the channel is not limited to increased flood frequency due to channel capacity reduction but also includes increased bank erosion.

While the exact threshold above background at which sediment began to aggrade in the Elk River watershed is not defined, evidence indicates it was somewhere less than 90-160% over background. Lisle et al. (2000) discuss observations by long-time Elk River residents indicating that the channel was noticeably filling with sediment and degradation of water quality had occurred in the early 1990's. By the time these effects were noticeable, the threshold for aggradation had already been surpassed by sediment inputs. A family of curves for four threshold levels above background is shown in Figure 3, assuming harvest is deferred following 2001. Figure 3 indicates that for the thresholds shown, the cumulative aggradable sediment curves have a similar shape. However, greater aggradation occurs for lower thresholds and consequently, recovery is greatest for higher thresholds. Additionally, Figure 3 shows that under deferred harvest conditions for all aggradation thresholds modeled, the river could begin to flush out aggraded sediment within the time period modeled.

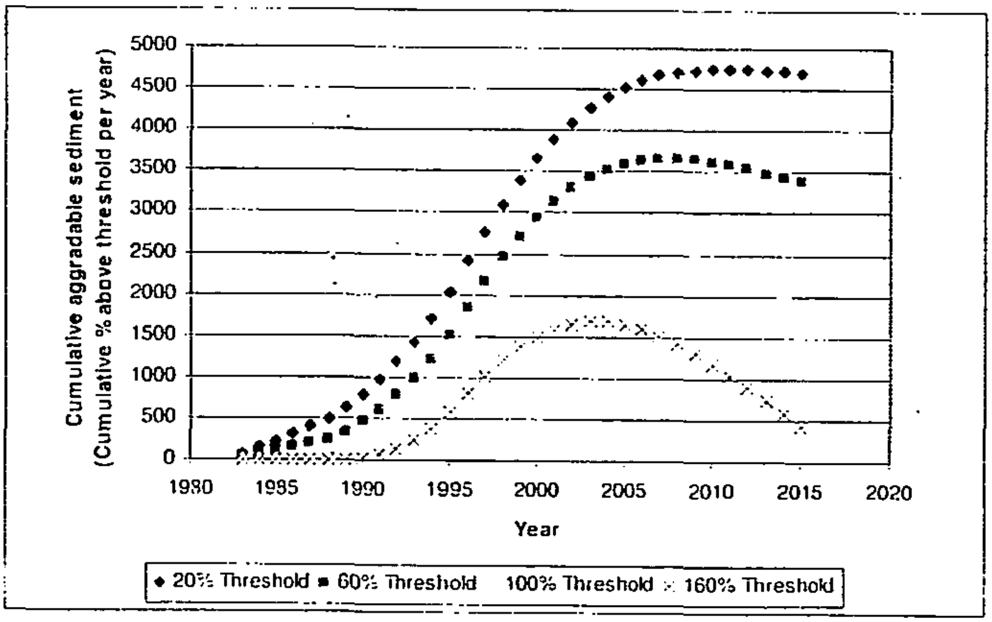

Figure 3. Cumulative aggradable sediment (sediment inputs above the stream's transport capacity above background levels). The depicted harvest scenario assumes that harvest is deferred after 2001.

In Figures 4-6, a threshold for aggradation of 60% is assumed. This assumption has not been validated. Figure 4 shows the cumulative aggradable sediment over time for two harvest scenarios, assuming aggradation occurs if sediment inputs exceed 60% over background levels annually:

1) deferred harvest beginning in 2001 and
2) 600 clearcut (CC) equivalent acres annually beginning in 2002, as proposed by CDF.

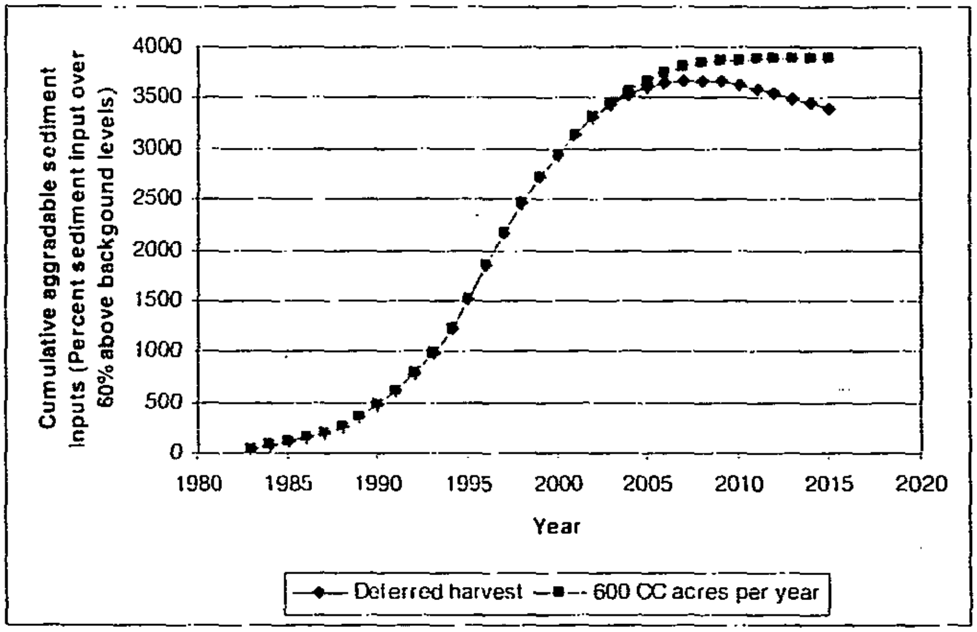

Figure 4. Cumulative aggradable sediment for two harvest scenarios, assuming the aggradation begins at 60% over background.

FLOOD FREQUENCY INDEX

The change in flood frequency is a result of the combined effects of increased peak flow volumes and increased sediment aggradation in the channel. In order to demonstrate the change in channel capacity between current and historic conditions, I relied on the review of Conroy (1998) conducted by Lisle et al. (2000). The review refers to historical data documented by USGS and recent data from Conroy (1998) pertaining to the same cross-section at the gage station on the mainstem Elk River just below the confluence of North Fork and South Fork Elk River. The USGS record indicates that between 1959 and 1967 bankfull discharge was 63 cubic meters per second (cms). Conroy indicates that in 1997 bankfull discharge was 25 cms.

The historic information indicates the bankfull channel capacity was reduced by 60% between 1967 and 1997. Figure 1 shows in 1997 there was a 15% increase in the 2-year recurrence interval flow compared to background conditions. Thus, in 1997, 85% of the change in flood frequency is attributable to reduction in channel capacity due to aggradation and the remainder of the impact is due to hydrologic changes.

It is imperative to note that 1997 is used as an index year because there were data to represent the relative portion of the total flood frequency increase attributable to sediment aggradation and to hydrologic changes. Figures 5 and 6 illustrate over time 1) the change in flood frequency due to hydrologic changes, 2) the change in flood frequency due to aggraded sediment, and 3) the total change in flood frequency. The total change in flood frequency is simply the summation of the hydrologic and aggradation effects.

A flood frequency index of 100% corresponds to 1997 conditions when conditions were significantly different than background: there was a 15% increase in the 2-year recurrence interval peak flow, silvicultural and road-related sediment inputs were 378% over background levels (silviculturally-related inputs were 316% over background levels and road-related sediment inputs were 61% over background levels), and cumulative aggraded sediment was 2169% over background levels (assuming a 60% over background sediment input threshold for aggradation). Figures 5 and 6 differ after 2001. Figure 5 shows results assuming harvest is deferred after 2001. Figure 6 shows results assuming 600 clearcut equivalent acres are harvested annually beginning in 2002 and continuing over the modeled time period.

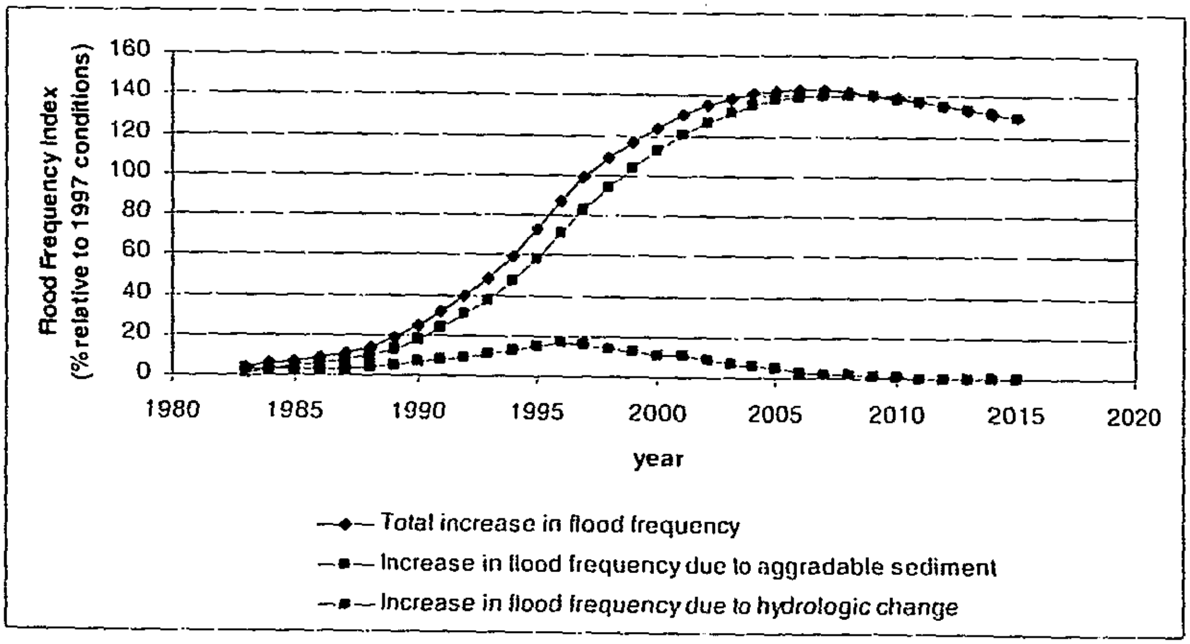

Figure 5. Flood frequency index for Elk River if harvest is deferred after 2001. Note that an index value of 100% corresponds to 1997 channel conditions.

Figures 5 and 6 indicate the current flood frequency is 135% greater than in the early 1980s. Figure 5 shows that if harvest is deferred after 2001, impacts will worsen until recovery begins in 2005, however flood frequency will remain greater than pre-2001 levels over the time period modeled. Figure 6 shows if harvest commences in 2002 at a rate of 600 clear cut equivalent acres per year, flood frequencies will increase over current conditions and stabilize at a level of 159% greater than observed in the early 1980s.

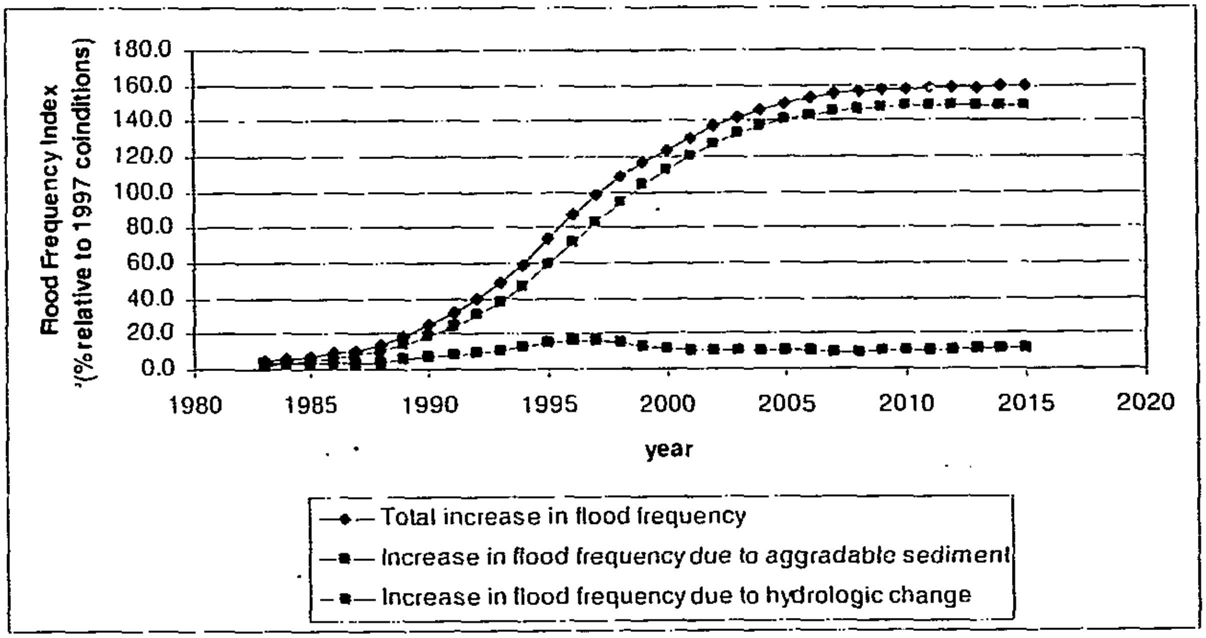

Figure 6. Flood frequency index for Elk River assuming annual harvest of 600 clearcut acres. Note that an index value of 100% corresponds to 1997 channel conditions.

Further Evaluations

Further evaluations should be conducted beyond those described in this memo. These include:

- Further evaluation of flood frequency changes under different harvest scenarios
- Incorporation of new road construction
- Evaluations under different antecedent wetness conditions

Conclusions

The results of this evaluation indicate the following:

- The flood frequency in Elk River has increased significantly (135%) as compared to historic conditions and will continue to increase until after sediment inputs are abated and after conditions stabilize at an unprecedented high level of flood frequency.

- The evaluation conducted by Munn (2002) apparently lead CDF to conclude that allowing 600 clearcut equivalent acres to be harvested annually would not exacerbate the existing significant impact. However did CDF not evaluate sediment impacts on flood frequency, which is the primary contributor to the impacts. In addition, Munn (2002) did not extend the calculation far enough into the future to observe the cumulative impact resulting from harvesting. Figure 1 indicates an increase in peak flow will result solely from the hydrologic change if 600 acres are clearcut annually and peak flow increases will stabilize at a level greater (10.9% % increase in 2-year recurrence interval peak flow) than current conditions (10.3% increase in 2-year recurrence interval peak flow) as long as that harvest scenario continues. The results presented in this analysis indicate that if harvest commences in 2002 at a rate 600 clear cut equivalent acres per year, flood frequency will increase over current conditions and stabilize at a level of 159% greater than observed in the early 1980s.

- The CDF proposed harvest scenario would slow the rate of recovery for Elk River.

- The flooding frequency in 2002 is 27% greater than in 1997.

- If 600 clearcut equivalent acres are harvested annually starting in 2002, there will be no decrease in the aggradable sediment inputs in the foreseeable future. Because sediment is the same pollutant impairing beneficial uses of water, there will be no recovery of impaired beneficial uses in the foreseeable future under the CDF-proposed harvest scenario.

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wshed	site	area	year	ppt	peak	ei	eca.ac	eca.pct	eca2
Elk	511	56.91	2003	54.18	1.532	304	428	0.03	0.06
Elk	511	56.91	2004	37.58	0.573	71	379	0.026	0.06
Elk	511	56.91	2005	40.17	0.704	77	337	0.023	0.05
Elk	511	56.91	2006	57.67	1.224	155	167	0.012	0.03
Elk	511	56.91	2007	35.94	0.685	83	129	0.009	0.02
Elk	511	56.91	2008	32.24	1.034	64	163	0.011	0.02
Elk	511	56.91	2009	27.85	0.255	48	76	0.005	0.02
Elk	511	56.91	2010	39.58	0.628	70	250	0.017	0.02
Elk	511	56.91	2011	43.75	1.22	120	67	0.005	0.02
Elk	510	50.34	2003	54.18	1.481	304	3	0	0.02
Elk	510	50.34	2004	37.58	0.671	71	134	0.011	0.01
Elk	510	50.34	2005	40.17	0.822	77	214	0.017	0.03
Elk	510	50.34	2006	57.67	1.131	155	25	0.002	0.02
Elk	510	50.34	2007	35.94	0.809	83	146	0.012	0.01
Elk	510	50.34	2008	32.24	1.06	64	215	0.017	0.03
Elk	510	50.34	2009	27.85	0.222	48	66	0.005	0.02
Elk	510	50.34	2010	39.58	0.663	70	258	0.021	0.03
Elk	510	50.34	2011	43.75	1.196	120	39	0.003	0.02
Elk	509	111.83	2003	54.18	1.452	304	589	0.021	0.04
Elk	509	111.83	2004	37.58	0.553	71	560	0.02	0.04
Elk	509	111.83	2005	40.17	0.705	77	342	0.012	0.03
Elk	509	111.83	2006	57.67	1.096	155	136	0.005	0.02
Elk	509	111.83	2007	35.94	0.686	83	354	0.013	0.02
Elk	509	111.83	2008	32.24	0.919	64	388	0.014	0.03
Elk	509	111.83	2009	27.85	0.239	48	145	0.005	0.02
Elk	509	111.83	2010	39.58	0.531	70	399	0.014	0.02
Elk	509	111.83	2011	43.75	0.998	120	105	0.004	0.02
Elk	517	5.75	2003	54.18	2.179	304	182	0.128	0.13
Elk	517	5.75	2004	37.58	0.893	71	0	0	0.13
Elk	517	5.75	2005	40.17	1.006	77	0	0	0
Elk	517	5.75	2006	57.67	1.574	155	0	0	0
Elk	517	5.75	2007	35.94	0.854	83	61	0.043	0.04
Elk	517	5.75	2008	32.24	1.041	64	64	0.045	0.09
Elk	517	5.75	2009	27.85	0.336	48	71	0.05	0.1
Elk	517	5.75	2010	39.58	0.687	70	0	0	0.05
Elk	517	5.75	2011	43.75	1.101	120	0	0	0
Elk	519	4.92	2003	54.18	NA	304	17	0.014	0.01
Elk	519	4.92	2004	37.58	0.829	71	0	0	0.01
Elk	519	4.92	2005	40.17	0.912	77	0	0	0
Elk	519	4.92	2006	57.67	1.425	155	0	0	0
Elk	519	4.92	2007	35.94	1.01	83	0	0	0
Elk	519	4.92	2008	32.24	1.28	64	0	0	0
Elk	519	4.92	2009	27.85	0.284	48	0	0	0
Elk	519	4.92	2010	39.58	0.924	70	0	0	0
Elk	519	4.92	2011	43.75	1.941	120	0	0	0
Elk	522	4.31	2003	54.18	2.281	304	0	0.029	0.03
Elk	522	4.31	2004	37.58	0.694	71	37	0	0.03
Elk	522	4.31	2005	40.17	0.994	77	97	0.044	0.04
Elk	522	4.31	2006	57.67	1.455	155	21	0.116	0.16
Elk	522	4.31	2007	35.94	0.93	83	0	0.025	0.14
Elk	522	4.31	2008	32.24	1.071	64	0	0	0.02

Elk	522	4.31	2009	27.85	0.371	48	0	0	0
Elk	522	4.31	2010	39.58	0.752	70	0	0	0
Elk	522	4.31	2011	43.75	1.986	120	0	0	0
Elk	532	35.08	2003	54.18	NA	304	170	0.02	NA
Elk	532	35.08	2004	37.58	NA	71	224	0.026	NA
Elk	532	35.08	2005	40.17	0.898	77	266	0.031	0.06
Elk	532	35.08	2006	57.67	1.567	155	144	0.017	0.05
Elk	532	35.08	2007	35.94	0.811	83	122	0.014	0.03
Elk	532	35.08	2008	32.24	1.167	64	91	0.01	0.02
Elk	532	35.08	2009	27.85	0.329	48	30	0.003	0.01
Elk	532	35.08	2010	39.58	0.661	70	25	0.003	0.01
Elk	532	35.08	2011	43.75	1.451	120	44	0.005	0.01
Elk	188	16.23	2003	54.18	2.19	304	1	0	0
Elk	188	16.23	2004	37.58	0.811	71	112	0.027	0.03
Elk	188	16.23	2005	40.17	1.148	77	214	0.052	0.08
Elk	188	16.23	2006	57.67	1.57	155	21	0.005	0.06
Elk	188	16.23	2007	35.94	0.976	83	146	0.035	0.04
Elk	188	16.23	2008	32.24	1.488	64	78	0.019	0.05
Elk	188	16.23	2009	27.85	0.486	48	0	0	0.02
Elk	188	16.23	2010	39.58	0.851	70	0	0	0
Elk	188	16.23	2011	43.75	1.757	120	7	0.002	0
Elk	183	19.56	2003	54.18	2.124	304	1	0	0.09
Elk	183	19.56	2004	37.58	0.821	71	112	0.027	0.03
Elk	183	19.56	2005	40.17	1.134	77	214	0.052	0.08
Elk	183	19.56	2006	57.67	1.567	155	21	0.005	0.06
Elk	183	19.56	2007	35.94	1.074	83	146	0.035	0.04
Elk	183	19.56	2008	32.24	1.528	64	78	0.019	0.05
Elk	183	19.56	2009	27.85	0.529	48	0	0	0.02
Elk	183	19.56	2010	39.58	0.833	70	0	0	0
Elk	183	19.56	2011	43.75	1.903	120	7	0.001	0
Elk	533	6.32	2003	54.18	NA	304	0	0	NA
Elk	533	6.32	2004	37.58	NA	71	0	0	NA
Elk	533	6.32	2005	40.17	NA	77	0	0	NA
Elk	533	6.32	2006	57.67	1.332	155	0	0	0
Elk	533	6.32	2007	35.94	0.84	83	0	0	0
Elk	533	6.32	2008	32.24	1.046	64	137	0.168	0.17
Elk	533	6.32	2009	27.85	0.248	48	34	0.042	0.21
Elk	533	6.32	2010	39.58	0.634	70	166	0.204	0.25
Elk	533	6.32	2011	43.75	1.027	120	0	0	0.2
Elk	534	3.02	2003	54.18	NA	304	0	0	0
Elk	534	3.02	2004	37.58	1.025	71	0	0	0
Elk	534	3.02	2005	40.17	1.016	77	0	0	0
Elk	534	3.02	2006	57.67	1.425	155	0	0	0
Elk	534	3.02	2007	35.94	0.837	86	0	0	0
Elk	534	3.02	2008	32.24	1.338	66	0	0	0
Elk	534	3.02	2009	27.85	0.396	53	0	0	0
Elk	534	3.02	2010	39.58	0.731	79	0	0	0
Elk	534	3.02	2011	43.75	1.962	141	0	0	0
Elk	550	0.13	2003	54.18		304	0	0	0
Elk	550	0.13	2004	37.58		71	0	0	0
Elk	550	0.13	2005	40.17		77	0	0	0
Elk	550	0.13	2006	57.67	1.331	142	0	0	0

Elk	550	0.13	2007	35.94	0.777	86	0	0	0
Elk	550	0.13	2008	32.24	1.215	66	0	0	0
Elk	550	0.13	2009	27.85	0.269	53	0	0	0
Elk	550	0.13	2010	39.58	0.792	79	0	0	0
Elk	550	0.13	2011	43.75	1.608	120	0	0	0
Freshwa	500	2.17	2003	54.18	2.41	304	5	0.009	0.01
Freshwa	500	2.17	2004	37.58	0.699	71	65	0.122	0.13
Freshwa	500	2.17	2005	40.17	1.366	77	0	0	0.12
Freshwa	500	2.17	2006	57.67	2.033	155	0	0	0
Freshwa	500	2.17	2007	35.94	1.068	83	0	0	0
Freshwa	500	2.17	2008	32.24	1.194	64	0	0	0
Freshwa	500	2.17	2009	27.85	0.64	48	0	0	0
Freshwa	500	2.17	2010	39.58	0.975	70	0	0	0
Freshwa	502	17.13	2003	54.18	2.148453	304	82	0.013	0.02
Freshwa	502	17.13	2004	37.58	0.925803	71	64	0.01	0.02
Freshwa	502	17.13	2005	40.17	1.286106	77	176	0.027	0.04
Freshwa	502	17.13	2006	57.67	1.601985	155	66	0.01	0.04
Freshwa	502	17.13	2007	35.94	0.90648	83	96	0.015	0.03
Freshwa	502	17.13	2008	32.24	0.926503	64	53	0.008	0.02
Freshwa	502	17.13	2009	27.85	0.309165	48	86	0.013	0.02
Freshwa	502	17.13	2010	39.58	0.755984	70	0	0	0.01
Freshwa	502	17.13	2011	43.75	2.042	120	203	0.049	0.05
Freshwa	504	17.13	2003	54.18	2.361794	304	74	0.025	0.06
Freshwa	504	17.13	2004	37.58	0.804568	71	159	0.053	0.08
Freshwa	504	17.13	2005	40.17	1.062874	77	0	0	0.05
Freshwa	504	17.13	2006	57.67	1.239037	155	110	0.037	0.04
Freshwa	504	17.13	2007	35.94	1.025166	83	113	0.038	0.07
Freshwa	504	17.13	2008	32.24	1.377409	64	63	0.021	0.06
Freshwa	504	17.13	2009	27.85	0.521179	48	0	0	0.02
Freshwa	504	17.13	2010	39.58	0.762459	70	0	0	0
Freshwa	504	17.13	2011	43.75	1.679	120	0	0	0
Freshwa	505	6.16	2003	54.18	2.280357	304	61	0.038	0.09
Freshwa	505	6.16	2004	37.58	0.88	71	17	0.011	0.05
Freshwa	505	6.16	2005	40.17	1.280682	77	0	0	0.01
Freshwa	505	6.16	2006	57.67	1.495779	155	0	0	0
Freshwa	505	6.16	2007	35.94	1.132468	83	56	0.035	0.03
Freshwa	505	6.16	2008	32.24	1.121266	64	45	0.028	0.06
Freshwa	505	6.16	2009	27.85	0.483117	48	48	0.03	0.06
Freshwa	505	6.16	2010	39.58	1.063149	70	0	0	0.03
Freshwa	505	6.16	2011	43.75	1.873	120	7	0.004	0
Freshwa	506	8.19	2003	54.18	2.285959	304	53	0.026	0.06
Freshwa	506	8.19	2004	37.58	0.931746	71	0	0	0.03
Freshwa	506	8.19	2005	40.17	1.218071	77	136	0.067	0.07
Freshwa	506	8.19	2006	57.67	1.554579	155	0	0	0.07
Freshwa	506	8.19	2007	35.94	0.913919	83	0	0	0
Freshwa	506	8.19	2008	32.24	1.090965	64	74	0.036	0.04
Freshwa	506	8.19	2009	27.85	0.284982	48	42	0.021	0.06
Freshwa	506	8.19	2010	39.58	0.79536	70	140	0.069	0.09
Freshwa	506	8.19	2011	43.75	2.192	120	86	0.042	0.11
Freshwa	523	22.83	2003	54.18	NA	304	82	0.015	0.02
Freshwa	523	22.83	2004	37.58	NA	71	71	0.013	0.03
Freshwa	523	22.83	2005	40.17	1.12742	77	178	0.032	0.04

Freshwa	523	22.83	2006	57.67	1.601621	155	66	0.012	0.04
Freshwa	523	22.83	2007	35.94	0.850591	83	97	0.017	0.03
Freshwa	523	22.83	2008	32.24	0.926544	64	53	0.009	0.03
Freshwa	523	22.83	2009	27.85	0.286378	48	86	0.015	0.02
Freshwa	523	22.83	2010	39.58	0.755848	70	0	0	0.02
Freshwa	523	22.83	2011	43.75	2.04	120	304	0.054	0.05
Freshwa	526	5.12	2003	54.18	NA	304	0	0	NA
Freshwa	526	5.12	2004	37.58	0.902	71	0	0	0
Freshwa	526	5.12	2005	40.17	1.19	77	0	0	0
Freshwa	526	5.12	2006	57.67	1.574	155	0	0	0
Freshwa	526	5.12	2007	35.94	0.928	83	0	0	0
Freshwa	526	5.12	2008	32.24	0.895	64	0	0	0
Freshwa	526	5.12	2009	27.85	0.256	48	0	0	0
Freshwa	526	5.12	2010	39.58	0.529	70	0	0	0
Freshwa	526	5.12	2011	43.75	1.89	120	0	0	0
Freshwa	527	4.71	2003	54.18	2.102569	304	50	0.038	0.06
Freshwa	527	4.71	2004	37.58	1.12293	71	0	0	0.04
Freshwa	527	4.71	2005	40.17	1.139278	77	36	0.028	0.03
Freshwa	527	4.71	2006	57.67	1.546072	155	46	0.035	0.06
Freshwa	527	4.71	2007	35.94	1.094055	83	0	0	0.04
Freshwa	527	4.71	2008	32.24	1.115074	64	0	0	0
Freshwa	527	4.71	2009	27.85	0.319533	48	23	0.018	0.02
Freshwa	527	4.71	2010	39.58	0.677707	70	0	0	0.02
Freshwa	527	4.71	2011	43.75	1.577	120	0	0	0
Freshwa	528	12	2003	54.18	NA	304	32	0.011	0.02
Freshwa	528	12	2004	37.58	1.215	71	272	0.092	0.1
Freshwa	528	12	2005	40.17	1.595	77	0	0	0.09
Freshwa	528	12	2006	57.67	1.934	155	0	0	0
Freshwa	528	12	2007	35.94	1.503	83	24	0.008	0.01
Freshwa	528	12	2008	32.24	1.585	64	51	0.017	0.03
Freshwa	528	12	2009	27.85	0.452	48	205	0.069	0.09
Freshwa	528	12	2010	39.58	1.009	70	288	0.097	0.17
Freshwa	528	12	2011	43.75	2.039	120	0	0	0.1

eca10.15	eca10	sedhaul	sedrem	load	time.gt25	time.gt70	y10
0.049	0.038	689	215665	847.1	38.6	17.4	126
0.041	0.036	3179	212486	194.5	27.5	9.2	63
0.044	0.032	5425	207061	181.1	25.7	10.3	79
0.043	0.029	28832	178229	467.9	44.1	20.1	126
0.049	0.027	34543	143686	129.2	22.1	7.3	63
0.053	0.024	22541	121145	135.3	21.3	8.3	63
0.05	0.026	40591	80554	24.1	12.4	3.7	32
0.041	0.029	3851	76703	101.7	22.5	7.3	50
0.031	0.017	22663	54040	295.6	37.9	15.6	113
0.016	0.007	0	97717	1063.6	50.6	25.9	200
0.01	0.007	0	97717	258.6	34.4	12.2	80
0.008	0.009	NA	97717	184.7	27.8	12.2	79
0.005	0.009	984	96733	672.6	52.8	33.2	200
0.008	0.008	9670	87063	176	20.4	8.6	63
0.011	0.009	4691	82372	181	23.2	9.3	63
0.009	0.009	16670	65702	42.9	13.1	4.5	40
0.007	0.011	3234	62468	131.4	21.1	7.7	60
0.008	0.015	32497	30906	344.6	37.5	14.8	113
0.032	0.016	689	313382	957.2	29.6	12.6	100
0.025	0.015	3179	310203	162.5	42.8	12.7	70
0.026	0.015	5425	304778	214.8	32.3	12.8	80
0.025	0.013	29816	274962	534.8	52	30	200
0.029	0.012	44213	230749	159	29.4	9.6	70
0.032	0.011	27232	203517	167.8	25.8	11.3	79
0.029	0.011	57261	146256	43.5	17.3	5.8	40
0.024	0.013	7085	139171	103.9	26.1	8.9	63
0.02	0.014	55160	84946	336.8	44.1	16.1	113
0.034	0.042	0	738	636.5	63.8	19.4	100
0.034	0.042	0	738	81	29.3	6.7	50
0.037	0.04	0	738	61.6	27.1	5.9	50
0.057	0.03	404	334	193	56.3	13.7	79
0.09	0.018	0	334	62.6	31.1	3.6	45
0.091	0.022	0	334	52.2	22.1	3.1	40
0.058	0.027	163	171	10.3	16.3	2.3	38
0.058	0.027	0	171	51.1	26.8	4.9	50
0.055	0.027	0	171	76.3	37.5	14.8	113
0.084	0.008	0	35946	NA	NA	NA	NA
0.061	0.001	2531	33415	134.6	15.7	6.2	40
0.047	0.001	0	33415	148.4	22.1	7.9	63
0.026	0.001	2526	30889	404.5	35.3	15.8	126
0.016	0.001	13673	17216	292.7	21.7	9	63
0.014	0.001	1835	15295	345.5	25.2	11.5	85
0.013	0.001	2991	12304	53.5	17.7	6.7	50
0	0.001	0	10244	287.8	22.8	7.9	45
0	0	2060	10244	794.3	30.9	15.2	126
0.036	0.005			471	24.4	7	50
0.013	0.009			45	9.6	3.2	25
0.013	0.021			68.4	14.3	3.4	32
0.004	0.023			169.4	24.2	5.9	50
0	0.023			78.9	11.8	3.1	28
0.004	0.021			81.2	14.1	3.7	32

0.004	0.021			21.6	8.6	1.7	22
0.004	0.021			63.3	10.2	3.2	25
0.004	0.019			249.7	20.4	6	40
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	28822	98155	245.3	24.7	8.8	63
NA	NA	19230	75939	422.2	44.1	16.2	100
NA	NA	22216	35505	109.2	18.8	5.9	50
NA	NA	40434	35151	108.6	17.3	6	50
NA	NA	354	21088	34.2	12.6	3.6	32
NA	NA	14063	18064	102.3	21.4	6.2	50
NA	0.012	600	17464	361.7	29	11.5	79
NA	NA	0	50791	683.9	20	6	50
NA	NA	0	50791	107.9	10.6	3	32
NA	NA	0	50791	109.7	10.8	2.4	30
NA	NA	921	49870	216.3	23.9	5.9	50
NA	NA	1888	47982	86.2	7.5	2.2	20
NA	NA	3514	44468	104.1	7.7	2.3	20
NA	NA	5958	38510	13.4	5.4	0.8	18
NA	NA	3189	35321	64.3	6.2	2	22
NA	0.014	23237	12084	246.3	15.4	4.1	38
NA	NA	0	50791	936.1	26.9	7.8	63
NA	NA	0	50791	192.3	15.9	5.6	40
NA	NA	0	50791	81.2	15.4	3.3	32
NA	NA	921	49870	224.9	29.6	7	60
NA	NA	1888	47982	85.1	10.4	2.7	25
NA	NA	3514	44468	77.9	9.7	2.5	30
NA	NA	5958	38510	14	7.1	1	20
NA	NA	3189	35321	47.6	8	2.2	25
NA	0.012	23237	12084	239.3	18.3	4.9	40
NA	NA	NA	39599	NA	NA	NA	NA
NA	NA	0	39599	NA	NA	NA	NA
NA	NA	0	39599	NA	NA	NA	NA
NA	NA	0	39599	1305.4	65.1	40.3	360
NA	NA	7782	31817	587	84.1	18	120
NA	NA	865	30952	384.5	31.8	13.4	100
NA	NA	10303	20649	88.6	32.8	13.7	79
NA	NA	0	20649	281.2	30.6	14	100
NA	0.022	7318	13331	968.8	66.3	36.2	316
0	0	0	0	NA	NA	NA	NA
0	0	0	0	5.7	0.2	0	13
0	0	0	0	13.8	0.8	0	9
0	0	0	0	42.6	7.2	2.4	16
0	0	0	0	7.7	1.3	0	7
0	0	0	0	13.8	0.6	0.2	6
0	0	0	0	5.4	0	0	6
0	0	0	0	5.9	0.5	0	6
0	0	0	0	11.4	0.9	0.1	6.5
0	0	0	0	NA	NA	NA	NA
0	0	0	0	NA	NA	NA	NA
0	0	0	0	NA	NA	NA	NA
0	0	0	0	447.7	NA	NA	NA

0	0	0	0	17	9.8	1.3	25
0	0	0	0	22.5	22	2.1	40
0	0	0	0	1.6	10.3	1.09	25
0	0	0	0	22.5	12.1	1.4	25
0	0	0	0	104.1	17.6	2.4	38
0.008	0	0	0	696	31	5.6	50
0.008	0	0	0	112	25	3.3	40
0.008	0	0	0	97.7	22.1	3.7	40
0.007	0.009	0	0	304	45	6.1	57
0.001	0.002	0	0	53	15.2	2.5	32
0.001	0	0	0	64.5	13.8	2.2	40
0.001	0	0	0	13	9.8	0.9	25
0.001	0	0	0	57	12	2.5	30
0.011	0.01	349	11833	692	36.1	7.8	63
0.011	0.012	255	11578	106	16.7	4.3	40
0.012	0.016	66	11512	120.4	20.8	4	40
0.008	0.016	3736	7776	388	30.5	6.3	45
0.004	0.018	782	6994	106	16	2.9	37
0.008	0.017	145	6849	76.5	18.3	2.3	40
0.012	0.018	849	6000	14	10.3	0.9	25
0.012	0.018	3	5997	43	10.7	1.8	25
0.015	0.022	0	5997	233.6	24.2	5.2	45
0.025	0.012	195	29977	632.1	37.4	7.6	105
0.018	0.013	996	29081	77.6	39.8	5.8	50
0.014	0.014	896	29081	86.7	30.7	5	50
0.022	0.014	0	28918	193.5	46.9	7.1	63
0.025	0.017	163	22278	78.1	35.5	4.1	50
0.054	0.02	6640	16903	48.2	29.4	3.5	55
0.054	0.018	5375	8416	17.6	20.2	1.5	36
0.054	0.017	8487	8386	36.2	30.2	2.9	40
0.063	0.021	30	8356	101.8	43.1	3.4	50
0.037	0.026	378	17136	667.2	53.5	24.6	158
0.057	0.027	438	16698	120.6	41.5	13.5	85
0.057	0.027	384	16314	123.7	24.2	6	50
0.056	0.027	0	16314	341	38.2	11.3	63
0.051	0.029	841	15473	95.8	18.7	5.2	40
0.061	0.023	20	15453	42.2	15.3	3.1	38
0.044	0.023	1278	14175	16.2	11	1.2	30
0.024	0.023	8022	6153	87	18.7	3.7	36
0.036	0.019	0	6153	266.7	41.9	9.7	63
0.025	0.044	0	4175	689.9	32.8	14.8	126
0.022	0.047	69	4106	106.5	17.2	4.1	38
0.02	0.047	293	3813	86.2	18	4.1	40
0.04	0.03	235	3578	245.4	34.6	8.5	57
0.054	0.023	516	3062	84.2	14.4	3.1	32
0.066	0.017	0	3062	75.7	14.4	2.8	32
0.068	0.019	67	2995	11.6	10.8	2.2	27
0.068	0.022	0	2970	55.1	12.6	3.2	32
0.073	0.032	0	2970	218.1	19.1	3.6	40
0.008	0.01	349	11833	NA	NA	NA	NA
0.008	0.012	255	11578	NA	NA	NA	NA
0.009	0.016	66	11512	128.7	20.2	3.7	40

0.006	0.016	3736	7776	288.7	28.1	5.6	50
0.003	0.018	782	6994	85	21.5	3.5	40
0.006	0.017	145	6849	64.4	18.6	2.2	38
0.016	0.018	849	6000	16.3	11.5	1.2	30
0.016	0.018	3	5997	52.4	11.3	2.4	32
0.02	0.022	0	5997	203.9	16.6	2.9	32
0	0	0	0	NA	NA	NA	NA
0	0	0	0	118	8.9	2.7	25
0	0	0	0	89.8	10.5	1.9	25
0	0	0	0	197	17	2.5	32
0	0.024	0	0	49	6.4	1.4	18
0.001	0.073	0	0	35.2	3.4	1	13
0.005	0	0	0	10	2.1	0.2	12
0.005	0	0	0	25	2.4	0.4	10
0.006	0	0	0	134.7	7.1	1.4	20
0.001	0.065	1001	28844	644	37.4	8.6	63
0	0.061	152	28692	83.4	21.1	4.7	40
0	0.064	1253	27439	74.3	19.6	4.2	40
0.007	0.067	828	26611	159.2	38.3	5.8	50
0.031	0.066	0	26611	63.7	18.4	3	40
0.041	0.038	5392	21219	57.3	23.5	3.5	45
0.053	0.029	1002	20217	12.1	10.7	1.5	25
0.053	0.015	5190	15027	37.8	10.3	1.8	25
0.061	0.014	0	15027	96.1	19.5	2.9	38
0.023	0.005	2738	5993	NA	NA	NA	NA
0.03	0.052	2370	5993	120.5	26.4	5.9	50
0.03	0	0	5743	114	19.3	5	40
0.041	0.103	250	4830	230	33.4	7.2	63
0.06	0.182	913	4798	71.7	16.9	3.3	38
0.075	0.123	32	4542	69.2	18.1	3	40
0.074	0	255.5	4467	15.2	8	1.3	23
0.061	0	75	3020	52.4	9.8	2.2	25
0.066	0.031	1447	1573	103.7	19.3	3.8	40