Providing Opportunity to Family Forestland Owners

November 5, 2015
To: Board of Forestry
From: Jim James, Executive Director, Oregon Small Woodlands Association
Re: Riparian Rulemaking Process

My name is Jim James, Executive Director of the Oregon Small Woodlands Association. OSWA represents over 75,000 family forest owners in Oregon who own 42% of the private forest land. Whatever the Board does today could have a huge impact on the family forest landowners in our state.

You already know there could be a huge economic impact to landowners. Real people's assets and savings are at stake. It is my hope you also recognize after considering all the research related to fish and forest streams, that without question, the beneficial uses of forest streams for fish are being met today under the current FPA rules. But the Board needs every detail to determine what is practicable and what is not.

RipStream chose to delay the evaluation of the temperature change between stations 3 and 4, which is 300 meters downstream from each harvest unit. OSWA did not. From RipStream data, the average cooling from stations 3 and 4 was 0.8°Celsius which is more than the average temperature increases from stations 2 and 3 within the unit. Stream water cools down to its original temperature range a short distance downstream.

This finding should come as no surprise because it is supported by dozens of published research. The temperature increases do not continue downstream as hypothesized by EPA, NOAA Fisheries and DEQ, the master minds behind the PCW. This also debunks arguments that timber harvest will exacerbate climate change. The climate may warm, but the natural processes in forest streams mitigate any temperature changes caused by a timber harvest when following the FPA. The RipStream data proves this fact.

But we find ourselves chasing a fundamentally flawed policy called the PCW. My question to the board is; are you willing to throw science to the wind and follow a misguided policy call? Or are you willing to exercise your authority to select a riparian rule that meets the PCW to the maximum extent practicable after considering all the 'hidden' facts? Nowhere in the law does it say "Do not use common sense". I am not suggesting you ignore the PCW, but to put it into context with all the other factors related to a riparian rule change. Please consider all these factors when making your decision today.

Thank you for considering the OSWA testimony and thank you for your service to the state of Oregon.

Oregon Small Woodlands Association 187 High Street NE, Suite 208, Salem, OR 97301
Phone: 503.588.1813 - Fax: 503.588.1970 – Web: www.oswa.org

To: Oregon Board of Forestry

From: Executive Committee of the Oregon Small Woodlands Association

Date: November 3, 2015

Subject: Two Opposing Policy Decisions to Address Stream Temperatures

The Board can choose to address the Protecting Cold Water criterion (PCW) by adopting FPA riparian rules based on either a fundamentally flawed computer model, or, built on practical field-tested strategies developed by forest practitioners.

The purpose of the attached report is to describe the fundamental weaknesses OSWA has discovered in the RipStream study results. Consequently, the model that used RipStream data as its basis is flawed. OSWA then summarizes why we believe the recommendations of the Regional Committee will meet the PCW.

The Executive Summary includes the reasons for the major limitations in the RipStream study results and the Model created from those results.

Chapter 1 of the report summarizes the limitations of RipStream field data, challenges decisions made during the study, and refutes the conclusions of the RipStream model. The model has major limitations in predicting timber harvest buffer widths that meet the PCW. The RipStream study did not adequately evaluate the impact of natural stream temperature variations when the decision was made that all of the temperature increases measured in RipStream were due to timber harvest. There is sufficient reason and evidence that natural variability and other natural factors should not have been completely ignored, as they constitute a significant portion of the temperature gains. All of the temperature data collected at stations 1, 2, 3, and 4 for the seven years collected (2 pre-harvest years and 5 post-harvest years) was not used in the study results as originally designed in the study. This gives an incomplete picture of the temperature impacts from a timber harvest following the FPA. The large portion of the designed RipStream data was either not collected, or not used in the study results. This creates doubts about its credibility. These limitations should have been explained in more detail to the Board.

Chapter 2 describes how the practical recommendations submitted by foresters and landowners can address possible minor stream temperature issues related to harvesting near riparian areas.

OSWA strongly believes the Board's policy to address the PCW needs to be based on the practical recommendations of the joint Regional Forest Practices Committees.

Sincerely,

Scott Hanson
President

Rick Barnes
President Elect

Scott Hayes
Past President

Dave Schmidt
Second VP

Dick Courter
Second VP

Mike Barnes
Second VP

Donna Heffernan
Second VP

Executive Summary

After 900 hours of professional time spent reviewing the RipStream design, data collected, study report, and the model developed from the RipStream data OSWA has determined the study results and model have some major limitations when used to assist the Board of Forestry in determining regulatory changes to Oregon's FPA riparian rules. These limitations are summarized in this document and must be clearly defined to the Board of Forestry before offering this information as a tool for determining regulatory change.

RipStream was designed for 22 private and 15 State headwater sites to achieve ±1°C detection of stream temperature changes caused by timber harvest following the FPA. Each site had four locations to collect information, Station 1, 300m above the top of each harvest unit, Station 2 at the top of each harvest unit, Station 3 at the bottom of each harvest unit, and Station 4, 300m below the bottom of each unit. Water temperature data was required for 2 pre-harvest and 5 post-harvest monitoring years. Low flow was required at all 4 stations. Three air temperature probes were required on each stream. The study design repeatedly said these were essential to;

"to provide a comparison of the inherent variability between harvested and unharvested reaches. Without this control period, differences are assumed to be a result of the treatment and not pre-existing differences....and....to evaluate effectiveness, will utilize a pre/post-harvest measurement design coupled with control reaches".(Project Approach V2.2)

Much of the planned data was not collected or was compromised by field issues. More than half of the needed temperature and flow data was not collected or not used in the study results. See Section 2 page 6 for details. This data scarcity caused the planned analysis of individual streams and accuracy standards to be abandoned, and an alternate approach was employed, using multiple models, which in turn, required a large number of untried assumptions and interpretations of regulatory guidance.

The greatest limitation of the study and model is the inability to adequately address natural variability caused by air temperature and groundwater, tributaries, evapotranspiration, etc. that influence water flow and temperature. A successful temperature study needs to evaluate the factors influencing natural variability. Although special stations collected data to help calculate natural variation, this data was not used in the study. Shortfalls in addressing natural variation shed doubt on the study results and model procedures.

Air temperature is a key component in determining the natural variation in stream temperatures that was not addressed accurately. Air temperatures were collected at 7 sites, but were replaced with data from Remote Automated Weather Stations (RAWS) to estimate the influence of air temperatures on forest streams. The RAWS weather stations can't represent individual site conditions or microclimates, and external reviewers vigorously objected to this approach, but it was used anyway. This is a major limitation to the study results.

Flow levels are also a key component in determining the natural variation in stream temperatures and like temperatures, flow data was not collected adequately. Flow was measured during only 21% of the specified low flow periods or later, with half the sites plagued with very low flow (equivalent to a garden hose) for some or most of the monitoring season. The prevailing practice of measuring flow 3 to 4 times/season to accurately define natural variability was lost because of the lack of data. Flow data that was collected indicated flows between station 2 and station 3 ranged from no change to 40 times more flow. RipStream claimed that their flow data was of little value and instead took the unprecedented step of assuming that natural variability was addressed in the control reach between station 1 and station 2, even though conditions and lengths differ significantly. Such an assumption dramatically calls into question the study results.

PCW exceedance was calculated incorrectly by not accurately taking into consideration a stream's natural variability. RipStream assumed that all natural variability between station 2 and station 3 would be represented by the temperature differences between station 1 and station 2. This does not follow the normal scientific protocol for calculating natural variation and such an assumption limits the accuracy of the study results and overstated the actual PCW exceedance.

PCW exceedance was calculated using an incorrect interpretation of a hypothetical example in the DEQ guidelines. RipStream used DEQ's Temperature Standard Implementation Directive's hypothetical example of determining a PCW exceedance using only a one year pre-harvest and one year post-harvest data, clarifying they "interpreted the use of only 1year pre-harvest information as the minimally acceptable timeframe to describe ambient conditions". In this assumption they completely ignored the influence of natural variation. The example in this Directive describes a concept, and inherently expects that natural variability had already been properly addressed outside of the scope of this simple example. This misinterpretation adds to the limits to the RipStream study's results and the model created from those results.

By ignoring natural variability and using only one year per-harvest and one year post-harvest information there was no way to accurately address the big temperature swings year to year that effect natural variability. RAWS weather station data in the area of the private sites shows that the 2003 to 2006 seasons were unusually warm with 2005 being the hottest at +5.5ºF warmer than the twelve year historic average. Many of the maximum post year stream temperature measurements for private sites were made in 2005. The yearly temperature differences would have been addressed had RipStream followed accepted protocol for determining natural variation, but RipStream did not and without such determination the post-harvest temperatures used to calculate PWC exceedance are questionable.

To compare sites side-by-side, schedules needed to be synchronized. Studies designed for direct comparison need synchronized schedules, to avoid additional variables caused by weather and precipitation. Ripstream harvests were staggered overs 4 years, resulting in few sites with comparable schedules, significantly reducing accuracy.

There was abnormally heavy rainfall during the months of Dec. 2005, Jan. 2006, and Nov 2006, sufficient to cause multiple 50-year floods in some locations. This caused both private and state sites to be plagued with logjams, landslides, and one private and two state sites also had beaver dams during this period. Two private sites, Argue Cr & Buck Creek, had buffer gaps, and were also plagued with log jams, and their flows dwindled to zero mid-way through the season, resulting in no credible post-harvest data in the 2 year after harvest period. Any temperature changes resulting from these events would be natural not man caused. External reviewers recommended that these fundamentally different conditions warranted their suppression, but they were all kept in the study to keep the statistical number of sites up. They account for 0.22ºC of the reported average temperature change. These site inclusions create limitations to the study results and the model created from the study data.

The temperature increases on state sites, representing no harvest areas, were overlooked in the study results. Four state sites exceeded +0.3°C, resulting in a 26%, rather than a 5% probability of exceeding +0.3°C. The range of temperatures for the state sites was +2.6°C to -0.5°C, with an average of +0.21°C/site, which must be attributed to non-shade natural confounding factors since there was no harvest within 100 feet of the stream. This natural variability should have been addressed and was likely comparable to the natural variability between stations 2 and 3 on the private sites. Failure to adequately address the causes of the temperature increases on the state sites in relation to the private sites is a major omission in the study results.

RipStream study results failed to recognize the significant cooling below harvest units. In the RipStream private sites, cooling 300m downstream from station 3 was equal or greater than the temperature change from station 2 to station 3 for private sites, even though the average harvest unit length was over 700m. The cooling rate was 9 times greater than the rate of temperature change in one-sided harvests and 3 times greater than the average temperature change in two-sided harvests. This is an important detail when determining natural variation and the actual impact of a PCW exceedance. Leaving this information out of the RipStream study results was a major flaw.

There was no final report on how RipStream utilized the RipStream data to calculate the study results. Without such a report, it is almost impossible to understand how RipStream made the conclusions they made with the limited data they had to work with. RipStream's inability to clarify in detail how it manipulated the data to draw its conclusions creates doubts about the study results and how to determine the major limitations in those study results.

Study results need consistent data sources. During the detailed review of four RipStream data sources, the average private site temperature change was found to be 0.50°C to 0.78°C/site. Between these four sources, Argue Cr varied 2.1°C, Toad Salmonberry varied 1.3°C, with other private sites having discrepancies of between 0 and 0.9°C. Discrepancies between data sources were discussed with RipStream but no explanation was offered except three models were used to help interpret the data. Since there's only one set of field data, the only plausible explanation is that such discrepancies result from distortions created within the model. Pending a suitable explanation, temperature change would be more correctly stated as a larger range, rather than the values in the ODF Matrix.

A recently published study refutes RipStream model predictions. Cole/Newton 2013 and 2015 (Ref 7) had 6-fold higher data density than RipStream sites. It was able to show a great deal of year-to-year and inter-site variation over 2 pre-harvest and 6 post-harvest years, with a very strong ability to identify high variance. There were large deviations from steady patterns through the units. This study was able to analyze individual streams, without the data gaps found in RipStream. It demonstrated how flow decreases in summer, different sources of tributaries and hypothetic springs dry up at different times leading to changes in quantity, and where warming/cooling influences take place. Cole/Newton found no PCW exceedance for a 40 foot South sided buffer with a 20 foot buffer on the North side of a forest stream. The RipStream model does not predict the actual temperature measurements in the Cole/Newton research.

Any changes to the riparian rules will permanently impact Oregon's families, jobs, and Oregon's economy. Using the RipStream study results and model with its major accuracy limitations in making a riparian rule change is alarming. Regulatory over reach will significantly cut family profit margins, drastically impacting return on investments, and cause family forest owners to evaluate whether maintaining their forest as forestland is a good choice.

Chapter 1: Flawed Computer Model

The model created to predict buffers to meet different stream temperature increases is critically flawed:

1. The model used incomplete and inaccurate data gleaned from RipStream.
2. The model does not accurately predict real stream buffers and temperature data.
3. The model does not provide the high predictive confidence portrayed in the ODF Matrix provided to the Board of Forestry.

Introduction - The Ripstream model should not be the only tool employed by the Board when making a riparian rule decision. The Board's focus should be on the actual cause of any stream temperature increase, whether it is from natural variability, natural confounding factors, or man-made. The riparian rule decision should be based on actual outcomes from scientific research, common sense and practical experience, to meet the PCW for forest streams. This approach was followed by the Regional Forest Practices Committees (RFPC) when they were asked by the Board of Forestry to recommend a solution.

The biggest limitation of the RipStream study results and the model using the RipStream data was the inability to adequately address natural variability and natural confounding factors (groundwater, tributaries, evapotranspiration, and others) found in forest streams. Most scientists involved in RipStream acknowledge the complexity of determining the cause of stream temperature change and this issue was discussed in the study design. The Study Approach indicated a need for "two years of specific pre-harvest and five years of post-harvest data: to provide a comparison of the inherent variability between harvested and unharvested reaches. Without this control period, differences are assumed to be a result of the treatment and not pre-existing differences....and....to evaluate effectiveness, will utilize a pre/post-harvest measurement design coupled with control reaches". Ref (1).

In various publications, ODF indicated a knowledge of the challenges facing the stuly;

> "Determining changes in stream temperature and attributing them to timber harvest can be difficult because of natural temporal and special variability inherent in these streams. Longitudinal patterns may be highly variable in response to a variety of in-stream, micoclimate, and geologic processes.....stream volumes change seasonally, adjusting the contributing effects of hyporheic and surface flows. Groundwater inflows and outflows also influence stream temperature." Ref (4)

> "Pre-harvest reaches are highly variable, with a wide range of stream temperature conditions and spatial patterns....highlighting the complexity of processes influencing stream temperatures...Longitudinal patterns displayed alternating warming and cooling, with even greater extremes and rates of exchange than other studies...additional processes may determine stream temperature....studies should consider precise measures of substrate, streamflow, and groundwater exchange". Ref (10)

> "We interpret the results to indicate that anti-degradation compliance may be problematic for private lands in the Oregon's Coast Range. Our analysis strictly evaluated a regulatory question: as a consequence, it provides limited insight into the severity of temperature increases or their cause. We additionally do not know the biological significance of the rise in temperature to aquatic life in these systems, the expected duration of expected warming, or the persistence of this warming downstream. We therefore recommend that resulting

policy discussions about riparian standards occur after additional analysis not constrained by specific regulatory language."Ref (4)

There are well-established scientific methods to measure and determine natural confounding factors in streams, in contrast to the temperature change caused by timber harvest. Cole/Newton 2013 and 2015 used these methods by collecting complete and parallel data sets on 4 streams to avoid year to year changes. This approach achieved significantly richer data due to; more stream temperature probes, streamflow measured multiple times per season, air temperature data at each stream, and measurement of the influences of groundwater flux into and away from the stream. This study was also able to suppress natural variability, and determine temperature change associated with timber harvest. Cole/Newton 2013 carefully selected these four streams because of their sustained summer flow. Because of this, critical data was predictably collected and was far less likely to be compromised. The RipStream model does not accurately predict the measured outcomes of the Cole/Newton 2013 study because of its different design and lack of an ability to determine the causes of temperature change.

Although the RipStream study was unique in having many different landowners cooperating in a research study with multiple sites to collect information of stream temperature changes before and after harvest, it did not have the ability of the Cole/Newton 2013 study to determine the difference between natural variability, natural confounding factors, and the changes caused by timber harvest. The RipStream study design called for stream temperature and stream low flow at all four stations in each stream reach and air temperature at each stream reach over a seven years; two pre-harvest and five post-harvest. Additional temperature probes were added at over 130 locations to futher define confounding factors.

Unfortunately, for a variety of reasons, much of the planned Ripstram data was not collected or was compromised by a range of field issues, such as logjams, beaver dams, dry streams, and probe problems. In addition, the special stations specifically set to define tributaries, and significant groundwater sometimes ran dry before data was collected, and so the information needed to accurately determine what temperature changes were caused by nature and that caused by harvest was not collected. Instead, the study assumed the difference in temperature from station 1, 300m above the harvest unit, and station 2 at the top of the harvest unit represented the temperature impact from natural confounding factors for the entire stream reach. This assumption is unprecedented and is not supported by DEQ guidance (Ref 2) or good science and needs to be clearly understood by those using the RipStream information to make a regulatory change purely on the study results. This was a policy call made in the RipStream analysis that needs to be divulged when describing the RipStream study. RipStream did the best they could with the data they had, but a more rigorous study design and more robust data, like the data in the Cole/Newton 2013 study, would have likely had a different conclusion. This is born out when the RipStream model does not accurately predict the results of the Cole/Newton 2013 study.

Reasons for Concern of the RipStream assumptions of Natural Variation

Forest streams can have large variations in both flow and temperature from year to year. To avoid even more variables, it is essential for all streams in a study to be o the same schedule, where by sites are harvested in the same year, so pre- and post-harvest data is comparable. The Ripstream study was originally designed with harvests spread over two years, which was a factor leading to an overall detection level of ±1°C. Unfortunately, the Ripstream harvests were spread over 4 years, which adds significant weather and hydrologic variability to all data and significantly worsens the study's detection level. Side-by-side comparison of data from different sites involves increased inaccuracy, unless extraordinary steps are taken to normalize the data.

Air Temperature - The RipStream study design called for air temperature probes at each stream reach during each monitoring season, however, only 8% of the prescribed probes were actually installed. Instead, RipStream elected to substitute weather data from the nearest RAWS weather station which can be as many as 40 miles away which fails to account for site microclimates and unfortunately worsens the study's overall detection level. ODF did not provide the requested support information regarding the specific details of their use of RAWS stations. Since this is such an essential element of determining natural variation, we looked at RAWS data from 3 stations close to private sites; South Fork, Wilkerson Ridge, and Clay Creek. This data showed significant year to year weather variation, with 2004, 2005, and 2006 being extremely hot years.

Many of the post-harvest temperature measurements, particular those within 2 years following harvest, were made in those years. DEQ's 2008 Directive describes a protocol for dealing with air temperature when measuring stream temperature, which calls for an exception for stream temperature readings when the 7dAM (7-day average maximum) air temperature is above the 90th percentile of the 7dAM, using at least 10 years data. Twelve years data from the Wilkerson Ridge RAWS station, showed that between 2002 -2008, over 60 days, or 20% of the total days in the 7 seasons between 2002 and 2008 exceeded the 90th percentile value. All private sites had pre and/or post-harvest monitoring data collected during this period, and a significant portion should have received the ATE exemption. This speaks to the limitations of the RipStream study results and the model based on the study results.

Stream Flow – Like temperature, stream flow is essential to determine natural vs man caused temperature increases. For a variety of reasons, flow was measured only measured during only 22% of the specified low flow periods. With such meager results, RipStream said that flow for those private sites with some flow measurement, the average pre-harvest flow at station 3, at bottom of harvest unit, was an average of 2 times the flow at station 2, at the top of unit. The amount of flow and the ratio between station 2 and 3 varied as expected, with individual stream showing between 1 to 40 times more flow at station 3 vs 2. After harvest, the average flow increased between station 2 and station 3 by a ratio of 3:1. However, a full set of flow measurements would have been necessary to make a credible analysis.

Such substantial flow change between station 3 and station 2 as well as year-to year variability shows that substantial groundwater and surface water enters the stream, and other studies have also shown groundwater leaving a stream thru various natural processes, such as seepage, evaporation, evapotranspiration, and others. Other studies have demonstrated that the water at station 2 is not necessarily the same water that reaches station 3. RipStream concluded, stream flow was not a factor in the results because they already assumed the natural variability was addressed in the control reach between station 1 and station 2. However, stream flow does influence natural variability and Cole/Newton 2013 clearly shows how it can be used to determine the natural causes of stream temperature change. The RipStream process was incomplete and creates limitations on the validity of the study results and the model created rom those results.

Multiple Years Data – To address natural variability, one needs multiple years of data so the actual causes of stream temperature change can be determined. Ripstream and other studies are designed to analyze multiple years of both pre- and post-harvest data for that purpose; however Ripstream made an unprecedented policy call to make the PCW exceedance determination using only one year pre-harvest and one year post-harvest information. Using such limited data, there is no way to dampen natural variability and therefore provide a credible determination of what are the anthropogenic causes of temperature increases with any degree of accuracy. Ripstream claimed natural variation and natural factors were addressed in reach 1W-2W temperature change, therefore allocating all temperature change between station 2W and 3W as caused by timber harvest. This is in direct conflict with the Study Approach and counter to the actual site conditions. This significantly distorts and exaggerates the actual anthropogenic change between station 2W and 3W. Natural systems are not so neatly divided as this and are significantly more complex. Prevailing practices, as defined in DEQ guidance (Ref 2), as well as Cole/Newton 2013, clearly show the need for multiple data sets, to address natural variability. This allows determination of whether temperature change is natural or man caused.

DEQ's Temperature Standard Implementation Directive includes a hypothetical example of determining a PCW exceedance used by Ripstream. RipStream said they "interpreted the use of only 1year pre-harvest information as the minimally acceptable timeframe to describe ambient conditions" (Ref 4). While such a policy will give a number, it distorts any result and throws all scientific tenets regarding accuracy to the wind. The example in this Directive describes a concept, and inherently expects that natural variation had already been properly addressed outside of the scope of this simple example. RipStream did not have the data to separate natural and anthropogenic causes in temperature change between station 2W and station 3W. Without such data and its analysis, the study results have severely impaired accuracy, as does the model created from the study results.

This chapter has twelve sections that outline the RipStream study results and computer model weaknesses, ending with conclusions:

1. RipStream Goals, Study Design and Field Work did not Address Stream Natural Variability
2. Data Collected Failed to Meet Study Goals
3. Supporting Statements to Section 2
4. Use of Collected Data
5. Comparable Studies Refute ODF Model Predictions
6. Shade is not the Only Parameter Affecting Stream Temperature
7. State Site Data Issues
8. Questionable Decisions Impacted RipStream Results
9. PCW Determination Must First Address Natural Factors at Each Stream
10. Model Mischaracterized Temperature Increase
11. Station 4 Data Not Analyzed for RipStream Study Results
12. Conclusions

1. RipStream Goals, Study Design and Field Work did not Address Stream Natural Variability

The RipStream study was designed to determine, if forest stream temperatures increase following timber harvest under Oregon's Forest Practice Act (FPA) riparian rules and to measure associated shade level and Large Wood Recruitment potential. It was determined that 22 private sites would be needed to accurately predict temperature change within ±1°C accuracy. Natural variability and other natural factors were recognized as essential to address before determining any man-caused temperature increases.

The Ripstream Study Approach specifically identified the need to collect two years of specific pre-harvest data and five years of post-harvest data: "to provide a comparison of the inherent variability between harvested and unharvested reaches. Without this control period, differences are assumed to be a result of the treatment and not pre-existing differences..." and "...to evaluate effectiveness, will utilize a pre/post-harvest measurement design coupled with control reaches". (Ref 1)

RipStream's data did not follow the study plan and the data needed to determine the cause of temperature increase was not always collected, and when collected, not used. Cole/Newton 2013 & 2015 provides an example of the extent of natural variability and that several years of data are necessary to determine whether temperature changes are natural or man caused. When there are less than 2 years of pre-harvest and/or less than 5 years of post-harvest data, natural variability will not be as effectively addressed. Natural confounding factors, such as groundwater, tributaries, and evapotranspiration require complete data from core data stations, as well as special stations, to support site-specific analysis. Without addressing natural variability, complete data sets, and the necessary analysis to determine natural confounding factors, the default assumption that all temperature increase is man-caused (anthropogenic) is patently wrong. RipStreams interpretation of a hypothetical example of testing the PCW in DEQ's Temperature Water Quality Standard Implementation (2008) *Sturdevant* lacked the scientific rigger to make such a determination. This fact alone questions the RipStream study results.

2. Data Collected Failed to Meet Study Goals

To achieve ±1°C accuracy at a 95% confidence level, the Study Approach was designed, requiring 22 private sites and 15 State sites, 2 pre-harvest + 5 post-harvest monitoring years, with specific data requirements and goals (Ref 1). The collected data did not come close to meeting these requirements. The table below and supporting statements describe some of the issues that limit the credibility of the study results and the model using the study results.

	Data Requirement	Goal	Usable Data Obtained	Comment
1	# sites	22 private sites and 15 state sites	18 sites and 13 state sites	Various fireld problems compromised data. For example, Argue Cr & Buck Cr had 57% of their field data was suppressed. Two state sites had no pre-harvest data preventing a pre-harvest baseline and making post-harvest data meaningless.
2	Core data for station 1W to 3W temperature measurements 4W data not used	378 at private sites (=18 sites x 3 x 7) 693 at all sites (=33 x 3 x 7)	300 at private sites 543 at all sites	72% of the core data remained after suppression of compromised data.

3	Special stations for compounding factors	-	134 special stations provided temperature data and 58 stations provided flow data	Special station temperature and flow data was not used in the study results.
4	Pre-harvest data Post-harvest data	2 years 5 years	average 1.3 yrs. temp data average 4.2 years temp data	Typical data sets had; 40 days temperature data, 1/4 the low flow measurements & 1/6 the specified # of air temperature probes
5	Measure low flow	693 @ 1W to 3W +134 special stations measure @ low flow	387 +58 special stations	Only 21% of the specified low flow measurements. Failed to take flow into consideration in study results. Failed to address 7Q10 low flow impact.
6	# Air temperature probes	696 (@100% of reaches)	9% of goal	Needed for PCW air temp exclusion (ATE). At least 67 7DAYMAX readings failed to be suppressed.
7	# Upstream Control Reach per Treatment Reach.	1	1	Need control reach upstream of each harvest unit to analyze individual streams
8	# Downstream Control Reach per Treatment Reach	1	Station 4 data collected for only 49% of sites.	Station 4 data held back from study results.
9	Monitoring season	75 days (July1 to Sept 15 ; Ref 4[12])	40 days; July 15 to Aug 23 (Ref 10)	Only kept 40 days of temperature data, although probes were in place longer. Mid-August & later data needed to define confounding factors
10	Final Report	report due after last monitoring season	no report issued	Difficult to understand the many anomalies, gaps, & decision process without a report
11	Post-harvest monitoring	to start first year following harvest	1st year monitoring data at 6 sites, and 2nd year at 5 sites were suppressed	After the suppression of compromised data, 72% of all data remained.
12	Beaver/debris dams, landslides, wetlands, dry stream	Avoid sites with these features	28% of monitoring data was compromised and suppressed	Field issues compromised data at all sites.

3. Supporting Statements

3.1 The 18 private sites is less than the 22 site goal, resulting in the ±1°C detection level at a 95% confidence level to be missed before the fieldwork started. Severe field problems at Argue Cr, Buck Cr, Siletz Tributary, and other sites caused 28% of the collected data to be purged. The relative weight of sites with fewer data sets should be reduced in all statistical analysis.

3.2 The study design specified core data from stations 1W thru 4W, to provide upstream and downstream control, which are "designed to help isolate management or other effects from natural trends that may occur regardless of management. Harvest unit temperature trends can be compared to these 2 control reaches" (Ref 2). Station 4 also demonstrates downstream cooling.

3.2.1 Temperature change from station 1 to station 2 was intended as a control reach to assist in determining natural variation (OPSW Water Quality Monitoring Guidebook, but instead, RipStream assumed that temperature change represented the temperature impact from natural compounding factors for the entire steam from station 1 to station 3. This assumption runs counter to the actual site conditions and significantly distorts and exaggerates the temperature change between station 2 to station 3.

3.2.2 Station 4 data was collected for more than half the sites, but was not used. This prevented formation of a downstream reach, stream temperature profiles, and the demonstration of downstream cooling for each stream.

3.2.3 Table A shows the pattern of stream temperature data, with 67 data sets suppressed, 17 sites with zero or very low flow problems, and station 4 data was found for over half the sites.

3.3 Many sites had tributaries and groundwater inflow (usually of different temperatures), which cause temperature change and up to 40x flow change, with flow sometimes subterranean and other times negative. See Table A.

3.3.1 Confounding factors must be carefully addressed (Ref 2), and in spite of 20% of the fieldwork directed toward special stations for this purpose, the data was not used and confounding factors were not addressed on any site.

3.3.2 A model can be representative only if it analyzes the scope of all natural factors affecting individual stream temperatures. The Ripstream model did not analyze these.

3.4 There is always year-to-year variation in climate, groundwater flow, and stream runoff, resulting in inherent natural variation in stream flow and temperature. Studies are designed to deal with this by having multiple years of data at each station, before and after harvest, which inherently dampen most natural variation by averaging data. Without multiple years, there can be no data averaging, and no way to define statistical noise in data, hence statistical error. The Study Approach required two years of complete pre-harvest data and DEQ guidance states "it is critical to recognize that without pre-treatment data, inferences about management effects can be weak" (Ref 2).

3.4.1 After the purge of compromised data, there was an average of only 1.3 years of pre-harvest data, and a typical data set was incomplete, with; 21% the low flow measurements, and 8% of the specified number of air temperature probes. As shown in Tables A, B, & C, only 2 private sites (Drift Cr & Gunn Cr) had 2 years of complete temp, flow, & air probe data in the 2 years before harvest. Eleven private sites had 2 years of pre-harvest temperature data, but lacked flow and air probe data.

3.4.2 Similarly, there was an average of 4.2 years of post-harvest temperature data, with the same data shortfalls as the pre-harvest data. Per Table A, B, & C, only

3 private sites (Drift Cr, Gunn Cr, & Sand Cr) had 2 years of complete temp, flow, & air probe data in the 2 years before harvest. Three private sites had post-harvest temperature & flow data within 2 years after harvest, but lacked air probe data. Seven private sites had 2 years of post-harvest temperature data, but lacked flow and air probe data.

3.4.3 Two years of data are also needed to average data to make a pre-harvest baseline for each stream. Station 4 enables a downstream reference, from which it can be determined if a station 2 to 3 change is an aberration, probe malfunction, or viable. Without stations 3 and 4's natural variability can cause station 3 values to be misleading, particularly if there was only one post-harvest year of data, and even more so if there was also only one pre-harvest year of data.

3.4.4 The Study Approach was designed for 5 post-harvest years, which was specified to provide inherent data averaging. ODF did not utilize all post-harvest data, but instead focused solely on the 2-year period immediately following harvest, which provides far less data averaging and made natural variability far worse than it would have been with the original design. One year of data in this period would not have any averaging, and would be equivalent to losing a car's suspension, as every spike in the data (i.e. bump in the road) is noticed far more than normal. Having only 1 pre-harvest and 1 post-harvest data sets, exposes the full effect of natural variability, which leads to erratic values in both pre-harvest and post-harvest data. Considering 2 year periods before/after harvest: 5 private sites had 2 years pre-H + 2 years post-H data; 8 sites had 1 year pre-H + 2 years post-harvest, and 5 sites had 1 year pre-harvest + 1 year post-harvest. If RipStream had used a 3-year post-harvest period, there would have been at least 2 years of data for each site, lessening the effect of natural variability. The original design of 5 years would be the most effective at dampening natural variability and should have been used. The Board should be informed of these data gaps: six sites have four years, three sites (Siletz Tributary, Drift Creek, & Buck Creek) have 3 years, and Argue Creek has only 2 years of post-H data. The relative weight of sites with fewer data sets should be reduced in all statistical analysis.

3.5 The Study Approach specified that flow was to be measured at each station during the low flow period (normally mid-Aug to mid-Sept). However, the flow measurement schedule was erratic; all stream flows were measured once during the 2002 and 2003 period, none during 2004, about half during 2005, and most were again measured in 2006, 2007, and 2008, with none measured in 2009 or 2010. The value of streamflow measurements could have been vastly improved if they were done as specified, i.e.; consistently done each year at each station during the low flow period, with additional measurements as needed to define confounding factors. RipStream data shows some flows were measured 4 weeks before the season (7/15 to 8/23), some measured during the season, and the rest up to 7 weeks afterwards. Early & mid-season flows are of limited value, with low period flows essential to define confounding factors. Field notes show that while most temperature probes were in the field during the low flow period, temperature data was only kept up to August 23rd which is about 1 week after the start of the low flow period. Flow was measured during 34% of the monitoring seasons, and of these, only 22% were during the specified low flow period. Twenty-one percent of the flow measurements were made at the specified time. Stream flow often dwindled during the low flow period, with over half the streams having very low (≤1 l/s) or no flow by the end of one or more seasons. Two private sites had flow measured twice during the late summer of 2008, although confounding factors were not analyzed on these or any other stream. See Table B and Figure 1.

3.6 High air temperature has been shown to have a significant effect on stream temperatures. Air temperature probes were specified to measure hourly in every control, treatment, and downstream control reach. PCW air temperature exclusion (ATE) exempts data when the air is unusually warm. Air probes were set in only 8% of the reaches (Ref 5), which did not adequately monitor the many geographically dispersed sites. Ripstream did not use any onsite temperature data and instead used RAWS weather stations. The exemption trigger point is when a 7dAM exceeds the 90th percentile 7dAM (7-day air max temp), which has a 10% probability of occurring during an average year. RipStream indicated that averages of 3% of the 7-DAYMAX events were suppressed, although 2003 to 2006 seasons had significantly higher than normal temperatures. For example, our analysis shows this rate to be 91% in 2005 at the Wilkerson Ridge RAWS and 30% in 2005 at The Clay Creek RAWS weather station. A 20% suppression rate would be equivalent to the suppression of over 75 private 7DAYMAX events, which would significantly change reported maximum stream temperatures. See Table 3 and Figures a, b, and c.

# monitoring days > 90th percentile 7dAM air temperature									
	Wilkerson Ridge RAWS			Clay Creek RAWS			South Ridge RAWS		
Season	# days > 90th percentile	# days available	% days > 90th percentile	# days > 90th percentile	# days available	% days > 90th percentile	# days > 90th percentile	# days available	% days > 90th percentile
2002	4	33	12%	7	33	21%	0	33	0
2003	9	33	**27%**	13	33	39%	2	33	6%
2004	6	33	18%	9	33	27%	6	33	**18%**
2005	30	33	**91%**	10	33	30%	8	33	**24%**
2006	8	33	**24%**	8	33	24%	7	33	**21%**
2007	0	33	0	0	33		7	33	21%
2008	1	33	3%	1	33	3%	0	33	**0**

# monitoring days > 90th percentile 7dAM air temperature									
2009	1	33	3%	8	33	33%	11	33	33%
2010	0	33	0	0	3	0	5	33	15%
Total	59	297	20%	56	267	21%	46	297	15%

3.7 "Control reaches are essential for isolating the effect of management from natural trends that may occur regardless of management or other impacts. If riparian areas are all intact, then observed temperature trends through the harvest unit can be compared to these control reaches. These reaches should be located upstream and downstream of the harvest unit" (Ref 2).

3.7.1 After compromised data was purged, upstream control reaches were available for all treatment units, and if RipStream had used the station 4 data it collected, then downstream control reaches would also have been available.

3.7.2 A well-defined pre-harvest baseline is a necessary first step and the focus must next be on identifying causation of any temperature increase, whether it is from natural variability, natural confounding factors, or human-made. This study's goal of fully characterizing the pre-harvest period was not realized, making comparison of the inherent variability between the harvested and unharvested reaches limited. It also did not identify the causation of temperature increase, and largely ignored natural variability and confounding factors.

3.7.3 An incomplete assessment of pre-harvest conditions significantly penalizes private sites, since lacking characterization of natural variability and confounding factors, temperature differences unfortunately default to being labeled human-made, rather than their actual cause. RipStream shortfalls directly led to the inability to separate natural from human-made effects on individual streams.

3.7.4 The consequence of RipStream's actions is a model with limited value that ignores the contribution of natural factors and unduly classifies all temperature change as anthropogenic.

3.8 Downstream station 4W data was collected, but not used. Without 4W data, the downstream control function (Ref 2) is not possible, and the effect of natural variability of 3W increases. Downstream cooling rates were computed for several groupings of sites. For all private site groups, the cooling rate was 2.5 to 9 times greater than the rate of temperature change in the harvest unit.

	Ave Temperature Change/Site			
TYPE OF SITE	ODF spreadsheet	ODF Review Mtg Figure	Ave Temp Change/300m	Cooling/300m
All Private Sites	+ 0.73°C	+ 0.50°C	+0.24°C/300m	- 0.78°C
One-Side Harvest 4 @ ave L= 704m	+ 0.34°C	+ 0.26°C	+0.09°C/300m	- 0.80°C

	Ave Temperature Change/Site			
Two Side Harvest 14 @ ave L= 992m	+ 0.84°C	+ 0.57°C	+0.30°C/300m	- 0.77°C
State Sites	n/a	+ 0.20°C	n/a	- 0.04°C

3.9 The 75 day monitoring season was to be July 1 to September 15 (Ref 4) [12]), but data was kept for only about half this time (40 days from July 15 to August 23). As streamflow decreases in summer, different sources of tributaries and hypothetic springs dry up at different times, leading to changes in where warming and cooling influences take place (Ref 7). Temperature data gathered after August 23 was not kept in the database. While some low-season flow data was available, no attempt was made to analyze tributaries and hypothetic sources. Seventy-five day (or longer) monitoring periods and multiple flow measurements during the low flow period would have helped define these sources and their contribution to temperature change.

3.10 Following the last monitoring period, a summary report was to be prepared to explain the process, the data, anomalies, decisions made, and the resolution of issues. Without such a report, ODF's raw data and various spreadsheets are difficult to understand. Groom's technical papers (Ref 4 & 6) primarily explain model setup and assumptions, and do not explain the fieldwork, confounding factors, special stations, air probes, quality assurance or quality control issues, missed project goals, compromised data criteria and the purging process, nor the impact of each on accuracy and statistical variance.

3.11 Post-harvest monitoring was scheduled to start the first year after harvest. However, first year data for 6 sites and second year data for 5 other sites were compromised and their data purged. In total, 21 sites lost 1 or more years of post-harvest data, and on average, 16% of the post-harvest data was purged, shifting the "time after harvest" for some sites by up to a year. RipStream choose to not follow the Study Approach and instead of analyzing 5 years of post-harvest data, created a worst case scenario by focusing solely on the 2 year period following harvest, labeling this the "green-up" period, with the explanation that canopy shade would presumably be lowest, resulting in the greatest effect on stream temperature. However, 5 private sites had only 1 year of post-harvest data in this period, which substantially increased the effect of natural variability on these 5 sites. RipStream should have followed the study design and used all post-harvest data, so that all sites could benefit from the data averaging (see 3.4.4). The 2 year post-harvest "green-up" perspective was made even worse by the many data gaps, and may (or may not) have known that this increased natural variability and therefore increased private site temperature change. Jeremy Groom recommended the use of all post-Harvest data to "tell a richer story" (Ref 11), which is another way of saying that the use of all data, would significantly limit the effect of natural variability. This recommendation has strong merit and should have been implemented. RipSrtream needs to describe what portion of the 2-year "green-up" period temperature change was due to changes in shade/solar radiation and what portion was due to natural variability and other natural factors.

3.12 Sites were to be carefully inspected for beaver dams, landslides, debris, logjams, wetlands, and other potential causes of pooling, since history has shown them to impact stream temperature, and they should be avoided (Ref 1 & 2).

3.12.1 Argue Creek and Buck Creek went dry in mid-August and also had major logjams. Siletz Tributary also had wetlands/beaver dams. State site Knapp Knob had a beaver pond for 4 years.

3.12.2 More than 21 other stations went dry, had stagnant flow, negative flow, pooling, or other issues, leading to over a 1/4 of the monitoring core data to be compromised and subsequently dropped.

3.12.3 Sand Creek #7353 & Smith Creek #5106 have roads parallel to the stream, affecting the riparian canopy. This should have been addressed for potential effects on stream temperature and should have required special analysis in the model.

The purge of a fourth of the monitoring data is a significant activity and the process of selecting criteria, evaluating specific sites, and the purging process is normally a well-documented public process to refute possible claims of data "cherry picking". Normal practice on research studies is to retain all data unless proven to have had fundamentally different conditions or to be outside of established statistical criteria, such as four-sigma probability. For all 33 sites, only 13 had 2 or more years of pre-harvest temperature data, 18 sites had only 1 year, and two sites had none, for an overall average of 1.39 data sets/site. This is far less than DEQ's recommended minimum of 2-years of complete pre-harvest data for each site. Similarly, there was an average of 4.1 years of post-harvest data per site and the process of how post-harvest data sets were kept or purged was not apparent for 7 data sets for the 33 sites. The comparison of sites with less than two years of complete pre-harvest data is tenuous and "inferences about management effects can be weak" (Ref 2).

The RipStream data set was limited, with poor quality, and instead of being used for its intended application, it became the basis for a model used to prescribe regulated buffer widths. The model, created with poorly founded decisions along the way, developed significantly distorted predictive ability, particularly regarding the relationship of stream temperature with prescriptive buffer widths.

Section 3 Summary: The RipStream data set was limited, with poor quality, and instead of being used for its intended application, it became the basis for a model used to prescribe regulated buffer widths. The model, created with poorly founded decisions along the way, developed significantly distorted predictive ability, particularly regarding the relationship of stream temperature with prescriptive buffer widths.

4.0 Use of Collected Data

The collected data fell short of the Study Approach requirements. See Table 1, 1A, 2, and 3. They fell short due to:

4.1 A shortage of core and upstream control reach data;
4.2 Not using special station and 4W data, which was collected, but not used;
4.3 Only measuring half the stream flows, with only half of these made during the specified low flow period;

4.4 A limited number of air temperature probes, which prevented application of the PCW air temperature exclusion at 83% of the sites, resulting in an estimated 12 private 7-DAYMAX events not being suppressed;
4.5 An average of only 1.3 years of pre-harvest data per site, with a typical data set incomplete, due to either half the stated duration, only 1/4 the low flow measurements, and/or 1/6 the specified number of air temperature probes;
4.6 An average of 4.2 years of post-harvest temperature data per site, with a typical data set having the same data shortfalls as the pre-harvest data; and
4.7 A high number of beaver dams, logjams, landslides, dry streams, and subterranean/negative flows caused 1/4 of the monitoring data to be compromised.

Purging this data was necessary, but doing so created numerous data gaps, which significantly increased the effect of natural variability. Natural variability could be dampened by increasing the number of data sets included in the pre-harvest and post-harvest periods under consideration, but ODF's focus only on a 2-year post-harvest "green-up" period prevented this.

These shortfalls prevented a complete data set, which in turn, severely restricted the planned "ability to separate inherent variability from harvest effects" (Ref 6) and the definition of confounding factors on individual streams, which in turn would have allowed determination of what portion of the temperature gain was due to natural factors and what portion was anthropogenic. When RipStream abandoned individual stream analysis and instead commingled site data in a single pool and looked for "central tendencies" in the commingled data pool, the opportunity to determine natural factors was lost.

Individual stream variability, confounding factors, and channel characteristics were noted as being significant enough to warrant future study (Ref 4[48]). By not addressing them now, the default course led to the erroneous assumption that temperature differences are solely the result of treatment, rather than their actual cause. DEQ's guidebook states, "...it is critical to recognize that without pre-treatment data, inferences about management effects can be weak" (Ref 2). In the end, private landowners could be forced pay the price for RipStream's incomplete data and its cascading effects.

The cumulative effect of fewer sites, missed study data requirements and goals undoubtedly reduced accuracy to well above ±1°C and increased statistical variance, although RipStream did not specifically evaluate either, nor was this topic mentioned in the buffer options matrix prepared for the Board. Temperature data were also to be "given a quality rating based on length of record and data logger problems" (Ref 1), but there is no record of this rating. The reduced accuracy and the inability to define the cause of temperature change severely limits credible use of the data.

Studies designed to directly compare site buffer designs strive to have the same schedule and strive to normalize the effects of inter-year weather and streamflow variability. Direct site comparison was not a stated objective for the RipStream study. The study was planned around harvests in a 2-year period and was expected to result in complete data sets. RipStream harvests were actually spread over a 3-year period and, when coupled with the many data gaps, resulted in very few sites having comparable schedules and data sets. This makes comparison of out-of-sync sites tenuous and further reduces accuracy and increases variance. Commingling data from out-of-sync sites is similarly tenuous and results in further accuracy reduction and increased variance.

External reviewers of the Ripstream study indicated that their involvement was primarily in the planning phase, and that their role in developing assumptions, data analysis, and write-ups was limited. They expressed frustration that many of their recommendations were not seriously considered. They did not know that the end use of the data and model could possibly be used as the basis for regulatory change, which they emphasized. Such a study requires a far more rigorous approach and far better accuracy than described in the Study Approach (Ref 1).

5. Comparable Studies Refute ODF Model Predictions

Cole and Newton (Ref 7) had 6-fold higher data density than RipStream sites and because of this, was able to show a great deal of year-to-year and inter-site variation over 2 pre-harvest and 6 post-harvest years, with a very strong ability to identify high variance and showed far larger deviations from steady patterns through the units. This study was able to analyze individual streams, because it did not have data gaps or issues with core data, partial monitoring data, flow measurement, limited air probes, limited control reaches, or confounding factors. This study also showed that as flow decreases in summer, different sources of tributaries and hypothetic springs dry up at different times, leading to changes in quantity and where warming/cooling influences take place.

In Cole and Newton, seven harvests with 50 foot "no touch" buffers showed negligible temperature change. Three different buffer designs enabled specific data to be collected regarding their influence on stream temperatures. This study also had four "no buffer" harvests, to purposefully enhance unit warming and downstream cooling.

ODF chose to ignore the entire Cole and Newton study, arguing that there was some temperature carry-over from the "no-tree buffer" harvests into downstream units. They ignored an easy mathematical adjustment for it. The study is published research from two top researchers in this field and its findings should not have been suppressed. Private external reviewers recommended that this study be used to field validate the RipStream model, but ODF rejected this suggestion.

ODF's 1996 report on 17 coastal streams (Ref 8) showed similar patterns and a summary of these two studies is presented in Figures 1 to 4. Figure 1 shows the average pre-harvest and post-harvest temperature change for 3 different buffer designs; hardwood conversion (7 sites), 50 ft. no-touch both sides (10 sites), and 40 ft. buffer south-side only (7 sites), as negligible (-0.1°C , 0 °C, and -0.2 °C , respectively). The cooling rate in reach 3W-4W averaged 4 times higher than the reach 2W-3W average warming rate. These figures are based on actual field data, with the actual natural variability of individual sites shown in the graphs at the end of the attachments. These graphs also show the average temperature changes with each harvest prescription.

6. Shade is not the Only Parameter Affecting Stream Temperature

ODF admits that it is difficult to detect changes in stream temperature and attribute them to timber harvest, because of natural temporal and spatial variability inherent in these systems and confounding factors (Ref 4 [6]). Normal practice is to investigate each confounding factor and aberration for root cause and weight their influence. Cole and Newton (Ref 7) clearly shows that confounding sources of warming and cooling waters in a harvest unit have important influence on recorded temperatures. This study also shows year to year variation between pre-harvest and post-harvest warming rates, as well as the change that comes with harvest. ODF stream temperatures. This unfounded assumption that all temperature change is entirely due to timber harvest, rather than its actual cause started a chain of assumptions that is simply not true. The model developed on these assumptions does not accurately reflect real conditions.

Modeling shade-only scenarios results in a gross distortion of shade's influence, leading to the unfounded conclusion that large "no cut" buffers are needed to ensure a temperature increase of no more than 0.3°C.

While average private site shade change was 9%, RipStream had no actual field data proving a consistent relationship between buffer shade to stream temperature. Cole and Newton (Ref 7) measured solar radiation directly, and demonstrated that 40 foot buffers provide all possible shade and were adequate to limit stream temperature change. Cole and Newton's 2015 study of solar radiation (Ref 9) shows no significant differences between no harvest, 50 foot no-touch buffers on both sides, or 40 foot South-side only buffers. Data for the later design demonstrates minimal additional benefit from North-side buffers. This real data conflicts with the ODF model predictions and demonstrates the Ripstream model's limitations in determining riparian prescriptions.

7. State Site Data Issues

State sites are not consistent with the Ripstream model projections. Reporting on pre-harvest temperature patterns, Dent wrote that "additional processes may determine stream temperature when shade and canopy cover are consistently high" (Ref 10). The post-harvest temperature rise at three state sites exceeded 0.3°C, with two over 2.0°C , with an average post-harvest increase of +0.36°C for the 13 state sites with one or more years of pre-harvest data (ref 6, Fig 3). This demonstrates the general magnitude of natural variability and natural confounding factors that might be encountered at an average RipStream site with minimal shade change. One could expect the same range of natural variability to be found on the private sites. These real measurements do not align with ODF model predictions or statements, and raise the question why a separate model was not created for the state sites.

State site data is not accurately represented in the RipStream study results. Four state sites exceeded +0.3°C, resulting in a 26%, rather than a 5% probability of state sites exceeding +0.3°C. The range of temperatures for the state sites was +2.6 °C to -0.5°C and must be attributed to site-specific, non-shade factors since there was no harvest within 100 feet of the stream. The range of temperatures on the private sites were +2.6°C to -0.6°C, basically the same.

Four state sites also had beaver/debris dams or landslides, and should have been flagged as sites with low confidence data. They were not. Two state sites had no pre-harvest measurements and should have been removed from the study, but were averaged in with the other sites to calculate a state site average.

8. Questionable Decisions Impacting RipStream Results

Argue Creek and Buck Creek had fundamentally different conditions, such as logjams, pooling, and dry beds. These were natural effects, not human-made. External reviewers recommended that these sites be entirely removed from the study, but they were not, due to a desire to keep the statistical "n" number up. Instead, 4 years of Argue Creek data and 3 years of Buck Creek data were purged. This decision significantly impacted the average private site temperature change, since if Argue Creek and Buck Creek had been dropped, the average private site temperature change would be +0.48°C rather than +0.7°C. These sites were also noted as exceeding +0.3°C, and dropping them would reduce the percentage of private sites exceeding 0.3°C by 11%.

Shangri-La Creek had only one pre-harvest and one post-harvest year (in the green up period), so comparisons or inferences about harvest effects are weak (Ref 2). Shangri-La Creek was 0.11°C of the private site average, so its exclusion would further reduce the private site average to +0.37°C and the percentage of private sites exceeding PCW would drop to 24%. Siletz Creek had a beaver pond and wetlands, and had 3 years of data purged, even though it had minimal temperature change. The relative weight of sites with reduced data sets should be reduced in data averages or comparisons.

9. PCW Determination Must First Address Natural Factors at Each Stream

The PCW criterion limits anthropogenic activities that increase stream temperatures by more than +0.3°C above pre-harvest conditions. A well-defined pre-harvest baseline is a necessary first step, with the focus on identifying whether the cause of any temperature increase is natural variability, natural confounding factors, or human-made. As discussed above, RipStream's goal of a fully characterized 2 year pre-harvest period and 5 years of post-harvest monitoring were not realized, and many sites were left with only 1 year of partial data in the 2 year period before harvest and/or the 2 year period after harvest. The planned analysis of individual stream variability was not done, which prevented comparison of the inherent variability between harvested and unharvested reaches weak. Confounding factors for individual streams were also not addressed, even though 20% of the field data was specifically targeted for this purpose. When ODF abandoned individual stream analysis and commingled all site data in a single pool, the opportunity to address site natural variability and define confounding factors was lost. Any temperature difference unfortunately defaults to be anthropogenic and not its actual cause.

The PCW standard requires ±0.3°C accuracy, which requires study of at least 244 sites (or fewer sites with more probes), and field methods better than the ±0.5°C accuracy/precision associated with Level A data quality (Ref 2). DEQ guidance also defines rigorous SAP (Sampling and Analysis Plan) and QAPP (Quality Assurance Project Plan) are both needed for such an effort. Unfortunately, adopting a ±0.3°C standard can't improve the RipStream study's issues and poor accuracy. This should have been explained to the Board.

10. Model Mischaracterized Temperature Increase

When landowners harvest in an RMA, they typically do not remove all trees allowed for a variety of practical and operational reasons. Not all hardwoods are removed from an RMA. RipStream measured pre and post-harvest basal area by sampling 500 foot long by 170-foot wide vegetation plots in each unit, with the goal of using this data to help estimate large wood recruitment.

RipStream later used this limited basal area information to estimate how much additional basal area was left on the private sites beyond what is required in the FPA. After developing the ODF model, they then predicted what the temperature increases would have been by removing (in the computer model) all excess basal area, both conifer and hardwood. These were an arbitrary and capricious series of decisions that does not reflect reality, or provide a fundamental basis for making any amendments to current FPA rules.

The model projected that this hypothetical buffer would result in a 1.45°C average increase. Ignoring objections, ODF chose to conclude that current FPA rules would cause a 1.45°C increase, not the 0.7°C actually measured. ODF needed to first define the portion of this increase caused by natural variability and confounding factors, but instead sidestepped this task, and took the easy out of assuming that all temperature increase was harvest related. Using the model to predict the temperature changes from a FPA harvest lacks common sense and any practical experience in harvesting around forest streams.

As a reality check, in Cole and Newton (Ref 7), 4 harvests with 50 ft. no-touch buffers averaged +0.1°C rise and 4 harvests with partial south-side buffers averaged 0°C rise. The ODF model projection is flawed and does not predict real world scenarios.

11. Station 4 Data Not Analyzed for RipStream Study Results

The temperatures at station 4 are critical in calculating natural variability and also critical in determining whether a temperature increase is a PCW exceedance. There are three exceptions to a PCW exceedance when a stream temperature exceeds 0.3°C. One is "...colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperatures criteria." In other words, if the stream temperature returns to its normal temperature downstream from the exceedance it is not a violation of the PCW. From the RipStream data, OSWA has calculated that on average, stream temperatures on the private sites returned to normal at station 4. The RipStream study has yet to make that calculation and assumed station 4 would react similar to DEQ *[Boyd and Strudevant, 1997; DEQ, 1995]*. That assumption is wrong. There are many studies like Newton 1997 and Cole and Newton 2013 that show stream temperatures return to normal 300 meters downstream from a timber harvest. OSWA believes the RipStream data will show the same thing when finally published.

Conclusions

Headwater streams are known to have erratic flow and temperature changes, and were specifically selected for RipStream. Because of the significant challenge of headwater streams, RipStream fieldwork did not fulfill its data requirements. This led to numerous shortfalls in stream temperature, air temperature, and flow measurement core data as well as monitoring season duration. These challenges reduced study accuracy and increased variance. Essential data collected at station 4 and special stations to address natural variability were not used in the study results. Overall, 28% of the data was compromised and had to be suppressed, however, the criteria and process for doing so was not documented and thus is vulnerable to future claims of data 'cherry picking'. Data suppression caused significant data gaps impacting the ability to determine natural variability and the accuracy of the study. All fieldwork was to be described in a report, but no report was produced.

After all data was collected, data gaps cannot be retroactively filled to address new goals or to improve accuracy. Similarly, a study can't retroactively be pushed beyond its technical validity. To compare stream sites on an equal basis, common practice is to normalize weather and runoff by synchronizing all sites on the same schedule. RipStream sites were on four different schedules and had different data gaps. Direct site comparison or commingling site data into a common data pool resulted in reduced accuracy and increased limitations in the results.

RipStream did not follow the planned analysis of individual streams and missed the all-important goal of separating natural variability and natural factors from harvest-caused effects. Contrary to

References

1) Study Approach V2.2, Riparian Function & Stream Temperature: Effectiveness of Protection Rules & Strategies, Oregon Department of Forestry, February 2003.

2) OPSW Water Quality Monitoring Guidebook, DEQ.

3) 8/13/15 e-mail from Peter Daugherty to Greg Peterson.

4) Stream Temperature Change Detecting for State and Private Forests in the Oregon Coast Range, Groom, 2011a.

5) SITE NOTES 8/6/09, Oregon Department of Forestry.

6) Response of western Oregon stream temperatures to contemporary forest management, Groom, et al, 2011b.

7) Influence of streamside buffers on stream temperature response following clear-cut harvesting in western Oregon, Cole & Newton, NRC Research Press, 2013.

8) Temperature and streamflow regulation by side stream Cover, Newton & Zwieniecki, Oregon Department of Forestry,1996.

9) Relationships between radiation and canopy closure in streamside buffers in Western Oregon, Cole and Newton, Forest Science, 2015.

10) Summer Temperature Patterns in Headwater Streams of the Oregon Coast Range, Journal of the American Water Resources Association, August 2008

11) J. Groom, ODF/Regional Forest Practices Advisory Committee meeting, 3/3/11

Chapter 2: Practical Recommendations

Rejecting a flawed computer model, the Board's focus needs to be on the causation of any temperature increase, whether it is from natural variability, natural causes, or human-caused.

The Board's policy should be based on actual outcomes from scientific research, common sense and practical experience, to meet the PCW for forest streams. This approach was followed by the Regional Forest Practices Committees (RFPC) when they were asked by the Board to recommend a solution.

RFPC Approach

The committees approach to determine what changes are needed to address temperature issues include:

1. Analyze the sites in the RipStream study that had big temperature increases,
2. Determine the probable causes for the increases, and
3. Develop some rules to mitigate those causes.

That is what the Board asked the RFPCs to do. That is exactly what they did. After thoroughly reviewing all the sites in the study, evaluating the situations at each site compared to the flawed computer-modeled temperature increases at each site, the RFPC came up with a common sense recommendation that will meet the PCW.

ODF has not portrayed the anticipated outcomes of the RFPC recommendations accurately.

Although OSWA believes the RipStream data and results are flawed, as described, here is a list of common sense reasons why the RFPC recommendations will meet PCW.

1. The average temperature increase from the current FPA is 0.66°C, not 1.45 °C as the ODF model suggests. The measured increase would be 0.48 °C had the private sites impacted by non-human caused factors been removed from the average. Following the FPA, 40% (7 of the 18 sites) had increases at or below 0.3°C and 66% (12 of the 18 sites) averaged at or below 0.3°C.

2. The five sites with 70% of the average temperature increases in the study had obvious openings and gaps in the riparian areas that impacted the increases. The RFPC addressed these issues by:
   - 2.1 Recommending riparian leave trees be better distributed in the buffer areas and minimizing the gaps that can occur with the current rules.
   - 2.2 Adding basal area requirements to the riparian rules, doubling the basal area requirements for small streams and by 50% for medium streams.
   - 2.3 Recognizing one sided buffers do not have the same impact as two sided buffers so giving landowners options for harvesting only one side of a stream and allowing time for green up before harvesting the other side.
   - 2.4 Recognizing that the north sides of streams require less of a buffer to protect stream temperature, the RFPC recommended an alternative practice where landowners could remove more from the north side of a stream if they add basal area to the south side.

3. The Cole and Newton 2013 research clearly demonstrates measured temperature results for a 40-foot south sided buffer, with smaller buffers on the north side, with average

temperature increases below the PCW. The additional basal area requirements in the RFPC recommendations would create buffers on medium streams that would easily exceed 40 feet, and on small streams approach 40 feet.

Further evidence the current rules with RFPC recommendations will meet exceed the PCW.

1. ODF's compliance audits show that 50% of landowners do not enter the RMA during harvest, leaving 50 foot no touch buffers on small streams and 70 foot no touch buffers on medium streams.
2. ODF's compliance audits also show landowners leave many of their required wildlife trees in the RMA. The FPA gives ODF authority to ask a landowner to leave 25% of their wildlife trees in the RMA.

The Regional Forest Practices Recommendations Address the PCW to the Maximum Extent Practicable

Monitoring

OSWA believes a monitoring program is needed to continue to evaluate riparian issues in forest streams. New science that addresses both the biological and regulatory issues is essential.

New Riparian Rules will need to be monitored for effect in meeting the PCW. OSWA promotes a new study be done that uses recognized procedures for calculating natural variations in forest stream temperatures and temperature changes associated with timber harvest. This will require considerably more temperature probes than were used in the RipStream study. To minimize variables, all pre-harvest and post-harvest activities and measurements need to be in the same year. Different buffer widths and conditions need to be included, including one sided and two sided harvests. The stream direction also needs to be addressed to recognize the impact that Southern and Northern exposure has on stream temperatures. There also need to be an adequate number of both small and medium streams to determine the differences associated with steam size.

Attachments

Table A - RipStream Stream Temperature Summary - Referenced section 3.3

Table B - RipStream Data Stream Flow Measured relative to low flow – Referenced section 3.5

Figure 1 - RipStream Recorded Low Values at stations 1, 2, and 3. – Referenced section 3.5

Table C - RipStream Number of Air Probes per site – Referenced section 3.6

Figure a - Remote Automated Weather Stations (RAWS) summary information graphically showing about 20% of the 7dAM value for RipStream monitoring days exceeding the 90th percentile 7dAM

Figure b – Wilkerson Ridge RAWS Air Temp showing about 20% of days exceeding 90th percentile 7dAM

Figure c - Clay Creek RAWS Air Temp showing about 21% of days exceeding 90th percentile 7dAM

Figure d - South Fork RAWS Air Temp about 15% of days exceeding 90th percentile 7dAM

Table 1 – Private Site Summary from various RipStream sources

Table 2 - State Site Summary from various RipStream Sources

Table 3 - One-side Harvest Private Site Summary information

Table 1A – Detailed Summary of all Private Sites from various RipStream sources

Cole/Newton 2013 and 2015 graphs showing temperature effects on natural variation and showing temperature impacts of different harvest treatments.

Table A: Stream Temperature Seasons

ID	SITE NAME/ (State yeillow)		2002	2003	2004	2005	2006	2007	2008	2009	2010
5101	**Area 5 - Cook East**	*w/o PreH, PostH is meaningless. '07 big landslide*	FRE 1 suppressed	FRE 2 suppressed	FRE 3 suppressed	POST 1	POST 2	POST 3	POST 4 suppressed	POST 5 suppressed	
5102	Area 5 - Wolf's Foot	*which 2 of 3 pre-H ?*	FRE 1	no flow data	no flow data	POST 1	POST 2	POST 3	POST 4	no flow data	
5103	**Area 2 - Eck Creek**	*last day 04 season*	FRE 1 suppressed	no flow data	no flow data	no flow data	POST 3	POST 4	POST 5		
5104	Area 3 - Bale Bond (Miller Cr)	*03 15d season, '07 major landslide*	FRE 1 suppressed	no flow data	no flow data	POST 1	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed	
5106	Smith Cr RO044	*which 2 of 3 pre-H ?*	FRE 1	no flow data	no flow data	POST 1	POST 2 suppressed	no flow data	POST 4	no flow data	
5201	Nettle Meyer Combo - 2		FRE 1	FRE 2 suppressed	FRE 3 suppressed	POST 1	POST 2	no flow data	39d early; 1/1	no flow data	
5202	West Creek Combo		FRE 1	no flow data	no flow data	POST 1 suppressed	POST 2	no flow data	no flow data	no flow data	
5203	Big South Fork		FRE 1	FRE 2 suppressed	POST 1 suppressed	no flow data	POST 3	no flow data	no flow data		
5204	Ecola Creek / Ice Box		FRE 1	no flow data	no flow data	no flow data	POST 3	no flow data	POST 5 suppressed		
5205	Shangrila Cr		FRE 1	no flow data	POST 1 suppressed	no flow data	POST 3	no flow data	no flow data		
5206	**Section 27**		no flow data	no flow data	no flow data	no flow data	POST 3	no flow data	POST 5 suppressed		
5207	**Toad (Salmonberry)**		FRE 1	no flow data	no flow data	no flow data	POST 3	no flow data	POST 5 suppressed		
5253	**W. Hunt Cr. (McNary Cr.)**	*0 flow '06 1W*		FRE 1 suppressed	no flow data	no flow data	0 flow	no flow data	POST 2 suppressed	no flow data	no flow data
5301	Cezanne 2		FRE 1 suppressed	no flow data	no flow data	no flow data	POST 2	POST 3 suppressed	POST 4	no flow data	
5302	South Fork Trask River		FRE 1 suppressed	FRE 2 suppressed	no flow data	no flow data	POST 1	no flow data	POST 3	no flow data	no flow data
5354	McKnob (Gnat Cr.)	*04 to 08 Sta 2W & 3W out of sequence in data base, & likely mislabeled*		FRE 1 suppressed	no flow data	no flow data	FRE 4 suppressed	POST 1	POST 2	no flow data	no flow data
5355	Lotta Thin (Northrup Cr.Tr.)	*08 no T data, 09-10 Beavers*		no flow data	FRE 2 suppressed	no flow data	POST 1	no flow data	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed
5502	**Bridge Forty Creek**		FRE 1 suppressed	no flow data	FRE 3 suppressed	no flow data	Aug 14; 15/1	Sep 6; 11/1	10d early; 12/1	no flow data	no flow data
5503	Siletz River tributary	*BEAVER DAM '05 TO '09*	FRE 1 suppressed	no flow data	no flow data	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST 5	BEAVER DAM '05 TO '09	
5506	**Mary's River headwaters**		FRE 1	no flow data	no flow data	no flow data	11d late;	34d late;	8d early;		
5556	Drift Creek Trib.	*which 2 of 3 pre-H ?*		FRE 1	no flow data	FRE 3	POST 1	POST 2	POST 3 suppressed	no flow data	POST 5 suppressed
5557	**Buck Creek**	*LOGJAM '06 TO '10. DRY STREAMS SHORT SEASONS*		FRE 1 suppressed	no flow data	25 d season	0 flow	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed	
5558	**Gunn/Blue-Jay Creek**	*which 2 of 3 pre-H ?*		FRE 1	no flow data	FRE 3	POST 1	POST 2	negative 2W flow	no flow data	no flow data
5559	**Elk Creek North**			FRE 1 suppressed	no flow data	POST 1	subterranean flow	no flow data	POST 4	no flow data	
5560	**Elk Creek South**	*last day 03 & 04 seasons*		FRE 1	no flow data	POST 1	POST 2	no flow data	POST 4	no flow data	
5561	Green Back (Yaquina R.)	*03 2W dry season end, 07 1W negative*		FRE 1	no flow data	no flow data	FRE 4 suppressed	negative flow	POST 2	no flow data	no flow data
7353	**Sand Creek**	***Which pre-H yr in Groom spreadsheet?***		FRE 1 suppressed	no flow data	no flow data	POST 1	POST 2	POST 3	no flow data	no flow data
7452	**Schumacher Ridge**	*DRY STREAM, SHORT SEASONS*		dry 2W, 3W probes	no flow data	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST [illegible] suppressed		
7453	**Howell Creek**	*LIMITED T & FLOW DATA*		FRE 1 suppressed	POST 1 suppressed	POST 2 suppressed	0 flow	POST 4 suppressed	POST 5		
7454	**West Fork Silver Creek**	*03 & 04 Sta 2W & 3W out of sequence in data base, & likely mislabeled*		FRE 1	no flow data	POST 1	POST 2	POST 3	POST 4	no flow data	
7801	Knapp Knob Unit	*05 TO 07 Beaver Dam*	FRE 1	FRE 2 suppressed	no flow data	POST 1 suppressed	POST 2 suppressed	POST 3 suppressed	POST 4	no flow data	
7803	**North Nelson Unit**	*which 2 of 3 pre-H ? '07 3W 7day max falls in season gap*	FRE 1	no flow data	FRE 3 suppressed	no flow data	POST 1	POST 2	POST 3 suppressed	–	no flow data
7854	**Argue Creek**	*LOGJAM '06 TO '08. DRY STREAM, SHORT SEASONS*		FRE 1 suppressed	FRE 2	25 d season	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	only '09 T data available. '08 used in Review Mtg F[illegible]	
15	# State Sites (18 private)										

HARVEST

Table B: Date Streamflow Measured Relative to Low Flow Period (8/15 to 9/15) & 3W/2W Ratio

ID	SITE NAME/ (State yellow)	Issue;	2002	2003	2004	2005	2006	2007	2008	2009	2010
5101	**Area 5 - Cook East**	*Big '07 landslide*	*PRE 1 suppressed*	*PRE 2 suppressed*	*PRE 3 suppressed*	12d early; 13/1	5d late; 13/1	Aug 15; 4/1	*POST 4 suppressed*	*POST 5 suppressed*	
5102	Area 5 - Wolf's Foot		Aug 13; 1.5/1	no flow data	no flow data	18d early; 1/1	Sep 7; 2/1	32d late; 1.2/1	16d early; 0.8/1	no flow data	
5103	**Area 2 - Eck Creek**		*PRE 1 suppressed*	no flow data	no flow data	no flow data	Aug 23; 3/1	Aug 20; 3/1	Sep 2; 1.2/1		
5104	Area 3 - Bale Bond (Miller Cr)	*MAJOR LANDSLIDE 07+*	*PRE 1 suppressed*	no flow data	no flow data	Aug 4; 2/1	*POST 2 suppressed*	*POST 3 suppressed*	*POST 4 suppressed*	*POST 5 suppressed*	
5106	Smith Cr RO044		9d early; 3/1	no flow data	no flow data	20d early; 2/1	*POST 2 suppressed*	no flow data	22d early; 5/1	no flow data	
5201	Nettle Meyer Combo - 2		Aug 19; 1.4/1	*PRE 2 suppressed*	*PRE 3 suppressed*	14d early; 1.3/1	Aug 28; 1.3/1	no flow data	39d early; 1/1	no flow data	
5202	West Creek Combo		Aug 20; 1.8/1	no flow data	no flow data	*POST 1 suppressed*	Aug 30; 0.8/1	no flow data	no flow data	no flow data	
5203	Big South Fork		Aug 21; 1.4/1	*PRE 2 suppressed*	*POST 1 suppressed*	no flow data	Aug 29; 3/1	no flow data	no flow data		
5204	Ecola Creek / Ice Box		Aug 22; 1.5/1	no flow data	no flow data	no flow data	Aug 29: 1/1	no flow data	*POST 5 suppressed*		
5205	Shangrila Cr		Aug 29: 1.1/1	no flow data	*POST 1 suppressed*	no flow data	Aug 24: 0.6/1	no flow data	no flow data		
5206	**Section 27**		no flow data	no flow data	no flow data	no flow data	Aug 29: 6/1	no flow data	*POST 5 suppressed*		
5207	**Toad (Salmonberry)**		Aug 23; 6.6/1	no flow data	no flow data	no flow data	Sep 5; 6/1	no flow data	*POST 5 suppressed*		
5253	**W. Hunt Cr. (McNary Cr.)**			*PRE 1 suppressed*	no flow data	no flow data	*0 flow*	no flow data	*POST 3 suppressed*	no flow data	no flow data
5301	Cezanne 2		*PRE 1 suppressed*	no flow data	no flow data	no flow data	4d late; 2/1	*POST 3 suppressed*	Aug 21; 0.4/1	no flow data	
5302	South Fork Trask River		*PRE 1 suppressed*	*PRE 2 suppressed*	no flow data	no flow data	Sep 14; 2.2/1	no flow data	Sep 4; 2.3/1	no flow data	no flow data
5354	McKnob (Gnat Cr.)			*PRE 1 suppressed*	no flow data	no flow data	*PRE 4 suppressed*	18d early; 2/1	35d early; 2.4/1	no flow data	no flow data
5355	Lotta Thin (Northrup Cr.Tr.)	*BEAVER DAM, '09 & '10*		no flow data	*PRE2 suppressed*	no flow data	Aug 30; 0.4/1	no flow data	*POST 3 suppressed*	*POST 4 suppressed*	*POST 5 suppressed*
5502	**Bridge Forty Creek**		*PRE 1 suppressed*	no flow data	*PRE3 suppressed*	no flow data	Aug 14; 15/1	Sep 6; 11/1	10d early; 12/1	no flow data	no flow data
5503	Siletz River tributary	*BEAVER DAM '05 TO '09*	*PRE 1 suppressed*	no flow data	no flow data	*POST 2 suppressed*	*POST 3 suppressed*	*POST 4 suppressed*	*POST 6 suppressed*		
5506	**Mary's River headwaters**		Sep 10; 0.8/1	no flow data	no flow data	no flow data	11d late; negative flow	34d late; 1.3/1	8d early; 1.1/1		
5556	Drift Creek Trib.			60d early; 1.4/1	no flow data	26d early; 1/1	13d late; 1.2/1	30d late; 1.8/1	*POST 3 suppressed*	no flow data	*POST 6 suppressed*
5557	**Buck Creek**	*LOGJAM '06 TO '10, DRY STREAMS SHORT SEASONS*		*PRE 1 suppressed*	no flow data	Aug 16; 30/1	*0 flow*	*POST 3 suppressed*	*POST 4 suppressed*	no flow data	
5558	**Gunn/Blue-Jay Creek**			52d early; 2/1	no flow data	28d early; 1/1	Aug 31; 5/1	30d late; 2/1	negative 2W flow	no flow data	no flow data
5559	**Elk Creek North**			*PRE 1 suppressed*	no flow data	25d early; 1/1	subterranean flow	no flow data	Aug 19; 0.2/1	no flow data	
5560	**Elk Creek South**			57d early; 1.5/1	no flow data	25d early; 4/1	4d late; 1/1	no flow data	44d early; 9/1	no flow data	
5561	Green Back (Yaquina R.)	*'07 1W negative flow*		43d early; 2/1	no flow data	no flow data	*PRE 4 suppressed*	negative flow	Sep 3; 1.5/1	no flow data	no flow data
7353	**Sand Creek**			*PRE 1 suppressed*	**PRE 2 suppressed**	no flow data	Sep 13; neg flow	3d early; 0.3/1	Aug 14; 3/1	no flow data	no flow data
7452	**Schumacher Ridge**	*DRY STREAM, SHORT SEASONS*		37d early; 40/1	no flow data	*POST 2 suppressed*	*POST 3 suppressed*	*POST 4 suppressed*	*POST 5 suppressed*		
7453	**Howell Creek**	*LIMITED T & FLOW DATA*		*PRE 1 suppressed*	*POST 1 suppressed*	*POST 2 suppressed*	*0 flow*	*POST 4 suppressed*	30d early; 1.2/1		
7454	**West Fork Silver Creek**			39d early; 3/1	no flow data	Aug 18; 1.9/1	Aug 23; 1.6/1	Aug 7; 1/1	Aug 23; 0.4/1	no flow data	
7801	Knapp Knob Unit	*BEAVER DAM '05 TO '07*	15d early; 1/1	*PRE 2 suppressed*	no flow data	*POST 1 suppressed*	*POST 2 suppressed*	*POST 3 suppressed*	Aug 25; 6/1	no flow data	
7803	**North Nelson Unit**		16d early; 0.5/1	no flow data	*PRE 3 suppressed*	no flow data	10d late; 0.3/1	Sept 17; 0 flow	*POST 2 suppressed*	-	no flow data
7854	**Argue Creek**	*LOGJAM '06 TO '08, DRY STREAM, SHORT SEASONS*		*PRE 1 suppressed*	5d early, 2/1	no flow data	*POST 2 suppressed*	*POST 3 suppressed*	*POST 4 suppressed*	no flow data	
15	# State Sites (18 private)		17	**# sites with 0 or very low flow (≤1 l/s)**							

Table C: # of Air Temperature Probes/ Site

ID	SITE NAME/ (State yellow)	2002	2003	2004	2005	2006	2007	2008	2009	2010
5101	Area 5 - Cook East	PRE 1 suppressed	PRE 2 suppressed	PRE 3 suppressed	POST 1	POST 3		POST 4 suppressed	POST 5 suppressed	
5102	Area 5 - Wolf's Foot	PRE 1	PRE 2	PRE 3	POST 1	POST 2	POST 3	POST 4	POST 5	
5103	Area 2 - Eck Creek	PRE 1 suppressed	OTHER 1	POST 1	POST 2	POST 3	POST 4	POST 5		
5104	Area 3 - Bale Bond (Miller Cr)	PRE 1 suppressed	PRE 2	PRE 3	POST 1	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed	
5106	Smith Cr RO044	PRE 1	PRE 2	PRE 3	POST 1	POST 2 suppressed	POST 3	POST 4	POST 5	
5201	Nettle Meyer Combo - 2	PRE 1	PRE 2 suppressed	PRE 3 suppressed	POST 1	POST 2	POST 3	POST 4	POST 5	
5202	West Creek Combo	PRE 1	PRE 2	PRE 3	POST 1 suppressed	POST 2	POST 3	POST 4	POST 5	
5203	Big South Fork	PRE 1	PRE 2 suppressed	POST 1 suppressed	POST 2	POST 3	POST 4	POST 5		
5204	Ecola Creek / Ice Box	PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5 suppressed		
5205	Shangrila Cr	PRE 1	PRE 2	POST 1 suppressed	POST 2	POST 3	POST 4	POST 5		
5206	Section 27	PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5 suppressed		
5207	Toad (Salmonberry)	PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5 suppressed		
5253	W. Hunt Cr. (McNary Cr.)		PRE 1 suppressed	2	1	2	2	POST 3 suppressed	?	?
5301	Cezanne 2	PRE 1 suppressed	PRE 2	OTHER 1	POST 1	POST 3	POST 3 suppressed	POST 4	POST 5	
5302	South Fork Trask River	PRE 1 suppressed	PRE 2 suppressed	PRE 3	OTHER 1	POST 1	POST 2	POST 3	POST 4	POST 5
5354	McKnob (Gnat Cr.)		PRE 1 suppressed	PRE 2	PRE 3	PRE 4 suppressed	POST 1	POST 1/2	POST 3	POST 4
5355	Lotta Thin (Northrup Cr.Tr.)		PRE 1	PRE 2 suppressed	2	2	2	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed
5502	Bridge Forty Creek	PRE 1 suppressed	PRE 2	PRE 3 suppressed	OTHER 2	POST 1	POST 2	POST 3	POST 4	POST 5
5503	Siletz River tributary	PRE 1 suppressed	PRE 2	POST 1	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed		
5506	Mary's River headwaters	PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5		
5556	Drift Creek Trib.		PRE 1	3	3	3	3	POST 3 suppressed	?	POST 5 suppressed
5557	Buck Creek		PRE 1 suppressed	PRE 2	POST 1	POST 2	POST 3 suppressed	POST 4 suppressed	POST 5	
5558	Gunn/Blue-Jay Creek		PRE 1	3	3	3	3	?	?	?
5559	Elk Creek North		PRE 1 suppressed	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5	
5560	Elk Creek South		PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5	
5561	Green Back (Yaquina R.)		PRE 1	2	2	PRE 4 suppressed	negative flow	2	?	?
7353	Sand Creek		PRE 1 suppressed	PRE 2 suppressed	3	3	3	?	?	?
7452	Schumacher Ridge		PRE 1	POST 1	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	POST 5 suppressed		
7453	Howell Creek		PRE 1 suppressed	POST 1 suppressed	POST 2 suppressed	0 flow	POST 4 suppressed	POST 5		
7454	West Fork Silver Creek		PRE 1	PRE 2	POST 1	POST 2	POST 3	POST 4	POST 5	
7801	Knapp Knob Unit	PRE 1	PRE 2 suppressed	PRE 3	POST 1 suppressed	POST 2 suppressed	POST 5 suppressed	POST 4	POST 5	
7803	North Nelson Unit	PRE 1	PRE 2	PRE 3 suppressed	PRE 4	POST 1	POST 2	POST 3 suppressed	-	POST 5
7854	Argue Creek		PRE 1suppressed	2	3	POST 2 suppressed	POST 3 suppressed	POST 4 suppressed	?	

HARVEST

X	# air temperature probes/site
15	# State Sites (18 private)
7	# sites with air temp probes, thru '08
57	# air temp probe seasons, thru '08
8%	**% of specified # air temp probes, thru '08**
26	# sites without air temperature probes
378	# air probe seasons specified for private sites

Figure 1. Recorded flow values at probes 1W, 2W, and 3W in liters per second between 2002 and 2008. Different years are presented by color.
From; ODF_EPA_QAPP, Oct 1, 2010

Very low flow State sites & issues:

5101; Cook East cr; no pre-H yr, ,makes post-H meaningless
5103; Eck Cr
7452; Schumacher Cr; one pre-H yr, probes found dry
7453; Howell Cr; no pre-H yr, makes post-H meaningless

Very low flow private sites & issues:

5203; Big South Fk; minimal temperature change
5557; Buck Cr; one pre-H, dry bed & logjam so all post-H questionable
7353; Sand Cr; one pre-H, stagnant pool so 1 post-H questionable
5503; Siletz Tribut; one pre-H, beaver dam so 4 post-H questionable
7454; W Fk Silver; subterranean flow

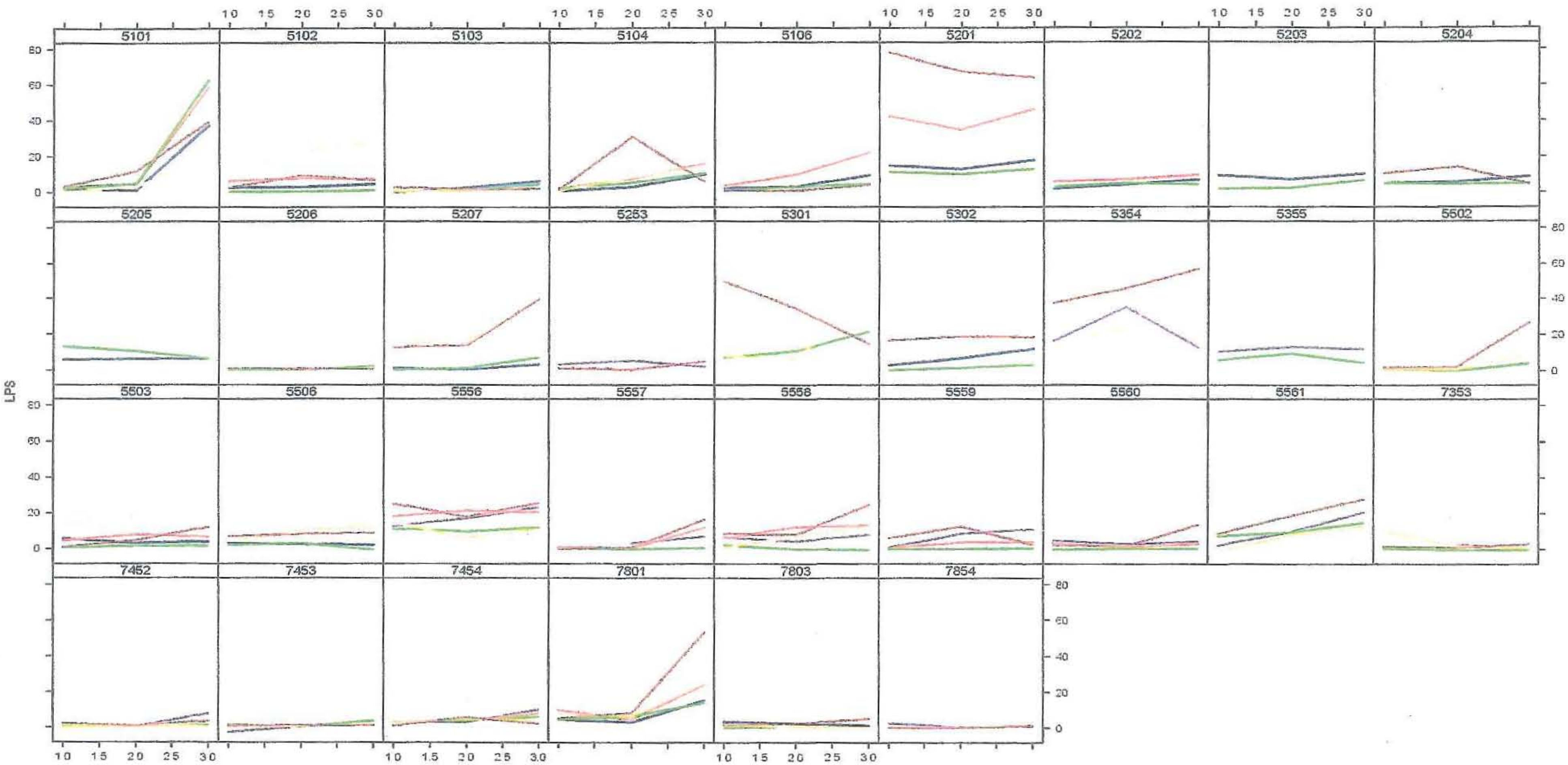


Figure a: RAWS Weather Station monthly average

Ave Max Air Temp/Mo

	Wilkerson Ridge RAWS				Clay Creek RAWs				South Fork RAWS				All 3 RAWS	Corvallis Ore RAWS	
	July	Aug	ave	deviaion from ave	July	Aug	ave	deviaion from ave	July	Aug	ave	deviaion from ave	combined	July	Aug
1997	80.1	81.1	80.6												
1998	82.7	85.1	83.9												
1999	77.2	75.7	76.4												
2000	78.9	83.4	81.2	-0.4	78.4	79.7	79.0	-2.8	69.9	71.6	70.7	-3.0	-2.0		
2001	79.7	79.9	79.8	-1.8	79.5	79.4	79.4	-2.4	69.5	71.4	70.5	-3.2	-2.5	79.7	82.2
2002	**84.1**	**83.1**	83.6	2.0	82.6	83.0	82.8	1.0	73.6	73.2	73.4	-0.3	0.9	83.90	83.4
2003	**86.3**	**83.4**	84.8	3.3	86.0	83.1	84.5	2.8	75.2	73.6	74.4	0.7	2.3	**86.5**	83.2
2004	**85.4**	**82.8**	84.1	2.5	84.2	81.6	82.9	1.1	75.2	73.2	74.2	0.5	1.4	**85.6**	**84.4**
2005	**84.5**	**88.7**	86.6	5.0	82.1	85.9	84.0	2.2	**89.2**	76.7	82.9	9.2	5.5	83.2	**86.4**
2006	**83.5**	**80.6**	82.1	0.5	84.2	82.6	83.4	1.6	75.8	74.5	75.1	1.4	1.2	**85.5**	83.7
2007	79.0	77.7	78.3	-3.2	81.0	79.5	80.3	-1.5	71.5	70.6	71.0	-2.7	-2.5	83.1	81.3
2008	83.0	78.6	80.8	-0.7	83.1	79.0	81.0	-0.7	72.7	69.8	71.3	-2.4	-1.3	83.6	82.3
2009	81.7	77.7	79.7	-1.9	83.9	79.8	81.9	0.1	77.2	71.4	74.3	0.6	-0.4	**85.6**	82.6
2010	81.2	78.6	79.9	-1.7	79.3 -		79.3	-2.5	73.2	72.3	72.8	-0.9	-1.7	82.2	82.5
Ave Month Max	**81.9**	**81.2**	81.5		**82.2**	**81.4**	81.8		**74.8**	**72.6**	73.7			**83.9**	**83.2**
90th percentile	85.1	84.6	84.9		84.2	83.4	83.8		77.2	74.5	75.8			85.70	84.6
Near 5557															

Notes;

Clays Creek Jan & Feb 2008 high monthly temps of 123 & 140 appear to be in error. Monthly average values substituted

Clays Creek Dec 2006 high month temp of 140 appear to be in error. Monthly average values substituted

Figure b; Wilkerson Ridge RAWS Air Temp

Daily Max & 7dAM, 90th %

Daily Maximum Air Temperature (F)

July	1999 Daily Max	2000 Daily Max	2001 Daily Max	2002 Daily Max	2003 Daily Max	2004 Daily Max	2005 Daily Max	2006 Daily Max	2007 Daily Max	2008 Daily Max	2009 Daily Max	2010 Daily Max
12	88	84	84	96	78	92	74	63	81	100	56	73
13	82	72	80	83	77	82	84	79	84	102	61	78
14	72	75	79	82	86	84	92	82	84	101	79	85
15	81	86	67	84	76	85	63	82	74	88	87	93
16	59	90	65	86	76	91	87	84	76	79	91	84
17	72	75	68	82	88	88	96	83	68	81	92	81
18	83	73	77	79	92	87	100	83	67	81	89	71
19	88	82	75	76	93	81	91	87	68	79	84	83
20	70	89	71	89	94	84	94	98	60	89	91	76
21	78	76	79	92	95	90	95	104	63	82	79	81
22	87	76	83	90	91	99	78	104	78	63	75	80
23	82	86	86	85	85	0	91	101	74	78	78	86
24	69	87	85	78	85	92	84	98	81	83	86	95
25	81	71	86	79	80	88	90	91	83	83	90	92
26	86	78	84	75	86	88	98	93	75	79	89	84
27	89	86	83	81	96	91	102	89	86	73	100	81
28	77	82	72	89	103	92	91	78	83	86	102	65
29	78	91	56	92	103	89	97	69	68	61	97	83
30	84	88	72	83	97	84	98	69	80	81	83	74
31	76	85	77	83	91	84	96	81	87	81	88	74
Aug..1	77	86	80	83	88	86	75	80	94	65	89	74
2	86	87	79	79	74	79	89	82	88	72	82	83
3	86	85	67	75	82	88	97	79	72	84	83	77
4	78	85	70	70	90	69	99	82	81	86	75	80
5	68	89	80	68	73	73	97	89	79	87	79	87
6	67	89	84	75	81	60	90	88	61	84	63	82
7	58	94	84	81	78	85	95	86	65	81	59	79
8	70	96	90	84	79	96	93	79	68	75	78	78
9	86	71	97	93	81	98	88	81	73	68	75	70
10	81	74	82	87	80	95	87	78	78	83	85	67
11	60	83	90	90	79	93	88	76	82	89	82	80
12	77	84	92	97	79	88	90	82	66	86	66	89
13	64	77	82	101	84	91	97	91	84	95	67	90
14	72	82	79	95	95	86	101	82	89	102	71	92
15	78	83	77	89	78	85	90	71	83	88	70	87
16	87	85	77	91	85	89	84	65	77	97	78	93
17	78	84	83	85	90	90	76	80	70	73	83	76
18	63	66	75	82	92	93	90	93	70	61	96	78
19	79	79	79	77	81	91	93	94	69	62	98	74
20	67	82	79	71	90	92	88	85	60	62	0	81
21	81	90	65	75	92	82	87	67	72	71	76	71
22	86	95	60	85	67	62	84	80	73	83	80	72
23	80	88	67	83	79	61	82	69	83	76	78	76

7dAM Air Temperature (F)

Date	1999 7dAM	2000 7dAM	2001 7dAM	2002 7dAM	2003 7dAM	2004 7dAM	2005 7dAM	2006 7dAM	2007 7dAM	2008 7dAM	2009 7dAM	2010 7dAM	7dAM 90th %
July 18	76.7	79.3	74.3	84.6	81.9	**87.0**	85.1	79.4	76.3	**90.3**	79.3	80.7	*86.8*
19	76.7	79.0	73.0	81.7	84.0	85.4	**87.6**	82.9	74.4	**87.3**	83.3	82.1	*87.1*
20	75.0	81.4	71.7	82.6	86.4	85.7	**89.0**	85.6	71.0	85.4	**87.6**	81.9	*87.5*
21	75.9	81.6	71.7	84.0	87.7	86.6	**89.4**	**88.7**	68.0	82.7	87.6	81.3	*88.6* x
22	76.7	80.1	74.0	84.9	89.9	88.6	**91.6**	**91.9**	68.6	79.1	85.9	79.4	*91.4*
23	80.0	79.6	77.0	84.7	91.1	75.6	**92.1**	**94.3**	68.3	79.0	84.0	79.7	*92.0*
24	79.6	81.3	79.4	84.1	**90.7**	76.1	**90.4**	**96.4**	70.1	79.3	83.1	81.7	*90.7*
25	79.3	81.0	80.7	84.1	**89.0**	76.3	**89.0**	**97.6**	72.4	79.6	83.3	84.7	*89.0*
26	79.0	80.4	82.0	84.0	88.0	77.3	**90.0**	**98.4**	73.4	79.6	84.0	84.9	*89.8*
27	81.7	80.0	83.7	82.9	88.3	78.3	**91.1**	**97.1**	77.1	77.3	85.3	85.6	*90.9*
28	81.6	80.9	82.7	82.4	89.4	78.6	**90.6**	**93.4**	80.0	77.9	88.6	83.3	*90.5*
29	80.3	83.0	78.9	82.7	91.1	77.1	**93.3**	88.4	78.6	77.6	**91.7**	83.7	*91.7*
30	80.6	83.3	76.9	82.4	**92.9**	89.1	**94.3**	83.9	79.4	78.0	92.4	82.0	*92.8*
31	81.6	83.0	75.7	83.1	**93.7**	88.0	**96.0**	81.4	80.3	77.7	92.7	79.0	*93.6*
Aug..1	81.0	85.1	74.9	83.7	**94.9**	87.7	**93.9**	79.9	81.9	75.1	92.6	76.4	*93.7*
2	81.0	86.4	74.1	84.3	**93.1**	86.4	**92.6**	78.3	83.7	74.1	91.6	76.3	*92.5*
3	80.6	86.3	71.9	83.4	**91.1**	86.0	**91.9**	76.9	81.7	75.7	89.1	75.7	*90.9*
4	80.7	86.7	71.6	80.7	**89.3**	82.7	**93.0**	77.4	81.4	75.7	85.3	77.9	*89.0*
5	79.3	**86.4**	75.0	77.3	85.0	80.4	**93.0**	80.3	83.0	79.4	82.7	78.4	*86.3*
6	76.9	**86.6**	76.7	76.1	82.7	77.0	**91.9**	83.0	80.3	79.9	79.9	79.6	*86.2*
7	74.3	**87.9**	77.7	75.9	80.9	77.1	**91.7**	83.7	77.1	79.9	75.7	80.3	*87.4*
8	73.3	**89.3**	79.1	76.0	79.6	78.6	**94.3**	83.6	73.4	81.3	74.1	80.9	*88.7*
9	73.3	**87.0**	81.7	78.0	80.6	81.3	**94.1**	83.4	71.3	80.7	73.1	79.0	*86.6*
10	72.6	**85.4**	83.9	79.7	80.3	82.3	**92.7**	83.3	72.1	80.6	73.4	77.6	*85.3*
11	70.0	85.1	86.7	82.6	78.7	85.7	**91.1**	82.4	72.3	81.0	74.4	77.6	*86.6*
12	71.3	84.4	88.4	86.7	79.6	87.9	**90.1**	81.4	70.4	80.9	72.6	77.9	*88.4*
13	70.9	82.7	88.1	90.4	80.0	**92.3**	**91.1**	81.9	73.7	82.4	73.1	79.0	*91.1*
14	72.9	81.0	87.4	92.4	82.4	**92.4**	92.0	81.3	77.1	85.4	74.9	80.9	*92.4*
15	74.0	79.1	85.6	**93.1**	82.3	90.9	**91.6**	80.1	79.3	87.3	73.7	82.1	*91.5*
16	74.1	81.1	82.7	**92.9**	82.9	89.6	91.0	77.9	79.9	91.4	74.1	85.4	*91.4*
17	73.7	82.6	82.9	**92.6**	84.3	88.9	89.4	78.1	78.7	**90.0**	73.9	86.7	*89.9*
18	74.1	80.1	80.7	**91.4**	86.1	88.9	**89.7**	80.6	77.0	86.0	75.9	86.4	*89.6*
19	74.4	79.4	78.9	88.6	86.4	**89.3**	**90.1**	82.3	77.4	82.6	80.4	84.3	*89.2*
20	74.9	80.1	78.4	84.3	87.3	**89.4**	**88.9**	81.4	74.0	77.9	70.9	83.0	*88.7*
21	76.1	81.3	76.4	81.4	**86.9**	**88.9**	**86.9**	79.3	71.6	73.4	71.6	80.0	*86.9*
22	77.3	83.0	74.0	80.9	85.3	**85.6**	**86.0**	80.6	70.1	72.7	73.0	77.9	*85.5* x
23	76.3	83.4	72.6	79.7	84.4	81.6	**85.7**	81.1	71.0	69.7	73.0	75.4	*84.3*

Wilkerson

Season
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Bold indicate days whose 7dAM exceeds 90th percentile of 7dAM air temperature

5557	(blue)	Buck Cr 8/1/05 & 7/27/06
5506	(magenta)	Marys River Headwaters 8/21/04 & 8/6/05
5559	(light pink)	Elk Creek No 8/16/05 & 7/27/06
5560	(cream)	Elk Cr South 8/19/05 & 7/27/06
5556	(green)	Drift Cr 7/27/06 & 8/5/07
5502		Bridge Fork 7/27/06 & 7/28/07

Season	> 90th %	# days; 7/15-8/22	
2002	4	33	12%
2003	9	33	27%
2004	6	33	18%
2005	30	33	91%
[illegible]	[illegible]	[illegible]	24%
2007	0	33	0%
2008	1	33	3%

Figure c; Clay Creek RAWS Air Temp

Daily Max & 7dAM, 90th %

Daily Maximum Air Temperature (F) / 7dAM Air Temperature (F)

July	1999 Daily M	2000 Daily M	2001 Daily M	2002 Daily M	2003 Daily M	2004 Daily M	2005 Daily M	2006 Daily M	2007 Daily M	2008 Daily M	2009 Daily M	2010 Daily Max	1999 7dAM	2000 7dAM	2001 7dAM	2002 7dAM	2003 7dAM	2004 7dAM	2005 7dAM	2006 7dAM	2007 7dAM	2008 7dAM	2009 7dAM	2010 7dAM	7dAM 90th %
12	89	83	84	90	76	86	75	73	75	95	57	76													
13	88	76	81	78	78	82	76	80	87	95	71	74													
14	76	76	81	79	86	78	86	83	85	93	82	84													
15	79	82	70	85	71	83	76	81	76	89	88	91													
16	62	88	69	85	79	88	82	87	78	84	93	86													
17	73	64	69	81	86	83	92	86	68	85	93	85													
18	83	75	82	78	92	89	95	82	73	82	89	78	78.6	77.7	76.6	82.3	81.1	84.1	83.1	81.7	77.4	89.0	81.9	82.0	84.0
19	89	80	70	74	93	83	87	86	71	80	83	79	78.6	77.3	74.6	80.0	83.6	83.7	84.9	83.6	76.9	86.9	85.6	82.4	85.5
20	59	84	69	83	94	81	87	93	71	85	91	68	74.4	78.4	72.9	80.7	85.9	83.6	86.4	85.4	74.6	85.4	88.4	81.6	86.4
21	77	76	80	91	99	84	86	97	78	86	79	71	74.6	78.4	72.7	82.4	87.7	84.4	86.4	87.4	73.6	84.4	88.0	79.7	87.7
22	82	75	84	84	95	94	78	101	81	63	81	78	75.0	77.4	74.7	82.3	91.1	86.0	86.7	90.3	74.3	80.7	87.0	77.9	90.0
23	85	82	87	87	89	98	84	102	78	75	80	55	78.3	76.6	77.3	82.6	92.6	87.4	87.0	92.4	74.3	79.4	85.1	73.4	91.9
24	70	87	85	80	86	93	84	101	78	85	88	-	77.9	79.9	79.6	82.4	92.6	88.9	85.9	94.6	75.7	79.4	84.4	-	92.6
25	79	77	84	82	85	91	83	90	86	80	93	-	77.3	80.1	79.9	83.0	91.6	89.1	84.1	95.7	77.6	79.1	85.0	-	91.6
26	87	77	84	81	84	88	92	90	79	82	95	-	77.0	79.7	81.9	84.0	90.3	89.9	84.9	96.3	78.7	79.4	86.7	-	90.3
27	89	86	84	83	94	91	96	93	87	80	101	-	81.3	80.0	84.0	84.0	90.3	91.3	86.1	96.3	81.0	78.7	88.1	-	91.3
28	73	84	77	88	102	91	92	83	83	87	103	-	80.7	81.1	83.6	83.6	90.7	92.3	87.0	94.3	81.7	78.9	91.6	-	92.3
29	73	91	58	88	104	89	91	76	72	70	99	-	79.4	83.4	79.9	84.1	92.0	91.6	88.9	90.7	80.4	79.9	94.1	-	92.0
30	82	89	70	91	102	85	93	78	78	78	81	-	79.0	84.4	77.4	84.7	93.9	89.7	90.1	87.3	80.4	80.3	94.3	-	93.9
31	73	89	76	77	95	85	93	81	88	80	87	-	79.4	84.7	76.1	84.3	95.1	88.6	91.4	84.4	81.9	79.6	94.1	-	94.1
Aug..1	79	86	75	87	87	82	78	82	93	74	90	-	79.4	86.0	74.9	85.0	95.4	87.3	90.7	83.3	82.9	78.7	93.7	-	93.7
2	84	85	81	75	71	70	82	81	92	73	78	-	79.0	87.1	74.4	84.1	93.6	84.7	89.3	82.0	84.7	77.4	91.3	-	91.3
3	86	88	68	78	80	84	89	83	82	79	84	-	78.6	87.4	72.1	83.4	91.6	83.7	88.3	80.6	84.0	77.3	88.9	-	88.9
4	78	84	71	73	91	69	97	81	82	87	78	-	79.3	87.4	71.3	81.3	90.0	80.6	89.0	80.3	83.9	77.3	85.3	-	89.0
5	67	87	80	69	75	77	95	89	80	87	79	-	78.4	86.9	74.4	78.6	85.9	78.9	89.6	82.1	85.0	79.7	82.4	-	86.9
6	68	89	85	73	81	63	93	90	62	85	67	-	76.4	86.9	76.6	76.0	82.9	75.7	89.6	83.9	82.7	80.7	80.4	-	86.9
7	61	87	84	78	80	81	87	84	69	78	62	-	74.7	86.6	77.7	76.1	80.7	75.1	88.7	84.3	80.0	80.4	76.9	-	86.6
8	72	93	88	81	83	94	91	81	80	77	80	-	73.7	87.6	79.6	75.3	80.1	76.9	90.6	84.1	78.1	80.9	75.4	-	87.6
9	84	74	96	89	81	94	93	87	77	74	79	-	73.7	86.0	81.7	77.3	81.6	80.3	92.1	85.0	76.0	81.0	75.6	-	86.0
10	84	66	79	87	78	93	88	84	78	83	87	-	73.4	82.9	83.3	78.6	81.3	81.6	92.0	85.1	75.4	81.6	76.0	-	85.1
11	62	77	90	87	79	94	85	80	80	87	86	-	71.1	81.9	86.0	80.6	79.6	85.1	90.3	85.0	75.1	81.6	77.1	-	86.0
12	77	77	90	93	81	90	81	81	74	86	72	-	72.6	80.4	87.4	84.0	80.4	87.0	88.3	83.9	74.3	81.4	76.1	-	87.4
13	69	75	80	103	86	92	83	89	85	90	67	-	72.7	78.4	86.7	88.3	81.1	91.1	86.9	83.7	77.6	82.1	76.1	-	88.3
14	72	80	75	101	91	79	93	87	90	98	75	-	74.3	77.4	85.4	91.6	82.7	90.9	87.7	84.1	80.6	85.0	78.0	-	90.9
15	76	77	73	94	80	83	88	76	81	93	73	-	74.9	75.1	83.3	93.4	82.3	89.3	87.3	83.4	80.7	87.3	77.0	-	89.3
16	88	81	75	91	84	88	85	74	76	98	79	-	75.4	76.1	80.3	93.7	82.7	88.4	86.1	81.6	80.6	90.7	77.0	-	90.7
17	82	78	79	87	89	90	81	79	75	76	87	-	75.1	77.9	80.3	93.7	84.3	88.0	85.1	80.9	80.1	89.7	77.0	-	89.7
18	62	63	76	81	90	87	83	92	69	60	94	-	75.1	75.9	78.3	92.9	85.9	87.0	84.9	82.6	78.6	85.9	78.1	-	87.0
19	80	73	78	80	86	93	93	96	63	67	99	-	75.6	75.3	76.6	91.0	86.6	87.4	86.6	84.7	77.0	83.1	82.0	-	87.4
20	73	80	80	72	83	93	86	86	62	63	75		76.1	76.0	76.6	86.6	86.1	87.6	87.0	84.3	73.7	79.3	83.1		87.0
21	80	82	68	73	90	79	84	71	79	68	79	-	77.3	76.3	75.6	82.6	86.0	87.6	85.7	82.0	72.1	75.0	83.7	-	86.0
22	86	90	63	85	68	68	83	80	77	79	82	-	78.7	78.1	74.1	81.3	84.3	85.4	85.0	82.6	71.6	73.0	85.0	-	85.0
23	83	84	70	84	79	63	76	80	83	84	76	-	78.0	78.6	73.4	80.3	83.6	81.9	83.7	83.4	72.6	71.0	84.6	-	83.7

Season	> 90th %
2002	7
2003	13
2004	9
2005	10
2006	8
2007	0
2008	1
2009	8
2010	0
	56

Bold indicate days whose 7dAM exceeds 90th percentile of 7dAM air tempera

Season	> 90th %	# days; 7/15-8/22	
2002	7	33	21%
2003	13	33	39%
2004	9	33	27%
2005	10	33	30%
2006	8	33	24%
2007	0	33	0%

7854 Argue Crrek 8/22/05

7454 West Fork Silver Cr 8/8/05 & 7/28/06

Figure d; South Fork RAWS Air Temp

Daily Max & 7dAM, 90th %

Daily Maximum Air Temperature (F)

July	1999 Daily M:	2000 Daily M:	2001 Daily M:	2002 Daily M:	2003 Daily M:	2004 Daily M:	2005 Daily M:	2006 Daily M:	2007 Daily M:	2008 Daily M:	2009 Daily M:	2010 Daily Max
12		74	74	88	70	85	101	56	75	86	53	61
13		68	73	74	61	76	103	67	79	85	54	65
14		64	70	70	73	77	79	72	78	85	77	80
15		75	67	76	70	73	67	73	67	83	82	79
16		86	53	74	68	81	69	76	67	71	87	73
17		71	54	72	81	82	83	69	61	74	84	72
18		70	53	69	82	75	87	73	58	68	78	71
19		75	58	63	83	64	76	78	62	73	76	73
20		80	70	77	85	72	79	87	55	79	83	71
21		68	57	84	87	81	90	99	60	75	79	78
22		62	73	89	61	87	70	98	61	65	69	69
23		76	72	76	-	91	75	96	63	68	74	79
24		80	77	71	-	89	72	87	70	78	80	90
25		62	75	72	-	78	78	83	75	73	83	83
26		67	76	66	-	77	86	89	68	66	88	80
27		73	73	69	-	84	92	79	76	64	95	76
28		75	72	72	-	82	81	68	72	73	98	72
29		82	55	78	-	80	83	64	65	55	99	77
30		86	54	68	-	72	85	60	71	63	85	69
31		78	59	73	-	76	82	69	79	67	86	61
Aug..1		75	68	71	-	75	71	70	88	59	92	73
2		76	65	68	-	71	78	71	82	63	84	71
3		78	59	66	-	71	82	73	67	72	78	70
4		82	60	57	-	62	90	75	73	82	72	80
5		82	71	60	53	61	86	84	69	89	72	80
6		79	71	62	71	56	79	85	66	82	57	76
7		76	73	69	69	67	84	80	58	75	58	65
8		83	81	76	69	80	79	74	67	66	61	69
9		74	92	80	68	90	75	70	66	53	70	63
10		71	78	74	71	86	74	69	71	62	69	59
11		67	81	82	63	85	71	64	71	78	62	73
12		71	83	84	69	81	81	76	54	73	60	78
13		65	78	93	77	83	83	82	79	81	60	83
14		68	80	80	89	77	88	78	82	91	56	87
15		69	70	75	60	78	82	67	75	94	60	90
16		75	67	80	76	79	74	63	67	96	72	93
17		71	76	74	81	79	62	77	65	80	82	86
18		57	62	74	82	84	77	87	60	56	90	68
19		60	68	70	72	86	80	88	65	57	90	70
20		67	70	62	79	81	79	83	57	57	65	70
21		74	58	63	82	68	76	64	65	60	69	65
22		83	57	78	68	59	74	72	69	72	72	61
23		78	56	76	72	57	61	60	76	72	65	71

7dAM Air Temperature (F)

2000 7dAM	2001 7dAM	2002 7dAM	2003 7dAM	2004 7dAM	2005 7dAM	2006 7dAM	2007 7dAM	2008 7dAM	2009 7dAM	2010 7dAM	7dAM 90th %
72.6	63.4	74.7	72.1	78.4	**84.1**	69.4	69.3	**78.9**	73.6	71.6	*78.9*
72.7	61.1	71.1	74.0	75.4	**80.6**	72.6	67.4	**77.0**	76.9	73.3	*77.0*
74.4	60.7	71.6	**83.4**	74.9	77.1	75.4	64.0	76.1	**81.0**	74.1	*81.0*
75.0	58.9	73.6	**79.4**	75.4	78.7	79.3	61.4	74.7	**81.3**	73.9	*79.4*
73.1	59.7	75.4	78.1	77.4	79.1	**82.9**	60.6	72.1	**79.4**	72.4	*79.4*
71.7	62.4	75.7	-	78.9	80.0	**85.7**	60.0	71.7	77.6	73.3	*80.6*
73.0	65.7	75.6	-	79.9	78.4	**88.3**	61.3	72.3	77.0	75.9	*80.7*
71.9	68.9	76.0	-	80.3	77.1	**89.7**	63.7	73.0	77.7	77.6	*81.2*
70.7	71.4	76.4	-	82.1	78.6	**91.3**	64.6	72.0	79.4	78.6	*83.1*
69.7	71.9	75.3	-	83.9	80.4	**90.1**	67.6	69.9	81.1	79.3	*84.5*
70.7	74.0	73.6	-	84.0	79.1	**85.7**	69.3	69.6	83.9	78.4	*84.2*
73.6	71.4	72.0	-	83.0	81.0	80.9	69.9	68.1	**88.1**	79.6	*83.5*
75.0	68.9	70.9	-	80.3	82.4	75.7	71.0	67.4	**89.7**	78.1	*83.2*
74.7	66.3	71.1	-	78.4	83.9	73.1	72.3	65.9	**90.6**	74.0	*84.5*
76.6	65.3	71.0	-	78.0	82.9	71.3	74.1	63.9	**91.9**	72.6	*83.8*
77.9	63.7	71.3	-	77.1	81.7	68.7	76.1	63.4	**91.3**	71.3	*82.7*
78.6	61.7	70.9	-	75.3	80.3	67.9	74.9	64.6	**88.9**	70.4	*81.1*
79.6	60.0	68.7	-	72.4	81.6	68.9	75.0	65.9	**85.1**	71.6	*81.9*
79.6	62.3	66.1	-	69.7	**82.0**	71.7	75.6	70.7	81.3	72.0	*81.4*
78.6	64.7	65.3	-	67.4	**81.1**	75.3	74.9	73.4	77.3	73.0	*78.8*
78.3	66.7	64.7	-	66.1	**81.4**	76.9	71.9	74.6	73.3	73.6	*78.6*
79.4	68.6	65.4	-	66.9	**82.6**	77.4	68.9	75.6	68.9	73.0	*79.7*
79.1	72.4	67.1	-	69.6	**82.1**	77.3	66.6	74.1	66.9	71.9	*79.4*
78.1	75.1	68.3	-	71.7	**81.0**	76.7	67.1	72.7	65.6	70.3	*78.4*
76.0	78.1	71.9	66.3	75.0	**78.3**	75.1	66.9	72.1	64.1	69.3	*78.1*
74.4	79.9	75.3	68.6	**77.9**	77.6	74.0	64.7	69.9	62.4	69.0	*77.9*
72.4	80.9	79.7	69.4	**81.7**	78.1	73.6	66.6	69.7	62.9	70.0	*80.9*
71.3	81.9	81.3	72.3	**83.1**	78.7	73.3	70.0	72.0	62.6	73.1	*81.9*
69.3	80.3	81.1	71.0	**82.9**	79.1	72.3	71.1	76.0	62.4	76.1	*81.1*
69.4	76.7	81.1	72.1	**81.3**	79.0	71.3	71.3	**82.1**	62.7	80.4	*81.3*
69.4	76.4	81.1	73.6	80.3	77.3	72.4	70.4	**84.7**	64.6	**84.3**	*84.3*
68.0	73.7	80.0	76.3	80.1	78.1	75.7	68.9	**81.6**	68.6	**83.6**	*81.6*
66.4	71.6	78.0	76.7	**80.9**	78.0	77.4	70.4	79.3	72.9	**82.4**	*80.9*
66.7	70.4	73.6	77.0	**80.6**	77.4	77.6	67.3	75.9	73.6	**80.6**	*80.6*
67.6	67.3	71.1	76.0	**79.3**	75.7	75.6	64.9	71.4	**75.4**	**77.4**	*77.4*
69.6	65.4	71.6	**77.1**	76.6	74.6	76.3	64.0	68.3	**77.1**	73.3	*77.1*
70.0	63.9	71.0	**76.6**	73.4	72.7	75.9	65.3	64.9	**76.1**	70.1	*76.1*

Season	> 90th %	# days; 7/15-8/22	
2002	0	33	0%
2003	2	14	14%
2004	6	33	18%
2005	8	33	24%
2006	7	33	21%
2007	7	33	21%
2008	0	33	0%

Season	> 90th %
2002	0
2003	2
2004	6
2005	8
2006	7
2007	7
2008	0
2009	11
2010	5
	46

For all 3

Season	> 90th %
2002	11
2003	24
2004	21
2005	48
2006	23
2007	7
2008	2
2009	20
2010	5
	161

Bold indicate days whose 7dAM exceeds 90th percentile of 7dAM air temperature

5207	**Todd Salmonberry 8/21/04 & 8/21/05**
6106	**Smith Creek 8/1/05**
5205	**Shangtils 8/4/05**
5204	**West Fork Ecola Cr 8/1/04 & 8/19/05**
5203	**So Fork Creek 8/5/05**

TABLE 1:PRIVATE SITE SUMMARY

3 ODF Data Sources

Daily_ Probe Data Base | 3W -2W | 3W -2W Private_sites _summary

Streamflow ← Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 – 4 times/season @ low flow

Name & #	Phase	YEAR	1W	2W	3W	4W	3W -2W Harvest Unit	4W-3W cooling	7/26/11 Review Mtg Fig	1st year	2nd year	# sides	3W & 2W Flow (l/s)	3W/2W ratio	Air Temp Probe	Comment
1st & 2nd highest Temperature Change																Buck+Argue are 0.25-0.4C of ave, depends on ODF data source. ATE suppression?
Buck Creek	Pre-H	'04	12.88	14.65	11.96	14.09	-2.69	2.13	-1.9	-1.47	-	two	-	-	none	no '04 flow data. For '03 3W=7, 2w= 3l/s so 2.3,
5557	post-H	'05?, 06?	12.37	12.37	12.19	-	-0.18	-	0.05	0.46	0.59		12, 0.4	30		'05 2W & 4W only 24 day data. Big flow change, very low flow
		PostH-PreH Difference=					2.51	-	1.95	2.0						Need '05 or "06 4W data, to show cooling
																06 to '10 logjam & unable to measure. yet Review figure has 06 & 09
Argue Creek	Pre-H	'04	15.78	16.78	15.43	16.78	-1.35	1.35	-0.1	0.05	-	two	-	-	'04	no '04 flow data. very low flow all years.
7854	post-H	'05	14.85	15.85	19.11	16.03	3.26	-3.08	2	2.55	-		-	-	'05	very low flow, dry stream, subterranean
							4.61	-4.43 SIGNIF COOLING	2.1	2.5						logjam & no 2W data '06 to '08, yet Review figure shows 08. '09 has T data, but no flow
3rd, 4th, 5th, & 6th highest Temperature Ch																
Shangrila Cr	Pre-H	'02, '03	14.92	15.07	15.08	15.08	0.01	-	0	0.36	0.44	two	6.7, 6.3	1.1	none	only '02 flow
5205	post-H	'05	14.13	14.37	16.55	15.89	2.18	-0.66	2	2.47	-		-	-		
		PostH-PreH Difference=					2.17	-	2	2.1						
Toad Salmonl	Pre-H	'02, '03	15.06	15.88	12.50	13.02	-3.38	0.52	-1.7	-0.78	-1.98	one	3.3, 0.5	6.6	none	2W to 3W cooling rate changed, yet NO warming
5207	post-H	'04, '05	14.92	14.88	13.24	13.29	-1.65	0.05	-1.3	-1.25	-0.61		7.4, 1.2	6.2		no '04– '05 flow data, use '06 flow data
		PostH-PreH Difference=					1.73	-0.46	0.40	0.45						Use which ODF Source?
Drift Creek	Pre-H	'03, '04, '05	15.11	14.53	14.65	14.67	0.12	0.02	0.1	0.76	0.43	two	-	1.2	04, '05	Which 2 of the 3 preH yrs were used?
5556	post-H	'06, '07	14.56	14.62	15.89	15.67	1.27	-0.23	1.1	2.08	1.36		-	1.5	06, '07	
		PostH-PreH Difference=					1.15	-0.25	1	1.1						
Elk Cr North	Pre-H	'04	12.83	12.42	13.21	-	0.79	-	0.30	0.63		two	-	-	none	
5559	post-H	'05 '06	12.52	12.55	14.32	-	1.77	-	1.65	2.76	1.63		3.9, 3.6	1.1		
		'06 flow											0.4, -0.04	10		
		PostH-PreH Difference=					0.98	-	1.35	1.57						Use which ODF Source?
																Logjams/ beaver dams at 3 of 18 private sites
Weighted Ave All Private Sites							0.78	-0.78	0.50	0.73		2-side 14 of 18	2.0x pre-H ave 3.1x post-H ave		air probes 4 of 18 sites	Weighted Average (by years data in 2 yrs pre/post-Harvest)
Simple Average All Private Sites							1.02	1.05	0.86	0.83						

TABLE 2:STATE SITE SUMMARY FROM VARIOUS ODF SOURCES

3 ODF Data Sources

- Daily_ Probe Data Base
- 3W -2W Fig 3 2011b Groom
- 3W -2W 7/26/11 Review Mtg Figure

Streamflow: Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 - 4 times/season @ low flow

Name & #	#	YEAR	1W	2W	3W	4W	Harvest Unit 3W -2W	4W-3W cooling	3W -2W Fig 3 2011b Groom: 1st year	3W -2W Fig 3 2011b Groom: 2nd year	3W -2W 7/26/11 Review Mtg Figure: 1st year	3W -2W 7/26/11 Review Mtg Figure: 2nd year	Streamflow: 3W & 2W Flow (l/s)	Streamflow: 3W/2W ratio	Air T probe	Comment
State Sites Without Pre-Harvest Datqa																
Cook East Cr No Pre-Harvest Years (04 harvest)																Limited probe data '02 to '04, '07 Big Landslide
5101 Post-H T meaningless, since no baseline for comparison																Review mtg chart shows post-H yrs 1, 2, 3, but all meaningless
Howell Creek No Pre-Harvest Years (03 harvest)																
7453 Post-H T meaningless, since no baseline for comparison																Review mtg chart shows post-H yrs 1, 4, but neither has 2W data. Yr 5 ('08) has data, but all post-H data meaningless
1st & 2nd highest Temperature Change sites																Use which ODF Source?
Eck Creek	Pre-H	'03	12.44	14.36	12.56	-	-1.80	-	-0.60		-0.60		6, 2.4	2.5		1 Pre-H year
5103	post-H	'04, '05	14.04	13.90	14.87	-	0.98	-	-0.50	-1.50	0	0				Highest T on 8/19/04, last day of season
	PostH-PreH Difference=						2.78		-0.4		0.6					05 diurnal range of 4 to 6C
Schumacher (	Pre-H	'03	14.21	15.54	15.37	-	-0.17	-	0.00		-0.30		8, 0.2	40		1 Pre-H year
7452	post-H	'04	14.47	13.83	16.12	-	2.29	-	2.10		2.1					04 diurnal range of 3 to 3.5C
	PostH-PreH Difference=						2.46		2.10		2.4					Use which ODF Source?
																These 2 sites are +0.4oC of average
3rd highest Temperature Change site																
West Hunt Cr	Pre-H	'04, '05	12.88	13.80	13.55	-	-0.26	-	0.0	-0.2	-0.1	+0.1				
5253	post-H	'06, '07	14.64	14.02	14.79	-	0.77	-	2.1	0.2	2.1	0.2				06 1W flow is at mid-season (8/14/06)
	PostH-PreH Difference=						1.02		1.25		1.15					06 first day of season, up to 7.7C diurnal range
																Use which ODF Source?
Cuzanne 2 C	Pre-H	'03, '04	13.10	13.89	14.60	13.78	0.70	-0.82	0.40	-0.40	0.20	-0.40				
5301	post-H	'05, '06	12.93	13.64	14.92	13.91	1.28	-1.02	1.10	1.20	1.10	1.20	21, 11	1.90		07; no 3W temperature data
	PostH-PreH Difference=						0.58	-0.20	1.15		1.25					Use which ODF Source?
													9x ave pre-H 3x ave post-H		air probes at 2 Sites	beaver dams/landslides at 4 of 13 Sites. Examples; Knapp Knob, Lotta Thin, Bale Bond, lower ave by -0.1C
Weighted Ave All Sites							**0.21**	**0.04**	**0.10**		**0.20**					Weighted Average (by years data in 2 yrs pre/ post-Harvest)
Simple Average							0.44	0.11	0.33		0.42					

TABLE 3:ONE-SIDE HARVEST PRIVATE SITE SUMMARY

3 ODF Data Sources: Daily_ Probe Data Base; 3W -2W; 3W -2W Private_sites_ summary

Streamflow — Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 - 4 times/season @ low flow.

Name & #	Phase	YEAR	1W	2W	3W	4W	Harvest Unit 3W -2W (Daily_ Probe Data Base)	4W-3W cooling (Daily_ Probe Data Base)	3W -2W 7/26/11 Review Mtg Fig	3W -2W Private_sites_ summary 1st year	3W -2W Private_sites_ summary 2nd year	# sides	Streamflow 3W & 2W Flow (l/s)	Streamflow 3W/2W ratio	Air Temp Probe	Comment
Toad Salmonl	Pre-H	'02, '03	15.06	15.88	12.50	13.02	-3.38	0.52	-1.7	-0.78	-1.98	one	3.3, 0.5	6.6	none	2W to 3W cooling rate changed, but NO warming
5207	post-H	'04, '05	14.92	14.88	13.24	13.29	-1.65	0.05	-1.3	-1.25	-0.61		7.4, 1.2	6.2		no '04- '05 flow data, use '06 flow data
L=3121'	PostH-PreH Difference=						1.73	-0.46	0.40	0.45						Use which ODF Source?
																Last day 04 season
Bridge Forty (	Pre-H	'04, '05	9.45	9.87	12.00	12.23	2.13	0.23	2.0	2.73	2.26	one	-	-	none	Longest harvest unit
5502	post-H	'06 '07	10.22	9.83	12.32	12.30	2.49	-0.02	2.0	2.53	2.35		4, 0.27	15		
L=6020'		'07 flow											9, 0.8	11		
	PostH-PreH Difference=						0.36	-0.25	0	-0.06						
Sand Creek	Pre-H	'05	15.49	16.22	16.97	17.41	0.92	0.44	0.4	0.88	-	one	-	0	04 & '05	no '05 flow data
7353	post-H	'06 '07	15.31	17.05	17.38	15.89	0.33	-1.49	0.7	1.41	0.86		-0.2, -0.3	-		ODF used 2006, although stagnant pool
L=2271'		'07 flow											.7, 2.1	0.3		06: 1W puddle, 2W negative flow, stagnant probe, 3W negative flow
	PostH-PreH Difference=						-0.59	-1.93	0.3	0.26						Use which ODF Source?
W Fk Silver Cı	Pre-H	'03 '04	14.41	14.00	13.62	-	-0.38	-	-0.1	0.09	0.11	one	10, 3.3	3	none	03 & 04 Stations 2W & 3W out of sequence, & perhaps mislabeld in data base
7454	post-H	'05 '06	14.92	14.80	14.96	-	0.16	-	0.05	0.83	0.42		7.8, 4.2	1.9		'05; 2W subterranean flow. although ODF used 05
L=1565'		'06 flow											6.3, 4	1.6		0
	PostH-PreH Difference=						0.54		0.15	0.53						
Weighted Ave 1-side Harvest Sites							**0.62**	**-0.8**	**0.26**	**0.34**						Use which ODF Source?
Simple Ave 1-side harvest							0.51	-0.88	0.21	0.29						
Weighted Average 2-side Harvest Sites							**0.82**	**-0.77**	-	**0.84**		≥				

TABLE 1A: SUMMARY OF ALL PRIVATE SITES

3 ODF Data Sources: Daily_ Probe Data Base (3W -2W Harvest Unit; 4W-3W cooling) · 3W -2W (7/26/11 Review Mtg Fig) · 3W -2W Private_sites _summary (1st year; 2nd year)

Streamflow ← Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 – 4 times/season @ low flow

Name & #	Phase	YEAR	1W	2W	3W	4W	3W -2W Harvest Unit	4W-3W cooling	7/26/11 Review Mtg Fig	1st year	2nd year	# sides	3W & 2W Flow (l/s)	3W/2W ratio	Air Temp Probe	Comment
1st & 2nd highest Temperature Change																Need '05 or "06 4W data, to show cooling
Buck Creek	Pre-H	'04	12.88	14.65	11.96	14.09	-2.69	2.13	-1.9	-1.47	-	two	-	-	none	no '04 flow data. For '03 3W=7, 2w= 3l/s so 2.3/1 ratio
5557	post-H	'05?, 06?	12.37	12.37	12.19	-	-0.18	-	0.05	0.46	0.59		12, 0.4	30		'05 2W & 4W only 24 day data. Big flow change, very low flow
		PostH-PreH Difference=					**2.51**	-	**1.95**	**2.0**						Need '05 or "06 4W data, to show cooling
																06 to '10 logjam & unable to measure. yet Review figure has 06 & 09
Argue Creek	Pre-H	'04	15.78	16.78	15.43	16.78	-1.35	1.35	-0.1	0.05	-	two	-	-	'04	no '04 flow data. very low flow all years.
7854	post-H	'05	14.85	15.85	19.11	16.03	3.26	-3.08	2	2.55	-		-	-	'05	very low flow, dry stream, subterranean
		PostH-PreH Difference=					**4.61**	**-4.4**	**2.1**	**2.5**						logjam & no 2W data '06 to '08, yet Review figure shows 08. '09 has T data, but no flow
								SIGNIF COOLING								Buck+Argue are 0.25-0.4C of ave, depends on ODF data source. ATE suppression?
3rd, 4th, 5th, & 6th highest Temperature Change																
Shangrila Cr	Pre-H	'02, '03	14.9	15.07	15.08	15.08	0.01	-	0	0.36	0.44	two	6.7, 6.3	1.1	none	only '02 flow
5205	post-H	'05	14.13	14.37	16.55	15.89	2.18	-0.66	2	2.47	-		-	-		
		PostH-PreH Difference=					**2.17**	-	**2**	**2.1**	-					Use which ODF source?
Toad Salmon	Pre-H	'02, '03	15.1	15.88	12.50	13.02	-3.38	0.52	-1.7	-0.78	-1.98	one	3.3, 0.5	6.6	none	2W to 3W cooling rate changed, yet NO warming
5207	post-H	'04, '05	14.9	14.88	13.24	13.29	-1.65	0.05	-1.3	-1.25	-0.61		7.4, 1.2	6.2		no '04- '05 flow data, use '06 flow data
		PostH-PreH Difference=					**1.73**	**-0.46**	**0.40**	**0.45**	-					Use which ODF Source?
Drift Creek	Pre-H	'03, '04, '05	15.1	14.53	14.65	14.67	0.12	0.02	0.1	0.76	0.43	two	-	1.2	04, '05	Which 2 of the 3 preH yrs were used?
5556	post-H	'06, '07	14.6	14.62	15.89	15.67	1.27	-0.23	1.1	2.08	1.36		-	1.5	06, '07	
		PostH-PreH Difference=					**1.15**	**-0.25**	**1**	**1.1**	-					
Other Sites																
Elk Cr North	Pre-H	'04	12.8	12.42	13.21	-	0.79	-	0.30	0.63	0	two	-	-	none	
5559	post-H	'05 '06	12.5	12.55	14.32	-	1.77	-	1.65	2.76	1.63		3.9, 3.6	1.1		
		'06 flow											0.4, -0.04	10		
		PostH-PreH Difference=					**0.98**	0.00	**1.35**	**1.57**						Use which ODF source?

TABLE 1A: SUMMARY OF ALL PRIVATE SITES

3 ODF Data Sources

Daily_ Probe Data Base | 3W -2W | 3W -2W Private_sites _summary

Streamflow — Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 – 4 times/season @ low flow

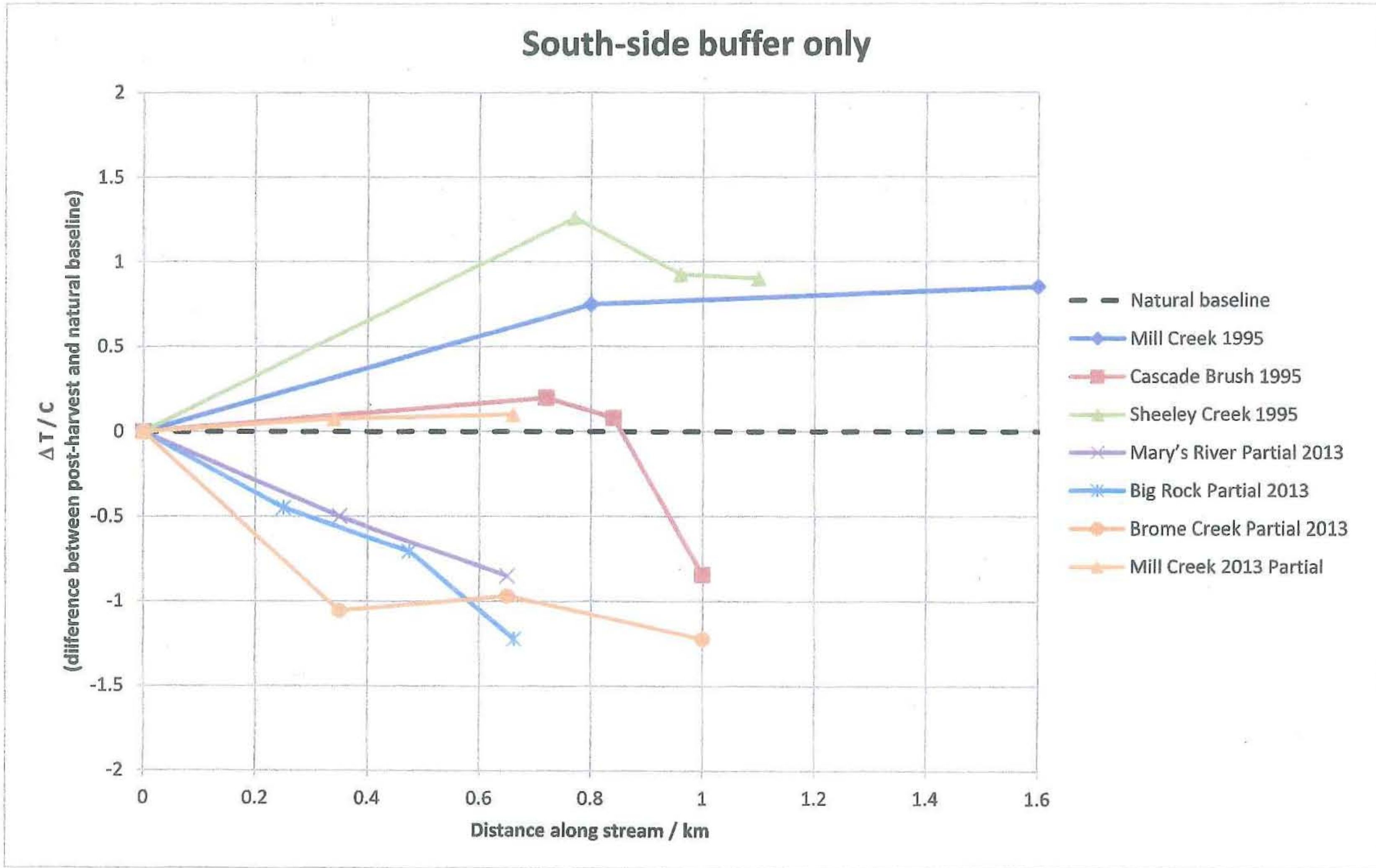
Name & #	Phase	YEAR	1W	2W	3W	4W	3W -2W Harvest Unit	4W-3W cooling	7/26/11 Review Mtg Fig	1st year	2nd year	# sides	3W & 2W Flow (l/s)	3W/2W ratio	Air Temp Probe	Comment
Smith Cr	Pre-H	02, 03, 04	14.5	14.06	14.22	–	0.15	–	0.25	0.80	0.68	two	9, 2.9	3.1		Which 2 of the 3 preH yrs were used?
5106	post-H	05	13.8	13.5	14.35	–	0.85	–	0.35	1.30	–		22, 9.9	2.2		
		PostH-PreH Difference=					**0.70**		**0.10**	**0.56**						Use which ODF source?
So Fork Cr	Pre-H	02	12.2	12.90	14.42	14.57	1.52	0.15	1.10	1.60	–	two	10, 7	1.4		
5203	PostH	05	12.5	12.82	15.2	12.82	2.38	-2.38	1.20	2.51	–					Immediately cools back to 2W temperature
		PostH-PreH Difference=					**0.86**	**-2.53**	**0.10**	0.91						
W Fk Ecola	Pre-H	02, 03	13.37	15.37	13.74	–	-1.64	–	-1.2	-0.59	-1.24	two	8.7, 5.8	1.5		3W probe exposed end of season
5204	PostH	04, 05	13.78	15.01	14.39	–	-0.62	–	-0.2	0.11	0.69					sign preH cooling fr confounding factors, varies yr to yr
		PostH-PreH Difference=					**1.02**		**1.0**	**1.32**						Use which ODF source?
Section 27 C	Pre-H	02, 03	13.2	13.30	14.15	14.41	0.85	0.26	0.6	1.32	0.82	two				'02 3W has no flow data
5206	PostH	04, 05	13.8	13.70	15.04	14.97	1.34	-0.07	1.1	1.92	1.37					
		PostH-PreH Difference=					**0.49**	**-0.33**	**0.5**	**0.58**						Significant Cooling
So Fk Trask	Pre-H	04, 05	11.4	12.28	13.30	13.98	1.02	0.67	1.1	1.45	1.71	two				
5302	PostH	06, '07	10.9	12.59	13.67	14.24	1.08	0.57	0.5	0.84	1.44		3.3, 1.5	2.2		
		PostH-PreH Difference=					**0.06**	**-0.10**	**-0.60**	**-0.44**						Use which ODF source?
Bridge Forty	Pre-H	03, '05	9.45	9.87	12	12.23	2.13	0.23	2.0	2.73	2.26	one	4, 0.27	14.8		
5502	PostH	06, '07	10.2	9.83	12.32	12.30	2.49	-0.02	2.0	2.53	2.35		9, 0.8	11.3		
		PostH-PreH Difference=					**0.36**	**-0.25**	**0.0**	**-0.06**						Use which ODF source?
Siletz Trib	Pre-H	03	15.67	14.96	15.75	–	0.79	0	0.6	1.13	–	wo side				no '03 flow data
5503	PostH	04	17	16.48	16.78	–	0.30	0	0.3	0.66	–					no '04 flow data
		PostH-PreH Difference=					**-0.49**		**-0.30**	**-0.47**						05 to '09 Beaver dam, yet ODF shows use

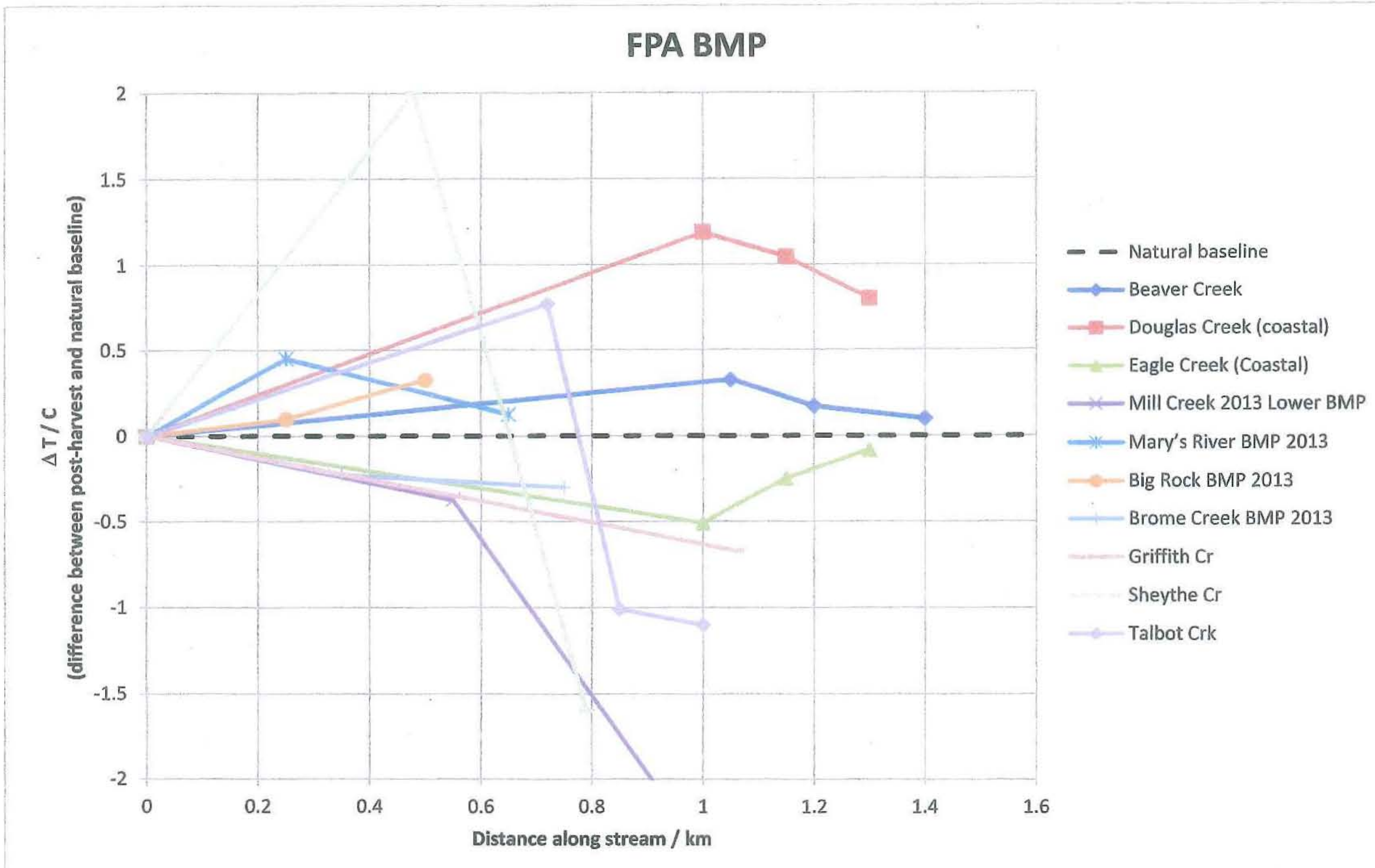
TABLE 1A: SUMMARY OF ALL PRIVATE SITES

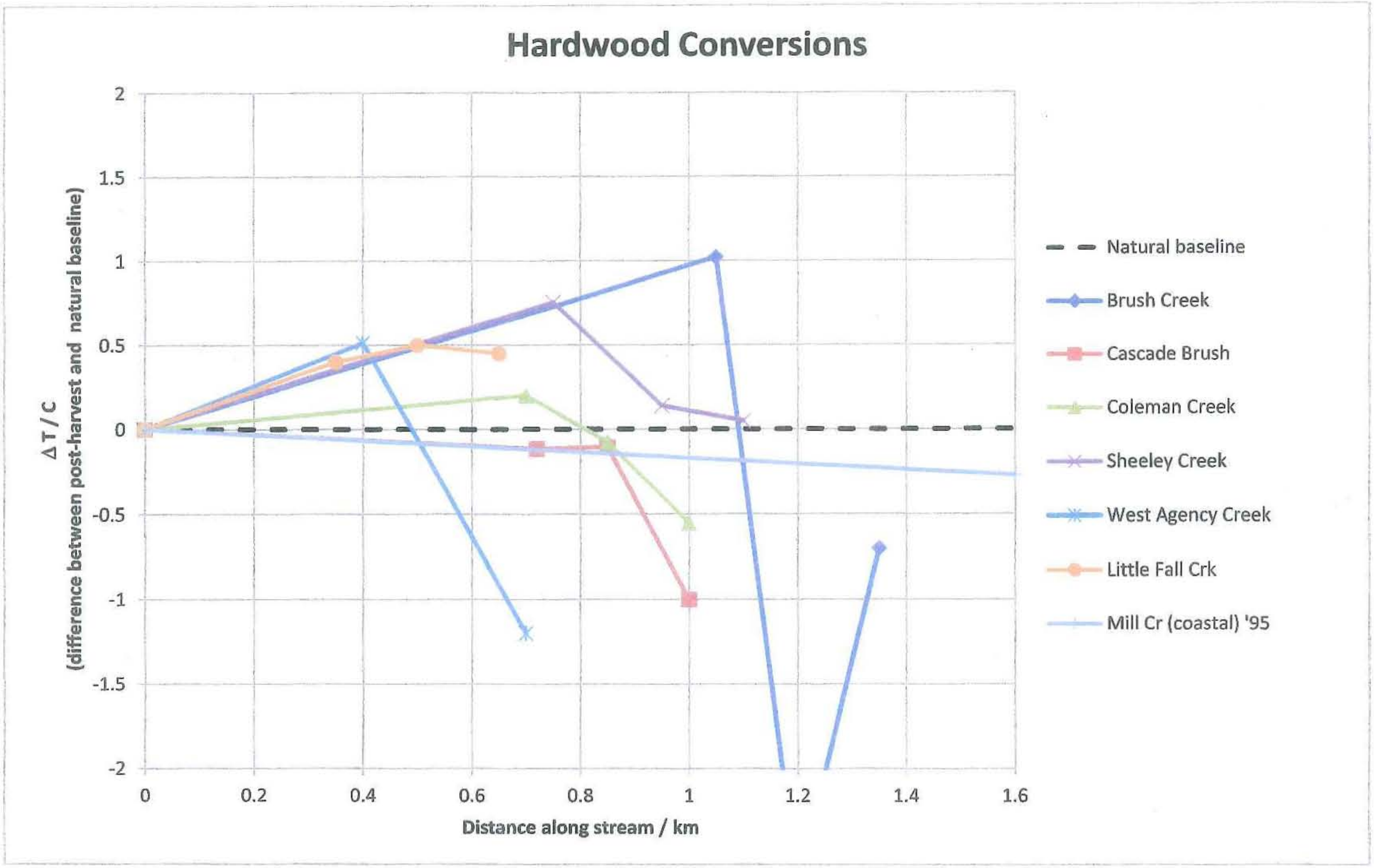
3 ODF Data Sources: Daily_ Probe Data Base (3W -2W Harvest Unit; 4W-3W cooling) · 3W -2W _summary (7/26/11 Review Mtg Fig) · 3W -2W Private_sites (1st year; 2nd year)

Streamflow — Required 1 at low-flow, but did 1/4 @ low flow. Current norm; 3 - 4 times/season @ low flow

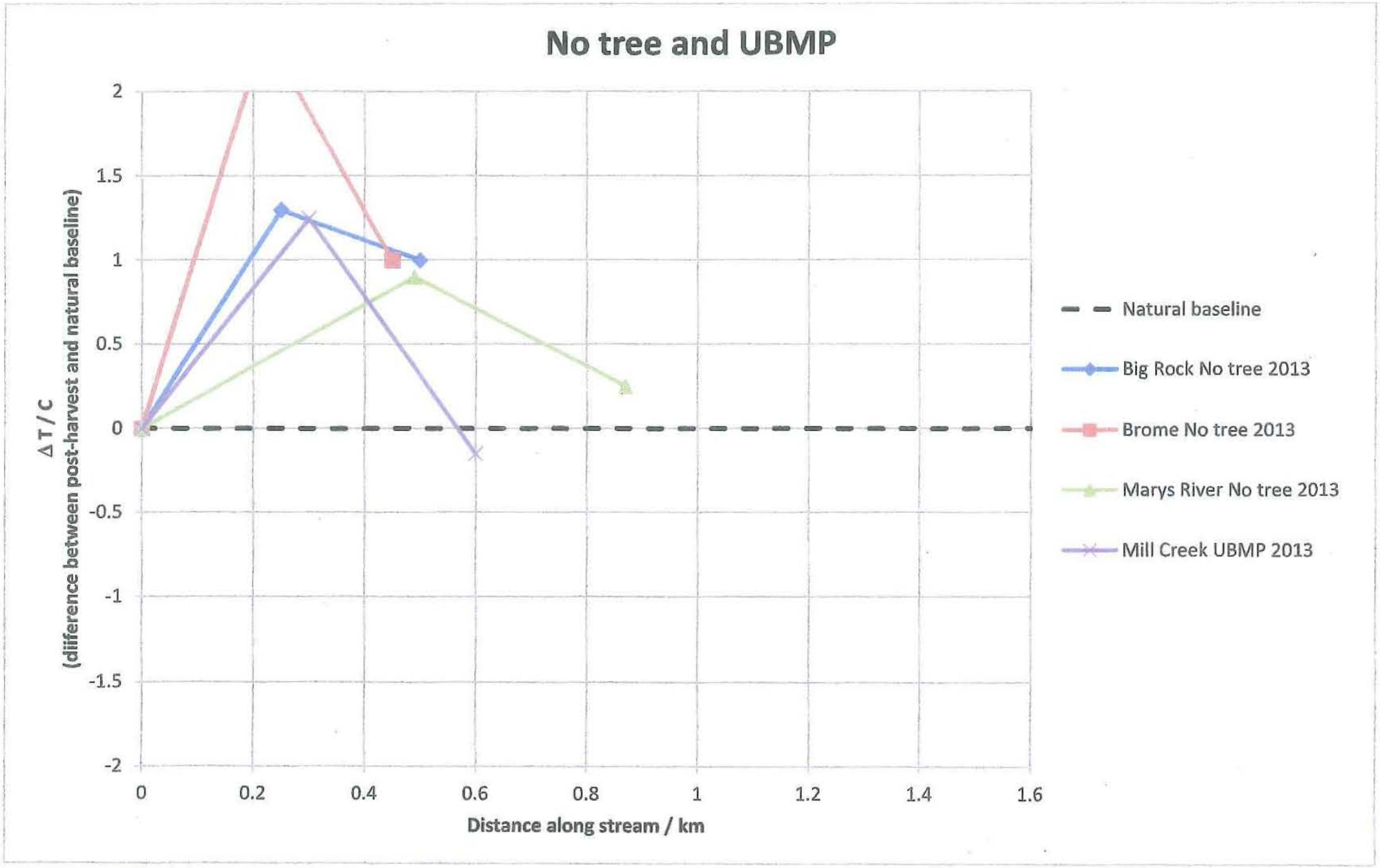
Name & #	Phase	YEAR	1W	2W	3W	4W	3W -2W Harvest Unit	4W-3W cooling	7/26/11 Review Mtg Fig	1st year	2nd year	# sides	3W & 2W Flow (l/s)	3W/2W ratio	Air Temp Probe	Comment
Mary's R HW	Pre-H	02, 03	12.66	12.81	12.61	12.39	-0.20	-0.22	-0.05	0.37	0.30	two				
5506	PostH	04, 05	13	12.97	13.73	13.11	0.77	-0.63	0.6	1.09	1.13					
	PostH-PreH Difference=						**0.97**	**-0.41**	**0.65**	**0.78**						Use which ODF source?
Gunn	Pre-H	03, 04, 05	12.7	13.90	13.26	13.99	-0.64	0.73	-0.5	-0.49	0.19	two	7.8, 4.2	1.9		Which 2 of the 3 preH yrs were used, or all 3?
5558	PostH	06, 07	13	14.38	13.99	14.50	-0.39	0.51	-0.4	-0.09	0.29		0.7, 0.14	5		
	PostH-PreH Difference=						**0.25**	**-0.22**	**0.1**	**0.25**						
Elk Cr So	Pre-H	03, '04	11.1	12.08	11.91	-	-0.17	-	0.0	0.33	0.43		4.2, 2.8	1.5		last day of 03 & 04 seasons
5560	PostH	06, '07	11	12.48	13.34	0	0.86	-	1.0	1.38	1.31		3.1, 0.8	3.9		06 1W negative flow, questionable
	PostH-PreH Difference=						**1.03**	**-**	**1.0**	**0.97**						Use which ODF source?
Sand Cr	Pre-H	'05	15.49	16.22	16.97	17.41	0.92	0.44	0.4	0.88	-	one	-		04 & '05	no '05 flow data
7353	PostH	'06 '07	15.31	17.05	17.38	15.89	0.33	-1.49	0.7	1.41	0.86	0	-0.2, -0.3	-		ODF used 2006, although stagnant pool
		'07 flow											.7, 2.1	0.3		06: 1W puddle, 2W negative flow, stagnant probe, 3W negative flow
	PostH-PreH Difference=						**-0.59**	**-1.93**	**0.3**	**0.26**						Use which ODF Source?
W Fork Silver	Pre-H	'03 '04	14.4	14	13.62	-	-0.38	-	-0.1	0.09	0.11	one	10, 3.3	3	none	03 & 04 Stations 2W & 3W out of sequence, & perhaps mislabeld in data base
7454	PostH	'05 '06	14.9	14.8	14.96	-	0.16	-	0.05	0.83	0.42		7.8, 4.2	1.9		'05; 2W subterranean flow. although ODF used 05
		'06 flow											6.3, 4	1.6		0
	PostH-PreH Difference=						**0.54**	**-**	**0.15**	**0.53**						Logjams/ beaver dams at 3 of 18 private sites
Weighted Ave All Private Sites							**0.78**	**-0.78** SIGN COOLING	**0.50**	**0.73**		2-side 14 of 18	**2.0x pre-H ave 3.1x post-H ave**		air probes 4 of 18 sites	Weighted Average (by years data in 2 yrs pre/ post-Harvest)
Simple Average All Private Sites							1.02	-1.05	0.66	0.83						


South-side buffer only
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Δ T / C
(difference between post-harvest and natural baseline)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Distance along stream / km
Natural baseline
Mill Creek 1995
Cascade Brush 1995
Sheeley Creek 1995
Mary's River Partial 2013
Big Rock Partial 2013
Brome Creek Partial 2013
Mill Creek 2013 Partial


FPA BMP
ΔT / C
(difference between post-harvest and natural baseline)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Distance along stream / km
Natural baseline
Beaver Creek
Douglas Creek (coastal)
Eagle Creek (Coastal)
Mill Creek 2013 Lower BMP
Mary's River BMP 2013
Big Rock BMP 2013
Brome Creek BMP 2013
Griffith Cr
Sheythe Cr
Talbot Crk

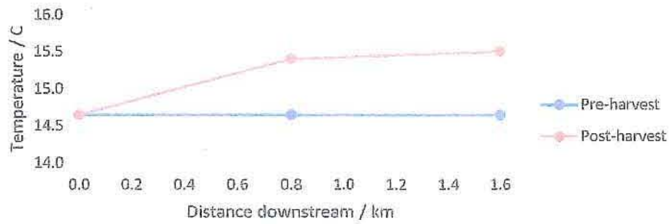


7-30-15 RS Model to dos EXCEL v4.xlsx HC Diff 1/4 8/17/2015 5:21 PM

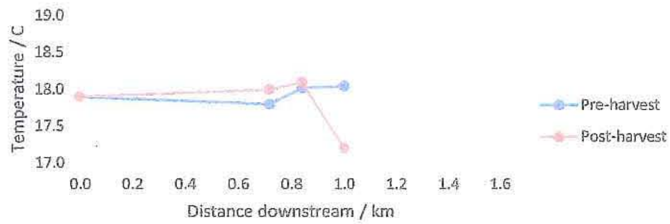

No tree and UBMP
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
ΔT / C
(diference between post-harvest and natural baseline)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Distance along stream / km
Natural baseline
Big Rock No tree 2013
Brome No tree 2013
Marys River No tree 2013
Mill Creek UBMP 2013

South side

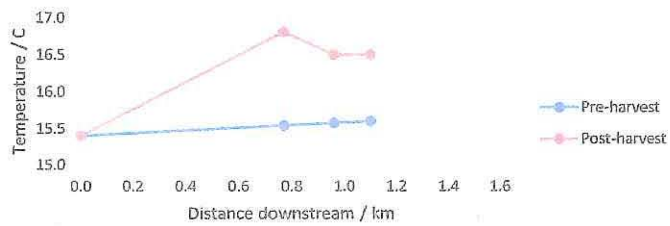
Mill Creek 1995



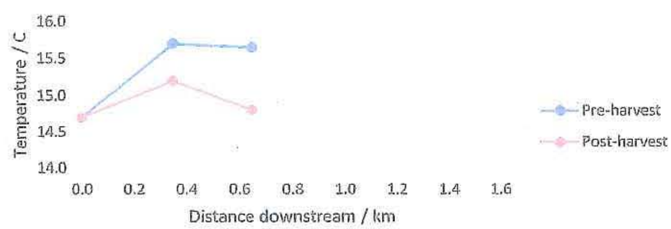
Cascade Brush 1995



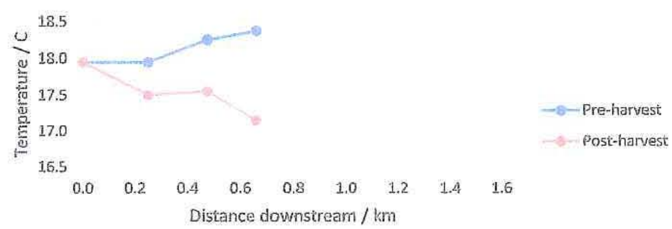
Sheeley Creek 1995



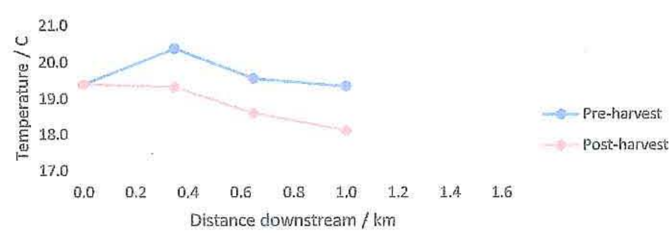
Mary's River Partial 2013



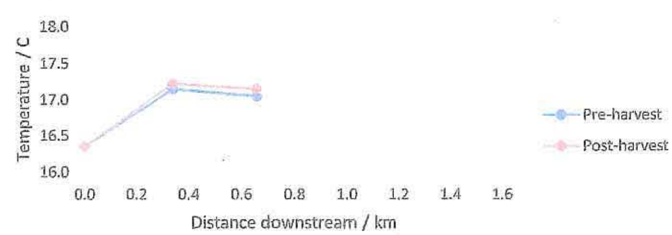
Big Rock Partial 2013



Brome Creek Partial 2013

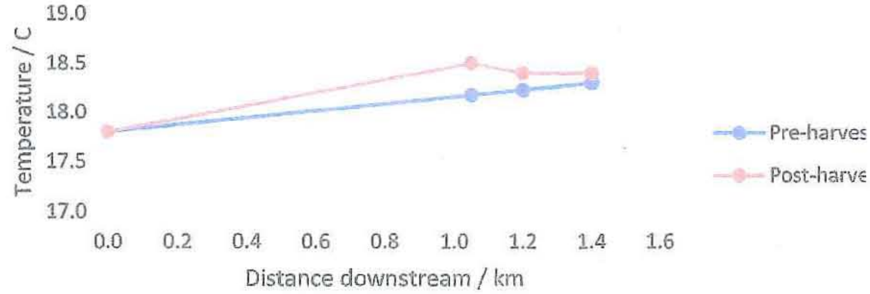


Mill Creek 2013 Partial

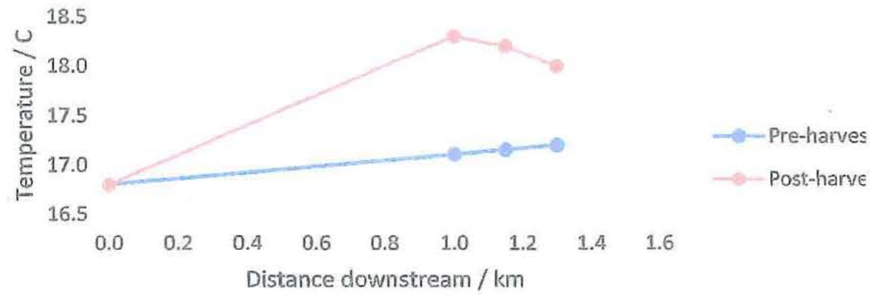


FPA BMP

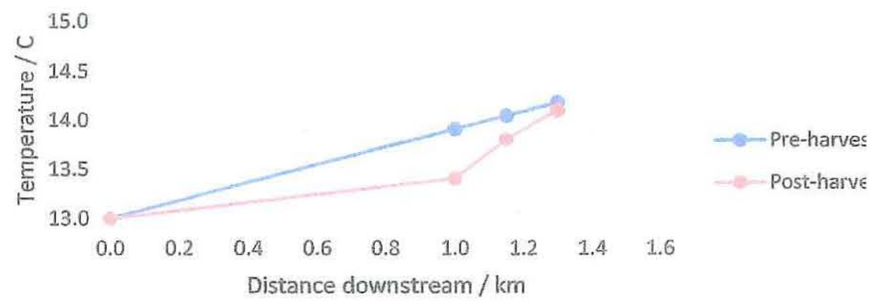
Beaver Creek



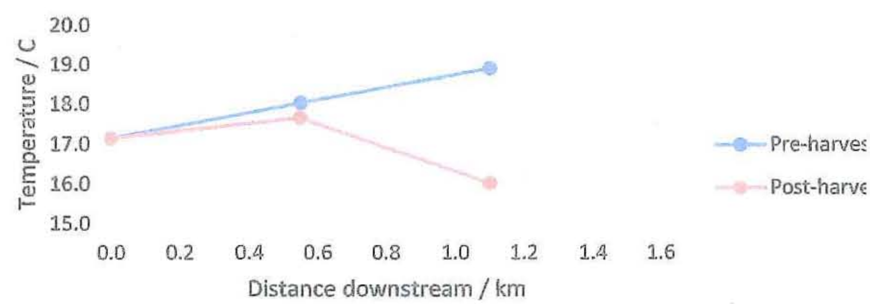
Douglas Creek (coastal)



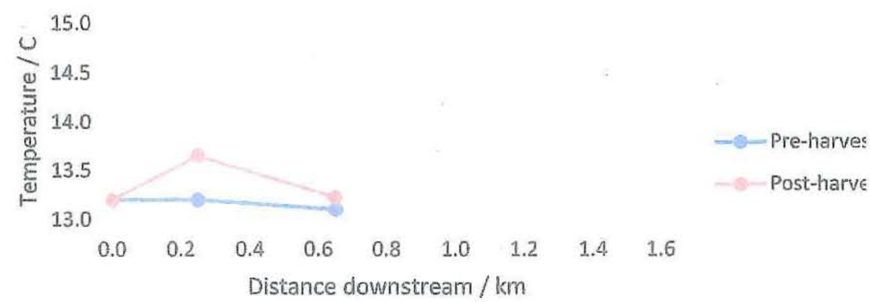
Eagle Creek (Coastal)



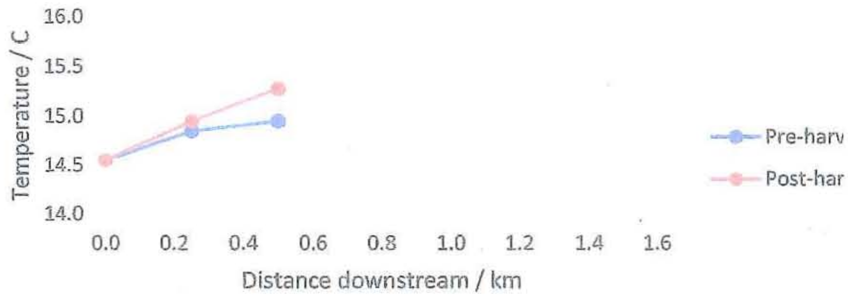
Mill Creek 2013 Lower BMP



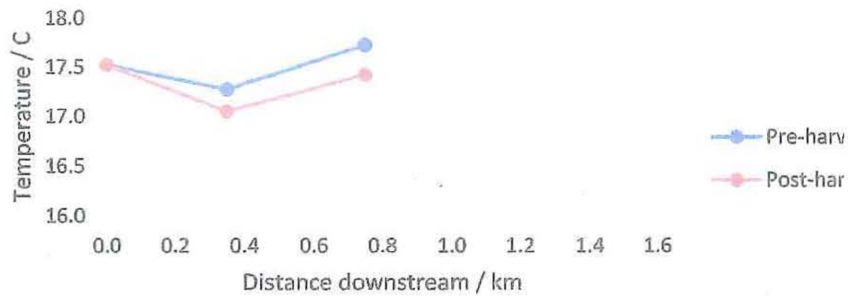
Mary's River BMP 2013



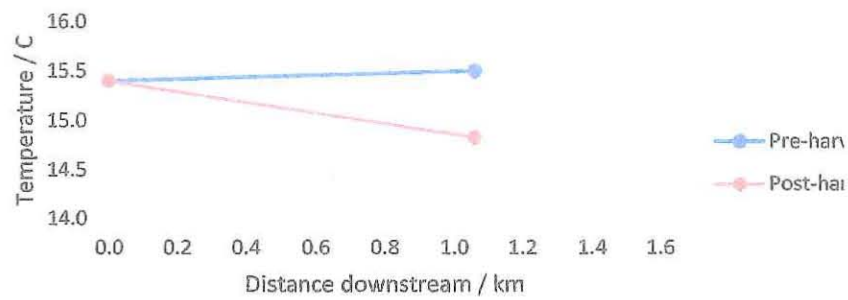
Big Rock BMP 2013



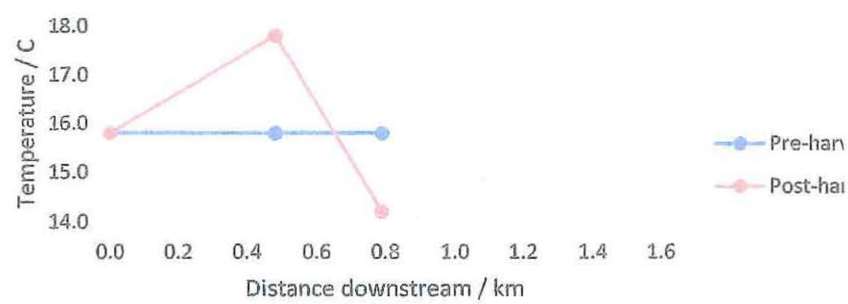
Brome Creek BMP 2013



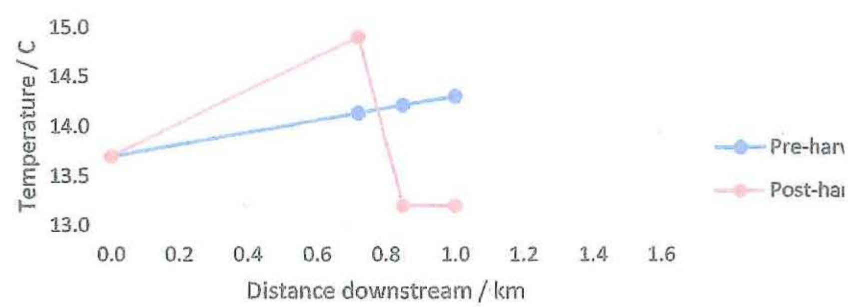
Griffith Cr



Sheythe Cr

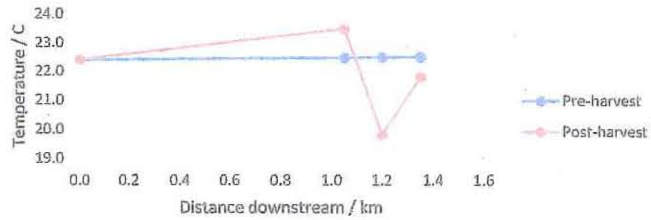


Talbot Crk

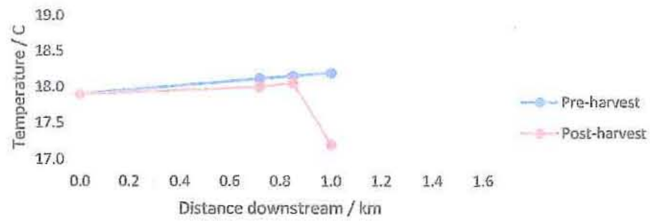


Hardwood Conversion

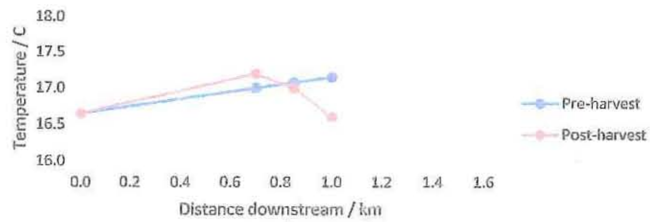
Brush Creek



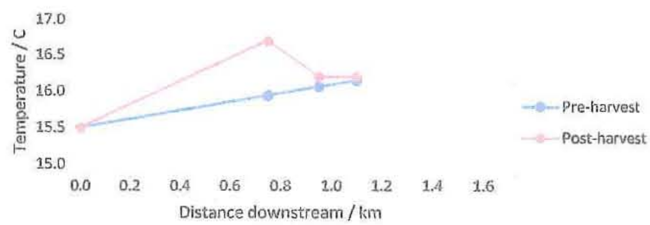
Cascade Brush



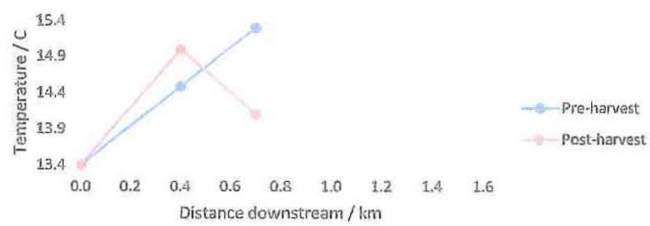
Coleman Creek



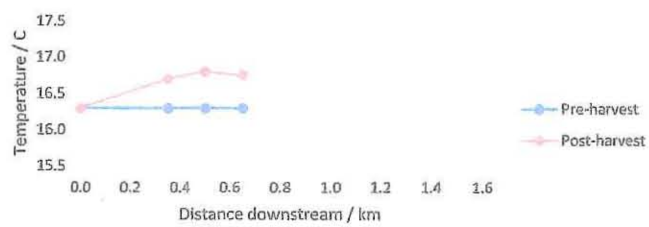
Sheeley Creek



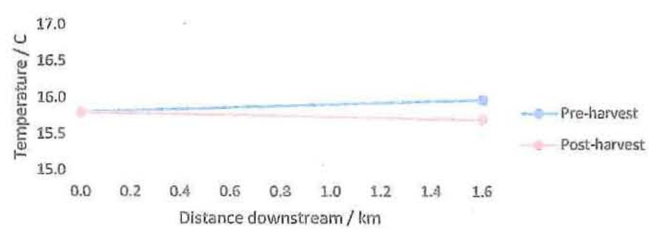
West Agency Creek



Little Fall Crk

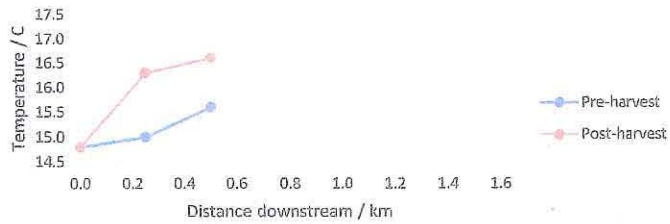


Mill Cr (coastal) '95

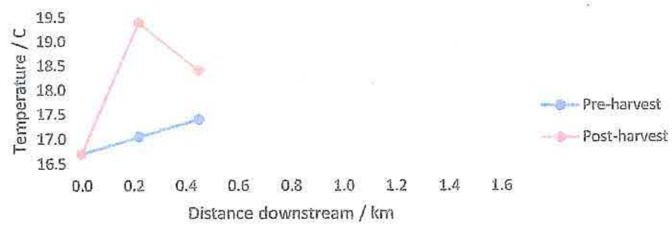


No tree & UBMP

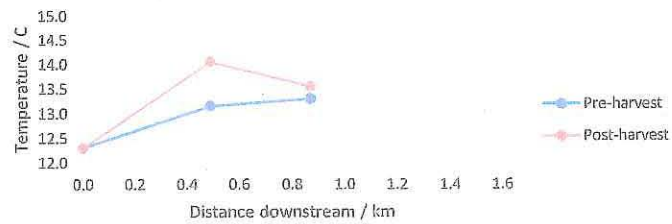
Big Rock No tree 2013



Brome No tree 2013



Marys River No tree 2013



Mill Creek UBMP 2013

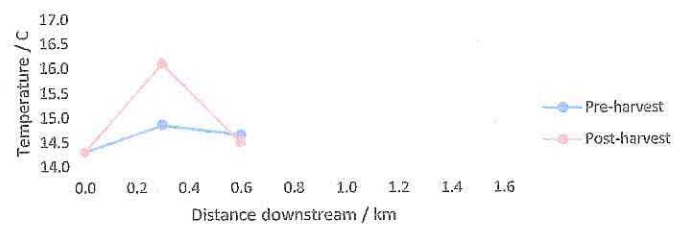


Figure 2
Influence of buffers on Stream Temperature

Fig. 7. Seven day moving mean maxima for the four streams for 2 years preharvest (solid lines) and 4 or 5 years postharvest (broken lines). Arrows pointing up indicate confluences. Symbols represent thermistor locations.