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**UNITED STATES DISTRICT COURT FOR
THE DISTRICT OF IDAHO**

IDAHO RIVERS UNITED, and FRIENDS OF THE CLEARWATER,	)	No. 3:16-cv-102-CWD
Plaintiffs,	)	**DECLARATION OF DR. JENNIFER L. PIERCE**
v.	)	
NEZ PERCE-CLEARWATER FOREST SUPERVISOR CHERYL F. PROBERT; UNITED STATES FOREST SERVICE; NOAA FISHERIES; and U.S. FISH AND WILDLIFE SERVICE,	)	
Defendants.	)	

I, Jennifer L. Pierce, hereby declare and state as follows:

1. My name is Jennifer Pierce and I am a resident of Boise, Idaho. The following matters are personally known to me, and if called witness I would and could truthfully testify thereto.

2. I have been asked, as a professional geomorphologist, to evaluate the

Johnson Bar Project area on the Clearwater River. Here I provide my opinion concerning the risks of mass movement and sedimentation related to the proposed salvage logging operation, and note several fundamental omissions and errors in the existing Johnson Bar Fire Salvage Project, as set forth in the Final Environmental Impact Statement (JB FEIS) and the Johnson Bar Fire Salvage Project Final Record of Decision (JB ROD).

3. In my professional opinion, as explained in more detail below, the omissions and errors in the JB FEIS and JD ROD result in a substantial under-estimation of possible sediment inputs to the Clearwater and Selway River systems.

PROFESSIONAL BACKGROUND AND QUALIFICATIONS

4. I am currently an Associate Professor of Geosciences at Boise State University, and have been on the faculty for over 10 years. As a professional geomorphologist, I study landforms and the processes that shape them. I am trained in geology, hydrology, soils, weather, and climate.

5. A primary area of my research is fire-related erosional events; moreover, and importantly for this case, these studies have been geographically focused in Idaho. My research addresses past and current relationships among fire, climate, vegetation and geomorphic response (e.g. erosion and deposition). In particular, I study mass movements (e.g. landslides, 'mudflows' and debris flows) and their effects on streams. I have studied hillslope and channel erosion related to fire in the South Fork Payette and North Fork Boise Rivers (Pierce et al., 2004; Meyer et al., 2001; Meyer and Pierce, 2003; Pierce et al, 2011), the Sawtooths and Middle Fork Salmon Rivers (Pierce et al., 2004; Svenson, 2010; Riley et al., 2015), the Danskin Mountains (Nelson and Pierce,

2010), and south-central Idaho (Weppner et al., 2013). In addition, I have active research in predicting sediment yields from burned basins following recent and future fires in the Boise region (Gibble et al., 2015a; Gibble et al., 2015b). Finally, I have examined the role of climate in influencing sediment inputs to aquatic ecosystems in the Middle Fork Salmon River region (Davis et al., 2013).

6. I received my PhD in Earth and Planetary Sciences from the University of New Mexico (2004); the focus of my dissertation work was fire and fire-related sedimentation in central Idaho (GPA 4.0). I received my MS in Geography from the University of Oregon (2000); the focus of my Master's Thesis was the impact of past mining activities on channel morphology and anadromous fish habitat in the John Day River system (GPA 4.04). I received my bachelor's degree from The Colorado College (1995); the focus of my undergraduate thesis work was the influence of Acid Mine Drainage on water quality in the Cooke City region of Montana (GPA 3.86). I received a Watson Fellowship following my undergraduate degree to study the influence of mining activities on Acid Mine Drainage production in China, Indonesia, and Australia.

BASIS FOR OPINIONS

7. In developing my opinions as stated here, I relied on my professional training, knowledge and expertise, including my familiarity with the geomorphic processes and functions of the Clearwater sub-basin; and on peer-reviewed scientific research and literature, including the studies cited in the References section below. I also reviewed the Johnson Bar FEIS and ROD, particularly their discussions of sedimentation processes, risks, and management measures to be undertaken as part of the Johnson Bar fire salvage project. In addition, I performed my own evaluation of

potential landslide risks on the Johnson Bar project area using well-established modeling techniques and GIS analysis, as described further below.

BACKGROUND INFORMATION

A. <u>Mass Movements and Sedimentation</u>

8. In steep mountainous areas such as the Clearwater region, mass movements are often the primary process by which sediment moves down slope and into streams. Mass movements, especially those related to prolonged rain-on-snow events or to wildfire, are the primary sources of sediment into channels. As shown by *Figure 1* below (Meyer et al., 2001), sedimentation from large events on the South Fork Payette River are several orders of magnitude greater than background levels of sediment input.

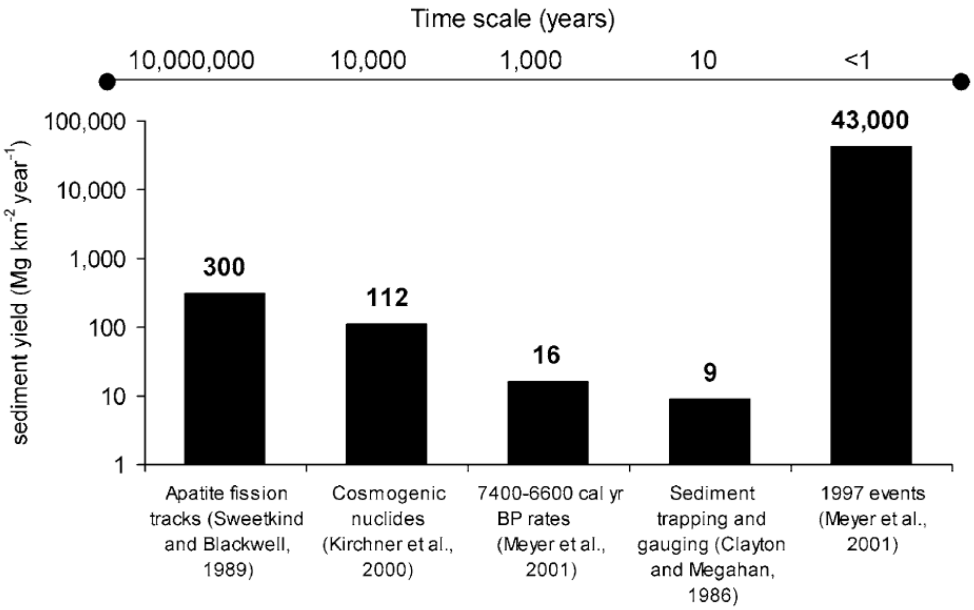


Figure 1. Estimates of sediment yield in the Payette and central Idaho region averaged over different time scales and from different techniques (note log scale). Very large sediment yields were measured in single 1997 debris-flow and sheetflood events in two 0.5 km2 basins in the Payette area. These estimates are from both burned, previously forested basins and from unburned rangeland basins. These debris flow events were triggered by fire and a rain-on-snow event.

9. Most debris flows originate from small 1st order streams or slope hollows that have little or no streamflow most of the year. These flows can exert enormous erosive forces and are capable of transporting large logs and boulders. Efforts to contain or stop these flows (e.g. straw bales, retention ponds, etc.) are almost always unsuccessful. Only large-scale heavily engineered structures can be effective (e.g. Hungr et al., 1984), and the cost of these measures is substantial.

B. Fire-related Sedimentation Events and Sediment Volumes and Impacts of Timber Harvest on Slope Stability

10. Prolonged droughts and increasing temperatures are driving longer fire seasons and increases in burnable area on a global scale (e.g. Westerling et al., 2006; Jolly et al., 2015). Over the 20th century, fire size and severity have increased in most in the northern Rocky Mountains. From 1908 to 2000, canopy fires burned 50% of the Boise National Forest in central Idaho, mostly during severe droughts in 1926–35 and 1986–2000 (Kunkel and Pierce, 2010; Pierce et al., 2004). Recent stand-replacing fires in this area have led to numerous large debris flows and sediment-charged floods in steep mountain drainages (Meyer et al., 2001; Pierce et al., 2004; Riley et al., 2015). Sediment yields from single large sedimentation events following severe 1989 and 1994 fires are three orders of magnitude greater than annual sediment yields measured without large events (Meyer et al., 2001; Kirchner et al., 2000).

11. Workers from the US Geological Survey have developed models to quantify post-fire debris-flow probability and volumes for the western US (Cannon et al., 2010). These models have been used to inform land managers of debris flow activity risks over several post-fire landscapes (USGS Landslide Hazards Program). Logging or deforestation increases the probability of colluvial failures and debris flows (e.g. Gray

and Megahan, 1981; Swanson, 1981; Meyer et al., 2001).

C. Impact of Post-wildfire Logging on Future Fire Risk and Natural Conifer Regeneration

12. Studies from post-fire logging in Oregon show that while natural conifer regeneration was abundant after high-severity fire, post-wildfire logging reduced median regeneration density by 71%, significantly increased downed woody fuels, and thus increased short-term fire risk (Donato et al., 2006). Additional reduction of fuels is necessary for effective mitigation of fire risk. Post-fire logging can be counterproductive to the goals of forest regeneration and fuel reduction (Donato et al., 2006).

13. Other studies (e.g. Beshta et al., 2004) show that in multiple sites throughout the western US, ground-based post-fire logging, removal of large trees, and road construction, as well as practices that adversely affect soil integrity, persistence or recovery of native species, riparian functions, or water quality, generally impede ecological recovery after fire.

OMISSIONS AND ERRORS IN THE JOHNSON BAR FEIS AND ROD

14. In my professional opinion, the Johnson Bar FEIS and ROD do not provide a scientifically sound or accurate evaluation of potential sedimentation impacts from the post-fire salvage activities proposed by the U.S. Forest Service, due to several key omissions and errors in their analysis, as detailed below.

A) Fire-related Sediment Inputs to Streams

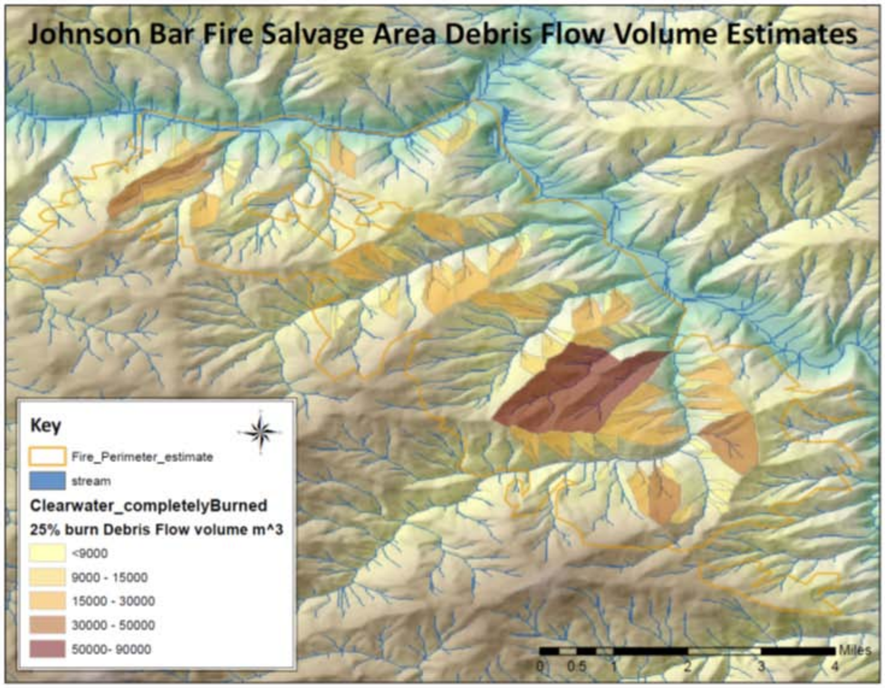
15. First, I find that the potential – indeed, likely – impact of increased sediment yields to the Selway, Lochsa, and Clearwater Rivers due to increased fire-related sedimentation events have not been adequately considered, particularly taking into account the cumulative impacts associated with the 2014 Johnson Bar fire and the

2015 Slide and Wash Fires. This error results in what may be a gross underestimate of fire-related sedimentation to the rivers and streams in the Johnson Bar FEIS and ROD, which must be taken into account as a baseline of impacts to gauge further impacts of the Johnson Bar salvage project activities.

16. Debris flows, hyper-concentrated flows, and sediment charged floods following fire are exceptionally common in central Idaho due to the highly erodable Idaho Batholith bedrock. The metamorphosed rocks of the Mesoproterozoic Belt Supergroup along the Clearwater River are also highly erodible. USGS mapped hazards in the Slide Fire area show multiple tributaries in the Slide Fire burn area may produce up to 100,000 m3 of sediment (http://landslides.usgs.gov/hazards/postfire_debrisflow/2015/20150813washslide/) – yet this information was not included in the Johnson Bar FEIS.

17. As a result, the combined effect of this sediment plus sedimentation due to logging activities has not been adequately considered. On page 7 of the FEIS, the Forest Supervisor states: "I find the wildfire effects do not significantly change the environmental effects of the project. . ." Given that there is a high likelihood that fire-related debris flows from adjacent and upstream burn areas will increase sediment and wood inputs to the Clearwater system, and that increased sedimentation due to logging is an issue of concern for fisheries, the combined possible impacts of sediment from both fire and proposed logging operations on aquatic ecosystems must be considered.

18. The following figure (*Figure 2*) presents drainage basin polygons that were assessed for post-fire debris flow volume in the Clearwater Johnson Bar proposed salvage timber project:



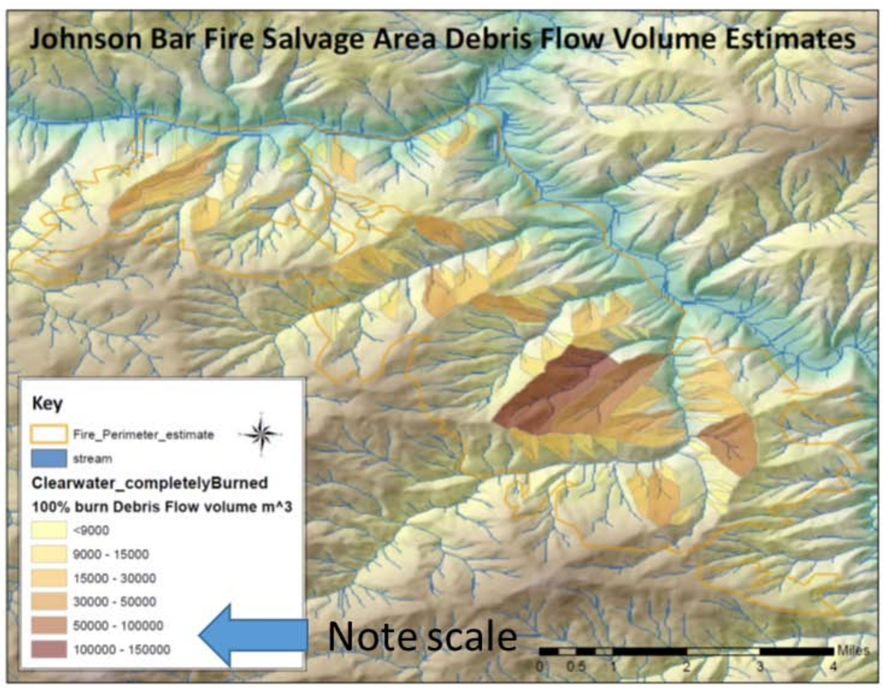


Figure 2: Modeled sediment yields from the Johnson Bar area based on 25% of basins burned at moderate and high severity (top) and 100% of basins burned at moderate and high severity (bottom) during a 2-year recurrence storm event (Cannon et al., 2001).

19. Figure 2 was developed for this report using models developed by the USGS (Cannon and others, 2010). The model requires attributes of soil, topography,

burn severity and precipitation. Attributes of soil and topography were calculated per basin using Spatial Analyst and Data Management tools in ArcGIS 10.3.1. SSURGO data and 30m DEMS were the data sources. Burn severity values were manually selected to represent a range of scenarios: 25% burn and 100% burn, where the '% burn' represents the percentage of an individual basin that burned at moderate and high severity. Precipitation values were taken from NOAA Atlas 2.The hazards expressed on the map represent a range of burn scenarios during a 2 year recurrence interval storm (e.g. the size of storm that occurs *every 2 years)*.

20. The take-home point from Figure 2 is that even without any addition of sediment from the proposed logging operation, even moderately burned basins in the project area are likely to produce large amounts of sediment under average storm conditions. While actual burn severity values range widely, even if the burn severity was only 25%, >360,000 m^3 (>470,000 cubic yards) of sediment would be produced. Higher burn severities yield estimates in excess of 600,000 m^3 (>780,000 cubic yards) of sediment.

B) Increased Risk of Fire

21. Droughts and increasing temperatures are driving longer fire seasons and increases in burnable area on a global scale (e.g. Westerling et al., 2006; Jolly et al., 2015). Over the 20^{th} century, fire size and severity have increased in most in the northern Rocky Mountains. From 1908 to 2000, canopy fires burned 50% of the Boise National Forest in central Idaho, mostly during severe droughts in 1926–35 and 1986–2000 (Kunkel and Pierce, 2010; Pierce et al., 2004).

22. As shown in *Figure 3* below, snowmelt date in Idaho has decreased since

the early 1900's. Early final snowmelt in the Boise National Forest is accompanied by increased fire activity (Kunkel and Pierce, 2010). The primary control of wildfire in the Western US is the timing of spring and snowmelt (Westering et al., 2006) and this trend is likely to continue (IPCC 2014). Therefore, it is reasonable to assume that fire activity (and related sedimentation events), will continue to increase in Idaho, including the Clearwater area.

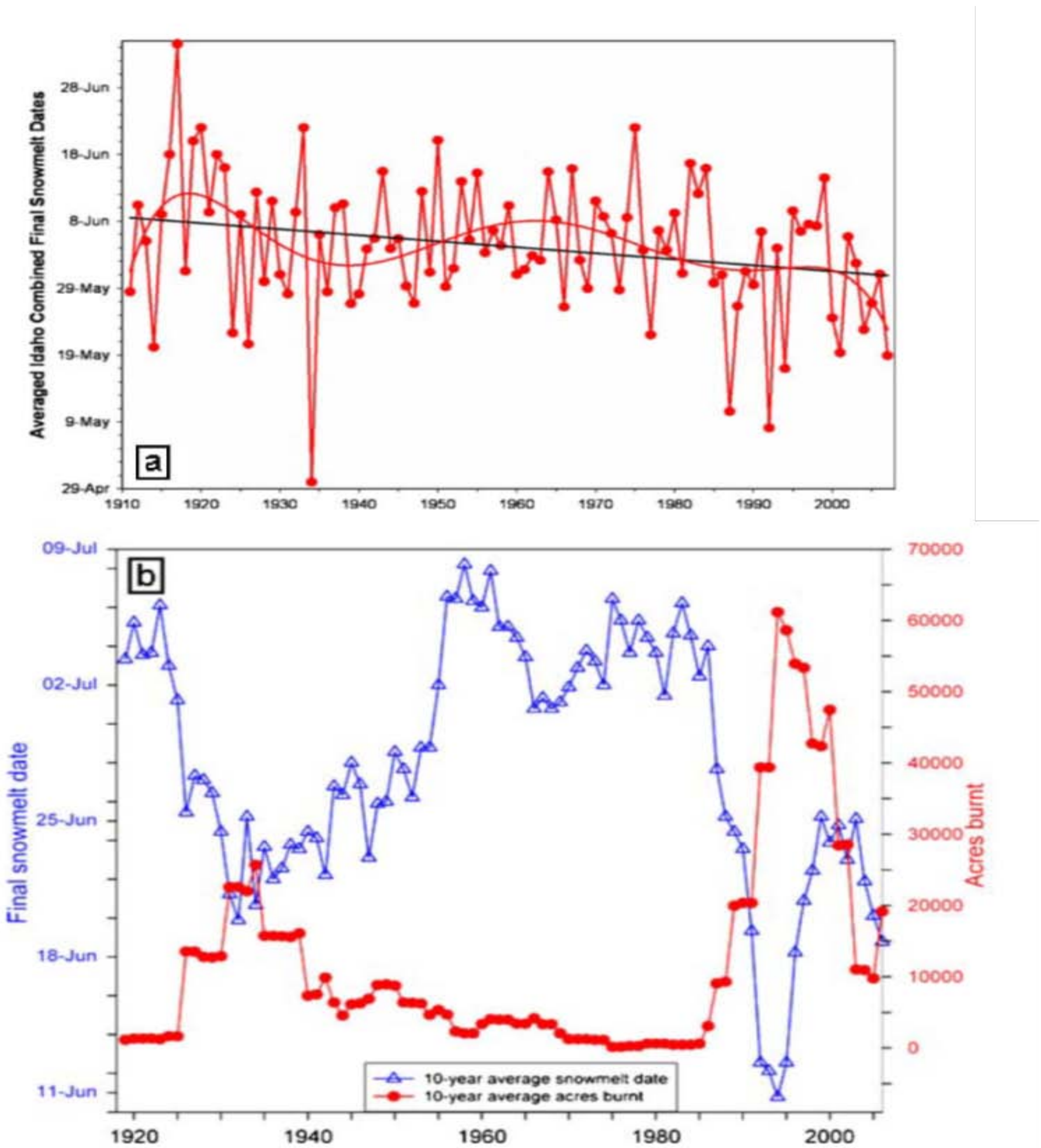


Figure 3: (a) Snowmelt in Idaho's watersheds is occurring earlier, and (b) early snowmelt in the Boise River watershed corresponds with increased fire activity (from Kunkel and Pierce, 2010).

3) Landslide Risks Are Not Evaluated

23. It is well-documented that the Clearwater region, given the nature of its geology and soils, is prone to landslide events, especially following fire or in wet conditions, such as above-average precipitation and rain-on-snow events. Yet I found that the Johnson Bar FEIS and ROD failed to discuss the history and impacts of landslide events that have been well documented in the region; and further failed to evaluate how the Johnson Bar Project activities may cause or contribute to similar landslide events when similar weather condition recur in the future.

24. Over 900 hundred landslide-type events, each in excess of 25 cubic yards (plus many more under that size), were documented in the Clearwater region during above-average precipitation conditions during November-December 1995 and in February 1996, as described in a Forest Service report on the slides (McClelland et al. 1997), which included rain-on-snow events. Periodic flood and landslide events have regularly occurred in the Clearwater region before then, including major events in 1974-1976 that were on a similar scale as the events of 1995-96, as well as other prior events in 1919, 1933, 1948, 1964 and 1968 (McClelland et al. 1997, p. 10).

25. Disturbance (reduced vegetation cover, road building, skidding, and removal of dead standing trees) all act to reduce soil cohesion and integrity, and may increase landslide risk. McClelland et al documented (pp. 12-13) that the majority (70%) of the 1995-96 landslides were found to be associated with roads (58%) or areas affected by timber harvest (12%). Given that landslides in the surrounding area (e.g. Elk City) are an active threat to communities and roads, landslide potential requires special consideration, which was not provided in the Johnson Bar FEIS and ROD.

C) Increased Risk of Rain-On-Snow Events

26. As shown illustrated by the winter 1995-96 rain-on-snow events addressed in McClelland et al., rain-on-snow greatly increases risks of colluvial failures (landslides) and debris flows throughout central Idaho. Rain-on-snow events also occurred in the winter of 1996-1997 (Meyer et al., 2001), which produced landslides and debris flows throughout central Idaho. An illustration is shown in Figure 4 below:

Figure 4: Example of large rain-on-snow colluvial failure in the South Fork Payette River area of central Idaho. Events like this are predicted to become more common in the future (Tennant et al., 2015; photo credit: Grant Meyer).

27. With warming winter temperatures, the likelihood of rain-on-snow events will increase both in the western US (Barnett et al., 2005) and in the central Idaho region (Tennent et al., 2015). Yet the Johnson Bar FEIS and ROD failed to address the likely impacts of such increased winter temperatures and rain-on-snow events in contributing to the likelihood of major landslide events recurring in the region, and specifically in the Johnson Bar project area. Therefore, in light of 1) recent large fires and 2) current and future climate-driven increases in the likelihood of rain-on-snow events, re-evaluation of

landslide-prone areas must be conducted.

D) Failure to Apply the GRAIP Model

28. The Geomorphic Road Analysis and Inventory Package (GRAIP) was produced by the US Forest Service's Rocky Mountain Research Station, and was developed and tested in Idaho (http://www.fs.fed.us/GRAIP/intro.shtml). It is designed to help land managers learn about the impacts of road systems on erosion and sediment delivery to streams. As the name implies, GRAIP couples analytical tools with an inventory process to build an approach to roads analysis that can be locally calibrated in a repeatable fashion and with minimal effort. The full scope of GRAIP includes methods to inventory roads and analyze the inventory for surface erosion, gully risk, landslide risk and stream crossing failure risks. Methods to measure road surface erosion from sample sites are also included.

29. Despite the obvious applicability to this proposed project, this analysis was not conducted for the proposed Johnson Bar salvage project. There is no explanation in the FEIS or ROD for why the Forest Service chose not to apply GRAIP to evaluate potential erosion risks and impacts of the Johnson Bar Project.

E) Hydrologic Connectivity Errors.

30. The FEIS and ROD erroneously project that sedimentation impacts of the Johnson Bar salvage activities are minimized because project areas are "hydrologically disconnected" from the Clearwater and Selway River systems. This is not true; the proposed project areas *are* hydrologically connected to the Clearwater and Selway River systems (see map of streams on *Figure 2* above). Water which falls and/or accumulates in the project area will end up in the Selway or Clearwater drainage systems—that is the

definition of a drainage basin. Therefore, disturbance, sediment and any spills of contaminants could influence the main channels.

31. On page 27 of the FEIS, it is stated that: "Alternative 4 Modified is designed to remove actions that will be hydrologically connected to the Selway River. In other words, roads and salvage units are placed in such a manner that any small amount of sediment produced will be filtered out or deposited long before reaching the river." Since most sediment is transported during episodic events (e.g. floods), and since the proposed activities are within tributary watersheds of the Selway and Clearwater Rivers, stating that erosion from salvage units will not reach the main river corridor during flood events does not make sense hydrologically.

F) Errors in Asserted Improvement of Water Quality

32. Also stated on page 27 of the FEIS: "The data in the FEIS indicate that this project will improve sediment and temperature conditions over the long-term, which will result in improved water conditions and water quality." I find this assertion to be highly questionable and almost certainly wrong. How will this project improve sediment and temperature conditions over the long-term?

33. As noted above, salvage logging practices and removal of dead standing trees has been shown to increase temperatures, hamper tree regeneration (Perry et al., 1989), decrease soil organic matter and moisture (Jenny 1980, Rose et al., 2001), increase runoff and increase the magnitude of erosive high flows (Karr et al., 2004), harm aquatic species, ranging from invertebrates to fishes (Waters 1995) and increase the potential severity of future fires (Odion et al. 2004). Yet these studies and their findings are not reflected in the Johnson Bar FEIS and ROD.

CONCLUSION

34. In conclusion, the oversights and errors discussed above in the Johnson Bar FEIS and ROD regarding likely sedimentation impacts are, in my opinion, scientifically unjustified and merit a re-evaluation of this project. In this case, the effects of recent 2015 fires, climate-driven changes in future fire activity and rain-on-snow, influence of landslides on infrastructure, the failure to apply the GRAIP model, and the obvious hydrologic connectivity between the project area and the Clearwater River system must be considered.

I declare under penalty of perjury pursuant to the laws of the United States that the foregoing is true and correct. Executed this 5th day of April, 2016 at Boise, Idaho.

/s/ Jennifer L. Pierce
Jennifer L. Pierce

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