DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
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Readiness Office 23 December 2015

SUBJECT: Technical Assistance Report concerning post-wildfire potential in Clearwater and Idaho Counties, Idaho

1. **Reference**. Idaho Bureau of Homeland Security letter, dated 17 November 2015, subject: Advance Measures Request (see appendix D).

2. **Project Background**.

Many large wildfires burned in the Clearwater River basin of Idaho in the summer of 2015. In particular, the Clearwater Complex and Municipal fires burned on lands adjacent to and upstream of the cities of Kamiah and Orofino, Idaho, respectively. While the fires have since been extinguished, threats remain in the burned areas. Soils in burn scars often lose their stability due to burned vegetation losing its root structure. These soils can also become hydrophobic. As a result, these areas are typically at risk for increased runoff from precipitation and snowmelt, as well as an increased risk for landslides and debris flows.

In November 2015, the State of Idaho requested Advance Measures Technical Assistance from the U.S. Army Corps of Engineers through the Idaho Bureau of Homeland Security on behalf of Idaho and Clearwater counties. This mission was approved and a team was deployed to Idaho and Clearwater Counties during the week of 30 November 2015. The team was made up on a hydraulic engineer, a sediment technical specialist, a geologist, and a civil engineer. Field reconnaissance was conducted to determine the condition of the burned areas, with a particular focus on changed hydrologic and hydraulic conditions, soil and geologic hazards, and potential mitigation efforts that may be pursued by the affected counties.

Some work was completed prior to the team deploying for field assessments. A composite risk map was generated for the Clearwater, Municipal, Teepee Springs, and Motorway fires, based on burn severity, slope, soil type, and burn proximity to infrastructure and mapped floodplains. Hydrologic modeling was conducted on Lawyers Creek upstream of Kamiah, Idaho, based on burn severity to assess the potential change in conditions.

Once deployed, the team visited the Lawyer Creek and Tom Taha Creek drainages in the vicinity of Kamiah, Idaho. Work was also completed in the Orofino Creek drainage upstream of Orofino, Idaho. Finally, cursory reconnaissance was conducted of Lolo Creek, a tributary to the Clearwater River upstream of the City of Orofino.

Upon returning from the field, the team worked to compile field observations and additional hydrologic, hydraulic, and geologic information from other sources and prepared general and site-specific mitigation actions for the counties to pursue. This report details the investigation and mitigation recommendations of the Advance Measures Technical Assistance team.

3. **Purpose and intent**.

This report is a *situation estimate*, and contains the professional opinions and insight of the Advance Measures Team, based on their pre-trip research, on the ground assessments, and subsequent modeling and/or analysis. This attempts to "set the stage" for the State and counties to prepare their own contingency and/or response plans. To do so, this report provides technical and professional information concerning the possible impacts in the burn areas due to rainfall and snowmelt conditions, and the potential for flooding due to debris dams and increased runoff in channels. The focus is on the impacts to life and improved property, including public infrastructure. Where possible, the team identified options for the counties to consider in their own planning, but those options do not include any designs or specifications, only ideas.

At no time was this report intended as a plan. Technical assistance permits the Corps of Engineers to support non-Federal governments in their efforts to plan for future conditions. In this situation, the intent is to support the State of Idaho, and the Counties of Elmore and Blaine, to plan for the impacts of the 2015 wildfires on their population, infrastructure, and general economic conditions, and to prioritize their efforts. Further, this helps to identify where they may need supplemental assistance from external sources. Those external sources are not identified, except for the Corps' Advance Measures program, where applicable. Requests for direct assistance under any Corps of Engineers program must be provided by the State or the Counties within the requirements of those programs. Contact information is included under paragraph 4.

4. **General comments**.

Weather events are not specifically addressed in this report, although the hydrologic analysis included some modeling. High runoff and debris flows in other parts of the Pacific Northwest provide a good example of the sort of short-notice weather events that could cause problems, but a "rain on snow" event is a concern as well. Spring runoff could see higher flows in the subject locations, as well as other parts of the impacted area.

Possible direct assistance missions under Advance Measures are discussed in this report. Such requests must be due to the existence of an imminent threat of unusual flooding. The threat must be established such that there is sufficient lead time to obtain emergency funding and mobilize an adequate response. The nature of the post-wildfire flood threat makes this difficult at best, and Advance Measures may not be feasible. Vigilance and preparedness on the part of the counties, tribe, communities, and individual property owners should be considered as the first step. Please contact Val Bogdanowitz, Chief of Readiness, at 509-527-7041, Val.P.Bogdanowitz@usace.army.mil, on further technical assistance for preparedness.

Geographic information system (GIS) based data and maps created by Walla Walla District as part of this effort are available for distribution to the State of Idaho, as well as Clearwater and Elmore Counties. The data will be transferred by the most viable, direct means feasible, depending on the total size. Hardcopies of this report will be provided as well. Questions concerning GIS data transfer or Corps support to non-Federal government concerning flood response operations, should be addressed to Jeff Stidham, Disaster Response Manager, at 509-527-7145, Jeffery.L.Stidham@usace.army.mil.

Questions concerning levees inspected by the Corps of Engineers should be addressed to the Levee Safety Program Manager, Herb Bessey, 509-527-7144, Herb.G.Bessey@usace.army.mil.

Regulatory permitting remains required for all in-water work. For Idaho County, contact Greg Martinez at the Boise Regulatory Office at 208-345-2154, Greg.J.Martinez@usace.army.mil, for more information. For Clearwater County, contact Mike Burgan at the Coeur d'Alene Regulatory Office at 208-433-4475, Michael.A.Burgan@usace.army.mil.

Questions concerning all other Corps programs within the State of Idaho should be directed to Bandon Hobbs, 208-433-4463, Brandon.W.Hobbs@usace.army.mil.

5. **Idaho County**.

a. Lawyer Creek, Suzie Creek, And Sevenmile Creek.

(1) Burned Area. The Lawyer Complex, which was later incorporated into Clearwater Complex, originated on Monday August 10th, 2015, at 1:15 PM. The fires in the complex impacted the drainages of Lawyer Creek, Tom Taha Creek, and Lolo Creek. Over 50,000 acres were affected by the fire. Approximately 50 primary structures and 75 out buildings were lost. The fire perimeter was less than two miles from the City of Kamiah, Idaho, and severely impacted much of the Lawyer Creek, Suzie Creek, and Sevenmile Creek drainages.

(2) Hydrologic Environment. The following summary of the hydrologic environment for Lawyer Creek, and main tributaries, is primarily assembled from *Flood Plain Information, Lawyer Creek – Clearwater River, Kamiah, Idaho and Vicinity* (NWW, 1975) and *Special Study, Lawyer Creek, Lewis and Idaho Counties, Idaho* (NWW, 1999), supplemented by other sources, as indicated:

While damaging floods have occurred from flows on the Clearwater River in Kamiah, the focus of this Advance Measures investigation for Idaho County is Lawyer Creek. Lawyer Creek is a tributary of the Clearwater River in north central Idaho, approximately 40 miles east of Lewiston, ID (NWW, 1999). The Lawyer Creek basin is 27 miles in length and 6 to 10 miles wide, with irregular-shaped rolling hills and deep narrow canyons. Mountain peaks reach 5,400 feet in elevation, and the upper basin averages about 3,000 feet with the confluence of Lawyer Creek with the Clearwater River at an elevation of 1,190 feet above sea level. This creates a rather steep stream with an average slope of 105 feet/mi above Kamiah, and about 60 feet/mi near Kamiah (NWW, 1999). The confluence of Lawyer Creek and the Clearwater River occurs at Kamiah, ID, and is characterized by the alluvial fan (*i.e.,* delta) common to steep streams, and the attendant wide lateral flood lines of such systems. The drainage area of Lawyer Creek at the confluence is 210 mi^2 (NWW, 1975). The city of Kamiah is built on the alluvial fan (NWW, 1999). Sevenmile Creek is a tributary of Lawyer Creek, within Idaho County, and has a drainage area of less than 20 mi^2. Sevenmile Creek accounts for about 11 percent of the drainage area of Lawyer Creek, but only about 9 percent of the annual precipitation (NWW, 1999). Suzie Creek, in Lewis County, enters Lawyer Creek from the north, upstream of Sevenmile Creek, on the Flying B Ranch.

The climate is characterized by warm summers, when temperatures may rise to above 100 ^oF, and cool winters, when temperatures may drop below 0 ^oF, with average annual temperatures of 45 ^oF. Average annual precipitation over the basin is 21 in, with the majority of this occurring in the spring and fall (NWW, 1975).

The flood plain along Lawyer Creek consists of open pasture and agricultural areas, along with blocks of residential areas in and around the City of Kamiah (NWW, 1975). High flows can build quickly in the nearby steep canyons, and swell Lawyer Creek beyond its channel capacity within 12 hours at Kamiah (NWW, 1999).

(3) Pre-Fire. Though the U.S. Geological Survey (USGS) measured stream flows in Lawyer Creek upstream of Kamiah near Nez Perce, ID, from 1967 to 1974, there are no systematic flow records at Kamiah. An Intermediate Regional Flood, corresponding with a 100-year average recurrence interval, was estimated for Lawyer Creek based on correlations of normal annual precipitation, basin mean elevation, stream flow records and runoff characteristics of nearby gaged streams. This data was statistically analyzed for consistency, and produced an estimated peak discharge of 7,300 CFS (NWW, 1975). Abbreviated numerical modeling of the Lawyer Creek, using the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS), was calibrated to reproduce a similar 1 percent annual chance exceedance event peak discharge of 7,400 CFS for the pre-fire condition. The Kamiah Special Study (NWW, 1999) also listed frequency-discharges from a 1985 Flood Insurance Study (FIS) of Kamiah. The 1985 FIS probability peaks, along with the estimated HEC-HMS discharges for Lawyer Creek, at the confluence, for a representative range of probabilities are listed in Table 1.

Table 1. 1985 FIS and HEC-HMS (Pre-fire Condition) Estimated Probability Discharges for Lawyer Creek, at Kamiah.

Annual Chance Exceedance	Peak Discharge (CFS) 1985 Flood Insurance Study	Peak Discharge (CFS) Advance Measures HEC-HMS modeling
0.10	3,800	2,400
0.02	6,100	5,600
0.01	7,300	7,400
0.005	10,200	--[1]

[1]Event not modeled.

(4) Post-fire. The HEC-HMS model used to produce the above pre-fire estimated peak discharges was edited to account for impacts to hydrologic behavior associated with the areas within the watershed that were burned by the Clearwater Complex fire. The burned area within the Lawyer Creek watershed is approximately 12 mi^2 (of approximately 214 mi^2 of the total drainage area), and was modeled as a distinct sub-basin in order to assess the response to the wildfire of the burned area. The results of the abbreviated HEC-HMS modeling for pre- and post-fire conditions are summarized in Table 2.

(5) Potential Risks

(a) Runoff. Damaging floods have been reported in Kamiah as far back as 1912, and the highest flood on Lawyer Creek in the 1975 report (NWW) occurring in 1948. That report predated the notable 1996 major flood (NWW, 1999).

Descriptions from earlier reports indicate that a flood in 1965 washed out a dike, causing flooding around residential property as well as the airport area, and changed course significantly enough as to isolate structures. A flood in 1957 also washed out a dike along the creek and damaged dwellings (NWW, 1975).

Table 2. HEC-HMS Pre-fire/Post-fire Estimate Comparisons.

Annual Chance Exceedance	Discharge at Outlet			Burned Area Junction Discharge			Burned Area Sub-basin discharge		
	Discharge (CFS)		% Increase	Discharge (CFS)		% Increase	Discharge (CFS)		% Increase
	Pre-fire	Post-fire		Pre-fire	Post-fire		Pre-fire	Post-fire	
0.10	2,400	2,500	4%	2,700	2,900	7%	200	1,400	86%
0.02	5,600	5,900	5%	6,300	6,600	5%	400	1,700	77%
0.01	7,400	7,700	4%	8,200	8,500	4%	500	1,900	74%

Lawyer Creek usually peaks between early January and late May, though extreme flows tend to occur between mid-January and early February. During these months, early spring rains melt winter snowpack, while the underlying ground is still frozen and incapable of infiltrating accumulated rainfall and snowmelt (NWW, 1999).

As seen in Table 2 above, percentage increases from estimated impacts of the burn, from only the burned sub-basin, ranged from about 75 percent, at the 10 percent annual chance exceedance, to almost a 90 percent increase in peak flow, at the 1 percent annual chance exceedance. When combined with the unburned portion of the drainage, the percentage increases drop significantly, with values ranging from 3 percent to 6 percent at the junction of the burned/unburned areas. Similarly, the increased peak discharges at the confluence range from 4 percent to 6 percent higher, as compared to the pre-fire condition. This indicates that, while overall flood flows would not be expected to increase significantly along the majority of the reach, there will likely be substantially increased peaks from the burned area that could result in increased local flooding. It is worth noting that the combined peak discharges at the burned area junction exceed those of the overall basin at the outlet, indicating potential for localized high peaks at tributary confluences, for example. Some areas, such as the outlet of Suzie Creek and along areas of Sevenmile Creek, could also produce significantly higher discharges in the shorter-term (the next 5 years or so) before the burned areas recover sufficiently.

Discussions with Idaho County Emergency Management revealed a history of repetitive flooding, with the damaging 1996 event the most prominent in recent memory. That flood did significant damage to, or completely obliterated, remaining segments of the previously-damaged levees on both sides of Lawyer Creek along the lower reach adjacent to Kamiah. Lower areas on the north side of the creek within Kamiah, such as near the high school, are apparently particularly flood-prone. Field observations support this, with remnant channel scars visible in the north overbank near the Hill Street Bridge. The 1975 report (NWW) indicated that the 1 percent water surface would be below the low chord of the Hill St Bridge, though the current bridge does not match the one pictured in the 1975 report (Figure 2, lower). The current bridge is a clear span deck, while the 1975 report picture a center pier pair. Assuming that the low chord of the newer (*i.e.,* current) bridge maintained at least the previous bridge's minimum elevation, it should have higher capacity than the old bridge. The 1975 report (NWW) shows that the 1 percent annual chance exceedance water surface elevation would be higher than the low chord of the Railroad Bridge at the lower end of Lawyer Creek (Camas Prairie Railroad). The Railroad Bridge observed during the most recent field work appears to be the same one pictured in the 1975 report. Idaho County personnel also noted the capacity limitations of the Railroad Bridge during high flows.

The levees along Lawyer Creek had an authorized capacity of 5,500 CFS, equivalent to approximately a 50 year flood event with 2 feet of freeboard. The levee was rated "unacceptable" in the 2010 Periodic Inspection and has not been rated since. The report documenting the 2010 Unacceptable rating noted significant erosion/ bank caving, seepage, and slope stability problems along the length of the levees, where they were still present. Field observations during the Advance Measures mission confirmed that the levee was still in this condition.

(c) Sediment and Debris. Little existing information regarding sediment in Lawyer Creek was found within the timeframe of the Advance Measures mission and subsequent report writing. Field observations suggest that the channel may still be aggrading at or near the Railroad bridge. The 1999 report (NWW) describes past dredging of the lower 1.7 mi of the creek to gain conveyance capacity, with dredge spoils being placed on adjacent banks to gain additional freeboard (NWW, 1999). The constriction imposed by the Railroad Bridge likely induces deposition, and creates a feedback loop that exacerbates this behavior.

The Nichols Rd Bridge and Highway 162 Bridge both appear to have sufficient capacity to pass higher flows, and the latter of these two lacks piers that tend to capture floating debris. The bridge upstream of Highway 162 (Robison Bridge?) may experience capacity issues and be flanked at moderate flows (*i.e.,* at probabilities greater than 10 percent). County officials also noted capacity problems at culverts along Sevenmile Rd, but they already had plans to address these.

The steep walls of the canyon upstream of the confluence of Sevenmile Creek along Lawyer Creek appear to have potential for sliding (see next section) and could potentially deposit enough material to reduce the conveyance capacity of Lawyer Creek to cause it to leave the channel. While performing field work, the team observed minor active sliding on a slope next to the roadway. This potential large source of sediment and associated woody debris, in turn, would induce further flooding risks as it occupied existing flood conveyance.

The mouth of Suzie Creek also appears prone to problems. Suzie Creek emerges from a deep, steeply-walled canyon and then makes a rather pronounced right turn before joining Lawyer Creek on the Flying B Ranch. It appears that mechanized means may have been employed to restrict flows from existing facilities at the ranch. The active channel appears to have been bermed on the down-valley side of the channel, and the channel appears to have realigned to a more southerly route at some time in the past. This realignment is upstream with respect to the general valley slope, and likely imposes additional energy losses on flows, thereby promoting higher water stages that would be expected to be prone to inducing flooding of the nearby kennels and outbuildings. The channel capacity also decreases as it nears entry to Lawyer Creek, pinching down to a narrow width and further constrained by a water pipe that did not appear operational during the site visit (see Photo 1 below).

(b) Landslides. Post-fire erosion rates are much greater than erosion rates on a well vegetated watershed and as a result landslides and debris or mud flows are a significant risk following wildfires. Burned areas can be largely devoid of vegetation, have little to no root structure left in the soils, and may have hydrophobic soils at the surface. The combination of lack of vegetation and hydrophobic soils will concentrate surface runoff from rainfall events.

The burn may also have sterilized the soils, meaning that a quick natural re-vegetation is unlikely.

On Sevenmile Creek, which is a tributary to Lawyer Creek, the burned area consists of only the downstream most 1.5 miles on the left bank of the creek. This is a relatively small affected area compared to some of the other burned areas observed. However, this 1.5 mile portion of the drainage contains State Hwy. 162, a primary route from Kamiah to the Prairie. The topography on the burned side of the canyon consists primarily of a near-vertical basalt cliff on the lower half of the canyon side, with the upper half of the canyon side having a moderate slope and shallow overburden. Landslide risk is moderate for the area at and below the basalt cliff, but given the rocky nature of the materials and relatively minimal amounts of sediment, the likelihood of a problematic slide is low. Most of the loose and slide prone material is talus at the base of the cliff. Photo 2 below shows the burned area along State Highway 162.

Photo 1. Restricted Suzie Creek channel near confluence. The water pipe and downed tree have the potential to catch debris and exacerbate the constriction at the mouth of Suzie Creek.

Suzie Creek is a tributary to Lawyer Creek that suffered a significant, near complete burn from top to bottom. The primary concern with landslides and other debris fall within this drainage is the formation of a debris dam that could break, creating a surge of water. There are no residences or infrastructure directly within the Suzie Creek drainage. However, the Flying B Ranch sits down valley of the confluence of Suzie Creek and Lawyer Creek, and there are dog

kennels and other outbuildings located on the alluvial fan of the drainage. The Flying B Ranch is a private hunting and fishing lodge. The risk of a landslide is low to moderate for this area. The entire drainage burned, but the soil is fairly rocky with an apparent thin overburden layer, the slopes are only moderately steep, and the primary cover pre-fire was grass, which has already started to come back in many locations. Slides in this drainage are not a significant concern. At the confluence of Suzie and Lawyer creeks, the canyon is wide pastureland, giving adequate space and distance to attenuate flows before they reach populated areas and infrastructure. The aforementioned outbuildings and kennels on the Flying B Ranch property may have some risk of flooding should a debris dam form and break during a large runoff event.

Photo 2. State Hwy 162 along the burned area in Sevenmile Creek.

Landslide risk on the main stem of Lawyer Creek is greatest and most concentrated on the left bank side of the canyon, particularly upstream of the State Highway 162 bridge. In this area, the canyon slope consists of a steep basalt cliff at mid-slope, with an accumulation of talus below it and moderately steep bare slopes above it. Lawyer Creek Road, which provides access to some residences and the Flying B Ranch, is located at the base of the slope. Lawyer Creek Road cuts into the talus which has initiated minor rockslides in the past. These slides will likely be more frequent and possibly larger in scale. Given the wide valley, these slides are not likely to impact flooding; however, they may temporarily cut off access along Lawyer Creek Road (see Photo 3 below). Conditions similar to those on Lawyer Creek Road are found on

State Highway 162, between the Lawyer Creek bridge and the City of Kamiah. Slides could potentially block the road in both locations.

Photo 3. Slide prone area along Lawyer Creek Road.

(5) Potential Impacts. As described above, the hydrologic modeling indicates that streams draining burned areas will experience increased runoff, imposing greater flood risks near their outlets and for some distance downstream. A specific example of this is the outlet of Suzie Creek, where it is anticipated that this steep and confined canyon could produce higher discharges than what it was already capable of before the fire. This behavior could be further complicated by increased debris, which would be expected to be more readily transported within the confines of the narrow canyon, but have a tendency to drop out and block channel conveyance as flows reach the valley bottom. There appears to be increased risk to nearby facilities, such as the dog kennels and outbuildings at the Flying B Ranch.

An existing HEC-2 (legacy Hydrologic Engineering Center river hydraulics software) water surface profile model from 1999 was located, and imported into the Hydrologic Engineering Center River Analysis System (HEC-RAS) software program to estimate stage responses to increased runoff associated with burned areas. It is worth noting that this water surface profile model is only an approximation of potential impacts, having numerous limitations; the existing HEC-2 model's geometry is quite old and did not include the Hill Street Bridge. Some of the other bridges within the model may not represent the current configuration, and no attempt was

made to update or recalibrate the model. The contemporary Hill Street Bridge was added to the model, based on rudimentary approximations of the dimensions, gathered from remotely sensed information. Time constraints did not permit more rigorous modeling of this bridge feature, but it was added to the model because field observations indicated this could be a critical area. The HEC-HMS modeling effort did not include the more frequent (*e.g.,* 10 percent annual chance exceedance) runoff events, the FEMA FIS discharges (middle column, Table 1 above) were scaled upwards based on the percentage increases indicated by the HEC-HMS model for the post-fire condition. The resulting pre- and post-fire peak discharges modeled are listed in Table 3.

Table 3. Scaled discharges modeled in HEC-RAS

Annual Chance Exceedance	Pre-Fire Peak (CFS)	Post-Fire Peak (CFS)
0.10	3,800	4,100[1]
0.02	6,100	6,500[2]
0.01	7,300	7,600[2]

1. Scaling percentage at burned area junction used.
2. Scaling percentage at outlet used.

The rudimentary HEC-RAS modeling suggests maximum water surface elevation increases of one-half-foot to one-foot in response to the increased post-fire discharges. The most pronounced increased stages occur upstream of the Hill Street Bridge and the Nichols Road Bridge. As noted above, the area upstream of the Hill Street Bridge was an area noted during field reconnaissance for increased potential flood risk. In general, the modeling indicates that flows escaping the channel have a propensity to flood the left (north) overbank, though some areas, in particular the lower end from approximately adjacent to Delaware Street downstream, overbanks on both sides of the river can be inundated.

In an effort to assist emergency managers, a discharge-elevation curve (Figure 1) was prepared using the rudimentary HEC-RAS model. Incremental peak discharges are plotted for the model cross-section just downstream of the Highway 162 Bridge, to supplement the temporary Rapid Deployment Gage installed by the U.S. Geological Survey (USGS). It is worth noting a number of limitations are inherent in this rating curve; the modeling geometry, as noted previously, is quite old (~1998 or earlier), the elevation datum for the geometry is unknown (assumed to be NGVD 1929), no attempt was made to calibrate the model to contemporary data, and the bridge geometry in the model is apparently from an earlier bridge, with piers, that has since been replaced by a clear-span bridge deck (Photo 4). This rating curve may be of some value to alert county staff when flow levels approach potentially damaging levels. An accompanying table of notable overbank flows observed from the HEC-RAS model for the flow range is shown in Table 4, below. It is understood that a discharge-stage rating curve will not be developed by the USGS. It may be necessary to apply a shift to the elevation values based on observed past behavior, and as it is applied. It should also be noted that overbank flows may remain out of the channel for some distance down-valley, once they occur.

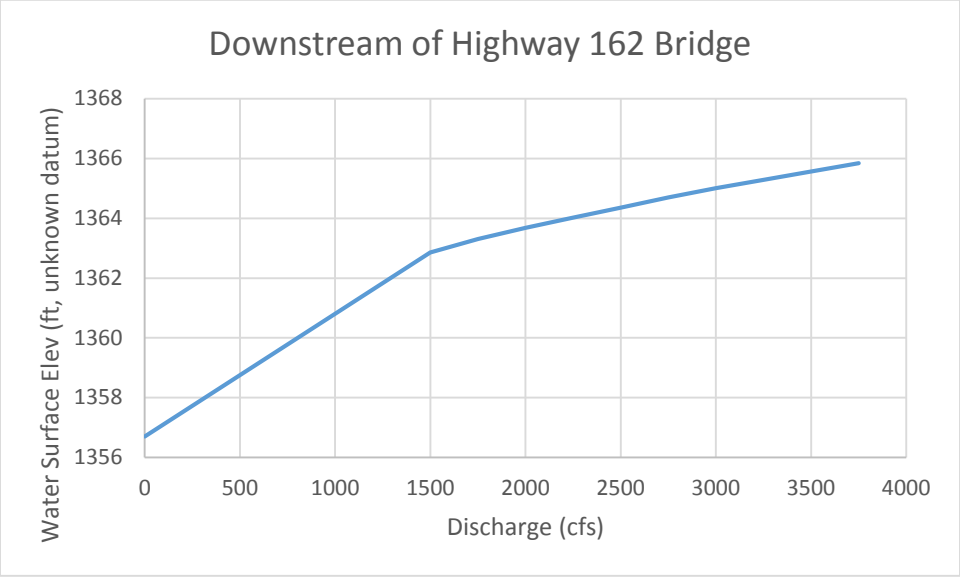

Figure 1. Discharge-elevation curve downstream of Highway 162 Bridge.

Table 4. Notable flooding observed from HEC-RAS modeling.

Discharge (CFS)	Model Water Surface Elevation (feet)	Affected Area Observed in Model
1,500	1362.9	Flows out of channel into right overbank upstream of Robison Bridge
1750	1363.3	Flows out of channel into left overbank downstream of Robison Bridge
2250	1364.0	Flows out of channel into left overbank upstream of Nichols Bridge Flows out of channel into left overbank downstream of Hill Bridge
2500	1364.4	Flows out of channel into left overbank downstream of Robison Bridge
2750	1364.7	Flows out of channel into left overbank upstream of Hill Bridge
3250	1365.3	Flows in left overbank upstream of Hill Bridge become extensive

Photo 4. Current Highway 162 Bridge over Lawyer Creek.

The primary concern with landslides in the Lawyer Creek drainage is cutting off access on roads. Most of the burned portion of the Lawyer Creek drainage is where the valley is relatively wide, with rangeland at the bottom. In this rangeland area there is room for the river to move around a landslide with minimal impacts. The other concern is debris which would cause problems further downstream.

(6) Recommendations

(a) General. Over the next 3-5 years, it is likely that areas that have frequently flooded in the past will be prone to flooding from less intense precipitation events over the watershed. Discharges may be particularly high at or near the more severely burned areas. In addition, there is potential for substantially increased sediment and debris loading in the water courses. This sediment and debris can further reduce already limited channel capacities and force even lesser flows out of bank. Because of these concerns, it will be prudent to reinforce weak points along channel banks and build up low berms where possible in advance, and to stockpile flood fighting supplies (*e.g.,* sandbags, riprap) nearby. Keeping heavy equipment available is also recommended. Regular channel maintenance activities should be prioritized and addressed frequently, in particular at constrictions such as bridges and culverts. In general, the left(north) overbanks appear more prone to flooding, though this can vary by location. Much of the left bank of Lawyer Creek, as well as some of the more severely burned ground, sits within Lewis

County, which is not part of the Advance Measures mission. However, it was deemed important to provide this information to Lewis County and the City of Kamiah to address potential threats to life-safety, property, and infrastructure.

Other general recommendations are as follows:

- Clean borrow ditches and culverts. Having capacity in both will reduce damage to roads from flood and debris flows.
- Identify riprap and fill material sources. In areas where emergency repairs or armoring may be necessary on short notice, having ready sources of materials will be useful. In talking with county officials, they indicated that in the past during emergency situations riprap has come from the Selway River or near Grangeville, Idaho.
- USACE investigated riprap sources as part of this Advanced Measures work by talking with multiple quarries in the area. Based on these calls, the closest source of riprap is in Orofino, Idaho at a quarry operated by Tripco. The rock type is basalt. They do not have a large stockpile of riprap on hand, as the rock has to be dug out of a hillside with an excavator, but the material is there and available. Rates from this pit are $15/ton for the rock and $85/hour for trucking. Atlas in Lewiston, Idaho, was also identified as a potential source. Atlas does not have any riprap stockpiled, but they have adequate raw material and are capable of producing riprap. Both quarries (Atlas and Tripco) need adequate lead time to produce any significant supply of riprap.
- The Idaho Transportation Department (ITD) also maintains a few stockpiles of riprap at various locations. One of these stockpiles is located on the Greer Grade Road, about one mile from Greer, Idaho. Idaho and Lewis counties and the City of Kamiah should confirm the locations with ITD and discuss the possible use of these stockpiles in emergency situations.
- Monitor and inspect culvert crossings through roads for plugging after precipitation events. Clearing culverts after even minor flows will maintain capacity for the larger flows, which may reduce impacts to roads.
- Identify areas where flooding has occurred in the past. These locations are at a higher risk of flooding over the next couple years and are likely places where flood fights or emergency flood protection may be necessary.
- Use Best Management Practices (BMPs) for erosion control.
- Seeding and mulching on burned slopes prone to slides may help reduce the chances of landslides and debris flows.

(b) Site Specific

To mitigate the potential for damage due to flooding, sediment and debris issues, and landslides, the following site specific recommendations are also offered. Note that Map 1 in Appendix C shows the locations of these recommendations:

- Recommendation 2-1. Clean the borrow ditch at the base of the hill along Lawyer Creek Road.
- Recommendation 2-2. Repair the left bank levee upstream of the railroad bridge. The left bank levee has been almost entirely eroded and is in danger of completely failing for a 300 foot segment immediately upstream of the railroad bridge. See Photo 5.

Photo 5. Eroded left bank levee upstream of the railroad bridge in Kamiah.

- Recommendation 2-3. Proactively repairing existing levees or building temporary levees or temporary setback levees. Temporary levees potentially could be built under Advance Measures authority, under direct assistance, if an imminent threat of unusual flooding is recognized with sufficient lead time (generally 30 days) to seek funding, and mobilize construction work. Repair of the levee rated as “unacceptable” in the 2010 Periodic Inspection Report is not feasible under Advance Measures. Idaho County and the District Readiness Office should discuss this topic directly. A non-federal effort could be undertaken proactively for the repairs or construction of temporary levees. Temporary levees could include:
    - Temporary or permanent setback levees could be constructed along the left bank of Lawyer Creek. The goal of installing a larger setback levee is to increase the potential capacity of the channel to deal with larger floods. A setback levee would need to be 6 feet tall on average (2 feet taller than the existing levees), with some lower areas requiring higher crests to maintain a constant crest as the topography changes. The levee could be installed as shown in Figure 2 with a total length of 6,229 feet. The levee could be potentially 7 feet in certain places, specifically east of Hill Street (downstream) where there are high impact areas. The material requirement for soil are 46,180 Loose Cubic Yards of common earth fill (33,220 Compacted Cubic Yards).

- The area upstream of the Hill Street Bridge appears susceptible to flooding, and flows escaping the channel here have potential to cause extensive flooding on the left overbank as water moves towards lower areas to the north of Lawyer Creek (following historic channel paths). This area is a candidate for proactive confinement by repairing the existing levees or building a new setback levee.
- The Railroad Bridge has historically been a flow constriction on Lawyer Creek, pushing excess flows out of bank and flooding parts of Kamiah. Given the increased likelihood of higher discharges, coupled with higher sediment and debris loads, this bridge constriction represents a good candidate for pro-active confinement, such as by raising (or adding, where no longer present) levee(s) (matches Dan's 2-1 Recommendation point). As also noted elsewhere, extensive bank erosion has occurred in this vicinity in the past, and it would be prudent to reinforce such areas.

Figure 2. Potential temporary setback levee extents to protect the City of Kamiah, Idaho against increased flood potential.

- Recommendation 2-4. See Map 1 in Appendix C. The left bank appears prone to erosion from the redirection of channel alignment from the bluff that enters the channel from the opposite bank. Supplemental armoring of the left bank may be prudent in this area.
- Recommendation 2-5. Several structures appear to be quite close to the channel near the Nichols Road Bridge, and susceptible to flooding. With what appears to be limited space available for constructing berms, sandbagging may be the best option.
- Stage, or pre-arrange proper equipment for clearing any slides that may block Lawyer Creek Road or State Hwy. 162.
- Stage sandbags and sand to be used to protect the city of Kamiah.
- Clean the Lawyer Creek channel to provide more capacity through town and at the railroad bridge.

b. Tom Taha Creek

(1) Burned Area. The fire that burned in Tom Taha Creek was part of the Clearwater Complex. Many of the structures that were lost in the fire were located within the Tom Taha drainage. Extensive areas of the drainage were burned, some severely.

(2) Hydrologic Environment. No historic information was located for the Tom Taha Creek during the limited amount of time available. However, given its geographic proximity to Lawyer Creek, the discussion of the hydrologic environment for that watershed would be expected to be representative of the Tom Taha Creek environment, as well, in terms of rainfall and temperatures, etc. The Tom Taha Creek channel, however, appears considerably steeper than Lawyer Creek, with a much more confined floodplain.

(3) Pre-fire. Several of the locations where Glenwood Rd crosses the Tom Taha Creek were spanned by quite large, multiple culverts (i.e., on the order of 24 feet bottom spans or more), suggesting the drainage is capable of generating substantial flows.

(4) Post-fire. The majority of the lower drainage area contributing to Tom Taha is within the Clearwater Fire perimeter. With severe fire, however, surface runoff can increase over 70% and erosion can increase by three orders of magnitude (Robichaud et al, 2000). Available Burned Area Reflectance Classification (BARC) mapping indicates that the steep hillsides along Tom Taha Creek and along Glenwood Rd saw moderate to high change in response to the fire.

(5) Potential Risks.

(a) Runoff. Though no quantitative analysis was prepared for this area in the limited amount of time available, it is a near certainty that runoff from burned areas will be much greater than those experienced under pre-fire conditions.

(b) Sediment and Debris. Increased sediment loading from post-fire erosion can further aggravate flooding risks in this area.

(c) Landslides. Portions of the Tom Taha Creek drainage burned very hot. While the drainage is not particularly deep or large, the side slopes are quite steep and almost all the vegetation on them burned, with the exception of intermittent large trees that survived. This topography and geology appear more conducive to smaller surface slides and debris flows, and less conducive to a larger deep-seated slide. Rock outcrops and road cuts reveal bedrock that appears to be shallow with a thin, somewhat loose layer of sediment on the surface. The loose layer of sediment may mobilize during a rain event.

(6) Potential Impacts. Downstream of the Adams Grade/Glenwood Road intersection the primary landslide concerns are a slide on the right bank that blocks Glenwood Road, or a slide on the left bank that blocks the stream and creates a weak dam. There are two residences down near the channel that have the potential to experience flooding. In this vicinity, the stream is well below the road and due to the steep topography it may not be possible to get equipment access to the channel to clean any debris dams that form. All other residences are higher up on the slope and above the road.

Upstream of the Adams Grade/Glenwood Road intersection, on Glenwood Road, there are no residences with flooding concern. The primary concerns are flooding of the road. Near the

quarry operated by Clearwater Rock Products, there is debris in the channel and evidence of past slides, both of which have the potential to push the stream out into the road (see Photo 6). At another location (downstream of the quarry where the stream takes a gradual leftturn) rock outcrop and the road constrict the channel to a narrow chute that could easily plug with debris. If a debris dam formed here flooding on the road would be very likely.

On the Adams Grade road there are no specific locations of concerns relative to slides. At the downstream end of the road there is a large embankment, approximately 50 feet tall, made by Glenwood Road (see Photo 7). A culvert runs through this the embankment. If this culvert were to plug, it would be difficult to remove the debris due to the inability of equipment to reach the culvert from the roadway, and access from within the channel itself would be inundated. This culvert and embankment is a potentially problematic location.

Photo 6. Upstream of the Adams Grade/Glenwood Road intersection. Potential flooding of the road is possible at this location where the channel could easily plug.

Photo 7. Culvert and embankment at the intersection of Adams Grade and Glenwood Road.

(7) Recommendations

(a) General. Numerous areas were observed along Tom Taha Creek where channel capacity decreases significantly, and appears insufficient to carry anticipated higher flows from the burned area. In areas where overflow and potential damage (including to roadways) are likely, the addition of confining berms or sandbags is advisable (where sufficient space is available).

(b) Site Specific. For the location of these site specific recommendations, see Map 1 in Appendix C.

- Recommendation 3-1. A reach of pronounced low-capacity channel was observed adjacent to Glenwood Rd (see Photo 8), where a material has apparently been added to confine flows. The berm is located directly alongside the minimal V-channel, though there is room to place a levee *set-back* some distance from the channel right bank. It is recommended that set-back berms be used where possible along this confined reach, to both add additional conveyance area as well as to better attenuate peak flows. Also, cleaning the creek channel on the slope below the Clearwater Rock Products quarry may improve conveyance.

Photo 8.Reach of apparently inadequate channel capacity, Tom Taha Creek adjacent to Glenwood Rd.

- Recommendation 3-2. The right-bank tributary drainage that enters Tom Taha Creek at the intersection of Adam's Grade and Glenwood Road raises significant concern. At this location, a four feet diameter culvert passes underneath some 40-50 feet of roadway

embankment. The tributary appears to drain a substantial area of steeply sloped watershed within the burned perimeter. Even without post-fire runoff, it appears that this culvert may be undersized for the magnitudes of flow that this area could generate. Additionally, it is anticipated that it would be extremely difficult to reach the culvert entrance with mechanized equipment, due to the high, steep embankment and canyon walls, making clearing all but impossible should it become clogged with debris. It is recommended that, at a minimum, a trash rack be installed to reduce the potential for clogging the upstream end of this culvert, and that consideration be given to adding an additional culvert to pass additional flow at this location. It may be possible to bore and jack a pipe through the embankment, to preclude the need to excavate the large amount of material. A clogged culvert may not back water up sufficiently to reach homes, but could cause significant damage to the road embankment.

- Recommendation 3-3. The culverted crossing to a gravel mine may be undersized for post-fire peak runoff magnitudes. It may be prudent to replace this with a larger-diameter culvert.
- Recommendation 3-4. Generally monitor the area upstream of the Adams Grade/Glenwood Road intersection, on Glenwood Road. The primary concern is flooding of the road. If a debris dam formed here flooding on the road would be very likely.
- Clean the borrow ditch along Glenwood Road.

6. **Clearwater County**.

a. Lolo Creek

(1) Burned Area. The Lolo Creek drainage was affected by the Lolo Fire, which later became part of the Clearwater Complex. The fire burned much of the Lolo Creek drainage, with some areas being severely burned. Lolo Creek is largely a recreational area, so the damage done is mostly to recreational and timber assets, rather than homes or critical infrastructure.

(2) Hydrologic Environment. No historic information was located for the Lolo Creek during the limited amount of time available. However, given its geographic proximity to Lawyer Creek, the discussion of the hydrologic environment for that watershed would generally be expected to be representative of the Lolo Creek environment, as well, in terms of rainfall and temperatures, etc.

(3) Pre-Fire. The Lolo Creek channel was not visited directly during field reconnaissance, due to time and access limitations. However, the surrounding topography of the Lolo Creek area appears to be somewhat steeper than that of Lawyer Creek.

(4) Post-Fire. Much of the drainage area contributing to Lolo Creek is within the Clearwater Fire perimeter. With severe fire, surface runoff can increase over 70% and erosion can increase by three orders of magnitude (Robichaud et al, 2000). Available Burned Area Reflectance Classification (BARC) mapping indicate that the steep hillsides along Lolo Creek, in particular those to the south of the canyon bottom saw moderate to high change in response to the fire.

(5) Potential Risks.

(a) Runoff. Though no quantitative analysis was prepared for this area in the limited amount of time available, it is a near certainty that runoff from burned areas will be much greater than those experienced under pre-fire conditions.

(b) Sediment and Debris. Increased sediment loading from post-fire erosion can further aggravate flooding risks in this area.

(c) Landslides. This drainage is almost all forest land. Only a cursory investigation was performed as there are very minimal residences and infrastructure. The primary concern with this drainage would be a landslide forming a weak dam that fails, causing flooding on the Clearwater River. The community of Greer is located approximately 1.5 miles downstream from where Lolo Creek flows into the Clearwater River and there is also a bridge near the mouth of Lolo Creek. Given the remoteness and difficult access into this drainage landslides were not evaluated in detail, however, the lack of population and minimal infrastructure make this an area of lesser concern.

(6) Potential Impacts. It would be prudent to expect increased runoff response from burned areas with the Lolo Creek canyon, and the associated flooding impacts of increased runoff and sedimentation.

(7) Recommendations.

(a) General. In areas where overflow and potential damage (including to roadways) are likely, the addition of confining berms is advisable (where sufficient space is available).

(b) Site Specific. No site specific recommendations are made for the Lolo Creek area, due to lack of specific site information.

b. Orofino Creek.

(1) Burned Area. The Municipal Fire originated on Tuesday, August 18th, 2015. The fire burned over 1,770 acres. Two homes and several buildings were lost. The Municipal fire was eventually added to the Clearwater fire in August and was renamed the Clearwater- Municipal North Complex Fire. The fire was identified as being human-caused. The fuels involved were timber (grass and understory), dormant brush, and hardwood slash.

(2) Hydrologic Environment. The Clearwater River and its tributaries drain all of Clearwater County, ID. Elevations in the Clearwater Valley near Orofino are approximately 1,000 feet, and increase to nearly 8,000 feet at the highest mountain peaks. The topography of the drainage is dominated by mountainous land, steep slopes, narrow canyons and valleys and a few sloping plateau lands. Clearwater County is relatively free of significant mountain barriers that would impede movement of moisture-laden air masses from the Pacific, while most of the annual precipitation is attributed to storms rotating about a center of low pressure traveling on an easterly course. Precipitation over the whole county averages about 48 inches, and ranges from about 25 inches at lower elevations (*e.g.,* near Orofino) to more than 60 inches at the highest elevations. The majority of precipitation arrives in January, normally as snow, with very little precipitation occurring in the summer months. Mean annual temperature at Orofino is about 52 ^{o}F, with the lowest temperatures occurring in January and the highest in July and August. Timber is the greatest natural resource within Clearwater County with 80 percent of the land classified as commercial forest consisting primarily of coniferous varieties (FEMA, 1979).

(3) Pre-Fire. Near the Orofino-Riverside area, intensely developed areas of residential, commercial and industrial complexes are prevalent throughout the flood plain. The drainage area of Orofino Creek is approximately 206 square miles, rising in the Sheep Mountain Range of the Clearwater National Forest. Residential and commercial complexes are located in the floodplain of this steep mountain stream. Flooding is usually the result of high spring runoff, warm winter rains and snow, or a combination of both (FEMA, 1979). Occasional high flows occur in late December or early January due to sudden warming and rain on frozen ground (NWW, 2001). Exceedance probability-discharges for Orofino creek at Orofino were determined for the 1980 City of Orofino, ID, Flood Insurance Study (FIS) and reported in NWW, 2001. They are presented in Table 5, including intermediate values interpolated in 2001.

Table 5. Orofino creek at Orofino, ID (NWW, 2001)

Annual Chance Exceedance	Peak Discharge (CFS)
0.10	4,500
0.05	5,400
0.02	6,600
0.01	7,600
0.002	9,900

(4) Post-Fire. Time constraints did not permit development of post-fire hydrologic modeling. The burned area within the Lower Orofino Creek 12-digit Hydrologic Unit (HUC 170603060405) measures approximately 2.3 square miles, or roughly 4 percent of this lower sub-basin (which, in turn, comprises about a quarter of the creek's total drainage area). The burned area perimeter extends along the north-facing slope of Orofino Creek, just outside of town, eastward along the creek (see Photo 9). Due to its close proximity to Orofino, potential increased runoff from the burned area could be substantial, particularly near the City of Orofino, Idaho.

(5) Potential Risks.

(a) Runoff. In lieu of quantitative information on increases in peak discharge, an existing HEC-RAS model was modified to examine river stage sensitivity to percentage increases in exceedance probability peaks. The existing model included a reach of the lower Orofino Creek, from its confluence with the Clearwater River upstream about 2 miles, was used to generate curves of additional river stage for increased exceedance peaks at 10% increase intervals. A family of curves showing the potential increase in Orofino Creek's water surface elevation for the peak flow percentage increases is shown in Figure 3, below. This figure indicates that increases in peak runoff of only 10 percent result in increased river stages of more than a foot for the 10 percent through the 1 percent annual chance exceedance probability events. Similarly, a 40 percent increase in peaks increases stages by more than 2 feet for the same range of events, with stages increased by more than 3 feet for a 60 percent increase in event peaks.

Photo 9. Downslope view from burned area towards Orofino (structures visible beyond intact conifers).

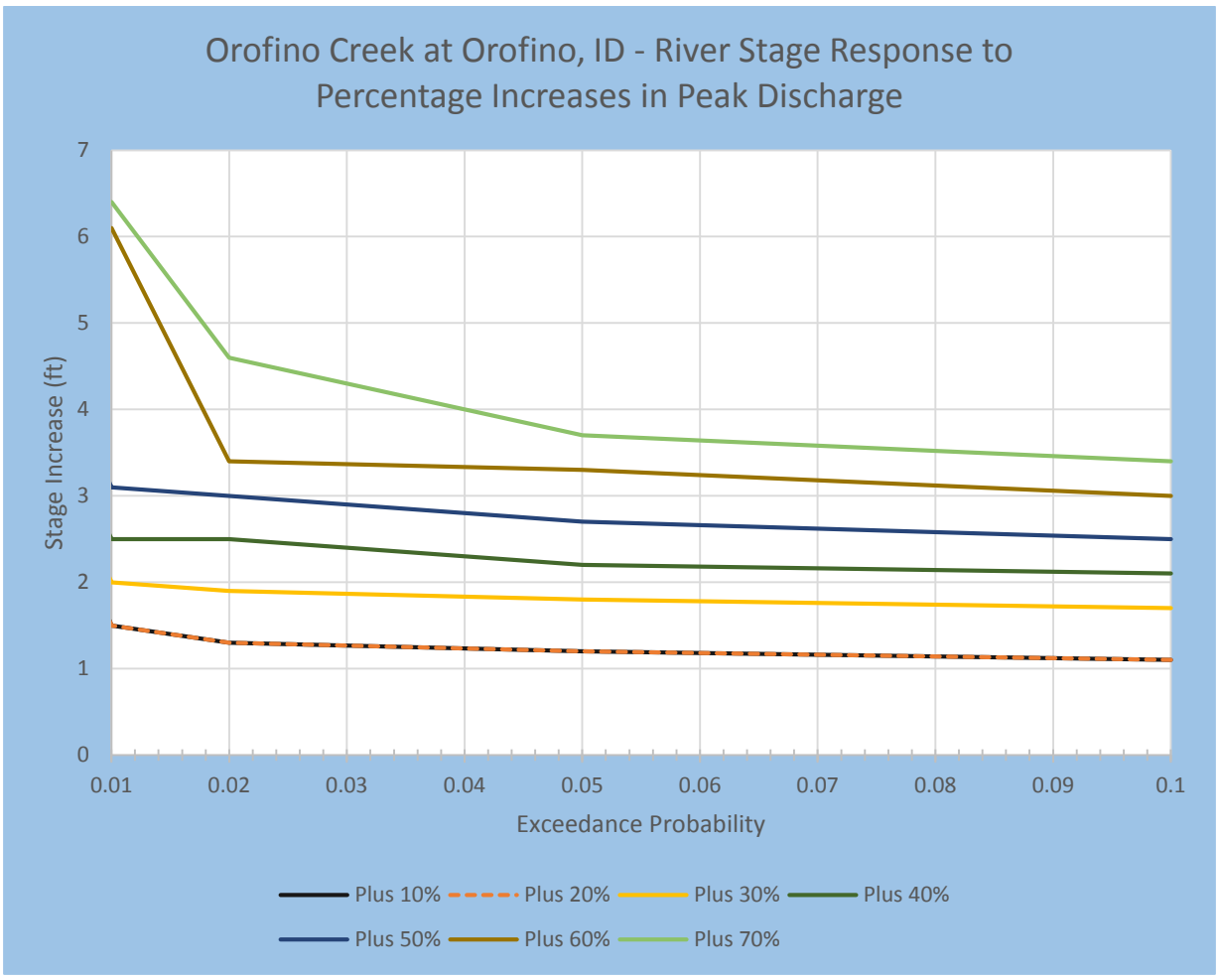

Figure 3. Increased Stage of Orofino Creek near Orofino, ID, vs. Percentage Increases in Exceedance Probability Peak Discharge.

(b) Sediment and Debris. Field conditions along the north-facing slopes adjoining Orofino Creek suggest that mass wasting slope failures can occur (see Photo 10), even without the impacts of wildfire. The changes in soil conditions following the fire, along with the loss of vegetation make such failures more probable. Such slope failures could introduce significant sediment, trees, and rocky debris into Orofino Creek.

(c) Landslides. The primary concern along Orofino Creek is between the Clearwater River and Whiskey Creek. This is the downstream most 3 miles of the creek. Along this reach Orofino Creek is bound by a steep slope on the left bank, and the City of Orofino on the right bank. Much of this steep slope burned all the way down to the creek. The primary concern is for a slide blocking Orofino Creek and causing flooding in town. Additionally, there are multiple homes and roads on the steep slopes within the burned area. Landslides and debris flows are a concern for causing damage to these homes and cutting off access.

During the Advance Measures mission field work, information was provided by Clearwater County from debris flow assessments that were performed by other agencies. These assessments by other agencies identified the slope above the Forest Street Bridge (Hollywood area) as a specific area of concern, in addition to the Franklin property, which is located about ¼

mile upstream from the Konkolville Motel. Both these areas were examined and a slide would put residences at risk in both of these locations.

Photo 10. Tree deformation upslope from Orofino, may be indicative of past slope failure.

In much of the burned area the slope is very steep and was severely burned leaving no cover vegetation on the ground. There are also multiple road cuts on the hillside which create a steep scarp and break in the uphill side of the slope. All of these factors make this terrain very susceptible to slides. Multiple trees that are curved at their bases were pointed out by county personnel. These curved trunks are typically evidence that creep is occurring on the slopes, so even before the slopes burned, they were susceptible to movement. One factor resisting slides is that the fire did not kill all the large trees. In some locations, only the underbrush burned. Where the large trees are still living their roots will help hold the soil in place.

(6) Potential Impacts. Based on engineering judgment, it is reasonable to assume that post-fire runoff stages on Orofino Creek will likely be 2 feet or more greater than normal. Localized increased stages may be much higher than this where concentrated burned area runoff enters the creek. In addition to the typical increased erosion produced by burned areas, mass wasting of steep slopes adjacent to the Orofino Creek could also add considerable sediment and other debris to the flowing water, creating channel conditions that are conducive to overbank flooding. Channel constrictions, such as culverted road crossings, can rapidly lose

sufficient capacity to pass flows, pushing flood waters out of bank and potentially causing increased damages.

Photo 11. Typical conditions in a heavily burned area on the slope above Orofino Creek.

The greatest concern from landslides is a slide that blocks Orofino Creek and causes flooding. Slides are also a threat to residences and access routes along the left bank of the creek.

(7) Recommendations

(a) General. Given the nature of the burned slopes and their proximity to the City of Orofino, it would be challenging to proactively mitigate many of the threats that are now present. It is not reasonable, for example, to engage in mechanical or engineered slope stabilization. Mulching and seeding in particularly burned areas may help with slope stability and the re-establishment of vegetation, but the best window for those mitigation actions are in the late fall before the snow flies. While there is a threat of unusual flooding, the nature of the threat provides little to no lead time. As a result, direct assistance under Advance Measures is not feasible. Overall, the best course of action is vigilance and preparedness.

Ongoing channel maintenance along Orofino Creek will particularly important, especially during typical winter flood seasons, until the watershed has recovered from fire impacts. Clearing of mass-wasting deposits and other deposition should closely follow runoff events. It is prudent to reinforce weak points along channel banks and raise low points where possible in advance, and to stockpile flood fighting supplies (*e.g.,* sandbags, riprap) nearby, along with keeping heavy equipment available. Given the proximity of the burned area, warning times will be minimal, making emergency notification difficult. Consideration should be given to pre-emptive evacuation of the most at-risk residences when weather forecasts indicate high flooding

potential. The existing HEC-RAS mapping uses a *Lateral structure* to confine flows to the channel area until terrain features are overtopped, when excess flows spill into a series of ponding area to the north of the confined floodplain (see Figure 4). The three ponding areas represent the greater Orofino developed area, in general. The (pre-fire) frequency discharge profiles indicate near overtopping (and minimal freeboard) of this confining feature for larger events. This suggests that there may be sufficient economic benefits to justify construction of a levee to better protect the developed areas in Orofino from flood risks associated with Orofino Creek. The potential benefits of such a feature (or suitable alternative) should be considered as a longer-term strategy.

It is recommended to have heavy equipment, particularly excavators with thumbs, loaders, and dump trucks, readily available to clear the channel in the event a slide blocks the creek or a debris dam forms. One of the advantages of the area is that below much of the burned area the creek is adjacent to a road. This provides quick access into Orofino Creek to clear it if it gets blocked. Knowing where equipment is located or having it staged beforehand will improve reaction time.

(b) Site Specific. Site specific recommendations are called out on Map 2 in Appendix C.

- Recommendation 5-1 contains a number of dwellings (see Photo 14) that appear particularly prone to flooding, due to their proximity to the creek and lower base elevations. There is also a bridge nearby, with its constriction on the floodway and potential for trapping debris. Consideration should be given to construction of temporary levee in this area to protect these vulnerable areas in the short-term. . Technical and material assistance for disaster preparedness may be feasible under other USACE authorities, and Clearwater County should discuss this topic directly with the District Readiness Office.

Photo 12. Typical conditions on the slope above Orofino Creek.

Photo 13. View of the steep slope, Orofino Creek, and the road.

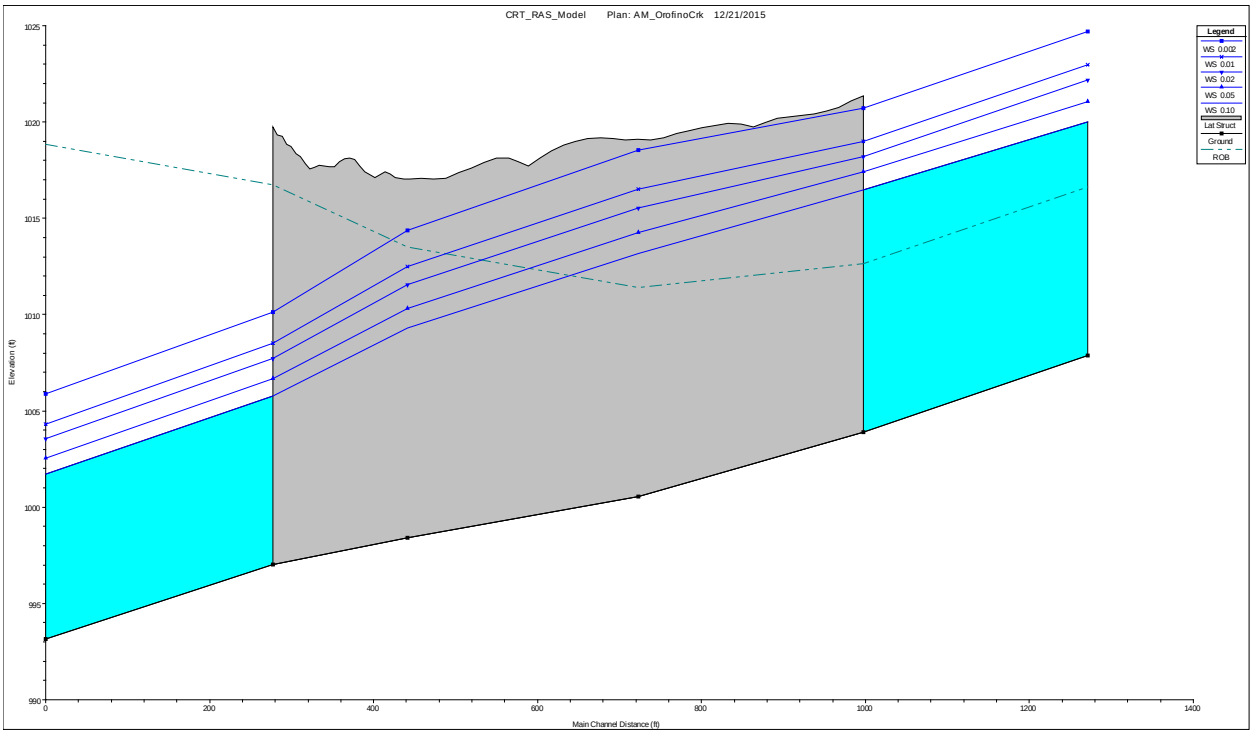

Figure 4. HEC-RAS profile plot, showing confining Lateral Structure (gray area) on right (north) bank of floodplain.

Photo 14. Flood prone structures along Orofino Creek.

7. **Authors**. This report was drafted by Brandon Hobbs, with input and/or modeling from 1LT Bruce Compton, Darrell Eidson, and Daniel Tucker. GIS mapping was prepared by Brian Schnick. Final review and editing was performed by Jeff Stidham.

8. **References**.

a. Federal Emergency Management Agency (FEMA), 1979. Flood Insurance Study – Clearwater County, Idaho, Unincorporated Areas. Washington D.C.

b. Robichaud, Peter R., Jan L. Beyers and Daniel G. Neary, 2000. *Evaluating the Effectiveness of Postfire Rehabilitation Treatments (RMRS-GTR-63)*. Fort Collins, CO.

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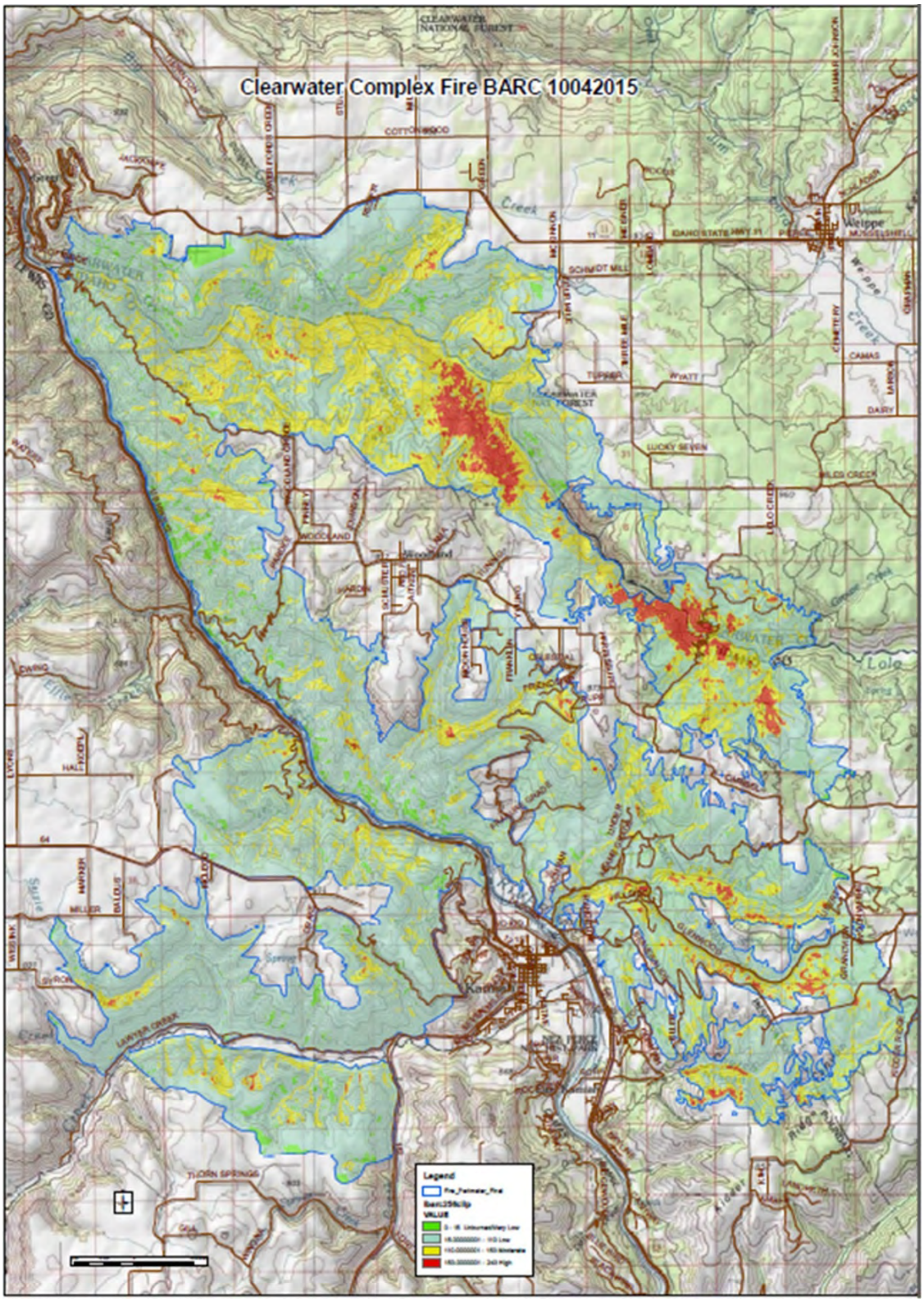
d. Walla Walla District, U.S. Army Corps of Engineers (NWW), 1999. *Special Study, Lawyer Creek, Lewis and Idaho counties, Idaho*. Walla Walla, WA.

e. Walla Walla District, U.S. Army Corps of Engineers (NWW), 2001. *Orofino, Idaho, Hydrologic and Hydraulic Study*. Walla Walla, WA.

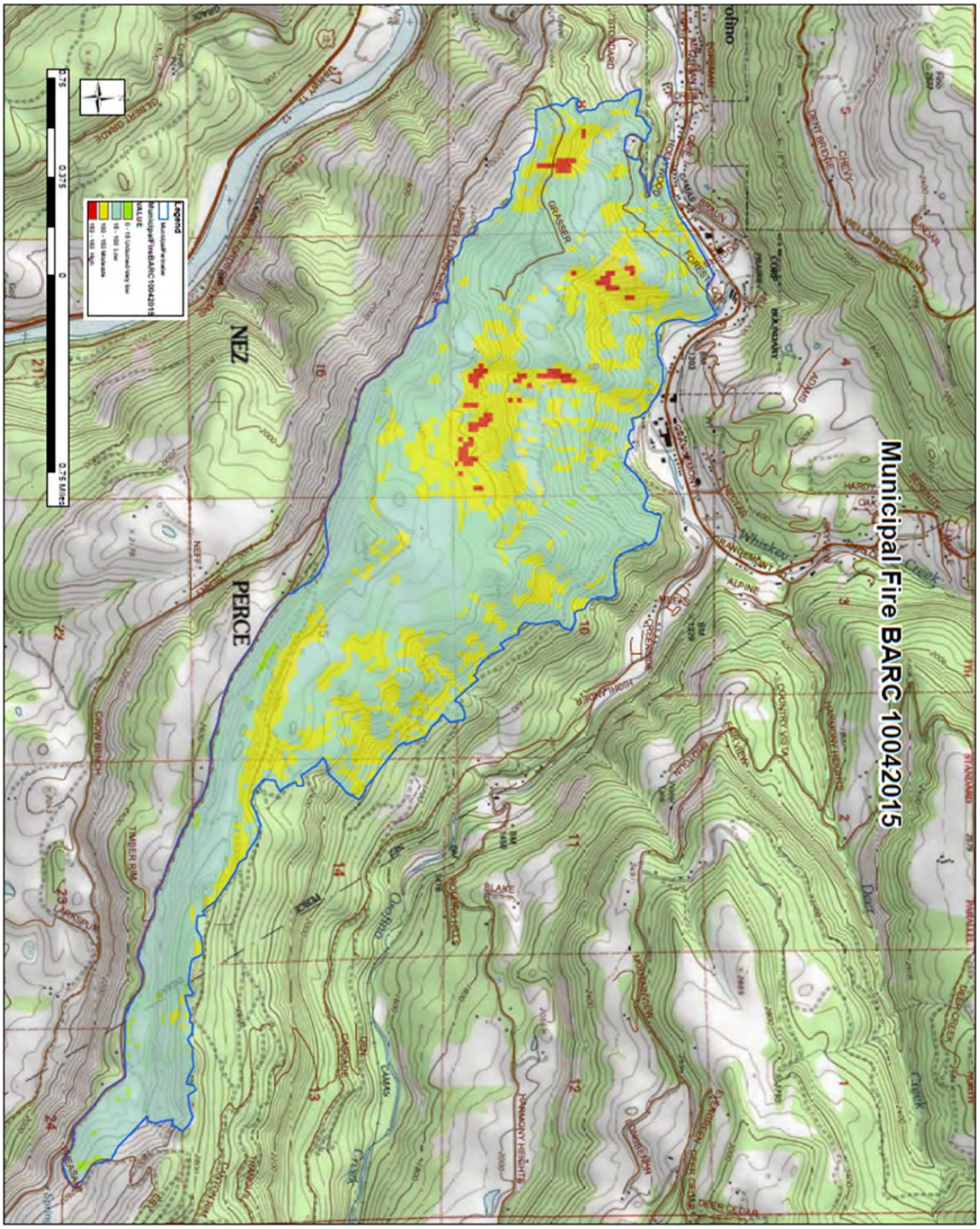
Appendixes:

- A: Burned Area Reflectance Classification Map, Clearwater Complex.
- B: Burned Area Reflectance Classification Map, Municipal Fire.
- C: Recommendation Location maps
- D: Idaho Bureau of Homeland Security letter, dated 17 November 2015, subject: Advance Measures Request

APPENDIX A: Burned Area Reflectance Classification Map, Clearwater Complex

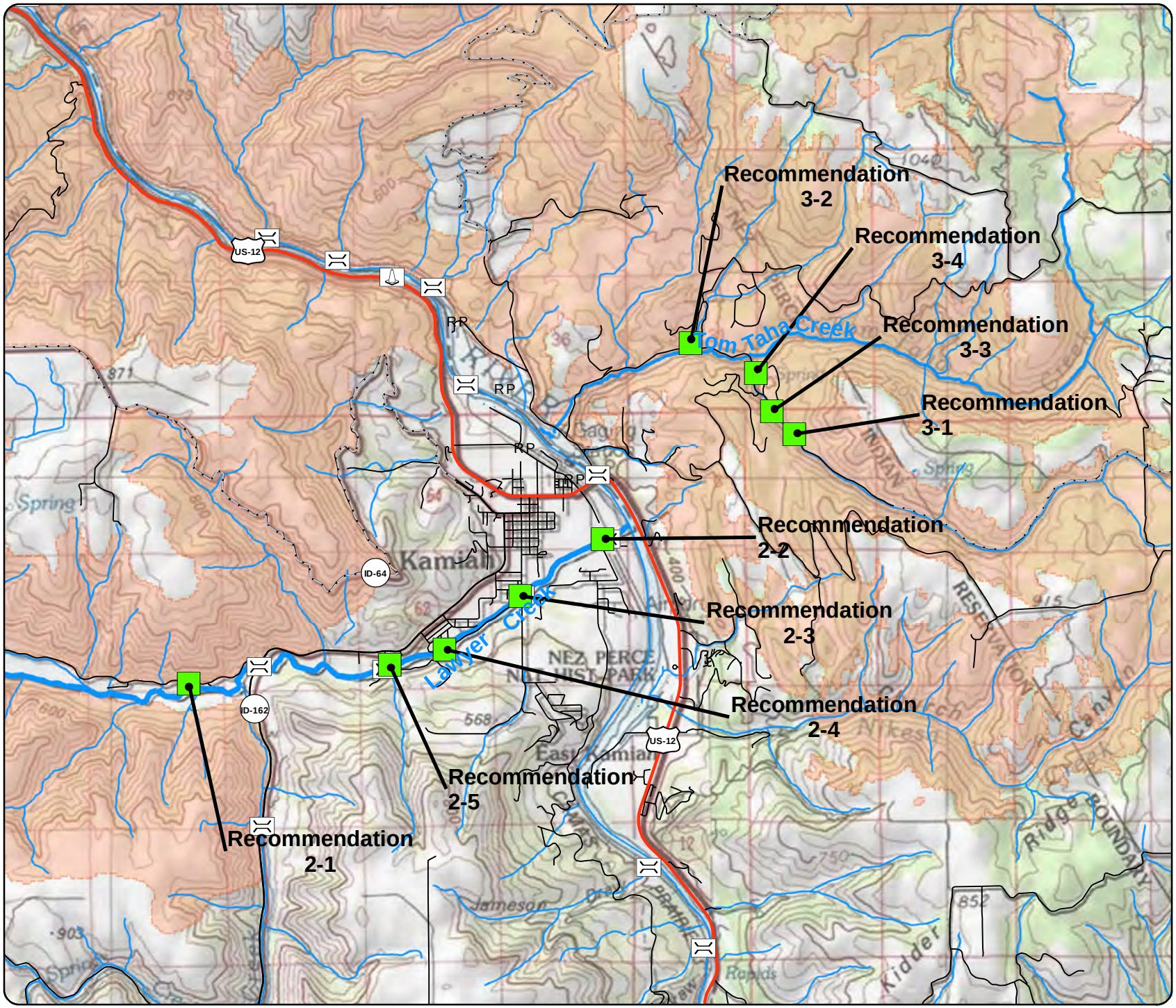


APPENDIX B: Burned Area Reflectance Classification Map, Municipal Fire



APPENDIX C

- Map 1: Recommendation locations, Idaho County
- Map 2: Recommendation locations, Clearwater County



Appendix C, Map 1

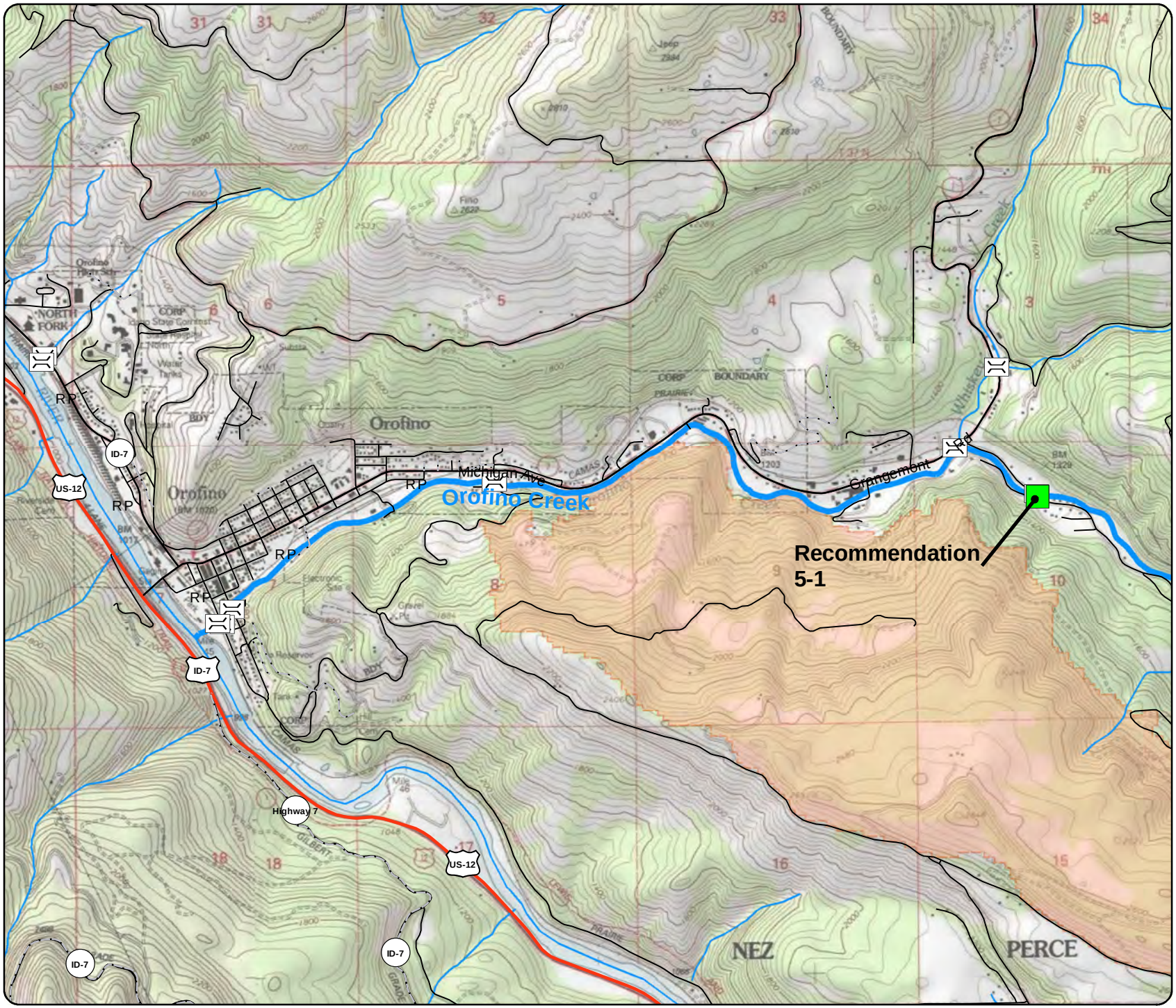
Kamiah, ID vicinity

- Comment Point
- Railroad Bridges
- RP Rail Points
- National Bridge Inventory (NBI)
- Automatic Traffic Recorder (ATR) Stations
- Streets
- NHD Flowline Creeks of Interest
- Clearwater Fire Perimeter

0 0.25 0.5 1 Miles

US Army Corps of Engineers
Walla Walla District

MAP ID: FireEventsFY16_Kamiah_ANSI_A
DATE: 12/22/2015



Appendix C, Map 2

Orofino, ID vicinity

- Comment Point
- Railroad Bridges
- RP Rail Points
- National Bridge Inventory (NBI)
- NHD Flowline Creeks of Interest
- NHDFlowline
- Municipal Fire Perimeter

0 0.125 0.25 0.5 Miles

US Army Corps of Engineers
Walla Walla District

MAP ID: FireEventsFY16_Orofino_ANSI_A
DATE: 12/22/2015

SUBJECT: Technical Assistance Report concerning post-wildfire potential in Clearwater and Idaho Counties, Idaho

APPENDIX D: Idaho BHS Request Letter for Advance Measures

SUBJECT: Technical Assistance Report concerning post-wildfire potential in Clearwater and Idaho Counties, Idaho

STATE OF IDAHO MILITARY DIVISION
BUREAU OF HOMELAND SECURITY
4040 W. GUARD STREET, BLDG. 600
BOISE, IDAHO 83705-5004

C.L. "BUTCH" OTTER
GOVERNOR

Maj Gen GARY L. SAYLER
ADJUTANT GENERAL

BRAD RICHY

November 17, 2015

US Army Corps of Engineers Seattle District
10049 College Way N.
Seattle, WA 98133
RE: Advance Measures Request

The recent Cape Horn fire in Bonner and Kootenai Counties have resulted in catastrophic fire damage and burn scars to timber stands and grasses on steep mountainsides and watersheds. On behalf of the aforementioned counties, the State of Idaho hereby requests from the US Army Corps of Engineers (USACE) that technical assistance for potential Advance Measures be authorized and conducted in those counties. The technical assistance requested includes, but is not limited to: 1.) contingency planning for expert analysis to determine the potential risks to lives and property and immediate, effective ways to protect both; 2.) hydraulic, hydrologic or geotechnical analysis to identify areas of potential debris flows or flash flooding that may threaten lives or property or impede essential evacuation routes; and 3.) risk assessments to identify potential advance warning systems for landslides, debris flows and/or flash floods.

Both Bonner and Kootenai Counties are experiencing typical fall weather with high winds, heavy rains and the beginning of winter snow at the higher elevations in and around the fire-impacted areas. Both Bonner and Kootenai Counties have previously identified post-fire landslide and flood risks in their respective Local All Hazard Mitigation Plans. An interagency meeting has been held in Coeur d'Alene, Kootenai County, with several county departments and Silver Jackets participation to discuss post-fire contingency activities.

The State recognizes that time is of the essence if effective emergency protective measures are to be identified and completed. USACE Advance Measures are needed as soon as possible.

Respectfully,

Brad Richy
Idaho Bureau of Homeland Security

BR:th:ms

Phone: (208) 422-3040 • Fax: (208) 422-3044 • 24-Hour Emergency Notification: (208) 846-7610