Burned Area Emergency Response (BAER) Report
Carlton Complex Fire (State and Private Team)
September 14, 2014

Introduction

This report summarizes fire and potential post-fire effects to critical values {e.g. human life and property (roads, buildings, water systems, etc.), and degradation of natural resource (soil productivity and hydrologic function), municipal, domestic, agricultural water supplies, habitat for federally listed species under the Endangered Species Act, and cultural resources}within or in close proximity to burned lands.

This rapid evaluation was conducted to determine if these critical values are at risk due to imminent post-fire threats and recommend emergency stabilization and long-term restoration actions that can be taken to minimize unacceptable impacts resulting from the Carlton Complex fire that burned private property, and lands managed by the Washington Department of Natural Resources, Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Nation, Bureau of Land Management, and the U.S. Forest Service.

Given the size and severity of the Carlton Complex fire on Washington State and private lands, the Okanogan Conservation District asked Governor Inslee to request for a Multi-jurisdiction Assessment Team for the Washington State and private lands. After President Obama signed the Disaster Declaration on August 11th, the Federal Emergency Management Agency (FEMA) began coordinating with the Okanogan Conservation District and the Forest Service to staff this team to complete an assessment on Washington State and private lands.

This Multi-jurisdiction Assessment Team has worked in close coordination with Forest Service BAER teams on the Carlton Complex Fire to create a seamless evaluation of all lands burned in the Carlton Complex Fire.

Burned Area Description

The Carlton Complex started on July 14th from four lightning caused fires (Stokes, Gold Hikes, French Creek and Cougar Flat) burning over 250,000 acres, consisting of National Forest System lands on the Okanogan-Wenatchee National Forest, Bureau of Land Management lands, Washington State and private lands. Hot weather and windy conditions pushed the fire over the ridge tops and into the town of Pateros resulting in a large number of evacuations. The fire made significant runs towards the cities of Brewster and Pateros between July 17th and 18th, consuming approximately 300 homes in its path and destroying critical infrastructure. These fires grew into one larger fire on July 20th. Great Basin Incident Management Team 1 assumed command of the Carlton Complex, along with the Little Bridge Creek Fire and the Upper Falls Fire on August 11th.

A. Fire Name: **Carlton Complex**

B. Fire Number: **WA-OWF-000781**

C. State: **WA**

D. County: **Okanogan**

E. Fire Incident Job Code: **PNH8HC1502**

F. Date Fire Started: **July 14, 2014**

G. Date Fire Contained: **August 25, 2014**

H. Suppression Cost: **$68,360,000 as of 8/22/14**

I. Fire Suppression Damages Repaired with Suppression Funds

Dozerlines (miles): **State <u>46.9 miles total</u>** **Private <u>58.7 miles total</u>**

Handlines (miles): **State <u>8.9 miles total</u>** **Private <u>0.9 miles total</u>**

J. Watershed Number(s): (6^{th} level hydrologic units, percent of watershed acres within fire perimeter):

Burn severity for example microsheds with potential BAER concerns

Drainage	Total Acres	Acres in Fire	% in Fire	Acres NOT in fire	Unburned	Low	Moderate	High
Beaver Creek above Frazer	54706	20,925	38%	33,781	2,009	14,413	3,471	1,042
Benson Creek @ mouth	24362	20,746	85%	3,616	1,263	8,856	5,607	5,027
Canyon Creek @ mouth	2348	2,076	88%	272	231	1,334	427	85
Chiliwist Creek @ mouth	26895	19,020	71%	7,876	1,929	10,278	5152	1,666
Cow Creek @ mouth	3689	3,688	100%	0	151	2,240	791	507
Frazer Creek @ Beaver Creek	13484	10,301	76%	3,182	920	5,778	2,200	1,407
Leecher Creek @ mouth	2771	2,204	80%	567	120	1,324	518	244
Texas Creek @ mouth	7150	6,524	91%	626	944	3,688	1,608	286

K. Total Acres Burned: **<u>255,181</u>**

NFS Acres (**<u>79,795</u>**) Other Federal (**<u>6,157</u>**) Tribal (**<u>590</u>**) State (**<u>69,885</u>**) Private (**<u>98,753</u>**)

L. **Vegetation Types**: Range – shrub steppe composed of blue bunch wheatgrass/antelope bitterbrush on all aspects at lower elevations and on south aspects transitioning to forest communities. Forested areas are composed of Ponderosa Pine and grass/shrub understory and mixed conifer types of Ponderosa Pine and Douglas fir with an understory of grass, forbs and shrubs.

M. **Dominant Soils:** Dominant soils within the burn area are well drained and have a xeric (dry) soil moisture regime and mesic (warm) and frigid soil temperature regimes. Mesic soils are present at lower elevations, and support shrub/steppe plant communities; where forested they occupy south and some west aspects and support Ponderosa pine/grass and shrub vegetation. Frigid, forested soils are on north and east aspects and support mixed conifer (Douglas fir and Ponderosa pine) and forb/shrub understory vegetation.

Soils on the terraces, ground moraines, foothills and mountains consist of medium to very coarse textures of granitic colluvium and residuum and outwash and till derived from mixed sources; but dominantly granitic in origin. Thick deposits of till and outwash overlie bedrock composed of granite, schist and metasedimentary rock. In areas where the till mantle has thinned; soils have developed in residuum and colluvium derived mainly from igneous (intrusive), metamorphic and some metasedimentary rock. The surface of the soils are influenced and mantled with volcanic ash from air fall events from various sources (dominantly from Mt. Mazama). Generally, the surface textures are medium and coarse and have moderate and high infiltration. Subsoil textures range from medium to very coarse and have moderate to very rapid permeability. In subsoils in which a dense layer is present, permeability is restricted. Surface and subsurface rock fragment content ranges from 0 to over 65 percent and range in size of gravel, cobbles and stones. Many areas within the burn area have rock outcrop, cobbles, stones and boulders on the soil surface.

Soil depth ranges from less than 20 inches to greater than 60 inches to restrictive layers. Dominant restrictive layers are unweathered (hard) and weathered (soft) bedrock generally granitic in origin and dense (compacted), non-cemented subsoil layers formed in till parent materials. Dominant soils are Haploxerolls, Inceptisols and Andisols and are represented by the Conconully, Kartar and Parmenter soil series respectively.

The erosion hazard within the fire perimeter varies by soil type. Their texture, structure, rock content, permeability, and slope are principle factors in their susceptibility to surface erosion. Item C under "Watershed Condition" displays the proportion of relative erosion hazard on the non-federal lands within the fire (USDA 2008, USDA 2010).

N. **Geologic Types:** The burned area lies in the Columbia Intermontane Province within the Columbia plateau and on the eastern slope of the Cascade Mountains. The Cascade Mountains, Eastern Slope, is a transitional area between the Cascade Mountains to the west and the lower lying Columbia Basalt Plateau to the south and east. It has some of the landforms typical of both the mountains and plateau. The mountainous areas consist mainly of Pre-Cretaceous metamorphic rocks cut by younger igneous intrusives mantled with thick surficial deposits of Pleistocene aged drift and till deposits from the Okanogan Lobe of the Cordilleran Ice Sheet (USDA 2006, USDA 2008). Major landforms include terraces, moraines, foothills and mountains. Valley bottoms and riverine systems with their associated floodplains are dominated by quaternary alluvium.

O. Miles of Stream Channels by Order or Class: **Perennial: 358 miles** **Intermittent: 196 miles**

P. Transportation System: **State Roads: 247 miles** **Private Roads: 598 miles**

Watershed Condition

Ownership	Unburned	Low	Moderate	High
Private	12,569	67,957	15,497	2,730
State	47,047	6,779	12,511	3,548
Tribal	465.8	96	28	0.2

B. Water-Repellent Soil (acres): **8,073**

C. Soil Erosion Hazard Rating (acres):
54,152 (low) **72,768** (moderate) **37,230** (high) **3,385** (unavailable)

D. Erosion Potential: Forested **2.8** ton/acre Range **3.1** ton/acre

E. Sediment Potential (Relative Pre- vs Post-Fire change, from AGWA model):

0.77", 25 year 1hr hour storm, NOAA Atlas 2			
	Sediment Yield (T/ac)		
		% Change	
Beaver Creek		1728	
Benson Creek		11581	
Canyon Creek		2077	
Chiliwist Creek		1153	
Cow Creek		1681	
Frazer Creek		1728	
Leecher Creek		835	
Texas Creek		1831	

Hydrologic Design Factors

A. Estimated Vegetative Recovery Period, (years): **2 to 5**

B. Design Chance of Success, (percent): **NA**

C. Equivalent Design Recurrence Interval, (years): **25 years**

D. Design Storm Duration, (hours): **1 hour**

E. Design Storm Magnitude, (inches):

- **2 yr event – 0.35**

Catchments	2 yr storm Q Pre (cfs)	2 yr storm Q Post (cfs)
Beaver Creek above Frazer	2	50
Benson Creek @ mouth	1	194
Canyon Creek @ mouth	0	12
Chiliwist Creek @ mouth	2	95
Cow Creek @ mouth	0	47
Frazer Creek @ Beaver Ck	1	80
Leecher Creek @ mouth	0	25
Texas Creek @ mouth	0	31

- **25 yr event - 0.77**

F. Estimated Reduction in Infiltration, (percent): **2-7% in moderate and high severity**

G. Adjusted Design Flow, (cfs at the pour points): **see table**

	Wildcat5			AGWA		
Drainage	**Pre Fire Q (cfs)**	**Post Fire Q (cfs)**	**% increase**	**Pre Fire Q (cfs)**	**Post Fire Q (cfs)**	**% increase**
Beaver Creek above Frazer	33	424	1185	126	187	48
Benson Creek @ mouth	22	1228	5529	3	65	2067
Canyon Creek @ mouth	1	109	9264	4	78	1850
Chiliwist Creek @ mouth	36	739	1941	36	436	1111
Cow Creek @ mouth	7	318	4317	15	220	1367
Frazer Creek @ Beaver Ck	20	516	2510	57	677	1088
Leecher Creek @ mouth	8	192	2297	18	144	700
Texas Creek @ mouth	10	302	2848	14	164	1071

Summary of Analysis

Describe Critical Values/Resources and Threats

Critical Value	Value-at-Risk	Drainage/Area with Value	Threat Description	Risk*
Human Life & Safety **Property**	Motorized Access Major Highways	Benson – Hwy 153 crossing Canyon – Hwy 153 crossing Cow – Hwy 153 crossing Leecher – Hwy 153 crossing Frazer – Hwy 20 McFarland to Alta Coulee – Hwy 153 (select steep facial drainage)	**Highways 20 and 153 -** Threats from flooding, debris flows, and breeching of ponds (select drainages) from runoff and sediment in drainages with extensive moderate-high burn severity. Highways currently have undersized culverts, inadequate ditchline relief culverts, and/or are located within portions of the floodplain. These events can top and plug culverts causing loss of road fill, surfacing, and ditchline scour blocking access for days or weeks on critical highways to local communities.	Very High
Human Life & Safety **Property**	Motorized Access Along Roads	Benson, Finley, Canyon, Cow, Texas, Leecher, Whitestone, Chiliwist, French, Frazer, Beaver, Squaw, Gold, McFarland, Black Canyon	Threats from flooding, debris flows, breeching of ponds (select drainages) from runoff and sediment in drainages with extensive moderate-high burn severity, and hazard trees, and rockfall. Many roads within the fire perimeter are heavily used by the public. Steep confined channels have already deposited debris and sediment from several intense rain events onto many of these roads.	Very High to High
Human Life & Safety **Property**	Homes, outbuildings	Benson, Finley, Canyon, Cow, Texas, Davis Canyon, French, Frazer, Beaver, Squaw, Gold, McFarland, Black Canyon	Threats from flooding, debris flows, breeching of ponds (select drainages) from runoff and sediment in drainages with extensive moderate-high burn severity; rerouting of runoff and sediment from roads that could redirect it into homes, outbuildings, etc. Some valley bottoms and stream channels have aggraded changing the stream courses redirect flows into buildings. The Natural Resource Conservation Service Emergency Watershed Protection Program identified 39 structures (homes, outbuildings, etc.) that were at high risk based on the two flood events that occurred August 12-13 and 21. Some additional structures have been identified through this assessment.	Very High to High
Human Life & Safety **Property** **Water Systems**	Dams/Ponds	Finley Canyon (Wenner Lakes), Leecher, Frazer	Threats from flooding/debris flows from slopes with extensive moderate-high burn severity that may fill ponds with sediment and runoff breeching dams deliverying stored water and sediment to homes and infrastructure downslope.	Very High

Property	Domestic Water Sources	Benson, Canyon, Texas, Davis Canyon, Frazer	Threats from flooding, debris flows, breeching of ponds (select drainages) from runoff and sediment in drainages with extensive moderate-high burn severity; rerouting of runoff and sediment from roads that could redirect it into wells. Some valley bottoms and stream channels have aggraded changing the stream courses redirecting flow/sediment into wells. Well heads have filled up with sediment in drainage affected by debris flows and may be impacted in other drainages.	Very High to High
Property	Water diversions/ Irrigation systems	Benson, Canyon, Frazer, Beaver, McFarland	Threats from flooding, debris flows, breeching of ponds (select drainages) from runoff and sediment in drainages with extensive moderate-high burn severity; rerouting of runoff and sediment from roads that could redirect it into wells. Some valley bottoms and stream channels have aggraded changing the stream courses redirecting flow/sediment into wells. Well heads have filled up with sediment in drainage affected by debris flows and may be impacted in other drainages.	Very High to High
Property	Utility lines (Above and Underground)	Frazer	Some above and underground lines are in debris flow paths or along roads that may be scoured by debris flows and runoff. These events could unbury and damage underground lines or knock down above ground poles in specific locations.	Very High
Human Life & Safety Property	Railroad	Watson Draw	Wood trestle was recently replaced with several culverts. Crossing could be at risk if headwater ponds breeched. However, overall burn severity in area is low and vegetative recovery should occur within a few years.	Intermediate
Human Life & Safety Property	Campgrounds	Alta Coulee, Bear	State campground at Alta Coulee could be at risk from rolling rocks on adjacent hillslope. However risk existed before fire. Debris flows were not a concern at state campground in lower Bear Creek due to a small amount of headwaters burned and low intensity of burn.	Low
Human Life & Safety Property	Rock Quarry	Whitestone	Small rock quarry occurs immediately below Rat Lake. However this area is not at risk due to low intensity burn above quarry and adequate storage above lake if debris flow occurred.	Low
Natural Resource	Steelhead (Critical Habitat)	Beaver Creek, Methow River, Gold Creek, Libby Creek, Black Canyon, Loup Loup Creek, and Okanogan River	Risk to steelhead and associated designated Critical Habitat due to the threat of post-fire runoff, erosion, ash, and sediment delivery. These threats have the potential to negatively affect steelhead populations and lead to the degradation of designated critical habitat, deterring recovery objectives. There are 45 miles of designated Critical Habitat within the fire perimeter.	High

Natural Resource	Spring Chinook (Critical Habitat)	Methow River	Risk to spring chinook and associated designated Critical Habitat due to the threat of post-fire runoff, erosion, and sediment delivery. These threats have the potential to negatively affect spring chinook populations and lead to the degradation of designated critical habitat, deterring recovery objectives. There are 25 miles of designated Critical Habitat within the fire.	High
Natural Resource	Bull trout (Critical Habitat)	Beaver, Methow River	Risk to bull trout and associated designated Critical Habitat due to the threat of post-fire runoff, erosion, and sediment delivery. These threats have the potential to negatively affect bull trout populations and lead to the degradation of designated critical habitat, deterring recovery objectives. There are 37 miles of designated Critical Habitat within the fire perimeter.	High
Cultural & Heritage Resource	Cultural Sites	Chiliwist, Squaw	Risk to historic sites (sawmill site, cemetery, roads, ditchlines) from debris flows, wind erosion, and burned vegetation adjacent to site. Threats to features and artifact assemblages from erosion or engulfed by debris/mud flows.	Very High
Natural Resource	Native or naturalized communities non-forested	All drainages within fire perimeter	Field reviews indicate that there is a substantial risk of noxious weed invasion along roads, handlines and dozerlines used during fire suppression activities. This threat is due to the liklihood that some noxious weed seeds were brought into the area by fire equipment that has been used on other wildfires and suppression activity within known noxious weed locations within the burn. The slow natural regeneration following moderate to high burn severity also leaves some areas at risk. Known noxious and invasive weed populations that include Dalmation toadflax, diffused knapweed, and other species are within the fire perimeter, and are expected to aggressively compete with native species for space and nutrients in burned areas.	Very High
Natural Resource	Soil productivity	Benson, Canyon, Cow, Whitestone, Chiliwist, French, Frazer,	In high and moderate soil burn severity areas the fire completely consumed the vegetation canopy and the effective ground cover that dissipates rainfall and regulates snowmelt runoff. Even with average precipitation, erosion rates will be accelerated in combination with higher surface runoff efficiencies. A 2- or 5-year rainstorm event occurring during the first two years following the fire will greatly increase the potential for loss of topsoil, including the ash from the burned plant litter and duff that also replenish the soil nutrient pool, and reduce the soil productivity of these sites. The potential soil loss due to snowmelt and thunderstorm runoff jeopardizes the natural vegetation recovery.	High
Non-Critical Values				

	Range allotments	All drainages within fire perimeter	Risk to rangeland readiness that supports livestock grazing within burned areas. Majority of rangelands burned at lower intensity and should recvoery within 2 years. However, it is important to defer grazing until vegetative recovery meets standards of rangeland health for the area.	N/A
	Farm Fields/Pastures	Benson, Leecher, Chiliwist, Frazer, Beaver, McFarland	Several fields, ochards, and pastures were impacted by debris flows in August and may be at risk to future flow events	N/A
	Fences	All drainages within fire perimeter	Many miles of fence was burned or knocked down within the fire. Fences will need to be repaired prior to grazing and to protect sensitive areas.	N/A
	Wildlife Habitat	All drainages within fire perimeter	Mule Deer, Western Grey Squirrel, Sharptailed Grouse, and Rough Grouse habitat was burned.	N/A

* Locations not described for values rated as very high to high were assigned an intermediate or low risk rating

Emergency Treatment Objectives:

The goal of the burned area emergency rehabilitation is to:

- Reduce threats to personal injury and/or human life to users of Highway 153 by armoring road shoulders and fillslopes at select crossings (Benson, Canyon, Cow, Leecher, and Squaw Creeks) where culverts can plug from future debris flows, wash over the road, and erode the road base.
- Reduce threats to personal injury, human life, and property on county and private roads by adequate draiange (waterbars, culverts, rolling dips, low water crossings, etc.) to handle increased runoff and debris flows.
- Reduce threats to personal injury and/or human life by installing warning signs along roads and select campgrounds.
- Reduce threats to personal injury, human life, and property by maintaining the early warning rain gage network recently installed by Department of Ecology, for 3 to 5 years post-fire.
- Reduce threats to personal injury, human life, and property (approximately 40 homes) as identified by the Natural Rescource Conservation Service (NRCS) through their Emergency Watershed Protection program during the weeks of August 3 and August 10.
- Reduce threats to personal injury and/or human life, property, natural resources in the event of future high runoff events that could breach ponds at "intermediate," high" or "very high" risk though inspections, repair and/or controlled breaching. Several ponds have already breached in the Finley Canyon and Leecher drainages causing significant damage.
- Reduce threats to property and natural resources (listed fish habitat and water used for domestic and agriculture) from increased runoff, debris flows, and mobilization of already deposited debris from previous debris flows into structures by installing flow deflection berms (protective berms).
- Control expected invasion of noxious weeds within the area, especially along and adjacent to Forest roads and dozer lines used by fire equipment and in existing populations within the Carlton Complex fire boundary.
- Reduce sediment delivery into the Methow River, Beaver Creek, and other streams to protect water quality by repairing and installing drainage features on roads.

Team Members:

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Treatment Narrative:

Protection/Safety Treatments:

Road, Trail, and Campground Hazard Signs

Purpose of Treatment: Provide education and early warning message for ongoing risks due to past fire activity and increased risks due to changes in weather conditions.

General Description: Signs will be placed on state highways and county roadways leading into the Methow Valley and side drainages with increased flooding risk warning of increased hazard from falling burned trees, debris flows and flooding. Portable Variable Message signs will be placed at strategic locations on State Highway 20 and 153.

Location (Suitable) Sites: County roads in Benson, Canyon, Cow, Texas, Leecher, Whitestone, Chiliwist, French, Beaver, McFarland, Squaw, Black Canyon, and Gold drainages. Portable Variable Message Signs should be placed along Highway 153 and 97 junctions, Loup Loup Summit on Highway 20, and Highway 20 and 153 junctions.

Design/Construction Specifications: All signs, portable and post mounted, shall meet all applicable WSDOT standard drawings and specifications.

Home Stabilization

Purpose of Treatment: The severity of burn in some watersheds, combined with structure location, high possibility of flash flooding and debris flow has increased the risk to infrastructure. The purpose of these treatments is to protect infrastructure against large water flows and associated.

General Description: Several home treatments have been prescribed for private lands located in the Carlton Complex fire area. These home may be or may have been directly impacted by post fire events. Treatments include removal of debris, rolling dips, flood diversion dikes, road regrades, earthfill super sack, ecology blocks and jersery barriers. Flood and debris flows can cause a safety and property loss risk. The above treatments can assist in reducing or eliminating the risk to property and life. During implementation an engineer or engineering technician should be on site to ensure proper placement and installation. The NRCS has developed a list of site specific treatments including flow deflection berms, raising road profiles, etc. Additional recommendation have been passed on to the NRCS through this assessment effort, but specific cost estimates will be complete by their agency.

Location (Suitable) Sites: Several structures were identified during field visits to the burn area. Additional structures were identified by using the burn intensity BARC map, and Forest Service, National Weather Service and U.S. Geological Survey modeling efforts. These sites are scattered throughout the burn area and treatment protection will be administered by the Washington State Conservation Commission on a site by site basis. In addition, a Multi-jurisdiction Assessment BAER team identified area of at risk homes and associated infrastructure. These areas are: Benson, Black Canyon, Canyon Creek, Davis Canyon, Frazer, French, Gold Creek, Leecher Creek, McFarland, Squaw Creek, Texas Creek, for homes.

Design/Construction Specification(s):

1. General - Survey, design, and contract administration by Conservation District personnel with support from NRCS. Use NRCS Specifications for Construction of the above mentioned treatments.

2. Debris Removal – Debris removal is designated as needed and directed on a case-by-case basis. Design considerations include elevation grades, establish gradient away from home or other infrastructure, and material to be removed at each site. For sediment and debris disposal identify:

- Sediment disposal areas with stakes and flags.
- Limits of excavation required.
- Vegetation to be left undamaged.

If you are removing a lot of material with numerous trucks, develop a traffic safety plan. Appropriate temporary road closures while equipment is working also may be necessary.

3. Ecology Block/Jersey Barriers – Construction of structural barriers can protect infrastructure and reduce or eliminate the risk of damaged caused by debris and flood flows. The location, elevation and placement of structural barriers should be under the direction of the engineer or engineering technician. The extent of the structural barriers should be flagged. Work limits should be marked. If placed barriers are a temporary treatment, a removal plan should also be developed and discussed before construction begins.
4. Rolling Dips – Clearly identify the locations of the dips using stakes, GPS coordinates, and maps. Consider equipment travel distance between sites and whether the equipment would be transported or walked from each location. Identify logical treatment units that reduce travel time.
   - Identify the segment to be treated and determine spacing guidelines.
   - Consider intervals suggested in guides based on erosion hazard rating, road grade, and road design speed.
   - Ensure that the existing design (spacing) of dips on the road may be sufficient especially when combined with an outslope or inslope to standard specifications.
   - Add dips to create a drivable overflow structure. Dip placement in this application is immediately below or downgrade of the culvert.
   - Perform any necessary clearing or grubbing to construct the dips as shown on the drawings.
   - Excavate and use borrow material during embankment; excavate drainage; shape the roadway (to 4-percent outslope unless otherwise designated in writing) in the drainage dips. The dip invert shall slope 4-percent greater than the road grade.
   - Construct dips with a skew angle to the line perpendicular to the centerline of the roadway, as designated in writing. The typical angle is 30 degrees.
   - Recommend armoring the surface and lead out.
5. Flood Deflection Dikes– Construction of flood deflection dikes can protect infrastructure and reduce or eliminate the risk of damaged caused by debris and flood flows. The location, elevation and placement of structural barriers should be under the direction of the engineer or engineering technician. The extent of the structural barriers should be flagged. Work limits should be marked.

6. Earthfill Super Sacks – Construction of flood deflection dikes can protect infrastructure and reduce or eliminate the risk of damaged caused by debris and flood flows. The location, elevation and placement of structural barriers should be under the direction of the engineer or engineering technician. The extent of the structural barriers should be flagged. Work limits should be marked.
7. Road Regrade – Design considerations include elevation grades, establish gradient away from home or other infrastructure, and material to be removed at each site. For sediment and debris disposal identify:
   - Sediment disposal areas with stakes and flags.
   - Limits of excavation required.
   - Vegetation to be left undamaged.

   If you are removing a lot of material with numerous trucks, develop a traffic safety plan. Appropriate temporary road closures while equipment is working also may be necessary.

Surface Impoundment and Dam Stabilization

Purpose of Treatment:

1. Protect existing function of dams and impoundments for storing water, providing wildlife habitat, stock watering, or other uses.

2. Protect downstream infrastructure, homes and natural resources from risk of damage by flooding associated with overtopping, breaching or other failure of the dam or impoundment.

The probability of damage or loss to downstream values for these various locations ranges from possible to very likely, and the potential magnitude of consequences varies from "moderate" to "major." Potential monetary values of the consequences have not been estimated at this time.

General Description: The eleven surface impoundments listed in Section B were found to have potential structural and/or operational risks due to erosion and sedimentation associated with increased stream flows. Risks include reduction in storage capacity, potential overtopping or breaching of the impoundment, and resulting damage to downstream resources and infrastructure from release of the impounded water and sediment.

The following basic treatment practices were identified for reducing structural and operational risks:

1. Inspection of structural integrity of impoundment dams. Dams that impound 10 acre-feet or greater of water must be inspected by a qualified engineer, per Washington Department of Ecology's dam safety inspection requirements in WAC 173-175-510 and WDOE's dam safety technical guidelines.
2. Dredging and removal of excess sediment and debris from the impoundment, outlet(s) and emergency spillway(s).
3. Reconstruction and/or upgrade of damaged or undersized outlets and overflow spillways to meet WDOE dam safety guidelines.
4. Repair of erosion damage to face of dams using compacted backfill and erosion control planting
5. Abandonment and controlled breaching of dams that are no longer serviceable and stabilization of remaining fill to reduce erosion potential. Alternatively, the dams may be temporarily breached for a few years to allow for upslope soils to stabilize, and then repaired, including installing outlets and properly-designed emergency spillways.
6. Long term stabilization of impoundment dams, exposed fill and steep slopes upstream of the dam using vegetation cover or rock armoring.

Location (Suitable) Sites:

Watershed	Description	Risk Assessment
Benson/Finley	35 ac-ft reservoir, partially breached (Wenner Lake #3)	Very high
Benson/Finley	100 ac-ft reservoir, intact (Rabel Dam/Wenner Lake #4)	Very high
Benson/Finley	Regulated pond, breached (Hawkins Dam/Wenner Lake #5)	Very high
Benson/Finley	Wildlife pond, intact (Wenner Lake #2)	Very high
Benson/Finley	50-ac-ft wildlife pond, breached (Wenner Lake #1)	Very high
Leecher Creek	Unregulated small pond	Very high
Frazer Creek	Unregulated small pond	Very high
Watson Draw	Unregulated small pond	Intermediate
Watson Draw	Unregulated small pond	Intermediate
Watson Draw	Unregulated small pond	Intermediate
Watson Draw	Unregulated small pond	intermediate

Design/Construction Specifications: NRCS Practice Standards No. 402 (Dams), No 378 (Ponds) and related Construction and Material Specifications. Surface impoundments with storage capacity of 10 acre-feet or greater must comply with Washington Department of Ecology's dam safety requirements, including the engineering/technical guidelines in Section IV "Dam Design and Construction" of WDOE's "Dam Safety Guidelines" (WDOE Publ. No. 92-55D, July 1993). Refer to Washington State

DOT's current Standard Specifications for Road, Bridge and Municipal Construction for general construction specifications.

WDOE's dam safety office has issued specific correction orders for the two WDFW ponds and the privately-owned Rabel Dam in the Benson/Finley watershed (September 2014).

Note that all construction practices will include draining or pumping the impounded water to allow for construction access. Work below the ordinary high water mark of impoundments located on natural streams may require permits from Washington Department of Fish and Wildlife and the U.S. Army Corps of Engineers, as appropriate.

Property Treatments:

Highway Drainage Improvements

Purpose of Treatment: Protect road infrastructure by minimizing erosion of the road surface and side slopes reducing excessive sediment delivery into the watersheds. Protecting the road prism will maintain multiple access paths to the upper Methow population.
General Description: Drainages listed below have either experienced damage due to storm events that have already occurred or have the potential for significant damage from further precipitation events.
Location (Suitable) Sites: Benson, Canyon, Cow, Leecher, and Squaw. Each site has significant elevation breaks from the road surface to the bottom of the drainages.
Design/Construction Specification(s): Armor road shoulders and slopes at locations of potential overtopping of highway. At locations where drainage facilities may become overwhelmed by flows and erosion of the downstream road prism material may occur, place erosion resistant fabric and rock material. At locations where flow may become routed down the road surface prior to fully crossing the road, material will be placed to channel flow directly across the road. WSDOT Standard Specifications and AASHTO guidelines for low volume roads will be used when required by the governing agency, ie County ROW. Private roads may follow FHWA Standard Specifications for Roads and Bridges on Federal Highway Projects (FP-03) with Forest Service supplemental specifications.

Road Drainage Improvements:

Purpose of Treatment: The severity of burn in some watersheds, combined with road location, high possibility of flash flooding and debris flow has increased the risk to road and trail infrastructure. The purpose of these treatments is to increase roadway stabilization to pass large water flows and associated bedload and protect road template from increased flows and decrease the chances of washing road fill into adjacent drainage structures and flow channels. Dips and low water crossings will be placed down flow from culverts that will possibly fail. In situations where placement of rolling dips or low water crossing is not feasible the culvert will be replaced. The replaced culverts will be upsized to manage the increased flows. Roadway warning signs and gated closures will be installed to protect forest users where appropriate.
General Description: Drainages listed below were found to have issues with the road drainage system due to the expected increase in flows. Road damage occurred in varying degrees of severity. Three levels of damage, high, medium, and low, have been determined to use as a generalized descriptors of each watershed. The watersheds will be analyzed based upon a combination of its assigned damage level descriptor and estimated mileage of road at risk.
Location (Suitable) Sites: County, State, and Private roads within the Benson/Finley, Canyou, Cow, Texas, Leecher, Whitestone, Chiliwist, French, Frazer, Beaver, McFarland, and Squaw-Gold drainages.
Design/Construction Specifications:

1. Construct Rolling Drain Dip – Roadway dips modify the road drainage by altering the template by allowing surface flows to run off the road to prevent any excessive erosion of the surface. Work includes placing rip-rap armoring required where runoff could possibly cause erosion to the road surface

and fill slope. For undersized culverts, rolling dips shall be constructed on each side of the culvert and rock armoring shall be placed on the downstream face of the road slope.

2. Construct Leadoff Ditch – Roadway runoff ditches convey stormwater runoff away from the road, helping to reduce excessive erosion of the surface.
3. Construct Roadside Ditch – Roadside ditches collect and convey stormwater runoff to a point down-gradient to an existing or newly constructed drain dip or runoff ditch to prevent excessive erosion of the surface.
4. Remove/Replace Culvert – Remove existing culvert and replace with new to better convey expected increased flows or remedy deficient culverts that are too damaged to repair. Work includes placing new surfacing necessary to provide proper cover over the pipe.
5. Recondition Existing Drainage Feature – Clean existing drainage dip, runoff ditch, roadside ditch, or channel at culvert inlet/outlet to better convey stormwater runoff off the road or around road to prevent excessive erosion of the surface. Work includes removing silt and debris that impede the flow or deflect it out of the drainage feature onto the road. Work also includes armoring of culvert inlet/outlet required where runoff could possibly cause erosion to the road surface and fill slope.
6. Debris Removal from Road – Removal of large woody debris and rock from road surfaces.
7. Decommission Road – Construct "tank trap" at the beginning of DNR or WDFW roads where damage that has occurred at a level that has made the road impassable or there is a risk of that level of damage occurring. Gates shall be chained and locked with signs providing information about fire and flood damage risks.

Point Protections: Utilities, Domestic Wells and Irrigation Systems

Purpose of Treatment: Increase protection to threatened infrastructure against damage due to erosion, hydraulic and mechanical forces, and sediment intrusion.

General Description: The utilities, wells, fish screens and irrigation systems listed in **the Enginering Report** Appendix 'A' were found to be vulnerable to damage from the expected increase in runoff and potential debris flows. Treatments to provide protection from future damage are similar: temporary or permanent installation of berms. Where practical, a minimum number of ecology blocks set to enclose the threatened infrastructure is the recommended treatment. Where ecology blocks cannot be properly seated for stability, a rock berm is recommended.

Location (Suitable) Sites: Benson, Canyon, Texas, Davis Canyon, Frazer, Beaver, McFarland, Gold, Black Canyon, and Squaw.

Design/Construction Specification(s): Imported rock material used will be sized to resist scour conditions likely to be encountered at the treated sites, at the judgment of the project engineer.

Natural Resource Treatments:

Land Treatments:

Seeding

Purpose of Treatment: High soil burn severity areas within the Carlton Fire areas are subject to spread of noxious weed communities and invasive species. Many of the noxious weed and invasive species have the potential to out compete native plant communities during post fire recovery. The treatments designed are to protect sensitive native plant communities and supplement remaining native seed banks that promote native plant community recovery and reduce the potential for invasion of noxious weeds into areas disturbed by fire suppression activities and in all burn severity areas.

Keep out noxious weeds; prevent weed spread, and secondary long term benefit of soil stabilization. Seeding to occur on infested or sensitive areas to prevent the spread of invasive species, noxious weeds

Soil Stabilization, Prevention seeding to occur in order to out compete noxious weeds & invasive species and erosion control

General Description: Hand seed dozer lines with native seed to discourage repeated ground disturbance and further weed spread from ORV recreation/ activities. Aerial seed moderate to severely burned areas where the risk of invasion from noxious weeds and invasive species is high secondary long term benefit of soil stabilization & soil health.

Location (Suitable) Sites:

- Frazer Creek: High Severity- 920 ac
- Cow Creek - 560 ac
- French Creek (Buckhorn Mountain) - 640 ac
- Finley/Chiliwist/Hooker (Thrapp Mountain) - 640 ac

Design/Construction Specification(s): Native seed mix is to be applied on dozer lines and identified polygons. Seeding to occur in areas identified by field survey, and severe burn severity and susceptible or known infestation areas. Use seed mix recommended by local seed company AgTech. Apply Aerial seed mix at a rate of 25 lbs/ac, hand/ broadcasting at a rate of 15 lbs/ac. using the "NRCS Critical Area Planting Standards 342" as a guide.

1. Seed mix is to be applied to dozer lines by hand or 4-wheeler where applicable.
2. Seed mix will be applied to polygons identified by aerial application.
3. Seeding should occur in late fall or early winter to allow seed to naturally stratify.
4. Application can be broadcast or aerial dropped directly on snow surface.
5. Seed mix rate determined using NRCS Critical Area Planting Standards 342 as a guide and consult.
6. Treatments include **47** acres of dozer lines and **2,760** acres of identified polygons within the high burn severity areas. Areas in polygons are subject to high probability of noxious weed intrusion, (See map for treatment locations).

Table 1. Rangeland Seed Mix

Common Name	Scientific Name	Quantity %	@ Total amount for Mix
Bluebunch Wheatgrass	*Pseudoroegneria*	45	12 lbs
Sheep Fescue	*Festuca ovina*	20	2 lbs
Pubescent Wheatgrass	*Thynopyrum intermedium spp. barbulatum*	5	2lbs
Sandberg Bluegrass	*Poa secunda*	25	6 lbs
Canby Bluegrass	*Poa canbyi*	5	2 lbs

Table 2. Forest land Seed Mix

Common Name	Scientific Name	Quantity %	@ Total amount for Mix
Bluebunch Wheatgrass	*Pseudoroegneria*	35	9 lbs
Mountain Brome	*Bromus carinatus*	20	5 lbs
Idaho Fescue	*Festuca idahoensis*	20	5 lbs
Sherman Big Bluegrass	*Poa ampla*	15	5 lbs
Canby Bluegrass	*Poa canbyi*	10	1 lbs

Noxious Weeds EDRR

Purpose of Treatment: The purposes of the monitoring are to prevent known noxious weed infestations from spreading and/or increasing in density, to detect and rapidly respond to new infestations associated

with fire suppression/fire effects and to prevent potential new infestations resulting from BAER emergency response action. When monitoring actions are initiated personnel will be equipped to immediately treat to eradicate or control infestations of noxious weeds (i.e. hand pulling, herbicide application, biological agent control, seeding of native species). This allows for the immediate treatment and eradication of infestations as they are discovered.

General Description: Well-known pathways of weed spread such as roads and drainages occur within the fire area. In addition, the area receives frequent strong winds which are capable of spreading weed seeds, and high levels of use by the public who inadvertently act as vectors for noxious weed spread. Because of dozerlines, handlines, roads, and previously infested areas encompass approximately 256,108 acres of state, federal, and private land. The newly burned soil is vulnerable to rapid establishment of noxious weeds and invasive, non-native plants. Add to this the presence of 152.6 miles of new dozer lines, (areas of soil disturbance), and 26.7 miles of hand lines, and it is clear that without prompt action, the potential for an explosion of invasive weeds on high and moderately burned soils, along with the dozer and hand lines is extremely high. Field reviews by Forest Service BAER team specialists indicate that there is a high risk of noxious weed invasion. This includes Common Mullein, Dalmatian Toadflax, Yellow Toadflax, Houndstongue, Leafy Spurge, Canadian Thistle, Musk Thistle, Scotch Thistle, and cheatgrass.

Location (Suitable) Sites: Across all state managed lands within the fire perimeter. Private, County, and Leased State Lands are responsible for weed treatment on their lands.

Design/Construction Specifications:

a. Conduct weed detection surveys to identify and remove newly discovered infestations adjacent to existing weed infestations.

b. Conduct weed detection surveys and remove newly discovered infestations along dozer & hand lines, and inside and around noted polygons of high and moderate burn severity areas that are designated for reseeding.

c. Treat areas with herbicides, mechanical practices.

d. Seed dozer lines with native seed to discourage repeated ground disturbance and further weed spread from ORV recreation/ activities.

Monitoring:

Cultural/Heritage Resource Monitoring

Purpose of Treatment: Full assessed including updating existing site forms and reevaluating sites for listing on the National Register of Historic Places (NRHP).

General Description: Both sites affected by flooding, including one precontact site located on state land and one precontact site located private land, be fully assessed. Date recovery should involve site visitation by a professional archaeologist to update existing documentation and evaluation of the site for National Register eligibility. Updated site forms should be submitted to appropriate State and Tribal officials (SHPO/THPO) to seek concurrence and/or comment on NRHP eligibility recommendations.

Location (Suitable) Sites: Just one of the eight sites identified within moderate burn severity areas located on private lands was relocated during this assessment. The site consists of the remains of a historic mining town and existing documentation indicates the site had combustible structures/features. During the field assessment no standing structures were observed indicating a significant loss of data has occurred. The site is located within the Squaw Creek drainage and is bisected by the creek. Moderate intensity burn areas within the site boundary and localized high intensity burn areas on the slopes adjacent to the site suggest the site is vulnerable to debris flows and flooding, which would further impact the site. One previously undocumented site was identified during the assessment. The site consists of the remains of a historic logging community with a sawmill, historic road segment, and historic ditch segment. The site was impacted by a low severity burn and subsequent debris flow/flood event. During the flood event water was channeled down the historic road segment, flowed downslope into the historic ditch and washed out a segment of the ditch berm. Chiliwist Creek flows through the

site, one flood event has occurred since the fire, and the site remains undocumented and at risk of future flood events.

Design/Construction Specification(s): None

Other: Ground disturbing activity recommended as a result of the BAER assessment, outside the scope of the cultural resources assessment, need to take into account the Governor's Executive Order 05-05 in regards to cultural resource compliance. Projects that have the potential to result in ground disturbing activity need to go through the cultural review process with the State Historic Preservation Office (SHPO) and Confederated Tribes of the Colville Reservation Tribal Historic Preservation Office (THPO). Activities that have been proposed during team meeting include but are not limited to removal/replacement of culverts, installation of fish screen structures, and construction of point protection structures.

Part VI – Emergency Stabilization Treatments and Source of Funds

Line Items	Units	Unit Cost	# of Units	BAER $
A. Land Treatments				
Noxious Weed Treatment	Acres	52.80	1,500	$79,200
Aerial Seeding	Acres	290.11	2,760	$800,704
Hand Seeding (Dozerlines)	Acres	161.50	117	$18,896
Subtotal Land Treatments				$898,800
B. Channel Treatments				
Subtotal Channel Treat.				$0
C. Roads and Other Property				
Road Drainage Improvements (state)	Miles	14,444	9	$129,996
Private Crossings	Each	1,672	39	$65,208
Road Drainage Improvements (county)	Miles	11,768	34.5	$405,996
Highway Drainage Improvements	Each	17,089	5	$85,445
Point Protections	Each	1,385	53	$73,405
Subtotal				$760,050
D. Protection/Safety				
Road and Campground Signs	Each	869	13	$11,297
Portable Variable Message Signs	Each	17,202	3	$51,606
Impoundment and Dam Stabilization	Each	241,800	1	$241,800
Home Stabilization	Each	872,500	1	$872,500
Subtotal Structures				$1,177,203
E. Monitoring				
Cultural/Heritage Resources	Each	10,000	2	$20,000
G. Totals				$2,856,053

Long-Term Restoration Recommendations

Human Life & Safety, Property

- Install bridges that do not constrict the floodplain or culverts that meet WDFW's "Stream Simulation" design guidance and other requirements of the Washington Hydraulic Code at select crossings (Benson, Canyon, Cow, Leecher, and Frazer Creeks) on Highway 20 and 153 where material from current or future debris flows may plug and wash out the crossing. Install relief culverts along ditchlines in Frazer Creek to reduce runoff volumes scouring the roads and spilling onto the highway. Portions of Highway 20 are in the floodplain of Frazer Creek and are now at stream grade due to stream aggradation from debris flows. Some debris fans are also as high or higher than the highway creating a situation where future debris events could more easily wash onto and damage the road. Options to relocate section of Highway 20 should be investigated.
- Structure relocation or property aquistion should be further evaluated in locations that are indefensible at home site identified by the NRCS that are in areas where deflection berms will not withstand larger strom events and rebuilding homes would place occupants at further risks from flood events.
- Reduce threats to personal injury and/or human life, property, natural resources damage from pond breaching by stabilizing and improving (e.g. inspecting the structural integrity of the dams, removing accumulated sediment, repairing and/or upgrading outlet structures and emergency spillways, etc.) impoundment structures to withstand future fire related runoff and debris flows. Alternatively some ponds may be replaced by installing wells that can irrigate downslope pastures and fields.
- Protect personal property and natural resources (water for domestic uses and agriculture, listed fish habitat, etc.) for wells and water diversions that are in harm's way for future flood-related damage. Owners should consider relocating sites outside of the floodplain or to more secure locations that are not prone to additional debris flows, increased runoff and sediment.

Noxious Weeds EDRR (Second Year of Treatment)

Purpose of Treatment: The purposes of the monitoring are to prevent known noxious weed infestations from spreading and/or increasing in density, to detect and rapidly respond to new infestations associated with fire suppression/fire effects and to prevent potential new infestations resulting from BAER emergency response action. When monitoring actions are initiated personnel will be equipped to immediately treat to eradicate or control infestations of noxious weeds (i.e. hand pulling, herbicide application, biological agent control, seeding of native species). This allows for the immediate treatment and eradication of infestations as they are discovered.

General Description: Well-known pathways of weed spread such as roads and drainages occur within the fire area. In addition, the area receives frequent strong winds which are capable of spreading weed seeds, and high levels of use by the public who inadvertently act as vectors for noxious weed spread. Because of dozerlines, handlines, roads, and previously infested areas encompass approximately 256,108 acres of state, federal, and private land. The newly burned soil is vulnerable to rapid establishment of noxious weeds and invasive, non-native plants. Add to this the presence of 152.6 miles of new dozer lines, (areas of soil disturbance), and 26.7 miles of hand lines, and it is clear that without prompt action, the potential for an explosion of invasive weeds on high and moderately burned soils, along with the dozer and hand lines is extremely high. Field reviews by Forest Service BAER team specialists indicate that there is a high risk of noxious weed invasion. This includes Common Mullein, Dalmatian Toadflax, Yellow Toadflax, Houndstongue, Leafy Spurge, Canadian Thistle, Musk Thistle, Scotch Thistle, and cheatgrass.

Location (Suitable) Sites: Across all state managed lands within the fire perimeter. Private, County, and Leased State Lands are responsible for weed treatment on their lands.

Design/Construction Specifications:

a. Conduct weed detection surveys to identify and remove newly discovered infestations adjacent to existing weed infestations.

b. Conduct weed detection surveys and remove newly discovered infestations along dozer & hand lines, and inside and around noted polygons of high and moderate burn severity areas that are designated for reseeding.
c. Treat areas with herbicides, mechanical practices.
d. Seed dozer lines with native seed to discourage repeated ground disturbance and further weed spread from ORV recreation/ activities.

Cultural/Heritage Resource -The remaining 34 sites that were identified in burned areas appear to be at less risk from post fire events. With this said, each of these sites are potentially eligible or eligible for listing on the National Register of Historic Places and have likely been adversely effected by direct and indirect effects of the 2014 Carlton Complex fire. Therefore, a recommendation is being made for updating existing site documentation and evaluation of each site for National Register eligibility. Following these actions data should be submitted to appropriate officials (SHPO/THPO) for concurrence or comment.

Fisheries

- Increase/encourage large wood recruitment and retention to mainstem Methow and fish bearing tributaries.
- Consider brook trout eradication in Frazer creek in 2015. The recent flood events in Frazer Creek have likely impacted brook trout populations and now may be the ideal time to eliminate this invasive, non-native species from Frazer Creek.
- Limit excessive fine sediment delivery to fish bearing streams but allow for bedload materials to be transported. Bedload provides gravels for spawning and larger material that provides habitat for fish.
- Riparian replanting and maintenance where weed invasions could limit recovery – this is important to reestablish shade to fish bearing streams.
- Improve irrigation diversion structures to accommodate increased sediment load that is predicted to affect stream conditions for the next 5-7 years. Additionally, fish screening screens should be updated to improve function.

Monitoring:

- Temperature monitoring in Beaver Creek
- Sediment monitoring in spawning areas in Beaver Creek and lower Methow
- Fish population recovery in Beaver Creek: Fish populations in the lower 6 miles of Beaver Creek were likely severely reduced by the recent flooding and mud flows. Recolonization will likely happen quickly. A robust fish distribution data set was collected in the years prior to the fire and provides a good opportunity to measure population recovery following a major disturbance.

Habitat project performance in Beaver Creek: Several major fish habitat projects were completed in 2012 and 2013 and were burned over by the fire. Comparing the recover y of these treated areas to non-treated area could provide important information that could be used in future project designs.

Rangelands

- Hundreds of miles of boundary fence and range fences have been lost. An inventory of fences need to be completed to paint an accurate picture of the loss and help prioritize replacement. It is encouraged that boundary fences, fences protecting sensitive areas (wildlife, riparian, etc.), areas needing longer recovery (slope with moderate to high severity burns), and areas being seeded be fenced first.
- Rangeland and grazeable woodlands should be rested for two years (2015-2016) and deferred thru the critical period of the third year (2017) based on field evaluations using NRCS Range criteria.

Wildlife

- **Mule Deer** – (**25% burned at moderate-high severity**) restore firelines to prevent the conversion to new motorized roads or trails, and include a variety of palatable shrub species (bitterbrush, choke cherry,

service berry, elderberry, mock orange) in rehabilitation plantings to provide for critical long-term winter forage.

- **Columbian Sharp-tailed grouse** – include water birch in riparian planting/seeding efforts to provide for critical winter forage.
- **Western Gray Squirrel** –avoid additional tree canopy removal in the affected areas and include ponderosa pine in any tree planting efforts.