COLVILLE NATIONAL FOREST
BURNED AREA EMERGENCY STABILIZATION PLAN

STICKPIN FIRE

ENGINEERING RESOURCE ASSESSMENT – ROADS

I. OBJECTIVES

A field review of existing forest roads within the boundaries of the Stickpin Fire, located on the Republic and Kettle Falls Ranger Districts of the Colville National Forest, was conducted between the dates of September 25 - 29, 2015.

The purpose of the engineering review was to assess potential negative effects on roads, bridges, culverts and other hydraulic structures attributable to the post-fire condition of the watersheds. The review also looked at safety and warning structures required to provide safer passage to motorists accessing the Forest on authorized roads within the burn area. A cursory look at select roads owned and maintained by other federal and local agencies was also performed for the purpose of informing these groups of possible threats that may impact these roads within and proximity to the fire perimeter. This report will provide a general summary of the issues, findings and recommendations.

II. ISSUES

The watersheds burned within the Stickpin Fire will show the effects of the fire due to increased post-fire runoff rates, erosion, sediment, and debris transport. This condition creates a future concern for roads, culverts, bridges, and channels along the drainage paths of the burned watersheds in that they may be plugged, overtopped or washed away more frequently than in its pre-fire condition. There is also increased danger to structures that remain in the flood path due to increased risk for debris slides and flooding.

This report identifies roads and structures that will continue to be impacted by post-fire debris flows and flooding, assesses their current condition and vulnerability, and where necessary, recommends treatments to minimize the risks to public safety and protect the investment of the transportation system from the expected increased post-fire runoff.

A field visit was also made to the intake structure/dam for the Town of Orient Municipal Water Supply on the East Deer Creek for information purposes only, no engineering assessment was made.

III. OBSERVATIONS

A. Background

The Stickpin Fire contains segments of forest system roads; the total mileage per maintenance levels is shown in Table 1 below:

TABLE 1: FOREST SYSTEM ROADS IN BURN AREA (miles)				
	ROAD MILES BY BURN SEVERITY			
Maintenance Level	**HIGH**	**MEDIUM**	**LOW**	**TOTAL**
1	14.9	4.4	18.2	37.5
2	25.3	12.8	41.4	79.5
3	6.7	2.9	8.8	18.4
TOTALS	**46.9**	**20.1**	**68.4**	**135.4**

B. Reconnaissance Methodology and Results

The engineering team was able to field visit most of the Forest's maintenance level two through three roads within the fire perimeter along with select Ferry County Roads that provide access to Forest roads. Priority for the field visit was given to roads that traversed areas showing high burn severity. The roads that were not examined were inaccessible due to road conditions, blocked by large or numerous downed trees or not in high burn severity areas. The forest service system roads and county roads that were visited included the following:

<u>Forest Service Roads</u>

- NFSR 2030000 from 6110 to approximately 2 miles SW
- NFSR 2030900 Blocked
- NFSR 2030920
- NFSR 2040700
- NFSR 2160000
- NFSR 6100215
- NFSR 6100350 to 6100370
- NFSR 6100370 Blocked
- NFSR 6100400
- NFSR 6100490
- NFSR 6100500
- NFSR 6100501
- NFSR 6100600

- NFSR 6100601
- NFSR 6110000 west of 6113
- NFSR 6110430 Blocked
- NFSR 6113000
- NFSR 6120000
- NFSR 6120070
- NFSR 6120470
- NFSR 6120450 approximately 1.5 miles until blocked
- NFSR 6120500

Ferry County Roads

- Boulder Creek Road (CR602)
- Long Alec Road (CR582)
- St Peter Road (CR584)
- Lone Ranch Road (CR66)

The results of the field review identified threats to public safety, loss of government property, threats to downstream property and deterioration of the roadway system due to increased runoff and sedimentation.

A more detailed description of the proposed treatments and corrective action for the road infrastructure, as well as for the critical drainage crossings that were observed on these roads, is included in this report.

C. Findings

The reconnaissance of the roads and upstream drainages during the field investigations identified several issues pertaining to road stabilization and public safety. The major road stabilization issues identified were sediment and debris flows that will potentially plug culverts, damage road infrastructure, and wash heavy debris and sediment into the surrounding drainages. The main issue identified with public safety was the risk of adjacent hazard trees falling across the roads.

Table-2 contains a list of the roads that were examined during the field investigations along with their associated issues.

Table-2 Issues identified during field investigations

Road No., Name, & Maintenance Level	Issues / Observations
Forest Service Roads	
2030000 Albian Hill Road ML2	• From junction with 6110 Rd, south for approximately 2 miles, 2030 skirts the bottom of the fire and has a buffer of unburned vegetation adjacent to the roadway. • South Fork Boulder Creek crossed the road in a 5-foot high arch culvert, tributary area approximately with 7 square miles with significant areas of high and moderate burn severity. • Anticipate increased flows, sediment and debris impact to drainage features, particularly at South Fork Boulder Creek crossing.
2030900 ML2	• This road could not be accessed due to excessive amount of down trees • Accesses upper areas of Midget Creek with high and moderate burn area • Potential for high impact due to increased flows, sediment and debris
2030920 ML2	• Road is generally in good condition. • Hazard tree area observed at Ryan Cabin TH and parking area below. • Fence to side of road appears damaged due to fire.
2040700 ML2	• Very rough, well vegetated through unburned segment. It became virtually impassable with larger rocks and brush in the roadway about 1/3 mile in. • Upper section (not observed) traverses high burn severity.
2160000 ML2	• On hillside above St Peter Creek, traverses slopes with high to moderate burn severity. • Has regular cross culverts that will need higher maintenance to keep clear in the high to moderate severity areas
6100215 ML2	• Major portion of road is through unburned or low level burn area. Last half mile, before intersection with 450, is high severity burn area. • ½ mile before severe burn area road becomes almost inaccessible with vegetation overgrowth and rocky unmaintained road surface. • Culvert over East Deer Creek is 36” and is in heavily vegetated area. Lots of rock and soil and creek as well as vegetation. • Severe burn area will contribute substantial debris to flows
6100350 to 6100370 ML2	• Roadbed was rutted and rilled, looked to be low use. • Low burn area for 2/3 of length but high severity on two portions. Was not able to get to northern half of road due to vegetation blocking road. • Road 370 was not driven for same reasons. • Segment needs ditches and culverts cleaned for about ½ mile total.

6100400
ML2
	• Roadside ditches are filled, surface has scouring within the wheel tracks.
	• Heavy burnt timber along route (hazard trees).
	• Squash CMP, 44”x58” (loc: N 48° 50.741’, W 118° 22.917’)
	  o Mostly high severity burnt watershed upstream.
	  o Perennial stream flowing through pipe, rust line about 30% of pipe.
	  o Fill height above culvert approximately 3 feet, length approx..40 feet.
	  o If pipe plugs, overtopping down station for at least 200 to 300 feet.
	  o Berm closing road is approximately 30 feet up station of crossing.
	• 18-Inch CMP, (loc: N 48.85381°, W 118.38197°)
	  o Mostly high severity burnt watershed upstream.
	  o Perennial stream flowing through pipe.
	  o Rust line about 45% of pipe.
	  o Fill height above culvert approximately 20 feet.
	  o If plugs overtopping would go down station several hundred feet.
	• 36-Inch CMP, (loc: Just prior to intersection with Boulder Creek Rd.)
	  o Mostly high severity burnt watershed upstream.
	  o Perennial stream going subsurface under road and comes out approximately 10 feet below pipe.
	  o Rust line about 20% of pipe.
	  o Fill height above culvert approximately 20 feet.
	• Slight sag in road , any overtopping would cross back into channel.

6100490 ML2	• Roadbed was in fair condition, and looked to be low use. • High and moderate severity burn area for almost full length. • 18”Culvert over W. Deer Creek. • Has rolling dips for drainage.
6100500 ML2	• Inspected from intersection of Boulder Cr. Rd to intersection of NFSR 6100501 • Road has drainage problems, wheel tracks are rutted and scoured due to run-off. • Existing 24-inch CMP crossing at intersection of NFSR 6100501. Some time prior to fire culvert must have plugged, evidence of overtopping road, road scoured parallel to the pipe and the fill slope at the outlet had been eroded. • Drainage changes to rolling dips. Road 500 goes to trail designation at 501 • Road crosses a wet area and uses 2 culverts to drain and keep drivable. • Appears a gate and sign were present but burned. • Unable to drive the rest of the road due to several down trees blocking the road

6100600
ML2
	• Minimal drainage structure, wheel paths rutted, evidence of water on road
	• Moderately thick vegetation with burnt hazard trees along route.
	• Squash CMP, 39”x68” (loc: N 48° 50.741’, W 118° 22.917’)
	  o Mostly high severity burnt watershed upstream.
	  o Perennial stream flowing through pipe.
	  o Rust line about 10 inches from bottom of pipe.
	  o Fill height above culvert is approximately 4 feet.
	  o Length of pipe approximately 40 feet.
	  o Road sags over pipe so if it were to plug any overtopping would run parallel with crossing and dump back into channel.
	  o Survey: Inlet 9.6, Outlet 9.8, Surface Above pipe, 5.5

6100601
ML2
	• Road has basically no ditches or drain dips. The wheel paths are rutted with evidence of run-off running inside the wheel tracks.
	• Moderately thick vegetation with burnt hazard trees along route.
	• 30-Inch CMP, (loc: N 48.86477°, W 118. 42748°)
	  o Mostly high severity burnt watershed upstream.
	  o Rust line about 45% of pipe.
	  o Fill height above culvert approximately 2.5 feet.
	• Any overtopping would go down station for approximately 100 feet and then back into channel.

6113000
Bulldog Cabin Road
ML3
	• A good percentage of the road is outside burned area or has a good buffer of unburned vegetation immediately adjacent to roadway.
	• A segment of road in the vicinity of Cabin Creek, approximately 1.2 miles has severely burned slopes immediately adjacent to the road.
	
	• The road bed, ditches, sideslopes and culverts are generally in fair to good condition.
	• Anticipate increased flows, sediment and debris impact to drainage features, particularly through high burn areas.
	• 60-Inch CMP (loc: Intersection with Boulder Creek Rd.)
	  o The first rough mile of channel upstream of culvert was mostly not burned, rest of the drainages above that are in a high severity burn.
	  o Very heavily vegetated with down trees dropped in front of the inlet.
	  o Four to five feet of road fill over pipe
	  o Rust line about 35-40%.

6110000 Bulldog Cabin Road ML3	• Majority of the road has a good buffer of unburned vegetation immediately adjacent to roadway. • Indian Creek drainage, approximately 9 square miles tributary area, has high to moderate burned area in the upper reaches. This drainage crosses 6110 Road in a 60-inch CMP at a 20-foot fill. • Midget Creek crosses the road in an 18-inch CMP • Roadbed, ditches, sideslopes and culverts are generally in fair to good condition. • Anticipate increased flows, sediment and debris impact to drainage features, particularly at Indian and Midget Creeks.
6110430 ML2	• This road could not be accessed due to excessive amount of down trees • Accesses upper areas of Indian Creek with high and moderate burn area • Potential for high impact due to increased flows, sediment and debris
6120000 ML3	• On hillside above Lone Ranch Creek and crosses ridge into W. Deer Creek drainage, traverses slopes with high to moderate burn severity. • Has regular cross culverts that will need higher maintenance to keep clear in the high to moderate severity areas. • Roadbed is in generally very good condition.

6120000
(cont.)
	• Ditches and culverts are in need of cleaning on W. Deer Creek side.
	• Anticipate increased flows, sediment and debris impact to drainage features, particularly through high burn areas.
	• 24-Inch CMP at Second Creek (loc: N 48° 53.034', W 118° 26.175')
	  o High severity burnt watershed upstream.
	  o Inlet is partially crushed and sediment wedge at inlet.
	  o Rust line about 30% of pipe.
	  o Small woody debris in channel upstream channel.
	  o Fill height above culvert approximately 6 feet.
	  o Length of pipe approximately 50 feet.
	  o Road sags over crossing, any overtopping would go over top outlet of culvert.
	  o Survey: Inlet – 10.5, Outlet – 13.5, Surface Above pipe, 6.3
	• Large amount of hazard trees through areas of severe burn.

6120070 ML2	• Majority of the road has severely burned vegetation immediately adjacent to roadway. Large amount of hazard trees and downed trees. • Culvert was pulled from road at intersection with 6120. • Very rocky area, no ditches, or drainage apparent along road. • Stopped at downed trees in severely burned area
6120470 ML2	• Road has about 1/3 in severe burn area. Balance in low intensity burn area. Some boggy areas. • Very heavy fallen timber density and many hazard trees. • Very steep terrain with large amount of rock • Stopped by fallen trees ¾ mile in. • Roadbed is in generally good condition. • Ditches and culverts (mostly) 18", where present, are in need of cleaning. • Portions of road have outslope drainage.
6120450 ML2	• Road is almost fully in high severity burn area with very small patches in low to moderate burn severity areas. Some boggy areas • Very heavy fallen timber density and many hazard trees. • Very steep terrain with large amount of rock • Stopped by fallen trees 1.5 miles in. • Roadbed is in generally good condition. • Ditches and culverts (mostly) 18", where present, are in need of cleaning. Portions of road have outslope drainage.
6120500 ML2	• First segment crosses severely burned area. • Lone Ranch Creek crosses in a 36-inch CMP with about 5-foot fill. Area is boggy and culvert has gravel bar just before pipe entry. • Roadbed shows rilling and is in fair condition. • Drainage features are absent or not functional.

Ferry County Roads	
Boulder Creek Road (Ferry County Jurisdiction)	• Paved road which goes across several side drainages that have high to moderate severity burns above drainages leading to the culvert crossings. • Two long sections of burnt guard rails, burnt road warning sings. • 45-Inch CMP (loc: just west of intersection with FSR 6200500) o Culvert crosses Third Creek (perennial stream) under road. o High severity burnt watershed upstream. o Rust line approximately 25% of pipe. o Large amount sediment trapped behind down trees upstream o Outlet is partially blocked by several down trees. o Small woody debris in channel upstream channel. o Fill height above culvert 30 to 40 feet. o Fairly large storage basin below road at inlet of pipe. Could hold a large sum of storm water if pipe were to plug, though fill probably not designed as dam. • 24-Inch CMP (loc: Pipe Outlet - N 48.85965°, W 118.38100) o Small drainage basin alongside road with high severity burns upslope o Inlet is partially crushed and sediment wedge at inlet. o Large trees completely blocking inlet. o Access to culvert for maintenance, repair, or inspection is very difficult.
County 582 Long Alec Road	• Major portion of road was in good shape. • There is about 1.5 miles of road in the moderate to severe burn category. • The area with the moderate to severe burn has a lot of downed timber and ash that will contribute debris to storm flows. • Watershed is steep and narrow and though the road is vertically separated from the creek, risk to the road is high because of steep slopes.

IV. RECOMMENDATIONS

A. Fire Suppression Rehabilitation: None Recommended.

B. Emergency Stabilization:

Emergency stabilization treatments should be implemented as quickly as possible to protect public safety and minimize negative impacts to roads and identified values from expected debris flows and flooding.

1. Road Stabilization

a. Reconstruct Road Drainage to Accommodate Expected Runoff Flows

Situation: Historically, roads within burned areas have been impacted by debris flow and flash floods causing roads to be overtopped and culverts to

become clogged with sediment and debris. This has also caused roads to become damaged, resulting in channeled runoff and deposition of sediment into adjacent streams unless reconstructed and stabilized.

Segments of roads within the Stickpin Fire were noted to be vulnerable to this type of impact. For these segments, we observed existing culverts and drainage structures that are undersized and/or are insufficient for the expected increase in sediment and flows.

Recommendation: There are several methods to reconstructing roads to ensure the impacts from increased flows next to and over the roads can be minimalized. The following is a list of some of those methods that have been determined would be the minimum treatments necessary to stabilize the roads for expected increased runoff:

- Clean culverts, ditches, low points of rolling drain dips of sediment and debris. Install water bars, rolling drain dips and low water crossings where they will be most efficient and necessary. Rolling drain dips or sloping roads inward or outward should be installed on the down slope side of culverts where culvert failure is possible or likely. These road grade changes will assist in removing water from the roadbed that has become trapped on the road surface causing erosion and travel hazards. Low water crossings can be used when existing culverts need to be removed because of damage or being undersized. Low water crossings can also be used when large drainages cross the road and no engineering control is in place.
- Large culverts with high fills under higher level roads (Level 3 roads) will be very expensive to replace and should therefore be regularly maintained after each storm event. Where indicated, construct an armored rolling dip above or just downgrade of the culvert crossing in anticipation of storm and/or debris flows overtopping the road. Attach trash racks across the inlets of culverts where it is expected to receive boulder and woody debris.
- For culverts at risk with larger drainage areas, use construction equipment to clean out inlet areas to culverts, remove debris that will mobilize during a storm event, place riprap to protect at inlet area.
- For larger drainages on ML3 roads, where it is too costly or inefficient to upsize culverts, and an armored rolling dip is not appropriate due to road profile, a relief culvert can be added to convey excess flows.
- Install trash racks at culvert entrances where clogging with debris is an ongoing problem.

b. <u>Culvert Removal/Installation</u>

Situation: During the field observation, several culverts underneath roads within high severity burn areas were identified as being at high risk of being plugged and overtopped due to the expected increase in runoff and sediment.

Recommendation: For ML 1 roads, culverts are generally already removed, check and remove any still remaining. For ML 2 roads with at risk culverts, either remove the pipe and construct an armored road crossing or replace the culvert with a new pipe sized to pass the estimated post-fire flows. For ML 3 roads with at risk culverts, replace the culvert with new pipe sized to pass anticipated post fire flows.

Replacement of culverts to provide increased capacity is recommended for:

- NFSR 2030000 at S. Boulder Creek (Note: AOP may be required)
- NFSR 6100400 at NF Boulder Road Creek
- NFSR 6100600 at W. Deer Creek (Note; AOP may be required)
- NFSR 6110000 at Midget Creek
- NFSR 6110000 at Indian Creek (Note: AOP may be required)
- NFSR 6113000 at Cabin Creek
- NSFR 6113000 at N.F. Boulder Creek (Note AOP may be required)
- NFSR 6120000 at Second Creek

Maintain under Storm Patrols described below.

c. <u>Debris Racks</u>

Situation: Certain drainages contain large amounts of dead and down woody debris within the channels above the inlets of the existing culverts. The woody debris, when transported by higher post-fire flows, has a greater chance of plugging the culvert inlets. Plugged pipes then cause wide spread flooding in the drainage above the inlet and/or overtopping of roads.

Debris racks (see photo to right) are designed to protect culverts from catastrophic road failure by catching floatable debris in stream channels that would plug culverts.

Recommendation: Where indicated, install V-shaped debris racks across stream channels on the upstream side of the culvert. The structural stability of the debris rack shall be of such size to with stand the force of the expected heavy logs, stumps, or large boulders that it will come in contact with. The location and orientation of the debris rack shall be placed so it will deflect medium and large floating debris and large rocks from the culvert inlet to a storage area where the material will accumulate and be removed after the flood subsides.

Ensure the storage area behind the debris rack is large enough to retain the anticipated type and quantity of debris expected in one storm or between cleanouts.

d. Patrols for Storm Induced Road Hazards

Situation: The roads at burned areas have increased potential for rolling and falling rock and trees from uphill burned slopes and increased potential for sediment flows and drainage issues. With the loss of vegetation, normal storm frequencies and magnitudes can more easily initiate erosion on the slopes and it is likely that this runoff will cover the roads or cause plugging and/or washouts at drainage facilities (culverts) or stream crossings. These events make for hazardous access to forest roads and put the safety of users and employees at risk.

Recommendation: Monitor road drainage (i.e. culverts, drain dips, etc.) and roadbed conditions after significant storm events to ensure the maximum drainage capacity is maintained until the natural re-vegetation of the burned area has occurred. Maintain and/or repair any damage to road surfaces. Remove sediment and debris from ditches and entrances to culverts.

2. Public Safety

a. Install Warning Signs

Situation: The severity of burn in some watersheds, combined with road location, high possibility of flash flooding and debris flows has increased the risk to road users.

Recommendation: Install warning signs for flash flooding and potential debris flows. Install "Burn Area Warning" (see example to the right) signs where necessary to properly alert the travelers of the dangers ahead. Install "Road Closed" signs

where necessary to temporarily close roads that have received extensive damage. “Road Closed” signs should also be used in conjunction with gated closures.

b. Road Closures

Situation: Slopes within the burned watersheds have been made unstable due to the severity of burned soils. Increased flows from these slopes will likely cause road damage. The burn also increased the risk of adjacent hazard trees falling across the road.

Recommendation: For ML2 Roads in high and moderate severity burn, where travel has been determined to be unsafe, install closure gates (special order) on roads until other treatment is performed or until natural rehabilitation has taken place. Closure is recommended due to the high number of burned hazard trees observed on the adjacent uphill slopes of the ML 2 roads and due to observed burned trees down on the road. Observations also noted that significant drainage deficiencies exist, further impacting road safety.

A gated closure is recommended over alternative closure methods to prevent breach of the closure and to allow for administrative access to check for any drainage issues being carried downstream and for future assessment of road.

C. Rehabilitation: None Recommended.

D. Management Recommendations (non-specification related)

1. Patrols for Storm Induced Road Hazards

Situation: Storm inspection and response is only funded by BAER funds for the initial year of implementation.

Recommendation: Continue storm inspection and response until vegetation has reestablished in affected watersheds or for at least a total of two years.

2. Boulder Creek Road (Ferry County) – Undersized Culverts

Situation: During the field observation, a few culverts within the larger drainage areas were identified as being at high risk of being plugged and overtopped due to the expected increase in runoff and sediment from burned slopes.

Recommendation: Ensure to conduct storm inspections during and just after significant storm events. Monitor road drainage and roadbed conditions to ensure the

maximum drainage capacity is maintained until the natural re-vegetation of the burned area has occurred. Maintain and/or repair any damage to road surfaces. Remove sediment and debris from ditches and entrances to culverts on a more regular basis. Add rock inlet protection and/or an inlet riser for culverts with high sediment and debris potential. These treatments will increase inlet capacity and provide sediment storage. For inlet riser specification see: http://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/06251801L.pdf

3. Long Alec Road (Ferry County) – Damage to Road

Situation: During the field observation, a large hole, caused by a buried log that burned, was found in the roadbed extending out to shoulder. The hole was approximately 5' long, 15" wide and 12" deep. Location is approximately N48.83637, W-118.46740 .

Recommendations:
Repair hole in roadbed per county standards.

4.Town Of Orient Municipal Water Structure

Situation: Field observation of the Town of Orient Municipal Water Supply intake structure on E. Deer Creek was made, the intake structure is at higher risk during normal storm events as they will have higher flows and sediment transport from burned areas in the upper drainage. For the 25-year storm event a 150% increase in flow is estimated.

Recommendations:
Inform the Operator of the increased risk and the Town can take precautions and manage the intake accordingly when rainfall events are predicted.

V. CONSULTATIONS

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VI. REFERENCES

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