WHITETAIL
HAZARDOUS FUELS REDUCTION
PROJECT

WATER RESOURCES REPORT
EFFECTS ANALYSIS

Ashland Ranger District
Custer National Forest
Region 1 Forest Service

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October 24, 2007

INTRODUCTION

This project would treat 8,262 acres in the headwaters of four 6 HUC watersheds – Upper and Middle Beaver Creek, and Upper and Lower Little Pumpkin Creek. Vegetation treatments include commercial timber harvest (shelterwood/seedtree), thinning (commercial, pre-commercial and non-commercial), and prescribed burning. These treatments would reduce fuel accumulations and the risk of stand replacement wildfire. Mechanized equipment would be used on approximately 3700 acres. No new system road construction is proposed, although temporary road construction is proposed for approximately seven miles to facilitate log hauling. New temporary roads would be closed and obliterated after treatment activities are completed using a variety of methods including scarifying/ripping, seeding, signing, obstructing (with slash) and recontouring where needed. Maintenance would occur along approximately 15 miles of existing system road.

ISSUES

What are the effects of the proposed activities on hydrologic processes and water resources; specifically water yield, sedimentation, channel and floodplain function, and riparian habitat? Units of measure: equivalent clearcut area acres (ECA), number of stream crossings, miles of new system or temporary roads.

ENVIRONMENTAL EFFECTS

EFFECTS OF THE NO ACTION ALTERNATIVE

Watersheds, undisturbed by human influences, are not static systems. Deep snowpacks and heavy spring rains can cause significant flooding. Wildfire, wind, or insect and disease mortality can drastically alter the vegetative composition of a watershed. Depending on the extent of mortality and rate of stand decomposition, impacts to stream systems can be significant. Beneficial uses, including aquatic and riparian habitat, can be negatively affected by these natural events. However, watersheds left undisturbed after natural events, can and do recover rapidly, and ultimately provide conditions that fully support all beneficial uses within a relatively short period of time. These natural disturbances occur infrequently, which allows for significant and generally rapid recovery of hydrologic and erosional processes prior to the next major disturbance event. This results in pulse effects, which are moderate to high in magnitude, but low in frequency. Within the current climatic regime and prior to significant human influence, aquatic systems have developed under pulse type disturbances.

DIRECT EFFECTS

There are no directs effects associated with the no-action alternative.

INDIRECT EFFECTS

Natural disturbance events will continue to influence hydrologic and erosional processes within the project area. Given the current vegetative conditions and associated fuel accumulations, there is potential for wildfires to occur that may be outside the range of conditions (intensity and duration) that have occurred over the last few hundred years. If actions are not undertaken to reduce the risk of catastrophic wildfire, the risk of impact to soil and hydrologic functions will continue to increase as fuel loads increase. Depending on the intensity and area burned, accelerated soil erosion is likely, particularly if hydrophobic soils are formed. Significant channel adjustments could be expected, especially during high precipitation/runoff events. Stream systems will however stabilize as vegetative recovery occurs during post-fire years.

CUMULATIVE EFFECTS

Livestock grazing on and below the Forest, along with crop production on private lands are widespread and generally concentrated along valley bottoms and therefore, potentially the major influence on water resources within the Beaver and Little Pumpkin Creek watersheds. These activities have occurred for many decades in the past and are expected to continue well into the future. However, the direct and indirect effects of these activities on water resources have not been fully documented on or below the forest boundary.

Past and planned timber management activities have also occurred both within the project area and on private land below the forest boundary. Timber stands have also been influenced by past wildfire events. On Forest Service land, 1436 acres of commercial treatments have occurred, while 1403 acres of wildfire have occurred, mostly within the last two decades. Commercial treatments are planned under the East Otter Timber Sale on approximately 1350 acres.

Past and present vegetation treatments and wildfire have been quantified by estimating equivalent clearcut area (ECA) acres for activities on National Forest System land and are displayed in Table 1. Past or present activities have not been quantified for other ownerships within the 6 HUC watersheds. Refer to the next section – Effects of the Action Alternative for a discussion of ECA calculations.

TABLE 1 - ECA ACRES – PAST AND PRESENT

WATERSHED ID	WATERSHED NAME	ECA acres[1] – vegetation treatments and wildfire	ECA acres – roads	ECA percent of watershed
100901020601	Upper Beaver Creek	1247	81	9.3
100901020603	Middle Beaver Creek	53	70	< 1
100901021101	Upper Little Pumpkin Creek	255	140	1.5
100901021102	Lower Little	80	81	< 1

	Pumpkin Creek			

[1]ECA acres do not reflect hydrologic recovery (regrowth) of timber stands previously harvested or burned because field validation of hydrologic recovery has not occurred. ECA acres presented therefore reflect a worse case scenario where little to no recovery has occurred.

The ECA estimates suggest that activity levels in all watersheds are too low to cause measurable increases in water yield or streamflows. Even Upper Beaver Creek, at 9.3 percent of the watershed affected, is well under the 50 percent that Stednick (1996) suggests may be sufficient to detect changes in annual water yield for the Central Plains.

The potential for large scale stand replacement wildfire events followed by high intensity rain events will continue within the Beaver and Little Pumpkin Creek watersheds. Similar situations have occurred on the District in the past and have resulted in significant surface runoff, and subsequent scour and deposition in drainage bottoms within and below the Forest boundary.

In the event wildfire occurs within the project area, existing roads and grazing will compound the effects of post-fire precipitation events. Roads will increase surface and subsurface drainage efficiency, routing upslope waters to natural channels at higher rates, thereby increasing floodwater levels. Roads that restrict floodwater access to floodplains will also result in higher flood stage. Concentrated livestock trampling and trailing along water courses can also increase drainage efficiency, and also destabilize stream banks. The combination of these conditions will increase the risk of more flood damage to streams and adjacent human developments following a wildfire. The effects are expected to be highest in those drainages or subdrainages that burn with high intensity over a large area, and where road and livestock densities are high.

EFFECTS OF THE ACTION ALTERNATIVE

DIRECT EFFECTS

Construction of new stream crossings, i.e., bridges, culverts or fords, is the only action that is considered a direct effect to water resources. This is due to the immediate sediment delivery and flow disruption that generally occurs during the construction period. A stream crossing would be required for temporary road T17. Although the type of crossing is not known at this time, it would meet the requirements of a MT-DFWP 124 permit and would likely be in place only for the duration of the harvest activities. Impacts to water quality and adjacent riparian area will be short term (1-2 yrs) and recovery rapidly due to high resiliency of the site.

INDIRECT EFFECTS

In contrast to direct effects, indirect effects occurs at a later time and/or distance from the activity. Indirect effects concerning water resources generally result from changes in soil and hydrologic processes, i.e., increases in either water or sediment yield across a landscape, and the subsequent effects of these increases on channel, floodplain and wetland functions and habitats.

Water Yield

The influence of vegetation treatments on water yield is typically measured by the degree of crown reduction in the mature timber stand. Reductions in crown cover were estimated for the proposed vegetation treatments and converted to an equivalent clearcut area (ECA). Equivalent clearcut area calculations reflect different harvest prescriptions that remove different levels of forest canopy. The results standardize these harvest areas to a percentage of a clearcut acre. For example, 10 acres of a 2-story harvest that removes 60 percent of the canopy is equal to 6 ECA acres, and 10 acres of commercial thinning that removes 40 percent of the canopy is equal to 2.5 ECA acres. The relationship of percent canopy removal to ECA acre is nonlinear as presented in Forest Hydrology Part II (USDA Forest Service 1973).

As suggested in Forest Hydrology Part II, treatments that remove less than 17 percent of the overstory canopy have no effect on water yield. Most of the proposed vegetation treatments focus on thinning understory (seedling, sapling and pole sized trees), not mature trees. Proposed treatments that fall into this category include road fuel break thinning, special cuts, prescribed burning with pretreatment (mechanical or hand), prescribed burning with pretreatment (hand only), prescribed burning without pretreatment, and seed tree removal. Seed tree and special cuts will not remove more than 17 percent of the existing overstory canopy. Prescribed burning is expected to cause less than 10 percent overstory mortality in all treatment types except, where pretreatment by mechanical or hand. Mortality in these stands is anticipated to be less than 15 percent for jackpot burn stands (NCBJ) and less than 20 percent for broadcast burn stands (NCBB). ECA acres for NCBB stands are included in the calculations below.

Acres of commercial and pre-commercial harvest treatments were converted to ECA acres and are displayed in Table 2 by the appropriate watershed. Additionally, temporary road miles were converted to ECA acres based on a 12 foot road prism.

TABLE 2 - PROPOSED TREATMENT ACRES AND ESTIMATED ECA ACRES

WATERSHED ID	WATERSHED NAME	Total acres - vegetation treatments	ECA acres – vegetation treatments	ECA acres – temporary roads	ECA percent of watershed
100901020601	Upper Beaver Creek	3155	100	2	< 1
100901020603	Middle Beaver Creek	1410	75	0	< 1
100901021101	Upper Little Pumpkin Creek	2873	252	8	< 1
100901021102	Lower Little Pumpkin Creek	824	137	3	< 1

Stream flow increases from a reduction in timber canopy have been documented in forests throughout the west where deep snowpacks and snowmelt runoff play a significant role in the overall hydrology of a watershed (Troendle 1983, Stednick 1996, and Bosch and Hewlett 2001). Documentation of streamflow increases from low elevation watersheds across eastern Montana where spring snowpack depths are usually minimal and snowmelt runoff is generally not significant, is limited.

According to Trondle (1983), 20 to 30 percent ECA in a watershed is required to initiate measurable changes in streamflow. Stednick (1996) suggests that 15 percent is sufficient to detect changes in annual water yield in the Rocky Mountain region, while 50 percent is necessary for the Central Plains.

The percent of watershed acres affected by the proposed activities are less than one percent for the watersheds that headwater within the analysis area. Therefore, the influence of the proposed vegetation management activities on water yield and streamflows (timing, duration and magnitude) are not expected to be measurable and would result in a very low risk of affecting channel/floodplain processes and water quality downstream. Stream systems and associated riparian habitat in these watersheds would actually benefit from increases in flow (magnitude or duration).

Sediment Yield

The proposed management activities have the potential to increase upslope sediment production and downslope sediment transport to water courses. The level of risk is a function of the degree of soil disturbance, slope, slope distance and slope filter capacity. Sediment yield in Region 1 Forest Service is typically modeled using the R1/R4 Guide for Predicting Sediment Yields From Forested Watersheds. This project analysis however, does not utilize sediment yield models for the following reasons. Natural surface erosion rates have not been validated for the Custer National Forest and management related erosion rates have not been developed for activities other than wildfire, road construction and harvest of green timber stands. These types of models cannot provide precise quantification of erosion rates due to high degree of error inherent in the modeling process and therefore are useful only for alternative comparison. This project involves only one action alternative. Additionally, existing models are not capable of adequately quantifying to a single cumulative value, the effects of other, non-timber management activities in the project area including recreation, grazing, and agricultural activities. The only way to address all of these activities cumulatively, is to address each activity individually and then qualify, in general terms, the cumulative effects between specific activities where appropriate.

The seven miles of proposed temporary roads would likely result in the greatest degree of soil disturbance, relative to all other proposed activities. However, road locations are generally along ridgetops or upper slopes which provide adequate filter distance between the road and the nearest water course downslope. Additionally, the nearest water courses are, for the most part, ephemeral or intermittent which reduces the risk of sediment transport to perennial systems. Since these roads will be rehabilitated after project

implementation, sediment production and transport will be short term. Exceptions to this involve short road segments located near the bottom of water courses. If roads are constructed in the very bottom of draws, even though the roads would be temporary and the draws may be ephemeral, there is an increased risk of affecting water resources, mainly during intense summer precipitation events. Ensuring the road prism is not located in the very bottom of draws will reduce the potential for runoff from high intensity events to concentrate on these roads and help ensure compliance with relevant BMPs. These roads include T5, T6 and T16.

Vegetation treatments also have the potential to disturb soils and route sediment to water courses, but mainly for those treatments that utilize machinery. Of the commercial treatments, approximately 1856 acres will be tractor yarded and 130 acres cable yarded. Of the non-commercial treatments, low ground pressure mechanical machinery would be used on approximately 1711 acres on slopes less than 30 percent. Following standard BMPs concerning frequency and location of skid trails and landings should limit long term soil disturbance and transport. This includes BMPs which recommend that skid trails and landing not be located in the very bottom of draws, similar to temporary road locations. In combination with low ground pressure machinery, risk of erosion and downslope sediment delivery to water courses should be low from these vegetation treatments

Non-commercial thinning treatments that will not utilize machinery are proposed on 2329 acres. Hand felling and piling on these non-commercial treatments is not expected to result in any measurable ground disturbance, except for small areas where hand piles were burned. Prescribed burning is proposed on 2332 acres and involves mainly non-forested vegetation types where fuel loads are relatively low. This burning is expected to result in minor consumption of the duff layer and only localized exposure of surface soils where fuels are concentrated. Overall, fire severity on soils is expected to be low. Both non-mechanical treatments and prescribed burning should result in a low risk of on-site erosion, sediment delivery and downslope effects to water courses.

Although on-site sediment production is anticipated, the majority of this sediment will be deposited and stabilized within intermittent and ephemeral drainage bottoms. Adhering to Streamside Management Zone (SMZ) regulations and Best Management Practices (BMPs) will help minimize sediment production from the proposed vegetation treatments and road construction/maintenance, and reduce sediment transport to drainage bottoms. Effects of temporary road construction and skidding operations will be short-term as roads and skid trails stabilize and revegetate after closure. Closure and obliteration of temporary roads will involve ripping, seeding, slashing and installation of appropriate drainage features.

The exception is for system roads that currently provide limited vehicle access due to conifer encroachment onto the road prism. Maintenance of these roads to facilitate hauling will require vegetative clearing, blading or other improvements and will likely result in increased vehicle traffic after project completion. Increased traffic on portions of these routes is likely to increase on-site erosion and sediment transport over pre-project

conditions, especially where erosive soils and steep slopes exist. However, these roads do not cross or drain to perennial streams and therefore sediment transport would only be to intermittent or ephemeral drainages.

Channel, Floodplain and Wetland Functions

Perennial stream courses are rare, disconnected and of limited length within the project area. Perennial systems are generally found below spring sources in open meadow landscapes and have low discharge, spring (groundwater) dominated flow regimes. Most drainage bottoms are dry grassy swales or woody draws with extensive litter cover. Intermittent channel scour is present along some reaches resulting in defined banks, but the scour is generally a result of infrequent natural disturbance events (stand replacing wildfire followed by high intensity summer rain events), not annual spring runoff and erosion events. Annual peakflow events are rare and do not play a major role in the morphology of these water courses. Active annual floodplains do not exist within the project perimeter and therefore no effects are anticipated.

However, short, localized riparian systems do exist and do support wetland plants and associated habitat. The risk of sediment delivery to these systems is low due to adequate filter distances and implementation of BMP's. The risk of affecting riparian or wetland function is also low as these systems are able to absorb high levels of sediment.

As discussed under direct effects, one temporary stream crossing would be necessary for this project and would meet permit requirements under the MT-DFWP 124 process. Additionally, yarding activities across perennial or intermittent stream courses would require prior approval through the Montana Streamside Management Zone rules and approval would only be granted when the design of the yarding activities would be shown to maintain the six SMZ functions. Therefore, long term indirect effects to localized channel and floodplain function, or wetland habitat is not anticipated.

CUMULATIVE EFFECTS

Livestock grazing on and below the Forest, along with crop production on private lands are widespread and generally concentrated along valley bottoms and therefore, potentially the major influence on water resources within the Beaver and Little Pumpkin Creek watersheds. These activities have occurred for many decades in the past and are expected to continue well into the future. However, the direct and indirect effects of these activities on water resources have not been fully documented on or below the forest boundary.

Past and planned timber management activities have also occurred both within the project area and on private land below the forest boundary. Timber stands have also been influenced by past wildfire events. On Forest Service land, 1436 acres of commercial treatments have occurred, while 1403 acres of wildfire have occurred, mostly within the last two decades. Commercial treatments are planned under the East Otter Timber Sale on approximately 1350 acres.

Cumulative vegetation treatments and wildfire have been quantified by estimating ECA acres for past, present and proposed activities on National Forest System land and are displayed in Table 3. Past or reasonable future activities have not been quantified for other ownerships within the 6 HUC watersheds.

TABLE 3 - CUMULATIVE ECA ACRES – PAST, PRESENT AND FUTURE

WATERSHED ID	WATERSHED NAME	ECA acres – vegetation treatments and wildfire	ECA acres – roads	ECA percent of watershed
100901020601	Upper Beaver Creek	1347	83	10.0
100901020603	Middle Beaver Creek	128	70	1.0
100901021101	Upper Little Pumpkin Creek	507	148	2.4
100901021102	Lower Little Pumpkin Creek	217	84	< 1

The cumulative ECA estimates suggest that activity levels in all watersheds are too low to cause measurable increases in water yield or streamflows. Even Upper Beaver Creek, at 10 percent of the watershed affected is well under the 50 percent that Stednick (1996) suggests may be sufficient to detect changes in annual water yield for the Central Plains.

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MITIGATION (incorporated into effects analysis**)**

Implement BMP's and SMZ Rules as recommended in Water Resources Report - Affected Environment, d. Best Management Practices, and Appendix A – Soil and Water Conservation Practices for Forest Management.

MONITORING

Schedule and complete a Forest level BMP Audit on select treatments and roads within 2 years of full project implementation (could exclude pile burning, but should include temporary road obliteration).

REFERENCES

Stednick, John D. 1996. Monitoring the effects of timber harvest on annual water yield. Journal of Hydrology. 176:79-95.

Troendle, Charles A. 1983. The Deadhorse Experiment: A Field Verification of the Subalpine Water Balance Model. U.S. Dept. of Agriculture - Forest Service, Research Paper RM425. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 7 p.

U.S. Dept. of Agriculture - Forest Service. 1973. Forest Hydrology Part II - Hydrologic Effects of Vegetation Manipulation. Northern Region. Missoula, MT. (page 39)