3.3 FIRE, AIR QUALITY, AND HERBICIDES

Affected Environment

Issues and Indicators – No issues relating to fire ecology were deemed significant (in NEPA terms) for this project. Rather, fire ecology relates to the purpose and need of the project (as identified in Chapter 1), particularly:

- Improve vegetation structure and pattern for cover types to move toward properly functioning condition at the landscape scale.
- Enhance ecosystem resiliency and to maintain desired fuel levels with fire operating within historical fire regimes.

Revised Forest Plan (RFP) Management Direction – The following information is from the Wasatch-Cache Revised Forest Plan (USDA Forest Service 2003):

Forestwide Goal 2 – Watershed Health

2a. Identify areas not in properly functioning condition. Improve plant species composition, ground cover and age class diversity in these areas. (RFP, p. 4-17)

Forestwide Goal 3 – Biodiversity and Viability

3d. Restore or maintain fire-adapted ecosystems (consistent with land uses, historic fire regimes, and other Revised Forest Plan direction) through wildland fire use, prescribed fire, timber harvest or mechanical treatments. See Forestwide Guideline G for desired landscape structure and patterns. (RFP, p. 4-19)

Forestwide Goal 4 – Fire and Fuels Management

4a. Increase the active use of fire to return fire dependent ecosystems to proper functioning and to reduce hazardous fuels. (RFP, p. 4-21)

4d. Reduce hazardous fuels (prescribed fire, silvicultural and mechanical treatments) with emphasis on interface communities (wildland/urban) and increase proactive participation of communities at risk. (RFP, p. 4-21)

Revised Forest Plan Objectives for Vegetation Management:

3.b. Stimulate aspen regeneration and reduce other encroaching woody species by treating (fire use and/or timber harvest) approximately 3,200 acres average annually for a 10-year total of 32,000 acres. (RFP, p. 4-30)

3.c. Restore natural disturbance patterns and increase age-class diversity in conifer cover types by treating (timber harvest and/or fire use) approximately 850 acres average annually for a 10-year total of 8,500 acres. (RFP, p. 4-30)

3.d. Increase grass and forb production and plant species and age-class diversity in sagebrush and pinyon/juniper by treating approximately 2,000 acres average annually for a 10-year total of 20,000 acres. (RFP, p. 4-30)

Bear Management Area - Vegetation Desired Conditions:

- Restoration and/or maintenance of a healthy and sustainable, broad scale, north south wildlife corridor within this management area will be a priority in all management decisions. Vegetation will form a mosaic of habitat types, diverse in species composition and structure approximating historic patterns. Fire use will play a role in reducing fuels, and restoring and/or maintaining the dynamic of aspen and mountain brush regeneration, and the balance of age classes in these types. The loss of aspen to conifer once apparent in the area will be curtailed and the proportion of young aspen will be within the historic range of variability. Vegetation treatments (including fire use and timber harvest) will be used to improve the ratio of aspen to conifer in the mix of vegetation across the landscape. Fire use, coordinated with livestock grazing management, will also be used to restore a balance in sagebrush age classes and cover ratios to forbs and grasses, resulting in improved forage and plant composition for both domestic and wild grazing animals.

- A balanced mix of age classes across the landscape, approximating historic patch size and juxtaposition, will provide habitat for a variety of forest, shrub and grassland wildlife species. A large, even-aged patch of young lodgepole pine in Slideout Canyon, characteristic of historical patterns of fire disturbance in this area, will provide habitat for interior species requiring this forest structure. In the spruce/fir forest, along the eastern portion of the management area, selective timber harvest will be used to approximate historic disturbances common in this type, such as small-scale fires. Vegetation treatments used to improve water flows in New and Old Canyons also will increase the ratio of aspen to conifer in this area. (RFP, p. 4-120 to 4-121)

The Revised Forest Plan (USDA Forest Service 2003) standards and guidelines that apply to this project are listed in Chapter 1, Tables 1.7.1 and 1.7.2.

Mitigation Measures/Design Elements – The mitigation measures/design elements applicable to this project are listed in Chapter 2, under "Design Elements and Mitigation Measures Common to Alternatives 1 and 3," Table 2.2.1b.

Area of Influence – The analysis area for landscape level fire ecology for this project is the Forest Service portion of the Big Creek Watershed (as identified in the Big Creek Watershed Assessment) (USDA Forest Service 2006d). The analysis area for stand-level fire, fuels, and vegetative effects is the proposed treatment units (and blocks of treatment units).

Existing Conditions

Fire History

Within the Big Creek analysis area, there are records of several fires in Forest GIS layers. The fires appear to have been mostly mixed severity, with relatively small patch sizes (within the burn perimeter). They burned mostly in sagebrush areas, along with a few small aspen stands, and very little conifer. Burned areas have generally come back well to early seral (or now mid-seral) vegetation. Although not in our fire records, there may have been a large, mostly stand-replacing fire in the later part of the 1800s. Several conifer and aspen/conifer areas in the north part of the analysis area (such as New Canyon) have extensive areas of mostly even-aged conifers (particularly lodgepole pine) that appeared to be between 100 to 150 years old; it is likely that these stands originated after a large fire (or perhaps extensive bug epidemic). Also evident were old charred logs and stumps from presumably the same fire event. Other forested (conifer) areas were generally dominated by larger, presumably older trees, with only rare fire scars or old burned stumps evident, indicating a fairly long fire-free interval. (Corbin field notes 2006)

A series of prescribed burns were implemented in 1990 and 1992 for range and wildlife benefits. The burned units were sagebrush areas with some adjacent aspen. They are now occupied by mid-seral (or relatively open) sagebrush stands.

See Table 3.3.2 for a list of fires recorded in the project area, and see specialist report for a map of recorded fires greater than 10 acres.

Table 3.3.2. Fire history.

Wildfires	Date	Reported size	Comments
Dry Canyon 2	August 1994	10,500 acres	Mostly east of the Forest. Only a small portion is within the analysis area (on the east edge, in sagebrush), and none within proposed treatment units.
Green Fork	October 1999	93 acres	All within the analysis area. Some overlaps with proposed mosaic fire and clearcut units.
7 small fires	1964 - 2005	<10 acres	
Prescribed Fires	**Date**	**Reported size**	**Comments**
Big Crawford Range	1990	100 acres	
Pole Canyon Wildlife	1990	360 acres	
Big Crawford Range	1992	Seven units: 9+20+29+158+43 +21+23 = 303 acres	Some on private lands. And some (NF) is within proposed burn/herbicide units for this treatment.

Fire Regime Condition Class

A Fire Regime Condition Class (FRCC) assessment was conducted for the Big Creek Watershed Assessment in 2005. See that document for specifics and more information. For that assessment, the FRCC was calculated for the Forest Service portions of the northern subwatersheds (Lower Big Creek, Little Creek, and Otter Creek collectively) and southern subwatershed (Upper Big Creek). In each watershed group, the sagebrush and aspen/conifer strata were assessed separately. See Table 3.3.3 for the strata departure summary. The natural fire regime of the area is Fire Regime Group III, or infrequent, mixed severity. The northern subwatersheds were determined to be in Fire Regime Condition Class 2, moderately departed from reference conditions (64% departure), while the southern subwatershed was FRCC 3, or highly departed (74% departure). In both aspen/conifer and sagebrush stands in both subwatersheds, the departure was due to the overabundance of old, dense vegetation compared to reference conditions. The few recent fires and the previous timber harvest in the Big Creek area have not been extensive enough to create the acreage of early and mid-seral vegetation comparable to reference conditions.

The FRCC was recalculated for this project analysis in December 2006, based on additional fieldwork to verify stand seral stage conditions. For this analysis, the entire project analysis area was used as the landscape (rather than separating two watersheds groups), which is probably a more appropriate scale for a FRCC assessment in these vegetation types. The same two strata were used (sagebrush and aspen/conifer), and the same reference conditions. See Table 3.3.4 for the strata departure summary for this secondary analysis. The landscape departure (weighted average of the two strata) was calculated to be 50%, or in FRCC 2, moderately departed from reference conditions. Again, this is due to the overabundance of mature, dense vegetation and the lack of early seral.

The balanced range of landscape structure in the properly functioning condition (PFC) concept (as per the Revised Forest Plan) is similar to the vegetation/fuels class composition portion of the FRCC analysis, although the actual numbers and seral/structure stages are a little different. Both are based on the assumption that under a natural disturbance regime (primarily fire, but also insects, disease, wind-throw, avalanches, etc.) there will be stands in a range of seral stages across the landscape. Landscapes are considered to be properly functioning, or with low departure from the natural fire regime, when the landscapes include proportions of seral stages within the natural range of variability. FRCC differs from PFC in that it also has a fire frequency and severity component in addition to the seral stage proportions, so it is possible for a landscape to have seral stages similar to reference conditions, but due to alterations of the fire return interval and/or fuel conditions influencing fire severity could be departed from reference conditions. However, in the Big Creek area, the FRCC departure is based mainly on the seral stage proportions, so it is similar to the PFC departure in this case.

Table 3.3.3. Big Creek Watershed Assessment FRCC seral stage analysis, 2005.

Veg-Fuels Class	Reference Condition % of landscape	Existing Condition – N subwatersheds	Existing Condition – S subwatershed	Strata Veg-Fuels Departure and FRCC rating
***Interior West Lower Subalpine Forest Stratum*[1]**				
A – early seral, post-replacement	20	2	0	N subwatersheds - 61% veg/fuels departure; FRCC 2. S subwatershed – 70% veg/fuels departure; FRCC 3
B – mid-seral, closed canopy	35	4	0	
C – mid-seral, open canopy	15	3	0	
D – late seral, open canopy	10	21	22	
E – late seral, closed canopy	20	70	78	
Mountain Big Sagebrush Stratum				
A – early seral, post-replacement	20	20	10	N subwatersheds – 70% veg/fuels departure; FRCC 3 S subwatershed – 80% veg/fuels departure; FRCC 3
B – mid-seral, closed canopy	20	0	0	
C – mid-seral, open canopy	35	0	0	
D – late seral, open canopy	15	0	0	
E – late seral, closed canopy	10	80	90	

Table 3.3.4. Big Creek EIS FRCC seral stage Analysis, 2006.

Veg-Fuels Class	Reference Condition % of landscape	Existing Condition	Strata Veg-Fuels Departure and FRCC rating
***Interior West Lower Subalpine Forest Stratum*[2]**			
A – early seral, post-replacement	20	4	46% veg/fuels departure; FRCC 2.
B – mid-seral, closed canopy	35	17	
C – mid-seral, open canopy	15	3	
D – late seral, open canopy	10	25	
E – late seral, closed canopy	20	51	
Mountain Big Sagebrush Stratum			
A – early seral, post-replacement	20	0	55% veg/fuels departure; FRCC 2
B – mid-seral, closed canopy	20	26	
C – mid-seral, open canopy	35	0	
D – late seral, open canopy	15	20	
E – late seral, closed canopy	10	54	

[1] This includes all conifer, aspen, aspen/conifer, and conifer/aspen stands in the Big Creek analysis area.
[2] This includes all conifer, aspen, aspen/conifer, and conifer/aspen stands in the Big Creek analysis area.

Specific Big Creek Fire Regimes and Alterations

The landscape fire regimes in the Big Creek analysis area would naturally be mixed severity (about 56% replacement fires) and infrequent (75 to 78 year return) fire frequency, based on coarse-scale default reference conditions for cool (mountain) sagebrush and interior west lower subalpine forest potential natural vegetation groups (see www.frcc.gov). The sagebrush areas would have a more frequent fire return interval, and the aspen/conifer areas a longer interval, but the weighted average of the landscape would be about 76 years.

***Sagebrush**:* Sagebrush tends to occur as small to extensive patches between the aspen and conifers, and with a higher proportion on the east side of the analysis area. Overall, it makes up about 40% of the acreage within the Big Creek analysis area. At least three species of sagebrush are present in the Big Creek area, each with its own plant community type: mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), low sagebrush (*Artemisia arbuscula*), and spiked sagebrush (*Artemisia spiciformis*).

Four general areas of potential sagebrush treatment have been identified (N to S):

1. One 139-acre unit SW of Monument Peak in the Green Fork block.
2. One 314-acre unit near Bowery Fork in the Right Fork block.
3. One 651-acre unit around Pole Hollow (the Pole Sage block).
4. The Crawford Bottom area, which currently has 7 different units totaling 1,409 acres, between The Valley and (almost to) Lamb Canyon. Some of these units are separated by private land parcels, or by conifer/aspen units.

The northern three units are generally a mosaic of mountain big sagebrush and low sagebrush. The low sagebrush tends to occur on the exposed ridge-tops with shallower soil, while the mountain big sagebrush tends to occur on the side slopes, and is often adjacent to aspen (and sometimes conifer) stands.

Figure 3.3.1. Typical low sagebrush and mountain big sagebrush mosaic, with aspen and conifer stringers. Near Bowery Fork.

Low sagebrush stands, besides being shorter in stature (well below the knee-high), usually have lower canopy cover and biomass, and thus a much lower fuel loading. Low sagebrush stands seldom burn, as fire generally does not carry through them.

Mountain big sagebrush areas have a higher fuel load with more continuous fuels, and can become overly dense and decadent in the absence of fire. Natural fire return intervals have been estimated at about 20 (Havlina 2005) to 49 (Major et al. 2005) years, and the fire regime is generally described as mixed across a landscape (although an individual sagebrush plant or patch is generally totally burned or unburned, rather than underburned). Mountain big sagebrush will not resprout, but will reseed into a suitable area if an adequate seed source is nearby (within about 40 feet).

In the Crawford Bottom area, the sagebrush vegetation consists of more continuous big sagebrush stands, with fewer low sagebrush stands than in the northern part of the project area. This is particularly true of The Valley area, as well as the Big Crawford Creek area to the south. In the general Crawford Bottom area, there have been recent prescribed burns, totaling about 380 acres. These previous prescribed burn units overlap with the larger, currently proposed treatment (mostly the burn/herbicide units, but also some with the proposed harvest/burn units). The previously burned areas have generally good mid-seral sagebrush stands; good grass and forb cover, and relatively low shrub cover (with currently more green rabbitbrush (*Chrysothamnus viscidiflorus*) than sagebrush, but with sagebrush becoming established).

Figure 3.3.2. Mid-seral mountain big sagebrush in The Valley, in previous Big Crawford Range Burn

In some of the proposed mosaic burn units in Crawford Top, there is spiked sagebrush (*Artemisia spiciformis*) in addition to mountain big sagebrush. It is generally in moister sites; in this case it was associated with aspen and/or snowberry stands. Unlike mountain big sagebrush, spiked sagebrush will resprout from the roots after fire, so it is expected to recover more quickly after fire than mountain big sagebrush. However, there is no indication that it increases after disturbance; generally its community composition stays about the same (David Tart, pers. com.).

In the Big Creek area, low sagebrush stands likely have less perennial grass cover than under reference conditions due to livestock grazing, but these shallow-soiled sites have always had low fuel loadings, and the fire regime within the low sagebrush microsite has not likely been greatly altered. Mountain big sagebrush areas have a fair amount of mid-seral from the 1990/1992 prescribed burns and a little from the 1994 and 1999 wildfires, but on the landscape scale there is still an overabundance of old, dense sagebrush, and a lack of early seral from recent disturbances.

In all three types of sagebrush in the analysis area, a good understory of native perennial grasses and forbs is present. Very little cheatgrass was seen, and even within the Dry Creek 2 burn area on the east edge of the analysis area, which was a wildfire at lower elevation than the proposed units, there is good native perennial cover. This indicates that a good native perennial response in the sagebrush treatment areas is expected.

Figure 3.3.3. Typical late seral, dense mountain big sagebrush, in The Valley area.

Aspen/Conifer*:* Areas mapped as aspen/conifer are proposed for a mosaic fire treatment. These areas have too little conifer for commercial timber harvest, and not heavy enough fuel loading to need fuels treatment before burning, but would have enough conifers to carry at least a patchy burn through the stands. The objective is to set back conifer encroachment into the aspen stands, and to create early seral stands (or at least patches) within the aspen and conifer landscape.

Some areas mapped as aspen/conifer are actually fairly heavy to conifer, and may be logged before burning, in order to reduce the heavy fuel component and reduce the chance of killing the aspen clone roots with too hot of a fire. Other aspen/conifer areas have fewer conifers. Some areas mapped as aspen/conifer are actually fairly heavy to conifer, and will be logged before burning, in order to reduce the heavy fuel component and reduce the chance of killing the aspen clone roots with too hot of a fire. Other aspen/conifer areas have fewer conifers. In some of these, at least some conifers will be felled before burning to create surface fuels to help carry the fire.

Implementing the mosaic burn in the aspen/conifer stands will be heavily influenced by adjacent stands. Many of these stands (heavy to the aspen component) will be difficult to get to burn (particularly under likely prescribed burn weather conditions). It is expected that fire activity will occur primarily around the edges adjacent to mountain big sagebrush stands (which are generally more flammable), and in conifer pockets within the aspen/conifer. This is likely to result in a very patchy mosaic burn, with limited aspen top-kill. This is certainly acceptable/desired in this patchy mosaic vegetative landscape. Within the aspen/conifer mosaic burn units 10 to 30% "black" top-kill is expected, although if burned in a particularly dry year it may be up to perhaps 70% black (based on recent Monte and Boulder Mtn. Prescribed Burn observations). Wherever aspen top-kill (and conifer fire mortality) occurs, abundant aspen resprouting is expected, creating the early seral aspen that is a primary desired condition for this project.

Figure 3.3.4. Aspen/conifer stand at the edge of mountain big sagebrush stand. Bowery Fork Headwaters area.

Conifer/Aspen*:* Stands mapped as conifer/aspen may be commercially harvested followed by mosaic burn. These areas have enough timber to make commercial harvest economically viable, and enough heavy conifer fuels (both dead and standing live) that it may burn so hot as to kill the aspen roots without removing some conifers first. But removing the commercial timber and scattering logging slash will provide enough smaller fuels to help carry a fire, while not creating excessive heavy fuels that would result in an undesirable high severity burn, and the fire would kill many of the non-commercial conifers in the stand.

In some of these stands (e.g., New Canyon), the conifer component appears to be very heavy and aspen patches within the stands often limited. As a result, burning these stands, even after conifer harvest, may be tricky, and may result in extensive high-severity burn areas devoid of both aspen and conifer regeneration. Thus, these stands may be treated with patch cuts in and around the aspen patches within the stands (group selection) alone, rather than to prescribe burn. Other conifer/aspen stands (particularly those adjacent to good aspen/conifer or sagebrush stands) may be appropriate to attempt a mosaic prescribed burn, to put some smaller early seral holes within the landscape.

Specific burn unit boundaries within the designated proposed burn areas will be identified during burn plan development, considering the logistics of holding and lighting lines.

In prescribed burning in this project area, there will be a fine balance between identifying a burn prescription that will create enough heat to get a fire to "go" and produce the aspen top-kill desired, without burning too hot and having control and undesirable fire severity issues (especially with so many adjacent conifer stands). Based on the recent prescribed burns done in the aspen/conifer types on the Wasatch-Cache NF, if it's too moist (like Monte 2005) there will be little aspen top-kill; Boulder Mtn. II (2003) produced about the right conditions for top-kill (but was implemented in a severe drought year and the same fall that Cascade II escaped). Rock Creek (1999) apparently produced good top-kill, but also escaped and burned some timber stands that were not intended for burning. (Sagebrush burning is generally easier, as it is more flammable under a range of moisture conditions.) So laying out burn units and burn weather parameters will need to be carefully considered.

Conifer/aspen stands are among the highest priority for treatment from a fire ecology standpoint, since these stands are most in danger of losing the aspen component (from replacement by conifer), and with relatively heavy fuel loading may burn with undesirable severity (and kill aspen below-ground stems) if a wildfire occurred under extremely dry conditions.

Figure 3.3.5. Conifer/aspen stand with low sagebrush in foreground. Near Bowery Fork.

Conifer: Conifer stands in the Big Creek area, like aspen/conifer and conifer/aspen stands, are dominated by mature trees across the landscape. A few early and mid-seral stands have been created by timber harvest activities, particularly in the northern subwatersheds, but the proportions are still heavily weighted toward mature stands. Conifer stands in the Big Creek area vary from lodgepole pine, spruce/fir (Engelmann spruce and subalpine fir), mixed conifer (mostly of those three conifer species), to Douglas-fir (mostly on drier limestone outcrops; sometimes with white fir). Because of the difficulty of using prescribed burning to safely create a desired mosaic of early (and late) seral conditions in conifer stands, logging, rather than fire, is the proposed tool for creating seral stage diversity in conifer areas. (Logging also achieves one additional aspect of the stated purpose and need: to provide commercial timber that contributes to a sustainable level of goods and services.)

Fuels Plots Data Summary

The fuels monitoring crew (Garner et al.) collected fuels and vegetation data for the Big Creek project in June – September 2006. Fifty-eight plots were established across the project area in the forested units. See specialist report for plot locations. The plots are 0.1 acre, circular, and permanently marked for post-treatment visitation. The plots were not randomly placed, but were based on access points and representative areas within the units. Plot data are stored in a FIREMON Access database at the Ogden Ranger District and are in the project record. Monitoring protocols may be found on the web at: www.fire.org/firemon.

Plot data include the following:

- Plot description – location, slope, aspect, soils, geology, general canopy, shrub and herb layers, soil cover estimates, photographs, etc.
- Tree data – tree species, DBH, height, general health, crown ratio, crown base height, etc.
- Fuel loading – dead and down fuels in 1-hour, 10-hour, 100-hour, and 1000-hour classes, duff, litter, and live and dead standing woody and herbaceous fuels, using Brown's Transects.

These data are being monitored in order to evaluate whether specific objectives are met. Tree data provide information on seral stages, size classes, species (conifer encroachment), and reproduction (such as aspen sprouts). Fuel loading provides information for determining whether fuel levels contribute toward fire operating within historic fire regimes.

Following is a summary of pre-treatment data from all 58 plots. Next will be a breakdown of plot data from each of the major treatment types within forested stands.

Table 3.3.5. Tree data.

Attribute	Average	Range (of plot averages)
Mature (>4.5"dbh), live trees per acre	196	40-480
subalpine fir	84	
aspen	74	
lodgepole	51	
Engelmann spruce	20	
Douglas-fir	11	
white fir	<1	
Mature, live tree height (ft)	46.5	22.8-67.4
Mature, live tree diameter (dbh in inches)	11.0	6.8-26.3
Saplings (>4.5' tall, < 4.5" dbh) TPA	297	0-1,220
aspen	159	
subalpine fir	132	
Seedlings and sprouts (<4.5' tall) TPA	1,145	0-6,970
subalpine fir	636	
aspen	374	
Snags (>4.5" dbh) TPA	42	0-200
Snag height (ft)	37.3	
Snag diameter (dbh inches)	9.9	

Table 3.3.6. Fuel loading: dead and downed (tons per acre).

Size class	Average	Range
1-hr	0.51	0.9 – 2.33
10-hr	3.10	0.61 – 28.46
100-hr	6.20	0 – 38.72
1000-hr	24.50	0 – 95.94
Duff	5.90	0.1 – 25.60
Litter	4.60	0.4 – 14.00
Total:	**44.81 tons/ac**	5.5 – 146.20

Table 3.3.7. Standing fuels (less than 6' high; tons per acre).

Class	Average	Range
Live woody	2.9	0 – 9.79
Dead woody	0.5	0 – 4.89
Live herbaceous	0.2	0 – 1.94
Dead herbaceous	<0.1	0 – 0.31

Data Summary from plots in the conifer – harvest only prescription areas[3]: (15 plots)

Table 3.3.8. Tree data.

Attribute	Average	Range (of plot averages)
Mature (>4.5"dbh), live trees per acre	229	50-410
lodgepole	115	
subalpine fir	93	
aspen	29	
Engelmann spruce	27	
Douglas-fir	3	
Mature, live tree height (ft)	49.8	40.2 - 57.9
Mature, live tree diameter (dbh in inches)	11.0	6.8-26.3
Saplings (>4.5' tall, < 4.5" dbh) TPA	199	0 - 520

[3] This includes several different silvicultural prescriptions: clearcut, group selections, overstory removal, etc.

Attribute	Average	Range (of plot averages)
subalpine fir	114	
aspen	77	
lodgepole	23	
Engelmann spruce	3	
Seedlings and sprouts (<4.5' tall) TPA	1,307	
subalpine fir	800	
aspen	233	
lodgepole	233	
Engelmann spruce	40	
Snags (>4.5" dbh) TPA	37	10 - 90
Snag height (ft)	37.7	
Snag diameter (dbh inches)	10.3	

Table 3.3.9. Fuel loading: dead and downed (tons per acre)

Size class	Average
1-hr	0.40
10-hr	2.6
100-hr	4.3
1000-hr	22.2
Duff	5.3
Litter	5.0
Total:	**38.8 tons/ac**

Table 3.3.10. Standing fuels (less than 6' high; tons per acre).

Class	Average
Live shrubs	1.7
Dead shrubs	0.2
Live herbaceous	0.1
Dead herbaceous	<0.1

Data Summary from plots in the conifer/aspen – conifer removal followed by mosaic fire prescription areas: (9 plots)

Table 3.3.11. Tree data.

Attribute	Average	Range (of plot averages)
Mature (>4.5"dbh), live trees per acre	217	90-370
aspen	149	
subalpine fir	131	
lodgepole	10	
Engelmann spruce	8	
Douglas-fir	3	
white fir	1	
Mature, live tree height (ft)	42.4	22.8 – 55.5
Mature, live tree diameter (dbh in inches)	10.2	6.8-16.4
Saplings (>4.5' tall, < 4.5" dbh) TPA	277	
aspen	161	
subalpine fir	153	
Seedlings and sprouts (<4.5' tall) TPA	1,322	
subalpine fir	867	
aspen	444	
Engelmann spruce	11	
Snags (>4.5" dbh) TPA	87	10 - 200
Snag height (ft)	29.9	
Snag diameter (dbh inches)	8.2	

Table 3.3.12. Fuel loading: dead and downed (tons per acre).

Size class	Average
1-hr	0.59
10-hr	2.7
100-hr	10.8
1000-hr	33.1
Duff	6.2
Litter	4.2
Total:	**57.59 tons/ac**

Table 3.3.13. Standing fuels (less than 6' high; tons per acre)

Class	Average
Live shrubs	2.8
Dead shrubs	0.7
Live herbaceous	0.4
Dead herbaceous	<0.1

Data Summary from plots in the aspen and/or conifer stringers within the sagebrush stands – mosaic fire, mechanical treatment, or herbicide prescription areas[4]: (7 plots)

Table 3.3.14. Tree data.

Attribute	Average	Range (of plot averages)
Mature (>4.5"dbh), live trees per acre	204	70-410
subalpine fir	96	
Douglas-fir	64	
aspen	57	
lodgepole	37	
Engelmann spruce	9	
Mature, live tree height (ft)	45.6	39.5 – 55.9
Mature, live tree diameter (dbh in inches)	11.1	9.1 – 15.6
Saplings (>4.5' tall, < 4.5" dbh) TPA	147	
subalpine fir	127	
Douglas-fir	27	
lodgepole	6	
aspen	4	
Seedlings and sprouts (<4.5' tall) TPA	557	
subalpine fir	357	
aspen	143	
Engelmann spruce	29	
Douglas-fir	29	
Snags (>4.5" dbh) TPA	59	0 - 160
Snag height (ft)	36.7	
Snag diameter (dbh inches)	8.7	

Table 3.3.15. Fuel loading: dead and downed (tons per acre).

Size class	Average
1-hr	0.67
10-hr	2.9
100-hr	7.5
1000-hr	17.5
Duff	5.9
Litter	6.1
Total:	**40.57 tons/ac**

[4] By chance, no plots were located in the aspen/conifer mosaic fire prescription areas.

Table 3.3.16. Standing fuels (less than 6' high; tons per acre).

Class	Average
Live shrub	4.8
Dead shrub	0.8
Live herbaceous	0.1
Dead herbaceous	<0.1

Data Summary from plots within the project area but outside of treatment units[5]: (27 plots)

Table 3.3.17. Tree data.

Attribute	Average	Range (of plot averages)
Mature (>4.5"dbh), live trees per acre	173	40 - 480
aspen	79	
subalpine fir	60	
lodgepole	32	
Engelmann spruce	23	
Douglas-fir	3	
white fir	1	
Mature, live tree height (ft)	46.0	33.3 – 67.4
Mature, live tree diameter (dbh in inches)	11.1	7.2 – 16.8
Saplings (>4.5' tall, < 4.5" dbh) TPA	396	
aspen	243	
subalpine fir	136	
lodgepole	19	
Engelmann spruce	3	
white fir	1	
Seedlings and sprouts (<4.5' tall) TPA	1,148	
subalpine fir	541	
aspen	489	
lodgepole	119	
Snags (>4.5" dbh) TPA	24	0 - 70
Snag height (ft)	40.2	
Snag diameter (dbh inches)	10.5	

Table 3.3.18. Fuel loading: dead and downed (tons per acre).

Size class	Average
1-hr	0.51
10-hr	3.5
100-hr	5.3
1000-hr	24.7
Duff	6.1
Litter	4.1
Total:	**44.21 tons/ac**

Table 3.3.19. Standing fuels (less than 6' high; tons per acre).

Class	Average
Live shrubs	3.1
Dead shrubs	0.5
Live herbaceous	0.1
Dead herbaceous	<0.1

[5] This also includes two plots without location coordinates.

Summary – Notice that, overall, the units have a moderately high number of mature trees, and the dominant species vary across the project area. The areas proposed for harvest only/conifer have the highest number of mature trees per acre, while the plots in the non-treatment areas have the lowest number. The predominance of mature trees is consistent with the FRCC and PFC analyses highlighting the overabundance of mature stands. There are also low to moderate numbers of seedlings, sprouts, and saplings within these mature stands, but generally a much higher proportion of these are conifers than aspen, unlike desired conditions. The average number of snags is relatively high, although distribution is patchy across the landscape. Snag diameters are generally slightly smaller than the live mature tree dbh averages. Fuel loading is generally moderate, and the largest contributor is in the 1000-hour fuels category (not unexpectedly). Small fuels (including standing shrubs and herbaceous material) loading is fairly light. The units proposed for conifer removal followed by fire (conifer/aspen stands) had the highest dead and down fuel loading, while the harvest only/conifer and forested pockets within the sagebrush treatment units had the lowest.

Environmental Consequences

Effects Analysis Method and Assumptions

This effects analysis concentrates on the project's changes in seral stage proportions, which affect the FRCC and PFC, at the landscape scale. The method for seral stage analysis is to assume that the harvest, mechanical treatment, and prescribed fire will cause changes in the vegetation-fuels class on a percentage of the treated areas. In this project, treatments generally will be converting late seral, closed canopy stands to early seral stands. Proposed treatments are not expected to generate appreciable amounts of open stands, or mid-seral stands. Estimated post-treatment seral stage proportions will be compared to existing to evaluate a change in the fire regime departure from reference conditions. Since FRCC and PFC use slightly different descriptions for seral stage classes, a crosswalk between the two classifications was developed; see Table 3.3.20. The FRCC veg/fuels classes also have a canopy cover component; this was incorporated using stand information (where available) or aerial photography estimates.

Table 3.3.20. PFC age classes to FRCC veg/fuels classes.

PFC Age Class(s)	FRCC Veg/Fuels Class(s)
Grass/Forb, Seedling/Sapling, & Young	A – Early Seral Post-Replacement
Mid	B – Mid seral closed, & C – Mid seral open
Mature & Old	D – Late seral open, & E – Late seral closed

This project will also likely change fuel loading, particularly in the largest fuel class in the mechanically harvested units. Fuel loading is estimated using current data from representative stand data (fuels crew plots for several treatment types) using the Fire and Fuels Extension of the Forest Vegetation Simulator model (FVS-FFE). Proposed treatments were modeled for select treatment types to generate post-treatment fuel loading. This will provide one measure for comparison of potential fire behavior before and after treatment.

The following assumptions were used for the effects analysis for the FRCC seral stage analyses:

Table 3.3.21. Approximate acres treated and early seral acres created.

Treatment	Alt 1 Treatment Acres	Alt 3 Treatment Acres	% Early Seral created on treated acres	Alt 1 Early Seral Acres Created	Alt 3 Early Seral Acres Created	Stratum
clearcut	206	137	95	196	130	forest
conifer removal/ patches	27	27	95	26	26	forest
conifer removal plus fire	556	343	95	527	326	forest

Treatment	Alt 1 Treatment Acres	Alt 3 Treatment Acres	% Early Seral created on treated acres	Alt 1 Early Seral Acres Created	Alt 3 Early Seral Acres Created	Stratum
group selection & thin	256	183	20	51	37	forest
groups and patches	150	0	20	30	0	forest
irregular shelterwood	71	211	0	0	0	forest
irregular shelterwood with groups/ patches	140	0	20	28	0	forest
overstory removal	130	130	95	124	124	forest
commercial thin w groups	38	0	20	8	0	forest
shelterwood prep	32	9	0	0	0	forest
prescribed fire mosaic	681	681	40	272	272	½ forest, ½ sage
prescribed fire/herbicide/mechanical	2,513	2,469	40	1,005	988	sagebrush
Total Treatment Acres:	4,800	4,190				
			Total Early Seral Created:	2,267	1,903	

Using the assumptions in Table 3.3.21, Alternative 1 will create about 1,141 acres of early seral sagebrush and about 1,126 acres of early seral forested vegetation (the Interior West Lower Subalpine Forest FRCC stratum). Alternative 3 will create about 1,124 acres of early seral sagebrush and about 779 acres of early seral forests. For the effects analysis, it was assumed that treatment acres came mostly from the late seral closed canopy veg-fuels class (80%) or late seral open canopy veg-fuels class (20%), so were converted from E (late seral closed) or D (late seral open) to A (early seral post-replacement). (This is generally although not exclusively the case.)

a. Effects Common to Alternatives 1 and 3

Both action alternatives will increase the amount of early seral in most vegetation types, across the landscape. The two alternatives differ in the number of acres treated, so they will differ in the amount of early seral created, and thus will differ in how much they reduce the landscape departure from reference conditions (as calculated in the FRCC analysis).

Both action alternatives will also change stand structure and fuel loading, and thus fire behavior at the stand level for treated stands. Alternatives will differ in the number of acres treated, and thus the volume of fuel loading reduced.

1. Direct Effects

Both action alternatives will have the direct effect of converting mostly late seral, closed canopy stands to early seral by removing or killing the overstory layer. Using the assumptions above, Alternatives 1 and 3 will result in the following acreage changes, and thus seral stage proportion changes. Alternative 2 (no action) is the same as the pretreatment acres.

Table 3.3.22. Approximate treatment unit acres only.

Strata	Pretreatment Acres per veg-fuels class (Alt. 2)	Post-treatment Acres per veg-fuels class (Alt. 1)	Pretreatment Acres per veg-fuels class (Alt. 3)	Post-treatment Acres per veg-fuels class (Alt. 3)

Strata	Pretreatment Acres per veg-fuels class (Alt. 2)	Post-treatment Acres per veg-fuels class (Alt. 1)	Pretreatment Acres per veg-fuels class (Alt. 3)	Post-treatment Acres per veg-fuels class (Alt. 3)
Aspen and Conifer	A 43	A 1169	A 42	A 821
	B 316	B 316	B 252	B 252
	C 14	C 14	C 12	C 12
	D 379	D 154	D 344	D 188
	E 1,084	E 183	E 756	E 133
	subtotal: 1,836	subtotal: 1,836	subtotal: 1,406	subtotal: 1,406
Sagebrush	A 0	A 1,138	A 0	A 1,121
	B 448	B 448	B 375	B 375
	C 0	C 0	C 0	C 0
	D 445	D 217	D 441	D 217
	E 2,072	E 1,162	E 1,970	E 1,073
	subtotal: 2,965	subtotal: 2,965	subtotal: 2,786	subtotal: 2,786

Table 3.3.23. Entire analysis area.

Strata	Pretreatment Acres per veg-fuels class (Alt. 2)	Post-treatment Acres per veg-fuels class (Alt. 1)	Post-treatment Acres per veg-fuels class (Alt. 3)	FRCC Reference Condition Acres per veg-fuels class
Aspen and Conifer	A 337	A 1,463	A 1,116	A 1,647
	B 1,279	B 1,279	B 1,279	B 2,883
Total acres: 8,236	C 267	C 267	C 267	C 1,235
	D 2,136	D 1,911	D 1,980	D 824
	E 4,217	E 3,316	E 3,594	E 1,647
Sagebrush	A 0	A 1,138	A 1,121	A 1,601
	B 2,059	B 2,059	B 2,059	B 1,601
Total acres: 8,005	C 0	C 0	C 0	C 2,802
	D 1,585	D 1,357	D 1,361	D 1,201
	E 4,361	E 3,451	E 3,464	E 801

For Alternative 1, the post-treatment fire regime departure (based on veg-fuels class, which is comparable to seral stages) for the Big Creek analysis area is 37%, which puts the landscape in FRCC 2, or moderately departed from reference conditions. This departure is a 13% reduction from the pre-treatment conditions. For Alternative 3, the post-treatment fire regime departure (veg-fuels class) is 39%, which also puts the landscape in FRCC 2. This departure is an 11% reduction from the pre-treatment conditions. Notice that although the Fire Regime Condition Class did not change (from FRCC 2) between pre- and post-treatments, and between treatment alternatives, the amount of departure did change. The post-treatment departure is almost FRCC 1 (with departures less than or equal to 33%).

Changes in fuel loading were modeled using the Fire and Fuels Extension of the Forest Vegetation Simulator model (FVS-FFE). Table 3.3.24 shows the results of that modeling exercise.

Table 3.3.24. FVS-FFE modeling of changes in fuel loading.

Veg Type	Treatment	Year	Surface Fuels[6]	Total Biomass[7]
Conifer/Aspen	pre-treatment	2006	46.2 tons/acre	92 tons/acre
	logged (conifer removal) in 2016	2016	61.3 tons/acre	78 tons/acre
	prescribed fire in 2022	2026	20.1 tons/acre	25 tons/acre

[6] Surface fuels include litter, duff, dead and down fuels and live surface fuels (herb and shrub).
[7] Total Biomass includes litter, duff, dead and down fuels, live surface fuels, and standing dead and live wood (<6' tall).

Veg Type	Treatment	Year	Surface Fuels[6]	Total Biomass[7]
Lodgepole Pine	pre-treatment	2006	14.7 tons/acre	81 tons/acre
	logged (clearcut) in 2016	2016	25.8 tons/acre	30 tons/acre
	(10-years post-log)	2026	17.0 tons/acre	24 tons/acre
Lodgepole Pine	pre-treatment	2006	14.7 tons/acre	81 tons/acre
	logged (thin from below) in 2016	2016	20.4 tons/acre	56 tons/acre
	(10-yrs post-log)	2026	16.5 tons/acre	56 tons/acre
Mixed Conifer	pre-treatment	2006	23.5 tons/acre	73 tons/acre
	logged (thin from below) in 2016	2016	27.7 tons/acre	63 tons/acre
	(10-yrs post-log)	2026	23.3 tons/acre	60 tons/acre

These results show a reduction in total biomass for each of the treatments. The reduction is greatest in the aspen/conifer that is logged and then burned; clearcut lodgepole stands show the next greatest reduction in total biomass, while the lodgepole and mixed conifer stands that are thinned from below show less reduction in total biomass. Surface fuels show a more complex pattern, with generally an increase after logging, but a great reduction after burning, or a lesser reduction (from post-logged but not necessarily pre-treatment values) over the decade following logging. In this mixed-severity fire regime, fires are usually driven as much by standing biomass as dead and downed wood. The expected change in surface fuels and total biomass as a result of the various treatments is likely to increase the patchiness of future wildfires, resulting in an increased mosaic of burn severities and likely a smaller wildfire size.

2. Indirect Effects

Besides direct effects on seral stages and fuel loading, the treatments will have indirect effects on fire behavior and fire effects, should a wildfire occur in this area in the future. As a result of treatments, both the total wildfire size and patch sizes of burned areas within the wildfire perimeter are expected to be smaller than if this treatment had not occurred. Likewise, the pattern of burn in a future wildfire is likely to be different in treated than untreated areas, with fire not expected to spread much (if at all) within treated areas. An indirect effect of this is that a future wildfire is likely to be much more controllable under treated conditions compared to an untreated landscape, and thus it will be easier to keep wildfire away from private lands, goshawk nest areas, and other areas where burning is not a desirable resource objective.

Another indirect effect of treatment is that future wildfires in treated areas are likely to be much less severe than in untreated areas. Therefore, we would expect less undesirable soil and watershed effects from severe burning (under typical wildfire conditions) with the treatment alternatives compared with the no action alternative.

All of these desirable indirect effects are likely to be somewhat greater for Alternative 1 than for Alternative 3, due to the difference in number of acres treated.

b. Alternative 2 – No Action

If no action is taken, there would be a continued, long-term effect, since the current conditions of out-of-balance seral stages (per FRCC and PFC) would continue without improvement.

c. Cumulative Effects

No cumulative effects are expected for fire regime departure and fuel loading as a result of this project when combined with past actions, present actions, and reasonably foreseeable future actions. Past actions of wildfires, prescribed burns, and timber projects have been incorporated into the assessment of current condition. Generally these projects had results similar to historic disturbances in severity, but been somewhat less abundant in frequency (as evidenced by the overabundance of mature vegetation in the FRCC and PFC analyses). There would be a cumulative effect of the No Action Alternative, since the current conditions of out-of-balance seral stages (per FRCC and PFC) would continue without improvement. Historic and current livestock grazing has probably affected the fuels somewhat (such as contributing to a higher than natural sagebrush canopy and lower grass and forb cover in some areas), which may be part of the reason for few wildfires in the last 100 years. However, current utilization does not appear particularly high in this area, and overall effects on the fire regime are probably not great (either currently or historically). Other actions in the area (such as localized noxious weed treatment, telecommunications cable removal, riparian improvement projects, the existing road and trail system, and dispersed recreation) all have very localized impacts, and will not significantly affect the fire regime or behavior.

AIR QUALITY

Affected Environment

Currently, air quality in the Big Creek project vicinity is very good. Rich County is in attainment of national ambient air quality standards (Utah 2006d). Due to the lack of large metropolitan areas or industrial centers nearby, relatively few pollutants are generated in the vicinity or upwind, and no sensitive receptors are immediately downwind. The small ranching communities of Randolph and Woodruff are eight or more miles downwind to the east of the project area. There are no Class I designated airsheds (highest protection) in northern Utah, per the 1977 Clean Air Act Amendment (USDA Forest Service 2003, FEIS, p. 3-58).

Environmental Consequences

a. Effects Common to Alternatives 1 and 3

Activities proposed in the Big Creek project will have short-term, minor effects on air quality. Prescribed burns will generate smoke, but smoke dispersal is considered in the fire planning process, and burns are implemented only on days with an adequate clearing index and when granted approval from the Utah Smoke Coordinator, to prevent cumulative air quality impacts.[8] Prescribed burns (and other vegetation treatments) are cumulatively likely to reduce the emissions from uncontrolled wildfires, since future wildfires are expected to be smaller and less intense (thus producing less smoke) than without treatments. Mechanical activities such as timber harvest and sagebrush treatment will generate some very localized, short-term dust, which is not expected to extend beyond the treatment unit boundary. Standard operating practices such as road watering during harvest activities will mitigate much of this effect. There will be no effects on Class I airsheds, and at most minor, temporary effects on the closest communities (Randolph and Woodruff).

b. Cumulative Effects

Prescribed burns will generate smoke, but smoke dispersal is considered in the fire planning process, and burns are implemented only on days with an adequate clearing index and when granted approval from the Utah Smoke Coordinator, to prevent cumulative air quality impacts. Therefore, there will be no cumulative effects to air quality.

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[8] See http://www.wrh.noaa.gov/slc/projects/ifp/html/webSMF_new.php for Utah Airshed Clearing Indices. Prescribed burns generally require a clearing index of 500 or higher.

HERBICIDES

Affected Environment

Herbicide treatment would involve using tebuthiuron (Spike®), 2,4D (2,4-dichlorophenoxy acetic acid), and/or picloram (Tordon K®) to kill some of the sagebrush (and other shrubs) and create a mosaic of younger shrub patches within the older sagebrush stands. Herbicide treatment units would generally be less than 40 acres in size, and about 30-40% of the area within the unit would be treated. Herbicide would be applied by ground-based (rather than aerial) methods, and strictly according to label specifications. Identified sensitive areas (such as riparian areas, Brewer's sparrow blocks, rare plant locations, shallow soil areas, etc.) will be avoided. Methods to increase efficacy to treat woody vegetation and reduce impacts to non-target species will be applied; for example, Spike® would be applied during the dormant season to minimize effects on perennial grasses[9] (Dow 2007).

Environmental Consequences

a. Effects Common to Alternatives 1 and 3

1. Direct Effects

Herbicide application to sagebrush units will kill some of the woody plants, particularly sagebrush (*Artemisia tridentata*) and snakeweed (*Gutierrezia sarothrae*) (Dow 2007), as desired. Other shrubs, such as rabbitbrush (*Chrysothamnus* spp.) under a Spike® application, may be less impacted (Williamson and Parker 1996). Grass and herbaceous forbs will have little or no direct effect from herbicide application, due to a combination of herbicide specificity and application timing. This selective thinning of woody vegetation will produce desirable changes in the species composition within treated units, shifting from woody to herbaceous vegetation dominance. This will also contribute to landscape-scale biodiversity improvement by increasing seral stage diversity as old sagebrush stands are replaced by younger ones. Herbicide application will produce a short-term increase in dead woody stems (and thus the standing dry fuel load), which are expected to break down within a very few years (pers. observation).

Direct effects of herbicides on wildlife are not expected. Residual herbicide in treated stands is generally low, and does not accumulate in wildlife tissue (Vallentine 2004). Toxicity to wildlife is not expected when herbicides are applied as labeled. The proposed chemicals are water soluble and rapidly excreted, so do not bioaccumulate (USDA Forest Service 2006e). As an indication of this, no label restrictions require livestock grazing to be delayed following application of Spike® (Dow 2007). Table 3.3.25 indicates the oral and dermal toxicity of the three proposed herbicides. LD_{50} refers to the lethal dose at which half of the test organisms perish.

Table 3.3.25. Oral and dermal toxicity of the three proposed herbicides.

Herbicide	Oral LD_{50}: rat	Dermal LD_{50}: rabbit	EPA Toxicity Category[10]
Tebuthiuron	>2000 mg/kg	>2000 mg/kg	III Caution
2,4D amine	764 mg/kg	>2000 mg/kg	III Caution
Picloram	>5000 mg/kg	>2000 mg/kg	III Caution

Since no herbicides will be applied in or near riparian areas, no effect to aquatic resources is anticipated. No application will occur on soils with rapid permeability or shallow water table, to avoid possible

[9] The Spike® 20P Specimen label states: "Spike 20P may cause temporary herbicidal symptoms to appear on perennial grasses. Dormant season application is recommended to minimize herbicidal effects on desirable forage grasses." (Dow 2007, p 3)

[10] EPA Toxicity Categories are: I Danger, II Warning, III Caution, and IV None.

contamination of ground water (Dow 2007; Williamson and Parker 1996). All three herbicides are moderately to highly toxic to fish. However, given the RHCAs and BMPs of buffer zones, relatively small application areas, and ground-based (rather than aerial) application, little or no herbicide movement (via drift, overland flow, or groundwater infiltration) is expected, and no effect to fish or other aquatic species is anticipated.

2. Indirect Effects

Indirect effects from herbicide application include a desired dominance by grass and forbs in treated stands for several years, until sagebrush reestablishes dominance. Since sagebrush and other shrubs will remain well-distributed within treated units, an adequate seeds source will be present for young sagebrush reestablishment. Mountain big sagebrush (*Mountain (ssp. Vaseyana*) dominance is expected to return within 20 years (Goodrich 2005), and sagebrush will remain an important component of the stands in the interim.

Indirect effects from herbicides on wildlife habitat are similar to effects from other vegetation treatments proposed (burning and mechanical brush thinning). Treated areas will have improved habitat conditions for species and lifecycle functions that prefer herbaceous vegetation (such as deer or grouse spring foraging) and reduced habitat conditions for species and activities that require older, denser sagebrush stands (such as Brewer's sparrow nesting). A mixture of older/denser and younger sagebrush stands will remain within the project area, and across the landscape. See Wildlife, Section 3.12 for additional discussion.

b. Alternative 2 – No Action

No direct, indirect, or cumulative impacts will occur in Alternative 2 since no herbicide application would take place.

c. Cumulative Effects

Herbicide has been and will be applied for noxious weed treatment in the Big Creek analysis area, in addition to the proposed vegetation management for this project. However, the area treated for noxious weeds is very small, as indicated by the fact that only about 4.5 acres of noxious weeds are currently mapped within the 21,000-acre analysis area, and not all of that is treated. The Wasatch-Cache's Noxious Weed Treatment Program FEIS evaluated direct, indirect, and cumulative effects of herbicide application for noxious weed treatment, and concluded that no unacceptable effects would occur. Because of the small acreages involved in noxious weed treatment, and due to mitigation included in the Big Creek project design, cumulative effects of herbicide application in the Big Creek area are expected to be minimal.

No cumulative effects from herbicide residues or soil or water transport are expected. Cumulative effects on vegetation changes as a result of herbicide application would be the same types of beneficial effects of contributing to improved seral stage proportions as described elsewhere.

3.4 HERITAGE

The Section 106 compliance process has been completed. The State Historic Preservation Officer concurred with the Forest Archaeologist's findings of "no effect" to cultural resources for Big Creek as of November 3, 2006 (Flanigan 2007).