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5.1 Introduction

Cumulative effects are the total effect, including direct and indirect effects, on a given resource resulting from the incremental impact of past, present, and reasonably foreseeable future actions. They can result from individually minor, but collectively significant actions taken over a period of time. Cumulative effects may arise from single or multiple actions and the effects may be additive or interactive. The net adverse effect of interactive actions may be less than the sum of the individual effects (countervailing) or the actions may interact to create a net adverse cumulative effect that is greater than the sum of the individual effects (synergistic). The magnitude and extent of the effect on a resource depends on whether the cumulative effects exceed the ability of a resource to function at a desired level (CEQ 1997).

5.1.1 Cumulative Effects Areas

In this Environmental Impact Statement (EIS), cumulative effects are evaluated in terms of each specific resource, ecosystem, and human community being impacted and, as a result, the boundaries of Cumulative Effects Areas (CEAs) vary by resource. The geographic layout of the Dixie National Forest, as well as public scoping input gathered for this EIS, provided the foundation for identifying CEAs. An attempt was also made for each resource to determine the extent to which the environmental effects could be reasonable detected and to include the geographic areas of resources that could be impacted by the environmental effects. However, for simplicity, ease of cumulative impact analysis, and in an attempt to avoid having only slightly different CEAs for some resources, CEA boundaries were left identical for the resources where is seemed reasonable and conservative to do so. In some cases, the CEA boundaries may be larger than absolutely required, but are still sized reasonably enough to prevent dilution of cumulative effects over large areas. Guidance from the Council on Environmental Quality (CEQ), “Considering Cumulative Effects” (CEQ 1997) was used in identifying both the CEA for each resource and the temporal boundaries of the analysis. The temporal boundary for all resources is 15 years, as this is the time period used in projections for the Reasonable Foreseeable Development Scenario (RFDS) (BLM 2007a). The CEA for each resource – and the rationale for its boundaries – is described in each resource subsection. Maps for each CEA are also included.

5.1.2 Past, Present, and Reasonably Foreseeable Future Actions

As the CEAs vary by resource, so do the list of past, present, and reasonable foreseeable future actions occurring within each CEA. However, at a minimum, all CEAs include the Dixie National Forest and for many CEAs, the Dixie National Forest makes up the majority or all of the CEA. As a result, the past, present, and reasonably foreseeable future actions on the Dixie National Forest have a proportionally greater focus in this analysis than off-Forest actions. As actions on the Dixie National Forest are common to all CEAs, they will be presented here and subsequent resource sections will refer back to this section for a discussion of these actions. This will help to avoid repetition between sections; however, as actions may affect resources in different ways, some discussion of these actions will also occur in each resource section. Additional actions on other land (primarily Bureau of Land Management (BLM)-administered, state, and private land) within the respective CEAs will be presented in the relevant sections. Furthermore, given the large size of the CEAs and the large number of individual actions within these areas, the discussion of actions will primarily focus on general land uses and management activity types. However, specific actions for which specific information is known will also be presented.

5.1.2.1 Dixie National Forest Management Activities

Much of the information used to summarize past, present, and future levels of management activities was taken from Dixie National Forest resource specialists and Specialist Reports for various projects on the Dixie National Forest, and Dixie National Forest annual Monitoring Reports through 2009. Information for future actions was obtained from the schedule of proposed actions (SOPA) for 2002 through 1st quarter of 2011, the Dixie National Forest website, the Dixie National Forest 5-year vegetation plan, the BLM Electronic Notification Bulletin Board (ENBB), and the State of Utah.

DEVELOPMENT AND POPULATION GROWTH

Population is increasing in southern Utah, particularly in Washington County and Iron County (see Section 3.11.4.1). Developments are occurring on private subdivisions within the Dixie National Forest boundary. The largest amount of private land within the boundary occurs on the Pine Valley Ranger District, on routes between Cedar City, Enterprise, and St. George; and on the Cedar City Ranger District, on routes between Panguitch, Hatch, Alton, Cedar City, Brian Head, and the numerous campgrounds and other recreation sites (e.g., Cedar Breaks National Monument, Brian Head ski resort, Panguitch Lake, and Navajo Lake). This type of development is expected to continue in the future. A relatively large future development is planned for private land around Panguitch Lake. The proposal would develop a resort, cabins, RV lots, and a boat marina.

FIRE

Historically, slow-moving ground fires and crown fires in old, dense timber played a major role in ecosystem processes on the Dixie National Forest. Historical fire cycles are thought to have constantly renewed the forest, creating a diverse mosaic-like forest landscape of mixed size and age classes. Historical fire levels likely averaged three percent per year, with up to six percent burning in active years (Bradley et al 1992, Barrett et al. 1997). One hundred and fifty years of fire suppression has created large mosaics of dense fuel loads in many areas, which has increased the frequency of large, severe fires. Large, severe fires remove vegetation, thus homogenizing landscapes, and increase the proportion of early succession (grasses and forbs) and nonnative invasive species such as cheatgrass (USFS 2006c). In addition to fire suppression, fuel loads are also the result of past management practices such as inadequate treatment of activity slash, lack of periodic disturbance resulting in higher levels of trees and fuel ladders, plant community succession from fire-resistant species to fire susceptible species (e.g., ponderosa pine to mixed conifer), exotic species introductions, and grazing practices. Beetle killed trees also contribute to the buildup of both ground fuel and ladder fuel, thus increasing the risk of dangerous and costly wildfires.

The largest fire season since 1970 was in 2002, in which 57,745 acres burned. The Sanford Fire in 2002 (Powell Ranger District) burned mainly sagebrush (41%), which is expected to reestablish in the short term by the existing seed bank, and mixed conifer (32%), which will be absent for the long term (USFS 2002). Aspen reproduction is thought to have been enhanced by the fire (USFS 2002). From 2004 to 2006 there has been a dramatic increase in the number of acres burned on the Pine Valley Ranger District within pinyon-juniper and mountain brush systems, which many have been brought on by the extensive levels of cheatgrass (Norton et al. 2004). Severe fires in the foreseeable future will remove vegetation and alter community composition by increasing the prevalence of early-succession species such as grasses, forbs, and aspen.

The use of prescribed fire and mechanical fuel treatments are also anticipated to increase over the next 5 to 10 years. From 2005 to 2009, an average of 4,347 acres has been burned by prescribed fires per year. The amount burned by prescribed fires will potentially increase to nearly 10,000 acres per year in the future. Most of the prescribed fires are small (average of 400 acres) and are low to moderate intensity. An increase in the number of prescribed fires and mechanical fuel treatments should ultimately lead to a decrease in the number of large, uncharacteristic fires.

LIVESTOCK GRAZING

Much of the CEA experienced intense overgrazing in the late 1800s and early 1900s prior to active management. Range conditions are generally better today than they were during the early 1900s (Kay 2002). Range vegetation trend studies were begun in 2004. According to monitoring reports: in 2004, localized heavy grazing occurred on the Pine Valley Ranger District, with nine of 14 study sites showing downward trends in composition and soil cover; in 2005, a downward trend was found at 52 of 65 sites; and in 2006, among three sites sampled a downward trend was found in two, both within the Pine Valley Ranger District on a burned area that had not yet recovered. In 2007, six of the 17 replicated upland range trend monitoring studies indicates a downward trend in vegetation condition, effective ground cover, and/or frequency of invasive species, and the other 11 sites demonstrated slightly upward trends (USFS 2008b). In 2008, ten of the 16 replicated monitoring studies indicated a downward trend in vegetation condition, effective ground cover, and/or frequency of invasive species, and the other six sites demonstrated stable or upward trends (USFS 2009a). According to AUM reports published annually, permitted AUMs on the Dixie National Forest have been relatively constant for the past five years. Grazing is expected to continue at current levels in the foreseeable future.

MINERALS ACTIVITY

Past oil and gas activity on the Dixie National Forest has been relatively low, with the Upper Valley Field being the only producing oil field. The Upper Valley Field is located on both the Dixie National Forest and on BLM-administered land. It is southwest of Escalante and consists of 19 wells. It was developed in 1964 and production is projected to continue into the future. In the past few years there has been a renewed interest in oil and gas on the Dixie National Forest. BLM records for oil and gas indicate that there are 54 authorized leases on the Dixie National Forest, with one pending lease. Five of these are located on the Cedar City, 40 on the Escalante, and 10 on the Powell Ranger Districts. In total, the 55 leases cover 13,454 acres. The Dixie National Forest is aware of many other oil and gas leases (including geothermal) on BLM lands adjacent to the forest, such as those just north of the Cedar City ranger district. Some of these leases fall within the CEAs for Recreation (5.4), Fish and Wildlife (5.5), MIS (5.6), Water and Watershed (5.7), and Transportation (5.10); refer to those sections for an overview.

Most mineral activity on the Dixie National Forest consists of the sale and free use of common mineral materials (e.g., sand, stone, gravel, pumice, cinders, and clay). The number of permits for mineral materials varies, and most of these permits are for existing gravel and cinder pits that have been in use for 30 to 40 years. Further, most of the operations are small and are often used for Forest and county projects. There is an increasing demand for mineral material sites and, as a result, the number of these sites will likely continue to increase. Other mineral activity (i.e., locatable minerals such as gold, silver, etc.) should be low due to a lack of such minerals on the Forest.

RECREATION

Overall, recreation on the Dixie National Forest has increased relative to past levels. A primary cause of the increase is the burgeoning populations in cities such as St. George and in Clark County (i.e., Las Vegas), Nevada. The areas of the Forest close to Interstate 15 (Pine Valley and Cedar City Ranger Districts) receive the largest amount of visitors from Clark County. Currently, most of the recreation on the Forest is centered on hiking (66 percent of visitors) and sightseeing (55 percent reported 'viewing natural features;' 43 percent reported 'viewing wildlife'; USFS 2010b).

In 2009, OHV use was reported by 5 percent of visitors and use of a designated OHV area was reported by 11.5 percent of visitors (USFS 2010b). Growth in demand for OHV use and other dispersed motorized recreation opportunities has increased on the Dixie, similar to other areas of the Western U.S. (USFS 2009c). The Dixie National Forest has completed a formal motorized route designation process that would eliminate off-trail or cross-country motorized travel (Motorized Travel Plan FEIS/ROD; USFS 2009c). The decision also makes moderate reductions in motorized route mileage across the Forest.

ROADS

There are approximately 2,700 miles of Forest Service Roads on the Dixie National Forest that are open to the public and approximately 1,000 miles of roads open to administrative uses (see Section 3.10, Transportation). The Motorized Travel Plan FEIS/ROD (USFS 2009c) reduces the amount of cross-country travel by OHVs and the mileage of "unauthorized" routes on the Dixie National Forest. Very few new roads are expected to be constructed in the future and the overall mileage of the entire system is expected to decrease from 2007 levels with additional projects designed to decommission unused roads. If the status of the 2001 Roadless Area Conservation Rule were changed due to judicial action, road construction could occur in IRAs at a rate similar to what is described above for the rest of the Dixie National Forest.

BARK BEETLE

Bark beetles (i.e., spruce beetle, mountain pine beetle, and Douglas-fir beetle) have been and continue to be the most notable cause of widespread tree mortality in the Intermountain Region for the past several decades. In the last 10 to 15 years, spruce beetle has caused up to 80 percent mortality on approximately 225,000 acres of Utah's National Forests (UDNR 2003). Many of the largest infestations in Utah are on the Dixie National Forest.

Insect and disease outbreaks are natural disturbances that have always shaped forests on the Dixie National Forest. Spruce beetle outbreaks are tied to (homogenous) stand density, (increased) tree age, lack of disturbance, climatic conditions, and triggers (e.g., drought, fire, and windthrow) that start the outbreak. During times of forest stress, particularly drought, forests are especially attractive to bark beetles because trees have less resin that ordinarily floods entrance holes and repels beetles (Hallion 2003). A lack of diverse forest structure also creates large, older stands, already under competition stress (for water and soil nutrients), and vulnerable to beetle outbreaks. For spruce greater than 10 inches dbh, mortality levels after an attack are often greater than 90 percent (Dymerski et al. 2001).

In the 1990s, spruce bark beetle populations grew to large landscape proportions in the Cedar City and Powell Ranger Districts. Spruce beetle infestation developed to large landscape proportions on the Escalante Ranger District by the early 2000s. Most of the mature and over-mature Engelmann spruce on the Cedar City Ranger District and parts of the Powell Ranger District was killed by 2004. Recent outbreaks have resulted in landscapes comprised of

thousands of dead trees (UDNR 2003) and the accumulation of downed woody debris. The historically spruce-dominated landscape on the Cedar City and Powell Ranger Districts is expected to revegetate initially to aspen (in the absence of excessive browsing) over the next century. Outbreaks are expected in the Pockets area of the Escalante Ranger District and mortality of most spruce greater that 10 inches dbh is expected.

TIMBER HARVEST

Historical logging, even-aged management, and historical fire suppression have created relatively dense, mid-succession, mixed conifer forests with relatively large accumulations of woody debris and fuel. In recent years, the number of acres harvested per year has generally decreased relative to historic levels as the emphasis of timber harvests has shifted from promoting wood growth (for production) to ecosystem health. Harvests such as clearcuts are rare; more frequent are commercial thinning treatments, salvage cuts, sanitation cuts, and thinning for stand improvement and to reduce susceptibility to bark beetle outbreaks. The levels of recent timber harvest have been variable and almost entirely in response to spruce beetle outbreaks. Timber harvests (mainly commercial thinning operations) were relatively high in 1998 (31,252 acres; 53% commercial thinning) and 1999 (20,280 acres; 94% commercial thinning). Annual harvest totals between 2000 and 2007 were only 2,657 acres on average and consisted mainly of sanitation cuts (61%), salvage cuts (19%), and improvement cuts (11%) in an attempt to create conditions favorable to tree regeneration and increased diversity in order to reduce the risk of severe outbreaks.

Spruce, fir, mixed conifer, and pine forests on the Dixie National Forest are relatively susceptible to fire, insects, and disease due to recent droughts (UDNR 2003) and past management, and are the focus areas of current timber management.

INVASIVE AND NON-NATIVE PLANTS

Invasive and nonnative plants, including noxious weeds, pose a new and serious threat to Utah's forests. In Utah, 350,000 new acres of infestations are added annually (UDNR 2003). Several species including knapweeds, leafy spurge, dyers woad, and thistles are spreading, reducing biological diversity, modifying wildlife habitats, altering fire and nutrient cycles, degrading soil structure, and damaging critical watersheds. Utah has 18 declared noxious weed species (Belliston et al. 2004) and another 14 species classified as new and invading.

There are over 1,800 acres of mapped weed infestations on the Dixie National Forest. In 2005, the Dixie National Forest reported 1,639 acres infested with invasive plants and treated 955 acres. The number of infested acres in 1998 was 930 acres, thus infestations are increasing. A few range areas in the Pine Valley Ranger District monitored by the Forest in 2006 indicated a downward trend in range condition due to cheatgrass invasion following fire (USFS 2006c). The trend of increased acres infested with invasive species is expected to continue on the Dixie National Forest. Weed treatments are scheduled for all four ranger districts but most will take place in the Pine Valley Ranger District over the next five years, as this is where most infestations have been reported. Yearly treatments planned in the foreseeable future (each year until 2011) include 46 acres on the Cedar City Ranger District, 7 acres on the Escalante Ranger District, at least 400-500 acres on the Pine Valley Ranger District, and 52 acres on the Powell Ranger District. About 700 acres of weeds have been treated on the Pine Valley Ranger District in each of the past four years.

VEGETATION CHANGES

Compared to historic conditions (late 1800s and early 1900s), most vegetation communities on the Dixie National Forest have changed in relative abundance. Grasslands and aspen communities have declined, having been replaced by dense coniferous forest in many areas (USFS 2006c). In general, late successional species (spruce-fir and pinyon-juniper) have invaded areas where early successional species (aspen, grass, forb, and sagebrush) once prevailed. Vegetation management on the Forest is currently attempting to reverse the trends of climax species encroachment.

WATER DIVERSIONS

Dams and other water diversions have resulted in changes to the quantity and timing of stream flow. For example, much of the water in streams coming off the Dixie National Forest is diverted and used for irrigation or municipal use; as this occurs, water quality deteriorates (BLM 2008a [Kanab Land and Resource Management Plan]) and in many cases streams are diverted to the point that water does not reach the major rivers (BLM 2008b [Richfield Land and Resource Management Plan]). Also, large dams alter hydrology by storing water for release during the irrigation season, for example, the Sevier River and its tributaries are regulated by storage reservoirs. Water demand is expected to increase due to increasing populations.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Dixie National Forest are listed below. Minor projects in the foreseeable future not listed below include routine maintenance, range projects, and minor ROW authorizations. Information on specific projects comes from the SOPA for 2002 through 3rd quarter of 2010, the Dixie National Forest website, the Dixie National Forest 5-year vegetation plan, and the State of Utah.

Table 5.1-1 Reasonably Foreseeable Future Actions on the Dixie National Forest

Project	Location	Description	Estimated Disturbance (if available)
Arial application of fire retardant	Forest-wide	The Forest Service proposes to continue the aerial application of fire retardant to fight fires on National Forest System lands, including the Dixie National Forest.	
Motorized Travel Planning	Forest-wide	Would designate identified routes open to motorized use. With designation of a motorized travel system, motorized cross-country travel would be prohibited. The Forest would remain open to other forms of cross-country travel such as hiking, horseback riding, cross-country skiing, and snowmobile use. FEIS ROD signed April 2009	Implementation is on-going and foreseeable
Cove Mountain Iron Ore Exploration Project	Pine Valley RD	Drilling and evaluation for iron ore deposits on mining claims. Located approximately 11 miles west of Central, Utah.	2 acres
Mt. Dutton Vegetation Management Project	Pine Valley RD	During the summer of 1998, several small spruce beetle mortality pockets were identified in the area of Pine Creek, Mt. Dutton, and Adams Head. These outbreaks tended to be isolated in areas previously not harvested. The project area is now infested by epidemic levels of spruce beetle. This has changed the live forest structure as the spruce beetle has killed nearly all the living mature spruce trees. These areas no longer have the number of live trees necessary to be classified as forested sites. The desired condition in these areas would be to establish a diverse mixture of conifer and aspen trees with at	870 acres 620 acres(2009) 200 acres (2010) 50 acres (2011)

Project	Location	Description	Estimated Disturbance (if available)
		least 150 live trees per acre. The project would include timber harvest, prescribed burns, reforestation, road reconstruction, and road decommissioning on 5,490 acres in the upper drainages of Hoodle Creek, Willow Spring Creek, Forest Creek, Pine Creek, and North Fork Deep Creek. Timber harvest would occur on approximately 870 acres, including approximately 620 acres in 2009, 200 acres in 2010, and 50 acres in 2011. Approximately 145 acres would occur in the Deer Creek IRA.	
Upper Santa Clara River Vegetation and Fuels Project	Pine Valley RD	The Project would treat vegetation in-and-around the Pine Valley Recreation Area on federal lands within the Dixie National Forest. This project entails vegetation treatments on approximately 1,662 acres of a 1,817-acre project area. There would be approximately 3.3 miles of temporary road construction, with 1.2 miles becoming part of system roads used to access existing campgrounds after Project completion. No activities will occur in any IRAs or within the Pine Valley Mountain Wilderness Area. Treatments will include a combination of timber harvest, thinning, brush removal, and prescribed burning. The purpose of the project is to modify the vegetation such that fuels will be reduced, wildland fire risk to private property and recreational facilities will be reduced, and forest health will be improved, while maintaining the vegetation esthetics of the Recreational Area. Pine Valley is included on the federal Register's list of Communities at Risk from wildfire. http://www.fs.fed.us/r4/fire/hfr/2009/upper_santa_clara_rvr.shtml	
Pine Valley Fuels Treatments	Pine Valley RD	Project involves the construction of fuel breaks around the communities of Pine Valley and Central. Approximately 516 acres were treated in 2003 and 2004. Future treatments include 217 acres in 2011.	217 acres (2011)
UNEV Pipeline	Pine Valley RD	Would install a petroleum pipeline from Salt Lake City to Las Vegas. The project would be located in the same ROW as the Kern River pipeline, which was last disturbed for another pipeline in 2003. Construction beginning 2010.	
Sigurd to Red Butte Powerline	Pine Valley RD	PacifiCorp, doing business as Rocky Mountain Power Company, has filed a ROW application seeking authorization to construct, operate, maintain, and decommission a 345 kV single-circuit overhead electric transmission line on Federal lands. The project would provide an additional 600 megawatts of reliable electrical capacity by 2014 to respond to anticipated load growth in Southwestern Utah. The proposed project begins at the existing Sigurd Substation near Richfield, Utah, and terminates at the existing Red Butte Substation near the town of Central, Utah. This analysis will also result in amending the SIO levels for several areas within the project area currently unassigned to either Low, Medium, High or Very High.	
New Harmony Irrigation Line	Pine Valley RD	The following are proposed for the project area: (1) Re-construct the point of diversion inlet structure. (2) Install approximately 5,300 feet of pipeline. a) Approximately 4,700 feet will be installed within Forest Road 30931. Approximately 600 feet will be installed within the existing irrigation ditch. (3) Provide 600 feet of temporary access for construction equipment from the end of Forest Road 30931 to the point of diversion construction site. (4) Construct a flow control sluice structure.	
Brian Head ATV Trail	Cedar City RD	This Project would involve new ATV trail construction to link the Brian Head community to the Markagunt ATV Trail System. Proposed trail is located southeast of Brian Head, Utah.	4 miles new ATV trail (2011)

Project	Location	Description	Estimated Disturbance (if available)
Duck Creek Fuels Treatment	Cedar City RD	The Project would treat approximately 13,700 acres on the Cedar City RD to reduce fuels, enhance fire-tolerant vegetation, and provide fuel breaks. The purpose of the fuels treatments is to reduce the risk of a large-scale high intensity wildfire from spreading to or from NFS lands, which may threaten or burn into public and private property and facilities within the Duck Creek area. In order to reduce this risk, surface, ladder, and crown fuels will be treated. Phase I of the Project treated 2,800 acres in 2007. Phase II will treat 600 acres in 2008 and Phase III 2,800 acres in 2008, 10,000+ acres in 2009, 5,000 acres 2010, and 1,500+ acres in 2011.	Phase I 2,800 acres (2007), Phase II 600 acres (2008), Phase III 2,800 acres (2008), 10,000+ acres (2009), 5,000 acres (2010), 1,500+ acres (2011)
Edward Spring Vegetation Treatment	Cedar City RD	Vegetation removal and increase in early succession grassland and aspen habitat.	1,108 acres
Harris Flat ATV Access Trail	Cedar City RD	The Project would involve new ATV trail construction to provide access from private lands to National Forest roads and trials. Located approximately 6 miles east of Duck Creek Village, Utah.	0.4 miles (2011)
Midway-Deer Valley Scenery Enhancement & Veg Treatment	Cedar City RD	The proposal is to accelerate improved visual quality along a scenic highway (Utah Highway 14). This will be done by treating dead vegetation in the Midway-Deer Valley area along State Highway 14, sixteen miles east of Cedar City, Cedar City Ranger District. The Project would remove dead vegetation and decadent aspen, including the salvage logging of dead spruce. The project would also include the construction of 3.8 miles of temporary roads and the prescribed burning of riparian meadows. Approximately 1,200 acres would be treated over the next three years: 600 acres in 2008, 400 acres in 2009, and 200 acres in 2010. The revenues generated from treatments will be used to accomplish ancillary activities associated with stewardship projects in recreation, vegetation, and wildlife habitat	1,200 acres 600 400 200
Little Creek-Red Creek Vegetation Treatment	Cedar City RD	Vegetation treatments, including mechanical and prescribed fire, to reduce forest fuels, regenerate aspen and sagebrush, thin conifer timber and reduce pinyon-juniper encroachment. Located approximately 9 miles east of Parowan, Utah.	9,281 acres (2011)
Navajo Basin Forest and Scenic Recovery	Cedar City RD	Salvage harvest of dead and dying Douglas-fir and other conifers. Regeneration of aspen and conifer reforestation. Located approximately 25 miles east of Cedar City, Utah.	4,737 acres (2011)
Red Desert Vegetation Treatment	Cedar City RD	This Project would involve vegetation treatments, including prescribed burning, to regenerate aspen. Located approximately 24 miles east of Cedar City, Utah.	2,225 acres (2011)
Tippets Salvage	Cedar City RD	Salvage dead and dying conifer. Located approximately 25 miles east of Cedar City, Utah.	250 acres (2011)
Cedar Mountain Winter Recreation Master Plan	Cedar City RD	Project would create new snowmobile and cross country skiing parking areas, as well as toilets along Highway 14. Expected implementation is 2011.	
Uinta Flat Dispersed Camping EA	Cedar City RD	Designation of up to 39 dispersed campsites by hardening and delineating. Located 4 miles east of Duck Creek Village, Utah.	9 acres (2011); no disturbance outside of existing campsites
Paunsaugunt Vegetation EA	Powell RD	Project would treat aspen stands to increase aspen regeneration, reduce conifer encroachment, and develop multi-aged aspen stands. Located south of Tropic Reservoir near the junction of Upper Kanab Creek and East Fork Sevier River	2,218 acres (2012)

Project	Location	Description	Estimated Disturbance (if available)
John's Valley Vegetation Project	Powell RD	Project would treat decadent sagebrush, pinyon, and juniper in an effort to rejuvenate the sage steppe community. Located in John's Valley on the East side of Mt. Dutton.	2,000 acres (2012)
Pink Cliffs Communication Site	Powell RD	Provide communications for Kane County and State of Utah Emergency Medical Services. Expected implementation is 2010.	3 acres
Tropic to Hatch 138kV Transmission Line	Powell RD	Construction of upgraded transmission line from Tropic, UT to Hatch, UT. EIS complete	31 miles transmission line 100 ft ROW to be constructed 2012
Bridge Fire Salvage and Restoration Project	Powell RD	Proposal is to salvage fire-killed or beetle-damaged timber, and to reforest within harvested area and to mitigate safety concerns from hazard trees along existing roads and dispersed camp sites. Located approximately 20 miles southeast of Panguitch, Utah, adjacent to Tropic Reservoir. Expected implementation is 2011.	711 acres
East Fork Boulder Creek Native Trout Restoration Project	Escalante RD	All fish would be removed from a section of Boulder Creek to prepare it for introduction of Colorado River cutthroat trout. This would involve chemical treatment with the fish toxicant rotenone, which would completely eradicate nonnative trout from the East Fork of Boulder Creek and a short segment of Boulder Creek. Located approximately 10 miles northwest of Boulder, Utah, within east fork of Boulder Creek drainage. The total treatment area would be as follows: 1) approximately 7.8 miles of East Fork Boulder Creek from the natural barrier (below headwater meadow) on the East Fork to its confluence with the West Fork Boulder Creek; 2) approximately 0.2 miles of lower West Fork of Boulder Creek from a previously constructed barrier to its confluence with East Fork Boulder Creek; 3) approximately 0.5 miles of Boulder Creek from the confluence of the East and West Forks of Boulder Creek downstream to a previously constructed fish barrier; 4) all seeps and springs flowing into those sections of streams proposed for fish removal; and 5) the Garkane Energy water transfer pipeline between the West Fork Reservoir and King's Pasture Reservoir ; Kings Pasture Reservoir; a pond on private property in King's Pasture, and the Garkane Energy penstock, between King's Pasture Reservoir and the Garkane Energy Boulder Creek Hydroelectric Power Plant.	8.5 miles of stream + seeps, springs, and reservoirs (2011)
Iron Springs Improvement and Salvage Project	Escalante RD	Commercial and non-commercial thinning to reduce stand densities, provide for more balanced age-class distribution and perpetuate aspen presences within the spruce-fir dominated forest. Located approximately 15 miles northwest of Escalante, Utah.	484 acres of salvage
Pretty Tree Bench Fire Treatments	Escalante RD	Project is to provide prescribed fire to create healthier vegetation conditions, enhance elk and deer winter range, reduce fuels, create a younger stand structure, and reduce stand densities within pinyon-juniper stands.	Approximately 12,000 acres over 8 years
Road Draw Salvage and Reforestation Project	Escalante RD	Salvage fire-killed or damaged timber within the 118-acre burn area. Located approximately 7 miles northwest of Boulder Utah along FR 166 (west of Highway 12).	82 acres

Project	Location	Description	Estimated Disturbance (if available)
Stump Springs Fire Treatments	Escalante RD	Project uses prescribed fire treatments to disturb vegetation, slowly moving heterogeneous patches towards a fine-grained landscape that is more resistant and resilient to fire and other disturbance.	Approximately 5,400 acres over 9 years
Dipping Vat Habitat Improvement Project	Escalante RD	Project would include the thinning of pine forests and the mechanical treatment of sagebrush for habitat improvement and fuels reduction in Johns Valley, approximately 7 miles north of Tropic. The Project would affect approximately 1,132 acres.	1,132 acres (2010)
McGath Lake Dam	Escalante RD	The McGath Lake Dam is deteriorating and in need of repair. Without action the dam is likely to fail and destroy an important fishery. McGath Lake is located approximately 16 miles north of Escalante. The Project is awaiting cooperative agreements.	
Pockets Vegetation Management	Escalante RD	The Project is designed to reduce bark beetle risk and improve habitat for northern goshawk. It would include commercial timber harvest, pre-commercial stand treatment, fencing, and travel management. Of 26 miles of existing road, 8.5 miles will be open to the public, 5 miles will be open as motorized trail only, 5 miles will be used for administrative purposes only, and 7.5 miles will be decommissioned.	2,233 acres conifer and 770 acres aspen would be treated
Toad Salvage	Escalante RD	Salvage of dead and dying ponderosa pine within the perimeter of a Wildland Fire Use burn area. September 2007, 1400 acres burned.	230 acres (2010)
Sawmill Point/Baldy Ridge Aspen Improvement	Escalante RD	Commercial aspen cleaning (121 acres), non-commercial cleaning (708 acres) and regeneration (65 acres); 0.7 miles temporary road construction.	894 acres (2011)

[1] Most of the project would occur on the Fremont River Ranger District administered by the Fishlake National Forest.

5.2 Visual Resources

5.2.1 Description of Cumulative Effects Area

The Cumulative Effects Area (CEA) for Visual Resources would include the entire Dixie National Forest including all of Cedar Breaks National Monument. In addition, the CEA would include all of Bryce Canyon National Park, a 1-mile buffer along the boundary between the Escalante and Fremont River Ranger Districts, a 1-mile buffer along the boundary between the Escalante Ranger District and the Grand Staircase-Escalante National Monument, and all area in between the Powell and Escalante Ranger Districts (Figure 5.2-1). The CEA is 2,037,882 acres (Table 5.2-1).

Table 5.2-1 Land Status within the Cumulative Effects Area

Land Management	Acres	Percent of Total CEA
Bureau of Land Management (BLM)	83,444	4
National Park Service	41,973	2
Private	109,777	6
State Lands	54,089	3
Forest Service	1,661,365	81
Forest Service Wilderness Areas[1]	85,323	4
Water	1,912	<1
Total	**2,037,882**	**100**

[1] Includes the Pine Valley Mountain, Ashdown Gorge, and Box-Death Hollow Wilderness Areas

5.2.1.1 Rationale

Cumulative effects of activities and actions within the Dixie National Forest may affect visitors to the Dixie National Forest as well as visitors to National Parks, National Monuments, and other National Forests with viewsheds that include Dixie National Forest lands. Oil and gas leasing activity possible on the Fishlake Forest or on state administered lands may compound visual effects of any potential oil and gas leasing activity on the fringes of the Dixie National Forest in these areas. The area in between the Powell and Escalante Ranger Districts was included as it is in close proximity to Dixie National Forest land and may also affect views from scenic Forest roads or wilderness areas. Activities outside the Forest may affect views from scenic Forest roads or wilderness areas.

5.2.2 Past, Present, and Reasonably Foreseeable Future Actions

Visual resources of the Dixie National Forest can be affected by any activities that change vegetation patterns or add man-made features to the Forest, or to areas beyond the Forest boundary, within Forest viewsheds. Natural events, such as wildfire or insect infestations may also impact the scenic resources of the Forest. In addition, the amount of casual use and recreation on Forest lands may affect the scenic experience. Past and present management activities continue to impact visual resources to some extent by altering vegetation communities. Development within and outside the Forest boundaries may affect scenic views.

General information on the past, present, and future levels of each type of activity for the Dixie National Forest is presented in Section 5.1.2.1. As a result, the information presented for these management activities in this section is relevant only to visual resources, information not

included in the general discussion in Section 5.1.2.1. Also any additional information relevant to other portions of the CEA (BLM-administered land, state land, and private land) is included.

DEVELOPMENT AND POPULATION GROWTH

As described in Section 5.1.2.1, population is increasing in southern Utah, with increased development on private land. With development is temporary land disturbance, landscape change, and increased use of produced light. Also, developments within and adjacent to the Forest remove vegetation permanently and increase the extent of urban-wildland interface which must be managed more intensely for fuels (e.g., Duck Creek and Pine Valley Fuels Treatments; see Table 5.1-1).

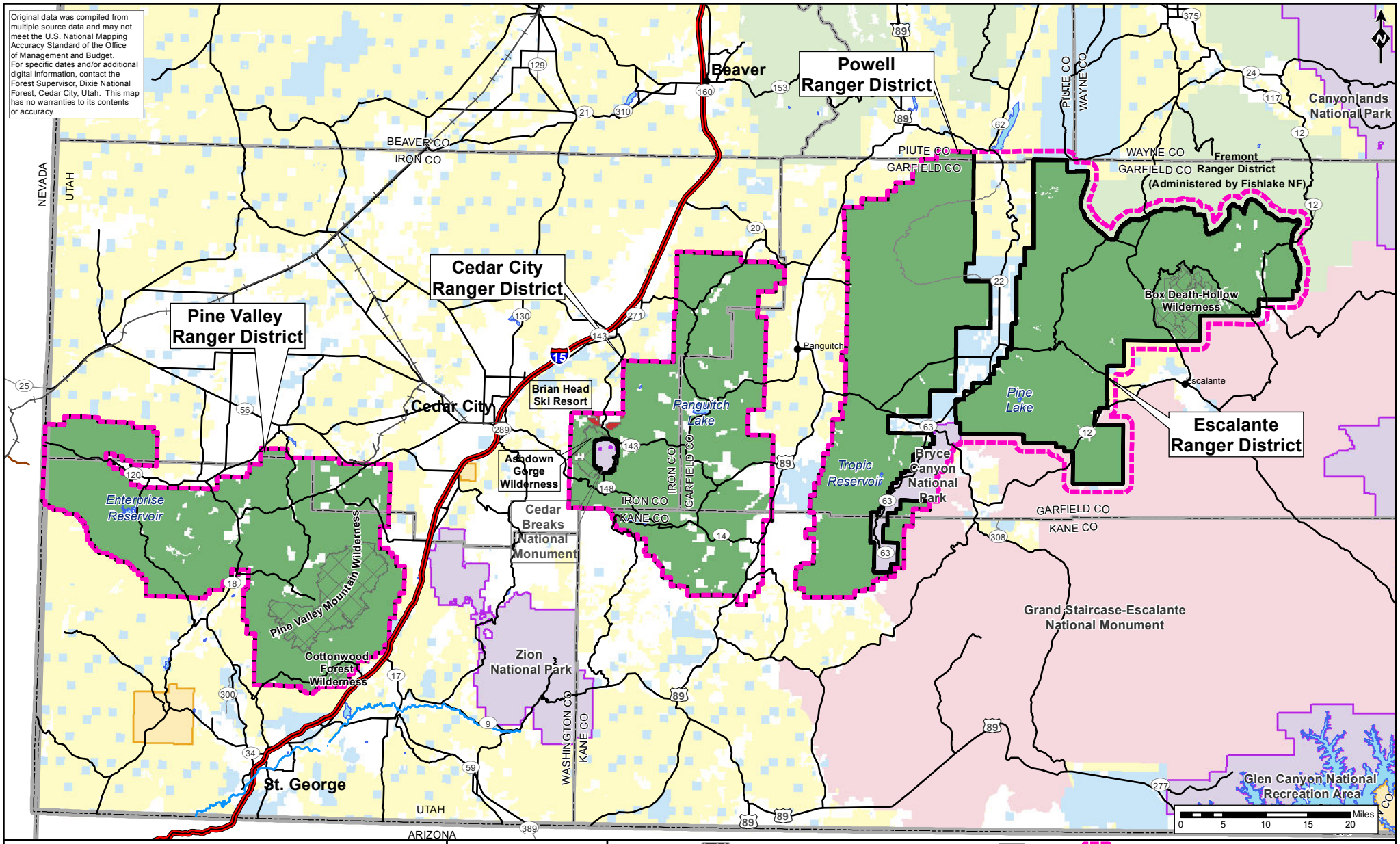
There are 109,777 acres of private land in the CEA (six percent). Of that, nearly 10 percent (10,752 acres) is within municipalities (Bryce Canyon City, Brian Head Town, Boulder, Enterprise, and Antimony). The majority of private land in the CEA outside of the Forest boundaries is within Garfield County. The Garfield County Planner indicated that the primary use of private land within the county is agriculture (outside of the municipalities). After agriculture, the primary industry is tourism. Accordingly, most development in the county consists of small subdivisions (second homes and recreational residences). Many of the subdivisions are single-lot splits, where a landowner splits a larger lot into 2-10 smaller lots. There are only 3-4 subdivisions planned that are larger, with over 50 lots. However, most of the subdivisions (both large and small) have not yet been developed. None of these subdivisions are of the large "resort" type and usually consist of dirt roads and single wells. There is also a RV park planned near Panguitch Lake (see Table 5.1-1), and a fair amount of development on private land around Panguitch Lake.

Population and development increases have brought higher levels of night lighting in proximity to National Parks and other areas where visitors seek solitude and the beauty of the night sky. Artificial light is 'practically nonexistent' in Bryce Canyon National Park such that the beauty of the night sky appears to be amplified (NPS 1987). Regarding development within the Grand Staircase National Monument, it is noted: "Few places are as dark as south-central Utah. It is one of the darkest spots on NASA's satellite image of the United States at night. As such, the BLM would not propose actions within the Monument that would contribute to light pollution, and would be proactive in preventing light pollution within the Monument. The BLM would also work closely with the surrounding communities to minimize light pollution (BLM 1999a)."

RECREATION AND MAINTENANCE

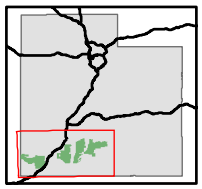
The increase in recreational use of the Dixie National Forest, including OHV use, is described in Section 5.1.2.1.

Maintenance of recreation facilities including trails can prevent visual degradation of landscapes. In Bryce Canyon National Park, there are three projects that have either recently been implemented, or are to be implemented in the near future. The Paria View Rehabilitation Project will rehabilitate walkways and railings at a scenic viewpoint. The Mossy Trail Rehabilitation Project will rehabilitate a trail that was washed out by a flood event, and will include installation of a viewing platform to reduce visitor impacts to the cave. The Tropic Canyon Highway Rehabilitation Project will fix a bridge damaged by flood events. These projects are expected to have minor, temporary, localized impacts, with beneficial effects for visitors to Bryce Canyon National Park.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest
FIGURE 5.2-1
Cumulative Effects Area
Dixie National Forest Boundary & Visual Impacts

1 in = 15 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Major Roads
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Includes Dixie National Forest Boundary, Bryce Canyon National Park, Cedar Breaks National Monument, area between Escalante & Powell Ranger Districts, and a 1-mile buffer of Escalante Ranger District.

The BLM's Richfield Field Office administers the BLM land around and to the south of Antimony, in between the Escalante and Powell Ranger Districts. Most of this area is Visual Class IV (Low SIO) which allows major modification. There are some Class III (Moderate SIO) areas along the western boundary of the Escalante Ranger District. Most of the area is open to cross-country motorized travel, except for roads up Pole Canyon, Pine Creek, Deep Creek, and Deer Creek (these are all canyons coming off the east side of the Powell Ranger District). The vegetation is mostly pinyon-juniper woodlands and is managed for livestock grazing.

FIRE

The past, present, and future levels of fire on the Dixie National Forest are discussed in Section 5.1.2.1. In the short term, fire can diminish the visual quality of the landscape, thus making some areas undesirable for viewing scenery and wildlife, and dispersed camping.

MINERALS ACTIVITY AND ENERGY DEVELOPMENT

Regarding existing oil and gas leases within the CEA, BLM data indicates that there are 55 authorized leases and one pending lease. In total, these leases cover 26,670 acres. Other than the Upper Valley Field, however, none of these leases are active.

Mineral leases in the Grand Staircase-Escalante National Monument include 18 federal coal leases encompassing nearly 53,000 acres, and 85 federal oil and gas leases encompassing about 136,000 acres. Estimates for disturbance related to development of valid existing mineral rights in the Grand Staircase-Escalante National Monument were not included in the FEIS for the management plan because of insufficient information on potential for discovery and extent of development (BLM 1999a). Existing BLM data indicates there are no pending leases on the portion of the Grand Staircase-Escalante National Monument included within the CEA. Development of wind energy in the Grand Staircase-Escalante National Monument is not allowed.

Within the BLM's Richfield District portion of the CEA, there are some oil and gas leases along the western edge of the Escalante Ranger District. However, the area has low development potential for oil and gas (BLM 2008b). It predicts an average of three wells per year (in an area that includes much more than the area between the two ranger districts) for the next 15 years. Estimated disturbance is 12 acres per well. The area is considered low potential for wind energy development, according to the programmatic EIS prepared for wind energy on all BLM land (BLM 2005).

Impacts to forest visual resources could occur as a result of the development of minerals on adjacent private land. Oil and gas activity on private lands near the forest is not required to meet the Forest's Land and Resource Management Plan standards for visual resources.

TIMBER HARVEST, BARK BEETLE OUTBREAKS, AND VEGETATION MANAGEMENT

These activities are described in Section 5.1.2.1.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

All of the above types of activities and development are expected to continue to some degree on the Forest and within the CEA. Project in the official planning stage on the Forest are listed in Table 5.1-1. The impacts to visual resources from these projects would be the same as already described. Regarding the Motorized Travel Management Project, it is anticipated that it will restrict motorized use to specific trails and will largely eliminate off-trail or cross-country motorized travel. This should reduce some of the impacts of recreation on visual resources. In

addition to the vegetation management projects listed in Table 5.1-1, vegetation restoration treatment of approximately 20,000 acres is also planned in the adjacent Grand Staircase-Escalante National Monument (BLM 1999a); however, the specific treatment areas are not disclosed.

Maintenance of recreation facilities is planned to continue within Cedar Breaks National Monument, and Grand Staircase-Escalante National Monument. In addition, the FEIS for the Management Plan for the Grand Staircase–Escalante National Monument (BLM 1999a) predicts several "Reasonably Foreseeable Actions," including communication sites, utility rights-of-way, road rights-of-way, and water developments.

Much of the 1-mile buffer in the CEA that includes Grand Staircase-Escalante National Monument is within zones designated as "primitive or outback." Activities that would impact visual resources such as rights-of-way would not be permitted in primitive zones, and communication sites would only be allowed for safety purposes. In the outback zones, communication sites and utility sites would only be allowed if no other reasonable location exists. Where they are allowed, new utility lines would be buried if possible, power lines would be non-reflective, and towers would be galvanized steel or wood.

In the portion of the CEA that occurs on lands administered by the BLM's Richfield Field Office, there is minor activity planned, including a few range projects, some work on the Piute Trail, and perhaps a few small ROW applications.

5.2.3 Cumulative Effects by Alternative

Generally, activities within the Forest or within BLM-administered lands are guided by the restrictions in place to maintain scenic resources. Cumulative impacts to visual resources of the Dixie National Forest would be likely to occur with extensive development of communities, industry, or natural disasters, within the viewsheds of the most highly utilized and appreciated scenic viewpoints. Other than natural disasters, which cannot be reliably predicted, other forms of extensive development are not included in the plans described above for areas adjacent to the Forest boundary. Based on this, the potential for cumulative effects to visual resources is minor, unless Forest Plan objectives are changed and activities are allowed to develop in scenic areas that are currently protected. In regard to the dark sky aspect of visual resources, although light pollution can be accurately measured, the cumulative effects of even minor development on the dark sky resources of the CEA are more difficult to assess, and extend far beyond the surface boundaries of the defined CEA.

5.2.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.2.3.2 Alternative B

Under Alternative B, the potential for cumulative effects to visual resources of the Dixie National Forest would be negligible to minor. The greatest potential for cumulative effects would be in Moderate SIO areas leased and developed under CSU-02, and High SIO areas that are adjacent to, or within view of private property developments or facility/resource development on non-Forest lands where compliance with scenic objectives is not required.

5.2.3.3 Alternative C

This alternative places a large portion of the Dixie National Forest into the NSO leasing option. Visual resources are protected under NSO. The potential for cumulative effects to visual resources would be greatest in Moderate SIO areas where development of oil and gas, in addition to any other development or vegetative management conditions, occur in the foreground or middleground views. Cumulative impacts to visual resources may occur in these areas if they have been impacted by and not recovered from past disturbance or if they are impacted by future management, development, and vegetation trends.

5.2.3.4 Alternative D1 (NSO in IRAs)

The scenic resources of IRAs would be protected under NSO under this Alternative. However, the scenic resources in High SIO areas of the Forest would not be adequately protected by a CSU leasing option assigned to this SIO under this alternative; this includes 57 percent of the High SIO lands. In these areas, there could be cumulative impacts to visual resources if exploration and development occur in concentrated areas and if such development occurs adjacent to, or within view of private property development or facility/resource development on non-Forest land where compliance with scenic objectives is not required. This scenario for cumulative effects is possible, but not likely to occur based upon the limited list of proposed developments on non-Forest lands.

5.2.3.5 Alternative D2 (CSU in IRAs)

Under this alternative the potential for cumulative impacts to visual resources would increase with IRAs available for leasing under CSU-04. For High SIO lands, the percentage increases from 57 to 83 percent of High SIO lands that would be inadequately protected. The amount of Moderate SIO areas under either CSU or SLT increases from 65 percent to about 91 percent of the Moderate SIO areas of the Forest. Accordingly, the potential for cumulative effects increases with the increased acreage available for leasing in categories that may not adequately protect visual resources, and with the associated increase in potential for adjacent lands being private or non-Forest lands and not subject to compliance with scenic objectives. This scenario for cumulative effects is possible, but not likely to occur based upon the limited list of proposed developments on non-Forest lands.

5.2.3.6 Alternative E1 (NSO in IRAs)

Under this alternative, cumulative effects to visual resources would be more likely than under Alternative D because more lands are available for leasing under less restrictive options. Accordingly, the potential for cumulative effects increases with the increased acreage available for leasing in categories that may not adequately protect visual resources, and with the associated increase in potential for adjacent lands being private or non-Forest lands and not subject to compliance with scenic objectives.

5.2.3.7 Alternative E2 (SLT in IRAs)

The potential for cumulative impacts to visual resources under this alternative is greater than under Alternative E with No Surface Occupancy in IRAs, since additional lands in IRAs are included as lands available under SLT.

5.3 Inventoried Roadless Areas, Unroaded and Undeveloped Areas, and Suitable Wild and Scenic Rivers

5.3.1 Description of Cumulative Effects Area

The CEA for IRAs, Unroaded-Undeveloped Areas (as defined in the Dixie National Forest's 2005 Inventory of Unroaded-Undeveloped Areas), and suitable Wild and Scenic Rivers is the Dixie National Forest boundary plus the outermost boundary of the Boulder Mountain/Boulder Top/Deer Lake and the Long Neck Mesa/Steep Creek/Oak Creek-Steep Creek/Oak Creek IRAs on the Dixie National Forest portion of the Fremont River Ranger District administered by the Fishlake National Forest (Figure 5.3-1). The outermost boundary incorporates all existing roads and other areas that were cherry stemmed out or excluded from these IRAs. The CEA is 1,936,223 acres (Table 5.3-1).

Table 5.3-1 Land Ownership within the Cumulative Effects Area

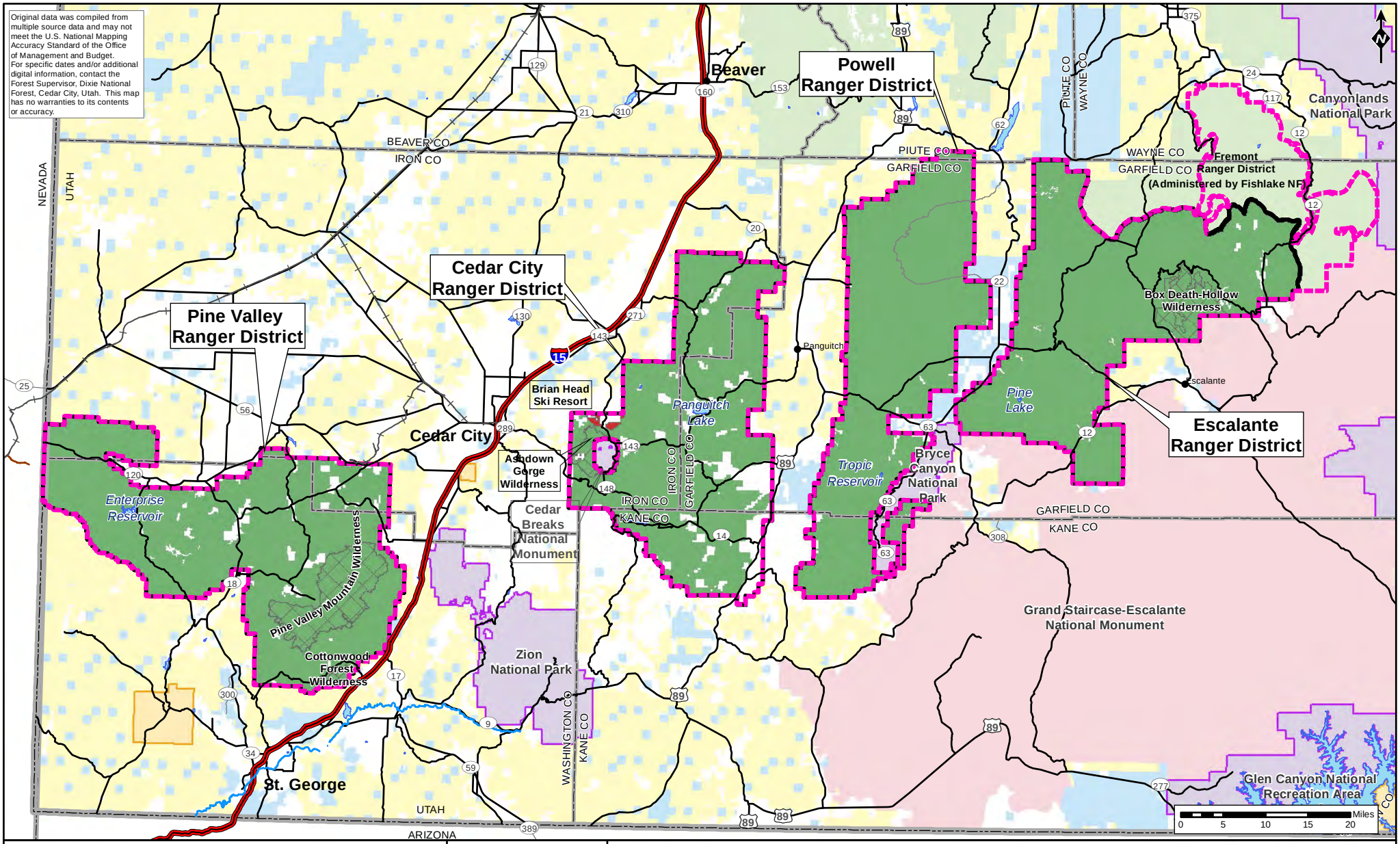
Land Management	Acres	Percent of Total CEA
Bureau of Land Management (BLM)	398	<1
National Park Service	75	<1
Private	78,083	4
Forest Service	1,770,403	91
Forest Service Wilderness Areas[1]	85,323	4
Water	1,942	<1
Total	**1,936,223**	**100**

[1] Includes the Pine Valley Mountain, Ashdown Gorge, Cottonwood Forest, and Box-Death Hollow Wilderness Areas

5.3.1.1 Rationale

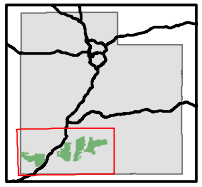
IRAs and Unroaded-Undeveloped Areas are designated on National Forest System land only and would generally only be affected by actions occurring within the Dixie National Forest. However, the Boulder Mountain/Boulder Top/Deer Lake and the Long Neck Mesa/Steep Creek/Oak Creek-Steep Creek/Oak Creek IRAs, as well as the Boulder Top and Long Neck Unroaded-Undeveloped areas, overlap the Dixie and Fishlake National Forest boundaries, with large portions of both IRAs/Unroaded-Undeveloped areas occurring on both Forests. The portions of these IRAs/Unroaded-Undeveloped Areas on the Dixie National Forest portion of the Fremont River Ranger District are included in the CEA as actions on the Dixie National Forest portion of the Fremont River Ranger District could affect the ability of these areas to be managed as IRAs/Unroaded-Undeveloped Areas.

Smaller areas that are not part of the IRAs, but are within the overall boundary were included both for simplicity as well as to incorporate any changes in these areas that could affect the ability of these areas to be managed as IRAs. In addition, some roadless characteristics such as the diversity of plant and animal communities and opportunities for solitude and primitive recreation could be affected by activities on land adjacent to the Dixie National Forest. However, these impacts would be discussed in the cumulative effects sections of other Specialist Reports, such as 5.4 (Fish and Wildlife) and 5.1 (Visual). In addition, all segments of streams suitable for inclusion in the National Wild and Scenic River System, including all upstream areas, are located entirely within the Dixie National Forest boundary and would not be affected by outside activities.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest
FIGURE 5.3-1
Cumulative Effects Area
Inventoried Roadless Areas & Suitable Wild & Scenic Rivers

1 in = 15 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Includes Dixie National Forest Boundary and Inventoried Roadless Areas and Areas of Wilderness Potential that intersect Fishlake National Forest.

5.3.2 Past, Present, and Reasonably Foreseeable Future Actions

As shown in Table 5.3-1, approximately 95 percent of the CEA is land managed by the Dixie or Fishlake National Forests. Only four percent is private land and most of that is located near developed areas (such as Duck Creek). Less than one percent of IRAs and Unroaded-Undeveloped Areas are on private land, and all suitable Wild and Scenic Rivers are located entirely on the Dixie National Forest. As a result, most of the discussion concerning past, present, and reasonably foreseeable actions will be focused on activities occurring on National Forest System land. Furthermore, the discussion will focus primarily on the following activities: timber harvest and road construction. In limiting the discussion to these activities, it is acknowledged that other types of activities may affect the broad array of roadless characteristics and wilderness attributes that help define IRAs and Unroaded-Undeveloped Areas. However, these activities will primarily be discussed in other sections.

General levels of timber harvest and road construction on the Dixie National Forest are discussed in Section 5.1.2.1. As a result, the only information presented here for these management activities is information relevant only to IRAs, Unroaded-Undeveloped Areas, and suitable Wild and Scenic Rivers, information not included in the general discussion in Section 5.1.2.1. Also, any additional information relevant to the Dixie National Forest portion of the Fremont River Ranger District is included.

ROADS

As discussed in Section 3.3.2, IRAs were set aside due to the fact that they were generally unfragmented by roads. Unroaded-Undeveloped Areas are those areas identified on the Dixie National Forest 2005 Inventory of Unroaded / Undeveloped Areas." According to Dixie National Forest GIS data, both open and administrative roads are present in IRAs and Unroaded-Undeveloped Areas. Projects on the Dixie National Forest and the portion of the Fishlake National Forests within the CEA that would include road construction are listed in Table 5.1-1. There are currently not any projects known on the Dixie National Forest portion of the Fremont River Ranger District that would involve new road construction. The only projects known to involve any road construction or reconstruction within IRAs/Unroaded-Undeveloped Areas are the Mt Dutton Vegetation Management Project on the Powell Ranger District, and the Pockets Vegetation Management project on the Escalante Ranger District and Tropic to Hatch 138 kV powerline. The Mt Dutton project would not involve any new road construction, but would involve maintenance and reconstruction of existing roads. The project would include a 274-acre portion of the Deer Creek IRA. Approximately 40 acres of this same area was previously harvested in 1990 and there is evidence of stumps, slash, skid trails, and landings, as well as three miles of Forest Road #30358 (USFS 2006d). The Pockets Vegetation Management project is only within Unroaded-Undeveloped areas, most of which have existing roads and previous timber harvest. The Tropic to Hatch Transmission line would widen and stabilize 3.5 miles of the existing administrative access routes in Cedar Fork Canyon in Henderson Canyon IRA.

On the North Fork of the Virgin River, a four-wheel-drive road provides access to private property below the Dixie National Forest Boundary. The only other road access is Forest Service Road #054, which ends 0.8 miles from the river corridor and is the starting point for the Cascade Falls Trail that provides access to a viewpoint at Cascade Falls. No other roads are planned on Forest Service land in the immediate vicinity; however, addition road construction could occur on private land below the Dixie National Forest Boundary.

TIMBER HARVESTING

Timber harvest is discussed in detail in Section 5.1.2.1 and future timber harvest projects planned for the Dixie National Forests are shown in Table 5.1-1. No timber harvests are planned within the portion of the CEA that includes the Dixie National Forest portion of the Fremont River Ranger District. None of the timber projects listed in Table 5.1-1 would impact suitable Wild and Scenic Rivers and only two, the Mt. Dutton Vegetation Management Project and the Pockets Vegetation project would occur within an IRA or Unroaded-Undeveloped Areas as described above for roads. If the status of the 2001 Roadless Area Conservation Rule were changed due to judicial action, timber harvest could occur in IRAs or Unroaded-Undeveloped Areas at similar levels to the rest of the Dixie and Fishlake National Forests.

5.3.3 Cumulative Effects by Alternative

5.3.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.3.3.2 Alternative B

Under Alternative B, a NL option would be applied to IRAs and suitable Wild and Scenic Rivers. As a result, oil and gas activity would have no direct effect on these resources. Indirect effects could occur as a result of oil and gas activity on adjacent land. Impacts to Unroaded-Undeveloped Areas would be limited to seismic activities and only minor impacts to wilderness attributes would occur. These effects would be negligible to minor and when combined with the past, present, and reasonable foreseeable actions in the CEA, would not be of a sufficient magnitude to result in cumulative effects.

5.3.3.3 Alternative C

Under Alternative C, direct effects to IRAs and suitable Wild and Scenic Rivers would be limited to seismic exploration by the application of an NSO leasing option (to IRAs), and overlap with NSO for Streams (for suitable Wild and Scenic Rivers). It is not expected that seismic exploration would produce disturbance of a magnitude sufficient to result in cumulative effects. For IRAs, the only portion of the CEA that is expected to be affected by other past, present, or reasonably foreseeable future actions is a small portion of the Deer Creek IRA on the Powell Ranger District. This area has been previously disturbed by a prior timber sale and may be disturbed by another (Mt Dutton Vegetation Treatment Project, see Table 5.1-1). If seismic exploration were to occur in the same area of the Deer Creek IRA, the disturbance would likely be undetectable relative to the disturbance that has occurred and will occur in the future from timber harvest. As a result, there would be no cumulative effects to IRAs under this alternative.

Some Unroaded-Undeveloped Areas that are covered partially by CSU under Alternative C would be affected by connected actions; these areas are listed in Section 4.3.5.3. Site-specific NEPA analysis would determine whether cumulative effects would occur to a specific Unroaded-Undeveloped Area if activities are proposed on a particular lease. In general, connected actions within Unroaded-Undeveloped Areas would not lead to cumulative effects when past, present, and future actions in Unroaded-Undeveloped Areas are considered.

5.3.3.4 Alternative D1 (NSO in IRAs)

Under Alternative D with NSO in IRAs, oil and gas activity in IRAs would be limited to seismic exploration by the NSO leasing option and there would be no cumulative effects as described for Alternative C. Cumulative effects to Unroaded-Undeveloped Areas would also be as described under Alternative C.

For suitable Wild and Scenic Rivers, up to 273 acres on the North Fork of the Virgin River could be disturbed by any of the activities predicted to occur by the RFDS, including roads, power lines, and pipelines, as limited by CSU-05. For the North Fork of the Virgin River, its outstandingly remarkable values are in spite of existing development in close proximity to the river. If this were combined with oil and gas activity of any type, it is possible that the stream would no longer be suitable for "Wild" status. This would be a major and long-term cumulative impact, as it would not likely be considered again in the near future.

5.3.3.5 Alternative D2 (CSU in IRAs)

Under this alternative, the majority of IRAs and Unroaded-Undeveloped Areas would be available under CSU and oil and gas activity within these areas could include pipelines, power lines, well pads, etc. However, the construction or reconstruction or roads would be prohibited in IRAs and the development of a production field would be precluded by the inability to construct roads. This alternative assumes that timber harvest and road construction could occur at rates similar to the rest of the National Forest System land within the CEA (due to changes in the 2001 Roadless Area Conservation Rule). Under this scenario, any areas of timber harvest would represent a direct loss of roadless acres for the life of the development. If oil and gas activity were to occur on the same IRA/Unroaded-Undeveloped Areas as other road construction or timber harvest, the direct loss of roadless acres would be larger than with either activity alone. This could result in increased fragmentation of these areas with subsequent impacts to the resources described in the roadless characteristics and wilderness attributes (see Section 3.3.2). As the amount of an IRA/Unroaded-Undeveloped Areas that may potentially be impacted by well pads is small and would not bisect the area into smaller segments, the cumulative impacts would be minor. The effects would be short term as the only likely development would be exploratory wells.

For suitable Wild and Scenic Rivers, the CSU-05 leasing option applied under this alternative would prevent degradation of the outstandingly remarkable values. As described for Alternative D1, disturbance under CSU-05 is not expected to be of a magnitude sufficient to result in cumulative effects. However, major and long-term cumulative impacts may result to the North Fork of the Virgin River (see Section 5.3.3.4).

5.3.3.6 Alternative E1 (NSO in IRAs)

NSO would limit oil and gas activity in IRAs to seismic exploration and there would be no cumulative effects as described for Alternative C. Cumulative effects to Unroaded-Undeveloped Areas would also be as described under Alternative C.

For suitable Wild and Scenic Rivers, up to 273 acres on the North Fork of the Virgin River could be disturbed by any of the activities predicted to occur by the RFDS, including roads, power lines, and pipelines. The impacts could include the degradation of outstandingly remarkable values and the possible loss of suitability for inclusion in the National Wild and Scenic River System due to the construction of roads.

5.3.3.7 Alternative E2 (SLT in IRAs)

Under this alternative, the majority of IRAs and Unroaded-Undeveloped Areas would be available under SLT and oil and gas activity within IRAs/Unroaded-Undeveloped Areas could include all activities predicted by the RFDS. This includes roads, pipelines, power lines, well pads, etc. Further, this alternative assumes that timber harvest and road construction could occur at rates similar to the rest of the National Forest System land within the CEA. Under this scenario, any road construction or timber harvest would represent a direct loss of roadless/unroaded acres for the life of the development. If oil and gas activity were to occur on the same IRA/Unroaded-Undeveloped Area as other road construction or timber harvest, the direct loss of roadless/unroaded acres would be larger than with either activity alone. This could result in increased fragmentation of these areas with subsequent impacts to the resources described in the roadless characteristics and wilderness attributes (see Section 3.3.2). Also, in some cases, particularly with the smaller IRAs/Unroaded-Undeveloped Areas, the fragmentation and loss of roadless acres may be enough that the area could no longer be managed as an IRA or considered as an Unroaded-Undeveloped Area, or simply as a large area of contiguous habitat. These impacts would be minor to moderate if they were to affect only a small portion of a larger IRA/Unroaded-Undeveloped Area; however, the impacts would range as high as major if a large proportion of IRAs/Unroaded-Undeveloped Areas and the unfragmented areas they cover were fragmented by roads and other development. The cumulative effects would be short term for exploratory wells and roads and long term for a production field with its associated roads.

For suitable Wild and Scenic Rivers, all of the streams located outside wilderness areas (i.e., North Fork of the Virgin River) would be available for lease under SLT and the impacts would be the same as described for Alternative E1. However, under this alternative more acres on suitable Wild and Scenic Rivers would be available under SLT and the potential for the impacts described in Alternative E1 to occur is increased.

Table 5.3-2 Summary of Cumulative Effects for IRAs, Unroaded-Undeveloped Areas, and Suitable Wild and Scenic Rivers

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Roads There are some existing roads within IRAs/Unroaded-Undeveloped Areas; however, these roads do not jeopardize the status of these areas. Timber Harvest Timber harvest was widespread throughout much of the CEA in the past.	Roads Most projects within the CEA focus on improving the management of roads and include road closures and decommissioning. A small amount of new roads are planned, mostly associated with timber harvest and salvage. Timber Harvest Timber harvest in the CEA has been greatly reduced relative to past levels and current harvest is primarily in response to spruce beetle outbreaks. Some portions of the Deer Creek IRA still show signs of past timber harvest.	Roads The amount of roads is not expected to increase. The Mt Dutton Vegetation Management Project would reconstruct roads in the Deer Creek IRA. If the 2001 Roadless Area Conservation Rule were not in effect, some road construction could occur in IRAs. Timber Harvest The Mt Dutton Vegetation Management Project would affect 247 acres of the Deer Creek IRA. If the 2001 Roadless Area Conservation Rule were not in effect, additional timber harvest could occur in IRAs.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts.	There would be no cumulative effects of oil and gas activity due to the lack of direct and indirect effects.
			Alternative B NL and leasing options would prevent direct disturbance to IRAs and suitable Wild and Scenic Rivers. Parts of Unroaded-Undeveloped Areas may be affected by seismic under NSO.	There would be no cumulative effects of oil and gas activity due to the lack of direct affects and the minimal nature of indirect effects.
			Alternative C NSO would limit direct disturbance in IRAs and most suitable Wild and Scenic Rivers and Unroaded-Undeveloped Areas to seismic exploration.	There would be no cumulative effects of oil and gas activity due to the minimal nature of both direct and indirect effects combined with the small amount of disturbance from past, present, and future actions.
			Alternative D1 (NSO in IRAs) NSO would limit direct disturbance in IRAs and most suitable Wild and Scenic Rivers and Unroaded-Undeveloped Areas to seismic exploration. Some development could occur near streams under a CSU stipulation.	There would be no cumulative effects to IRAs due to the minimal nature of direct disturbance. If oil and gas activity were to occur near the North Fork of the Virgin River, the existing level of disturbance when combined with oil and gas activity could affect outstandingly remarkable values. This would be a major, long-term impact.
			Alternative D2 (CSU in IRAs) Direct disturbance (not including roads or production fields) could occur to IRAs, Unroaded-Undeveloped Areas, and suitable Wild and Scenic Rivers located outside wilderness or other areas not available for leasing.	Minor short- -term cumulative impacts to IRAs/ Unroaded-Undeveloped Areas could occur if timber harvest and well pads were to occur in IRAs. Cumulative effects to suitable Wild and Scenic Rivers would be the same as described for Alternative D1.
			Alternative E1 (NSO in IRAs) NSO would limit direct disturbance in IRAs and most suitable Wild and Scenic Rivers and Unroaded-Undeveloped Areas to seismic exploration. Some development could occur near streams under SLT. .	Cumulative effects for IRAs would be the same as described for Alternative C. Cumulative effects for suitable Wild and Scenic Rivers would major and long-term if oil and gas development affected stream suitability for inclusion in the National Wild and Scenic River System.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative E2 (SLT in IRAs) Direct disturbance could occur to IRAs, Unroaded-Undeveloped Areas, and suitable Wild and Scenic Rivers.	Cumulative effects for IRAs and Unroaded-Undeveloped Areas would be major if oil and gas development, combined with other road development, led to a loss of IRA status or unroaded classification for Unroaded-Undeveloped Areas. Cumulative effect to suitable Wild and Scenic Rivers would be the same as described for Alternative E1.

5.4 Recreation Resources

5.4.1 Description of Cumulative Effects Area

The CEA for recreation includes all 6th level HUC subwatersheds occurring on the Dixie National Forest that are within the following boundaries: north of the Virgin River, east of the Union Pacific rail line located west of the Utah-Nevada border, south and east of US Highway 56 and Desert Mount Road, east of Interstate 15 north of Cedar City, and south and west of US Highway 12 on the Fremont River Ranger District. The CEA would also include all of Bryce Canyon National Park and all land between the subwatersheds and a buffer extending 5 miles south from US Highway 12 between the towns of Boulder and Escalante. No data existed for one of the subwatersheds on the west side of the Pine Valley Ranger District and a buffer was created by extending a boundary west from the nearest subwatershed (Nephi Draw HUC 160300061301) along an existing dirt road to an intersection with the Union Pacific rail line at Brown, Nevada. These boundaries were placed on the 6th level subwatersheds due to the presence of several subwatersheds that covered only very small portions of the Dixie National Forest, but extended long distances from the Dixie National Forest boundary. The portions of these watersheds eliminated are likely beyond the extent of any cumulative effects.

5.4.1.1 Rationale

The CEA covered by the 6th level HUC subwatersheds encompasses all of the land between the Cedar City, Powell, and Escalante Ranger Districts and a large portion of BLM land surrounding all four ranger districts. This area, with Bryce Canyon National Park and the buffer around US Highway 12 included, encompasses all major roads and highways used to access the Dixie National Forest and should encompass most recreational activities and settings in the general area. The CEA would also cover a large portion of most Limited Entry hunt units that occur on the Dixie National Forest, with the exception of the Paunsaugunt and Kaiparowits units, which extend south to Lake Powell and the Arizona State line. However, the CEA covers all of the crucial and substantial habitat for elk and approximately 32 percent of the habitat for mule deer. As a result, the CEA is considered sufficient to analyze impacts to hunting.

5.4.2 Past, Present, and Reasonably Foreseeable Future Actions

In general, most surface disturbing activity has the potential to result in cumulative impacts to recreation resources. The following management activities may affect recreation resources: increased recreation, prescribed fire, timber harvest, and minerals activity (including oil and gas). General information on these activities for the Dixie National Forest is presented in Section 5.1.2.1. As a result, the information presented for these management activities in this section is relevant only to recreation resources, information not included in the general discussion in Section 5.1.2.1. Also any additional information relevant to other portions of the CEA (BLM administered land, state land, and private land) is included.

RECREATION AND OHV USE

Increased recreation use as discussed in Section 5.1.2.1 continues to strain resources due to a lack of funding that has led to a large backlog of deferred maintenance for recreation facilities on the Forest. OHV use is considered one of the biggest impacts to the National Forest System (USFS 2006c) and the Dixie National Forest is no exception. It is anticipated that the Motorized Travel Plan, which restricts motorized use to designated routes and will largely eliminate off-trail or cross-country motorized travel. This should reduce some of the impacts of motorized

recreation on other resources; however, increased use will still continue on those routes open to motorized travel.

As a primary activity, OHV use will generally continue to trend upward. This is particularly the case for OHV use on established motorized trail systems. Monitoring of the trail system in 2004 and 2005 indicates that there was a Forest-wide increase in use of the more heavily traveled trails on the Forest, while there was a slight decrease in the amount of use on lesser-used trails (USFS 2004b). Much of the increased use on the heavily used trails can be attributed to an overall increase in OHV use on the Forest (USFS 2009c). Implementation of the MTP will increase maintenance on trails left on the system as motorized use is restricted to designated routes.

FIRE

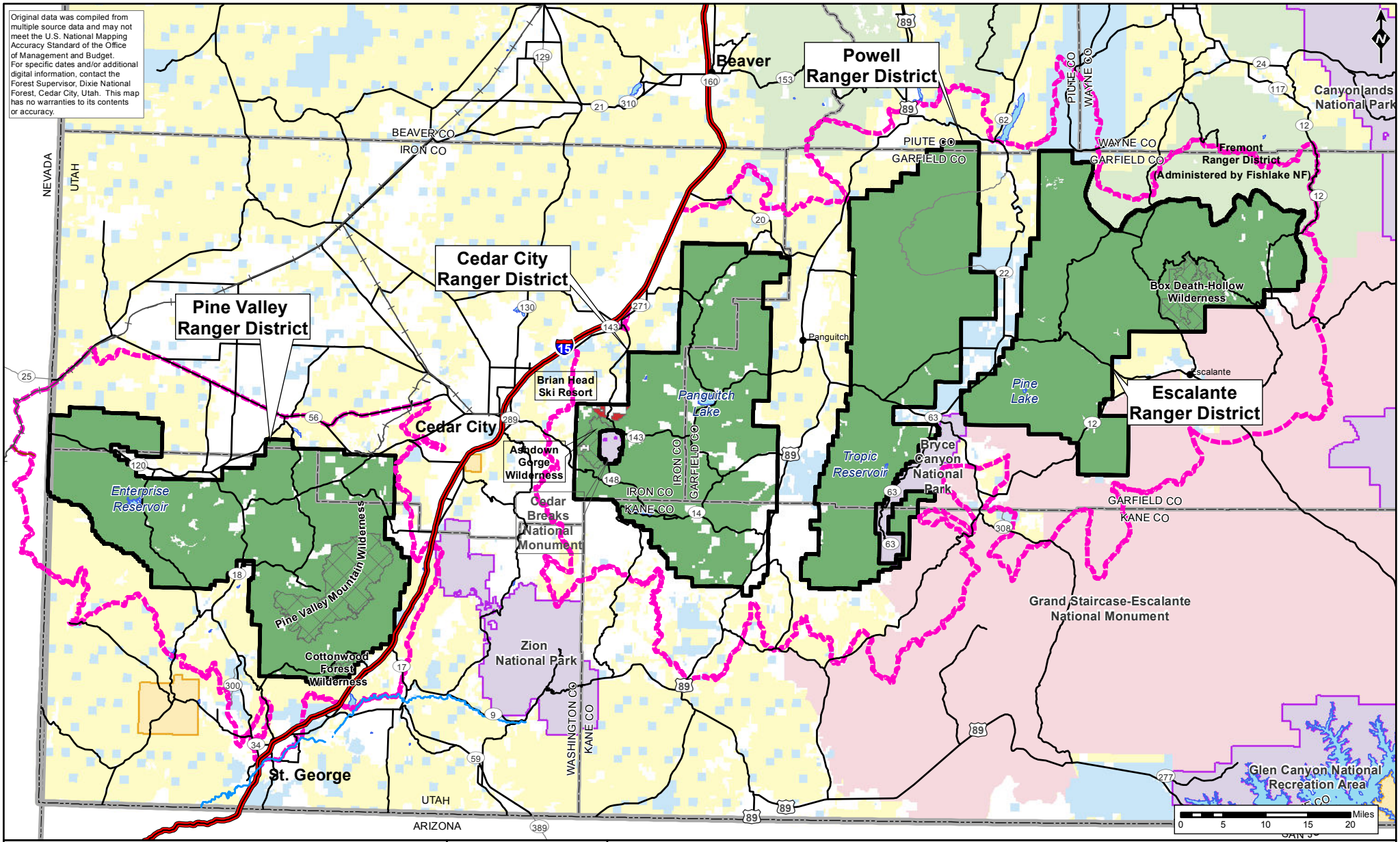
Fire on the Dixie National Forest was described in Section 5.1.2.1. Historical fire levels on other lands outside the Dixie National Forest are likely similar for timbered lands near the Dixie National Forest boundary, and lower in the lower elevation grasslands. Areas affected by fire are frequently closed to recreational activities until vegetation begins to recover. Fire can also diminish the visual quality of the landscape, thus making some areas undesirable for viewing scenery and wildlife, and dispersed camping.

TIMBER HARVESTING AND VEGETATION MANGEMENT

Timber harvest and vegetation management on the Dixie National Forest is described in Section 5.1.1.2. Timber harvest in other portions of the CEA (BLM, state, and private land) would be less that on the Forest, due to a lack of timber at these lower elevations. However, vegetation management, such as the chaining of pinyon-juniper may occur on BLM land.

The most common effects to recreational user groups include decreased forest lands available for recreation, disruption of visual quality, increased noise, increased traffic, and increased (temporary) road construction, reconstruction, decommissioning. Ultimately these effects can cause user groups to relocate to other areas. Should oil and gas exploration take place in close proximity to these activities, cumulative impacts to recreation could occur. The majority of these effects are temporary in duration, lasting as long as the harvest or management activity is active. Impacts associated with large-scale timber harvests, timber salvage, and prescribed burns tend to be short-term in duration. Impacts of these activities are generally associated with visual disruptions. However, once the vegetative integrity of these areas has recovered, the scenic quality of the affected area is often improved beyond pre-activity conditions.

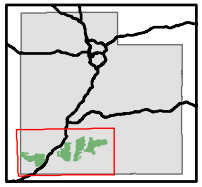
Ongoing and future timber harvesting and vegetation management projects are detailed in Table 5.1-1. Projects that could potentially result in cumulative impacts include, but are not limited to: the Mount Dutton vegetation management project, the Upper Santa Clara River vegetation and fuels project, the Duck Creek fuels treatment, Midway-Deer Valley scenery enhancement and vegetation treatment, and Pockets vegetation management.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.4-1
Cumulative Effects Area for Recreation Resources

1 in = 15 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Comprised of 6th-Level (HUC 12) Watersheds that occur on Dixie National Forest. Clipped to Selected Highways, the Virgin River, Railroads, Bryce Canyon National Park, and a 5-mile buffer of Highway 12 between Escalante and Boulder.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Forest are listed in Table 5.1-1. Table 5.4-1 re-lists these projects and describes the potential effects to recreation from each.

Table 5.4-1 Potential Impacts to Recreation Resources from Projects listed in Table 5.1-1

Project	Potential Impacts to Recreation Resources
Aerial application of fire retardant	Would temporarily increase noise and human disturbance. Would temporarily displace campers to other areas.
Pine Valley Campground Bridge Construction	Would temporarily increase noise, human disturbance, and traffic. Would temporarily displace campers to other areas. In the long term, it would improve access.
Mt. Dutton Vegetation Management Project	Would temporarily increase noise, human disturbance, and (temporary) traffic. Would enhance the long-term visual qualities of the forest.
Upper Santa Clara River Vegetation and Fuels Project	Would temporarily increase noise, human disturbance, and (temporary) traffic. Would facilitate campground access and reduce risk of wildfire.
Duck Creek Fuels Treatment	Would temporarily increase noise, human disturbance, and traffic. Would reduce wildfire risk.
Edward Spring Vegetation Treatment	Would temporarily displace campers to other dispersed areas until vegetation recovers.
Midway-Deer Valley Scenery Enhancement & Veg Treatment	Would temporarily increase noise, human disturbance, and (temporary) traffic. . Increase funding to accomplish ancillary projects in recreation.
Brian Head ATV Trail	Would temporarily increase noise and human disturbance; long term would increase motorized recreation opportunity.
Harris Flat ATV Access Trail	Would temporarily increase noise and human disturbance; long term would increase motorized recreation opportunity.
Outfitter Guide Special Use Permit Issuance	Would facilitate users in need of guides and outfitters.
Dipping Vat Habitat Improvement Project	Would temporarily increase noise, human disturbance, and traffic.
McGath Lake Dam	Would temporarily increase noise and human disturbance. May temporarily displace anglers to other areas. Would ensure the security of the fishery once complete.
Pockets Vegetation Management	Would temporarily increase noise, human disturbance, and (temporary) traffic. Long term, the project should enhance visual quality.
Toad Salvage	Would temporarily increase noise, human disturbance, and traffic. Long term, the project should enhance visual quality.

5.4.3 Cumulative Effects by Alternative

5.4.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.4.3.2 Alternative B

Under Alternative B, Developed Sites, Semi-Primitive Non-Motorized, and Recreation Residences would be categorized as NSO; however, large parts of these areas would be NL or NA due to overlapping leasing options with other resources. No cumulative impacts would occur to any recreation resources from seismic activities under NSO because noise and human presence impacts would be temporary. Semi-Primitive Motorized and Roaded Natural areas would be open to leasing under CSU or a more restrictive leasing option. Adverse cumulative effects could occur from the construction of roads if approved, exploratory well pads, and particularly a production field if these facilities are constructed in areas that have been impacted by past visual disturbance, such as fire or clearcuts. Future management activities such as timber harvests, facilities upgrades, and vegetation maintenance could add to noise, human presence, and traffic in such areas. These past and future disturbances could result in user displacement and groups abandoning certain areas. However, CSU regulations would require the oil and gas activities to be located so that they would not be obvious or interfere with recreation users, including controlling access routes and providing for extensive reclamation. Mitigation measures may also require that proposed well sites be individually sited on a case-by-case basis to take advantage of vegetative or topographic screening. These regulations could prevent oil and gas activities from being located in close proximity to areas of past disturbance and other management activities, and thus could prevent cumulative effects from occurring in Semi-Primitive Motorized and Roaded Natural areas. Cumulative impacts to recreation resources under Alternative B would be negligible.

5.4.3.3 Alternative C

Alternative C has less restrictive leasing options than Alternative B and more restrictive options than Alternative D. As under Alternative B, cumulative impacts from seismic activities in areas covered by NSO would be negligible because impacts would be temporary. Cumulative impacts in Semi-Primitive Motorized and Roaded Natural areas covered by CSU would also be negligible. Management activities that increase in noise, human presence, traffic, and other visual interruptions (such as timber harvest, thinning, and salvage) are occurring and will continue to occur in these areas. Because of oil and gas activities occurring in settings for various dispersed recreation activities in addition to current and foreseeable future management actions, users may abandon these sites and/or be displaced to other areas of the Forest; however, cumulative impacts would be negligible because dispersed activities can usually easily move to other locations.

5.4.3.4 Alternative D1 (NSO in IRAs)

The potential for cumulative impacts to recreation resources would be slightly higher under Alternative D with NSO in IRAs, relative to Alternative C, because more of these and surrounding areas are available for leasing. Primitive settings would be subject to NSO or NA under this alternative and Developed and Semi-Primitive Non-Motorized areas would be open to leasing under CSU or a more restrictive leasing option. Seismic activity noise and human presence under NSO would not lead to cumulative impacts within Primitive ROS settings. Oil

and gas developments within Developed Sites may lead to cumulative impacts considering the substantial amount of current and foreseeable management activities (i.e., fuels projects) occurring in these areas and the general lack of funding for maintenance. Cumulative impacts to Developed sites under Alternative D (both alternatives) could be minor and short to long term, depending on the duration of activities. Oil and gas developments within Semi-primitive Non-Motorized areas could change the character of these areas through road building and activities that involve vehicles; however, due to the substantial overlap with IRAs within Semi Primitive Non-Motorized ROS settings (63 percent NSO in IRAs), impacts are more likely to be limited to seismic noise and human presence. Thus there would probably be temporary impacts in these areas and no cumulative impacts.

5.4.3.5 Alternative D2 (CSU in IRAs)

Cumulative impacts to recreation resources would be the same duration and intensity as under Alternative D with NSO in IRAs with the exception of Semi Primitive Non-Motorized ROS settings. Cumulative impacts would be possible in these areas because 97 percent would be CSU or TL (for another resource), under which any oil and gas activities could occur. Although the CSU leasing option is designed to protect this resource, any motorized activity could compromise the character of a non-motorized area. Cumulative impacts to Semi Primitive Non-Motorized ROS areas under this alternative could be long term and minor.

5.4.3.6 Alternative E1 (NSO in IRAs)

Cumulative effects under this Alternative would be the same as described for Alternative E with SLT in IRAs, with the exception of Semi-Primitive Non-Motorized ROS settings. As under Alternative D with NSO in IRAs, these areas substantially overlap IRAs and would likely only be affected by temporary seismic noise and human presence under NSO. Cumulative impacts in Semi-Primitive Non-Motorized ROS areas would be negligible.

5.4.3.7 Alternative E2 (SLT in IRAs)

Cumulative impacts would be possible to Semi-Primitive Non-Motorized areas, developed sites, and recreation residences. Cumulative impacts to Semi-Primitive Non-Motorized areas would be as described under Alternative D with CSU in IRAs (the majority of these areas overlap IRAs). Cumulative impacts to developed sites would be as described under Alternative D with NSO in IRAs (these areas do not overlap IRAs). Cumulative impacts to recreation residences may occur for similar reasons as for developed sites: these areas are within those currently affected by fuels treatments and past impacts (i.e., fires, spruce beetle outbreaks) and thus may be rendered completely unsatisfactory to users if oil and gas developments occurred in the vicinity. Recreation residences are few in number and thus displacement could not be mitigated. Cumulative impacts to recreation residences under Alternative E (both alternatives) could be minor and short to long term.

5.5 Fish and Wildlife

5.5.1 Description of Cumulative Effects Area

The CEA for fish and wildlife is all 6th level HUC subwatersheds occurring on the Dixie National Forest that are within the following boundaries: north of the Virgin River, east of the Union Pacific rail line located west of the Utah-Nevada border, south and east of US Highway 56 and Desert Mount Road, east of Interstate 15 north of Cedar City, and south and west of US Highway 12 on the Fremont River Ranger District. No data exists for one of the subwatersheds

on the west side of the Pine Valley Ranger District and a buffer was created by extending a boundary west from the nearest subwatershed (Nephi Draw HUC 160300061301) along an existing dirt road to its intersection with the Union Pacific rail line at Brown, Nevada. These boundaries were placed on the 6th level subwatersheds due to the presence of several subwatersheds that covered only very small portions of the Dixie National Forest, but extended long distances from the Dixie National Forest boundary. The portions of these watersheds eliminated are likely beyond the extent of any cumulative effects.

The CEA is shown in Figure 5.5-1. Lands within the CEA are managed primarily by the Dixie National Forest (50% of the CEA, includes Wilderness). Twenty eight percent of lands in the CEA are managed by the BLM, within the Grand-Staircase Escalante National Monument or the Richfield, Kanab, Cedar City, or St. George BLM Districts. Sixteen percent of the CEA is private land; and the remainder is State Trust Lands (4%), National Park Service (1%; Cedar Breaks National Monument and Bryce Canyon National Park), and State Parks or wildlife reserves (1%). Actions within the CEA are discussed within 1) the Dixie National Forest National Forest, 2) the Grand Staircase-Escalante National Monument, or 3) various BLM districts (Richfield, Kanab, Cedar City, or St. George), since these areas make up the majority of the CEA. Actions on private or other lands are not discussed due to the small representation in the CEA or lack of data.

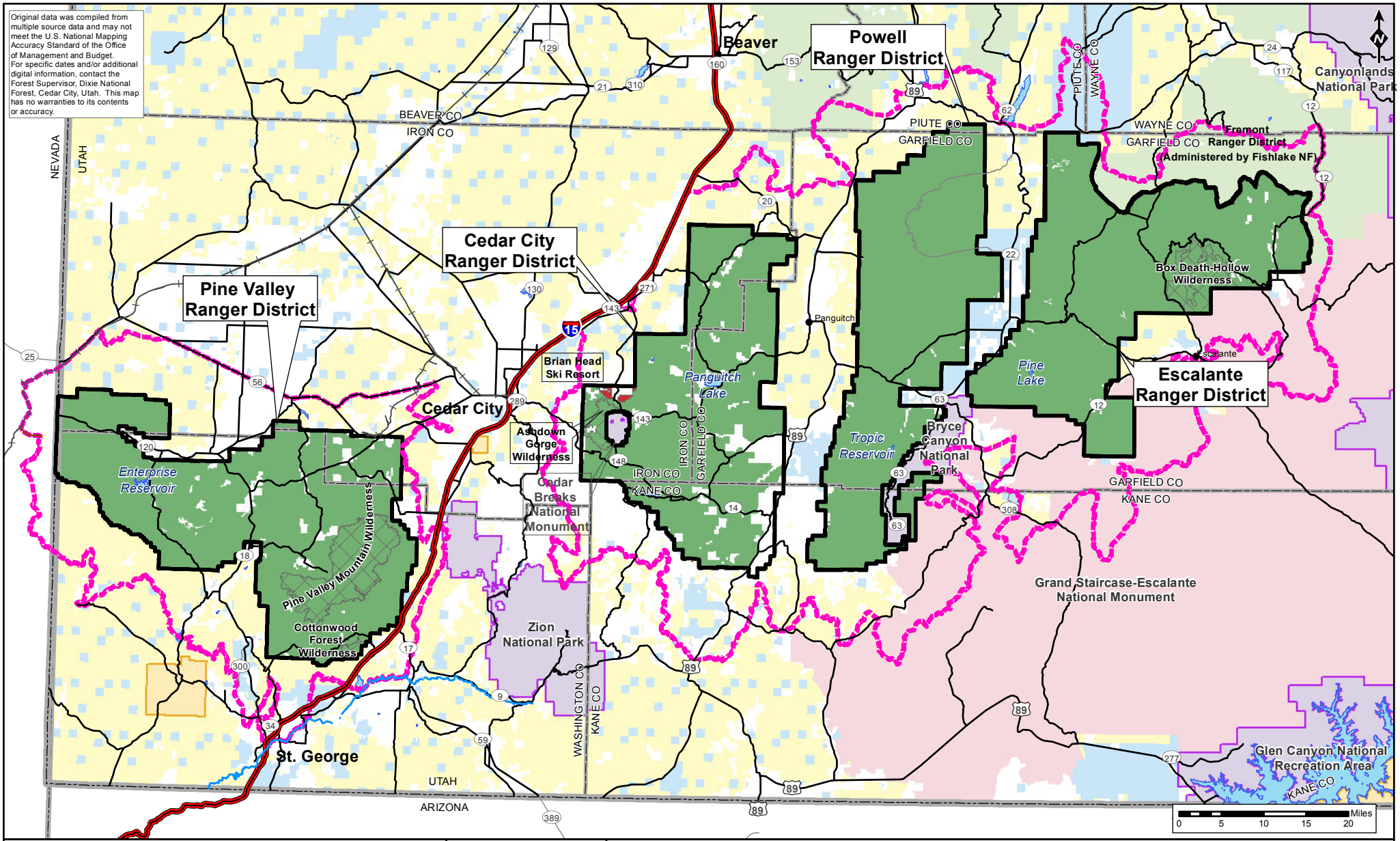
5.5.1.1 Rationale

The 6th Level HUC subwatershed level was chosen as the CEA because native fish are unlikely to migrate beyond these boundaries. Further, native fish are unlikely to migrate beyond the artificial boundary placed on several of the subwatersheds due to the distance these subwatersheds extend and a general lack of large streams in these subwatersheds. The subwatershed level would cover most terrestrial wildlife movements with the exception of migratory birds and wide-ranging predators and big game.

5.5.2 Past, Present, and Reasonably Foreseeable Future Actions

Throughout the CEA, wildlife habitats have been shaped by natural disturbances as well as active management and manipulation by humans. On Forest Service land, many forests are characterized by overstocking, layering, and encroachment by shade-tolerant climax tree species, which increases the susceptibility of these areas to fire and insect outbreak that can remove large areas of habitat. Past and present management activities on public lands (USFS and BLM) continue to impact habitat by removing vegetation and altering vegetation communities by changing species composition. In general, private lands are assumed to be in various stages of increasing development and to contain little wildlife habitat.

Within the Utah High Plateaus and Mountains region, riparian areas have been degraded by a variety of activities over the past several decades. Negative effects include the lowering of water tables, erosion of stream channels, invasive plant encroachment, removal of beaver populations, increased water temperatures, concentrated runoff and increased sediment from road construction, and changes in upland vegetation density and composition. Impacts to riparian and wetland areas on the Forest are discussed in Section 4.7 and 5.7. Native fishes and other aquatic species have been affected by the changes to riparian habitats, primarily by increased sediment levels from erosion where riparian vegetation has been altered or removed. Sedimentation reduces the amount of exposed gravels for native fish spawning, broadens stream channels, creates shallow waters, reduces the abundance and quality of pools, and increases water temperatures, all of which create conditions that are less suitable for native fishes and other aquatic species.


Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.
Beaver
Powell Ranger District
Canyonlands National Park
BEAVER CO
IRON CO
PIUTE CO
WAYNE CO
GARFIELD CO
Fremont Ranger District (Administered by Fishlake NF)
NEVADA
UTAH
Cedar City Ranger District
Pine Valley Ranger District
Box Death Hollow Wilderness
Panguitch
Escalante
Escalante Ranger District
Brian Head Ski Resort
Panguitch Lake
Pine Lake
Cedar City
Ashdown Gorge Wilderness
Tropic Reservoir
Bryce Canyon National Park
Enterprise Reservoir
Cedar Breaks National Monument
KANE CO
Pine Valley Mountain Wilderness
Cottonwood Forest Wilderness
Grand Staircase-Escalante National Monument
Zion National Park
WASHINGTON CO
St. George
ARIZONA
Glen Canyon National Recreation Area
Miles
0 5 10 15 20
Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest
FIGURE 5.5-1
Cumulative Effects Area for Fish & Wildlife
1 in = 15 miles
1:1,000,000
Horizontal Datum = NAD 83
Coordinate System = Zone 12N
Cities
Railroad
Minor Roads*
Major Roads
Freeways
Virgin River
Water Bodies
County Boundaries
State Lines
National Forest System Lands
Dixie National Forest
Wilderness Areas
Fishlake National Forest
Brian Head Ski Resort
Other Land Administration
Bureau of Land Management
GSENM**
National Park Service
Private
State of Utah
Tribal
Cumulative Effects Area***
*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Comprised of 6th-Level (HUC 12) Watersheds that comprise Dixie National Forest. Clipped to Selected Highways, the Virgin River, and Railroads.

The following management activities have had or may have impacts on fish and wildlife within the CEA in the foreseeable future: roads, livestock grazing, vegetation changes, fire, invasive plants, recreation, and oil and gas leasing. While impacts in the CEA continue to occur, many of the activities listed have decreased or become better managed in recent years on federally managed lands as the importance of overall ecosystem health has been recognized. The past and present levels of each type of activity on the Dixie National Forest and the expected level of future activity are presented in Section 5.1.2.1. This section described the general impacts to fish and wildlife that have resulted and any activity on lands other than the Dixie National Forest.

ROADS

The construction of roads in close proximity to streams has altered the structure and function of these areas within the CEA. Roads can channel surface water runoff directly into streams, when it would normally travel slowly or diffusely through the watershed. The result is that sediment inputs to streams are high in some areas and have degraded the quality of aquatic habitat. Table 5.5-1 shows the miles of Forest Service routes that have the potential to, or are currently impacting aquatic habitat.

Table 5.5-1 Forest Service Routes Impacting Aquatic Habitat

Impacts[1]	Miles of Forest Service Routes			
	Pine Valley	Cedar City	Powell	Escalante
Route presents a high or moderate risk to soil and water resources	342.2	374.2	426.1	551.4
Route impacts stream channels, floodplains, wetlands, or riparian areas	385.1	346.9	152.8	478.0
Route is within a stream channel	0.0	2.2	0.0	0.0
Routes with stream crossing	640.5	591.7	682.7	604.3
Routes within 200 feet of streams	700.7	670.1	815.8	710.2

Source: Dixie National Forest Route Analysis Database

[1] Motorized Travel Plan implementation (see USFS 2009c) will close some routes that are negatively impacting soil, water, and wildlife resources, and/or are not needed for future resource management activities.

LIVESTOCK GRAZING

Grazing is thought to have had moderate adverse impacts on watershed (Section 5.7) and aquatic habitat on the Dixie National Forest from grazing allowances in riparian areas, including a reduction in plant cover and soil compaction that have led to a decrease in natural surface water infiltration, a concomitant increase in surface water runoff, and changes in stream channel morphology (USFS 1995a). On all BLM lands, including the Grand Staircase-Escalante National Monument, grazing is allowed and is managed in accordance with BLM guidelines to protect the watershed, aquatic habitat, and water quality, and move toward or maintain properly functioning condition (BLM 1999a). Grazing in the Kanab BLM district has decreased significantly in order to recover from recent droughts and improve the range condition in recent years. Grazing on the Grand Staircase-Escalante National Monument, on BLM land, and on the Dixie National Forest is managed according to Utah Standards of Rangeland Health.

VEGETATION CHANGES

Habitat changes that have occurred on the Dixie National Forest (described in Section 5.1.2.1) have reduced the habitat available for many migratory bird species that breed in or utilize early succession habitats. Vegetation management on the Forest is currently attempting to reverse the trends of climax species encroachment, and vegetation "restoration" treatments on the Grand Staircase-Escalante National Monument are expected to cover approximately 20,000 acres over the next 15 years (BLM 1999a).

FIRE

Fire on the Dixie National Forest is described in Section 5.1.2.1. Large, severe fires remove vegetation and decrease infiltration rates, increasing the potential for large flood and sedimentation events, which can degrade aquatic habitats and alter channel morphology (Dwire and Kauffman 2003, Wondzell and King 2003). The removal of vegetation also directly decreases the amount of shaded habitat areas for fish and increases the water temperature. The Sanford Fire (Powell Ranger District, Dixie National Forest) that occurred in 2002 has resulted in changes to channel morphology in the Cottonwood Creek, Deep Creek, and Deer Creek watersheds (USFS 2004c). The frequency of large, severe fires is expected to increase in the future due to the limited acres than can be treated to reduce fuel loads and climatic changes. On the Grand Staircase-Escalante National Monument, fires have played a smaller role in the shaping of the landscape and there is little suppression activity (BLM 1999a). On the Richfield BLM District, there has been a spike in fire frequency over the past ten years; however, aquatic habitat in scarce due to water diversions.

INVASIVE AND NONNATIVE PLANTS

Invasive and nonnative plants on the Dixie National Forest are described in Section 5.1.2.1. Cheatgrass is a problem being addressed on the Richfield BLM District and has contributed to the increased fire frequency in addition to the loss of desert scrub, sagebrush, and grasslands. The BLM, including the Grand Staircase-Escalante National Monument, works cooperatively with local governments and private landowners to identify and control invasive plants. Many terrestrial species in the CEA have been affected by the spread of invasive plants, which are often less nutritious and less functional than natives as part of wildlife habitats. Invasive plants usually deplete soil and water resources more quickly and aggressively than native plants, thus out-competing them, and reducing the diversity of the vegetation, which tends to diminish the value of wildlife habitats in general. In riparian areas, tamarisk (*Tamarix ramosissima*), whitetop (*Cardaria draba)*, and Russian olive (*Elaeagnus angustifolia*) are slowly replacing native riparian vegetation such as willows (*Salix* spp.) and cottonwoods (*Populus* spp.) in the CEA. Aquatic habitats become degraded due to invasive plants replacing natives because grasses tend to replace native shrubs and trees that had stabilized banks from erosion (and sedimentation) and shaded the stream, keeping the water temperature low. Aquatic and wildlife species in the CEA have been impacted by the spread of invasive plants, and invasions are expected to increase in the foreseeable future.

RECREATION

OHV use, described for the Dixie National Forest in Section 5.1.2.1, particularly cross-country travel, has resulted in direct impacts to riparian and upland vegetation as well as noxious weed introductions. However, OHV cross-country use on the Dixie NF is expected to decrease as a result of the implementation of the MTP decision signed April 2009. On BLM districts, OHV use has increased from 5 to10 years ago and management strategies are still being devised to protect wildlife and fish habitats.

MINERALS ACTIVITY

Past and present oil and gas activity on the Dixie National Forest, including the Upper Valley oil field, is described in Section 5.1.2.1. In the past few years there has been a renewed interest in oil and gas within the CEA and there are currently 122 authorized leases and 14 pending leases, with a combined total lease area of 101,682 acres (UDNR 2008b). While these leases occur throughout the CEA, they tend to occur in clusters. Some of the larger clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante Ranger District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active. The only other recent activity on these leases has been the drilling of a five wildcat wells on state and private land, all of which have been plugged and abandoned (UDNR 2008a). While the lease acreage is not reflective of potential surface disturbance area, it may be likely that the larger lease areas and the lease clusters may eventually have a greater area of surface disturbance than a smaller, isolated lease. Further, it can be assumed that similar types of impacts as are described for on-Forest leases could occur on these leases as well.

The portion of the CEA within the BLM's Richfield District has a low development potential for oil and gas (described in Section 5.2.2). The RFDS for the BLM's Kanab District predicts 90 new well sits and up to 1,500 miles of seismic data. These would disturb an estimated 2,070 acres (23 acres per well) and 905.5 acres, respectively. Some of this development could occur on the portions of the Kanab District within the CEA. The BLM's Cedar City District RFDS on the eastern portion of the Field Office is three exploratory wells per year (BLM 2008d). There are currently 254 authorized oil and gas leases in the Cedar City Field Office, totaling over 450,000 acres, over 90 percent of which occur within the eastern half of the district in an areas bounded by I-15 (on the east) and the Union Pacific Railroad (on the west). Although nearly all public lands in the Cedar City Field Office have been under federal oil and gas lease at some time in history, future leasing interest is likely to be focused within this area. There are currently no oil and gas production facilities within the Cedar City Field Office.

On state land, there is the possibility of unquantified drilling for coal bed methane within the John's Valley area within the next 15 years. This would likely involve not only drilling but also establishment of a gas delivery system to market the gas if it occurred in paying quantities. Production would most likely be gas rather than oil. One of the five wells that was plugged and abandoned was a coal bed methane well in this area.

In addition to oil and gas activity, there are currently 25 separate minerals activities, more than half of which are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are all very small operations (less than five acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, all of these are inactive or in some stage of reclamation. There are two larger mines proposed for the near future: the Alton Coal Hollow mine and the Iron Spring iron mine.

Alton Coal Mine

The Coal Hollow mine is proposed by Alton Coal Development, LLC. The company plans to mine up to 2 million tons of surface coal on 635 acres of private land. An engineering evaluation and air quality impact analysis done for the air quality permit process found the proposed strip-mine development project meets federal and state air quality rules and regulations. The permit

for mining on private reserves was approved on November 8, 2010 after being upheld following contests from environmental groups.

The initial stages of mining will slowly roll out a smaller number of highway-approved tractor-trailers transporting coal from Alton to Intermountain Power Agency's plant near Delta. The number of trucks could eventually expand to as many as 300 coal trucks per day passing through Panguitch and other towns on state Route 89 (St. George Spectrum 09/20/2010).

Iron Springs Mine

Palladin Iron Corporation was recently granted Tentative Approval of Amended Notice of Intention to Commence Large Mining Operations at the Iron Springs mine. These mines were last active over 50-years ago and previously disturbed 417 acres. Plans over the next five years include the disturbance of 48 currently undisturbed acres and 14 acres that were previously disturbed.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Dixie National Forest are listed in Table 5.1-1. Table 5.5-2 re-lists these projects and describes the potential effects to fish and wildlife in the CEA from each. Focus areas for vegetation management on the Dixie National Forest in the near future include Mount Dutton, East Fork Sevier River, and the spruce fir forests on the Escalante Ranger District.

Table 5.5-2 Potential Impacts to Fish and Wildlife from Projects listed in Table 5.1-1

Project	Potential Impacts to Fish and Wildlife Resources
Upper Santa Clara River Vegetation and Fuels Project	Habitat removal: 1,662 total treatment acres, of which 352 acres will be treated in 2008, and 596 acres will be treated in 2009; decreased risk of uncharacteristic wildfire that would remove habitat.
Pine Valley Fuels Treatments	Habitat removal: 217 acres in 2011; decreased risk of uncharacteristic wildfire that would remove habitat.
Navajo Basin Forest and Scenic Recovery	Habitat removal (dead/dying conifers); regeneration of aspen and conifer habitat on 4,737 acres in 2011
Red Desert Vegetation Treatment	Habitat removal: prescribed burning to regenerate aspen habitat on 2,225 acres in 2011.
Tippets Salvage	Habitat removal (dead/dying conifers) on 250 acres in 2011.
Duck Creek Fuels Treatment	Habitat removal: Phase II will treat 600 acres and Phase III 2,800 acres in 2008, 10,000+ acres in 2009, 5,000 acres 2010, and 1,500+ acres in 2011; decreased risk of uncharacteristic wildfire that would remove habitat.
Edward Spring Vegetation Treatment	Vegetation removal and increase in early succession grassland and aspen habitat: 1,108 acres.
Paunsaugunt Vegetation Management	Habitat removal and modification in aspen stands to regenerate aspen habitat: 2,218 acres in 2012.
Sawmill Point/Baldy Ridge Aspen Improvement	Habitat removal and regeneration of aspen stands on 894 acres in 2011.
Midway-Deer Valley Scenery	Habitat removal, including spruce, aspen, and meadow; treatments include 600 acres in 2008, 400 acres in 2009, and 200 acres in 2010.

Project	Potential Impacts to Fish and Wildlife Resources
Enhancement and Vegetation Treatment	
Pretty Tree Bench Fire Treatments	Would enhance elk and deer winter range.
Stump Springs Fire Treatments	Habitat removal: 5,400 acres over 9 years; decreased risk of uncharacteristic wildfire that would remove habitat.
Dipping Vat Habitat Improvement Project	Improvement of sagebrush habitat on 1,132 acres.
John's Valley Vegetation Project	Improvement of sagebrush habitat on 2,000 acres beginning in 2012.
Mt. Dutton Vegetation Management Project	Habitat removal on approximately 870 acres, including approximately 620 acres in 2009, 200 acres in 2010, and 50 acres in 2011. Conifer and aspen trees would be established, thus creating a more diverse habitat than what existed before the outbreak.
East Fork Boulder Creek Native Trout Restoration	Impacts to non-native trout; long term would increase distribution of Colorado River cutthroat trout.
McGath Lake Dam	Reduce risk to fisheries in McGath Lake: 2008
Pockets Vegetation Management	Conifer (4,721 acres) and aspen (2,647 acres) habitat removal.
Toad Salvage	Removal of ponderosa pine trees.
UNEV Pipeline	Minor habitat disturbance due to pipeline establishment in existing ROW.

Projects in the official planning stage on BLM lands are listed below in Table 5.5-3. Minor projects in the foreseeable future not listed below include routine maintenance, range projects, minor ROW authorizations, permit renewals, wind testing projects.

Table 5.5-3 Reasonably Foreseeable Future Actions on the BLM land with the CEA

Project	Project Description	Approximate Project Location	Potential Impacts to Fish and Wildlife
Projects on BLM-administered land			
Sigurd to Red Butte Power Line Upgrade Project	Upgrade an existing power line from the Sigurd substation (6 miles northeast of Richfield) to the Red Butte substation (near Central).	BLM lands north of Pine Valley Ranger District	Would remove some wildlife habitat within the 150-foot ROW
Upper Kanab Creek Project	Within the upper Kanab Creek watershed, reduce hazardous fuels, restore sagebrush, increase plant species diversity, enhance habitat conditions for mule deer and sagebrush-obligates, and decrease pinyon-juniper encroachment. Project Area	BLM lands south of Cedar City and Powell Ranger Districts	Would remove some habitat for forest-dependent species; long term habitat enhancement for sagebrush obligates and mule deer;

Project	Project Description	Approximate Project Location	Potential Impacts to Fish and Wildlife
	includes 90,000 total acres of BLM lands.		
Alton Sage Grouse Habitat Project	Restore sage-grouse movement corridors by mechanical vegetation treatments and seeding. Project Area includes 400 acres of BLM lands predominantly pinyon-juniper/sagebrush	BLM lands south of Alton	Long-term enhancement of sagebrush habitat, also beneficial impacts to mule deer.
Shinob Kibe Riparian Treatment	Removal of salt cedar and planting of desirable riparian and upland species on 24 acres along the Virgin River floodplain.	BLM lands near Washington, Utah	Long-term improvement of riparian habitat for Virgin River chub, woundfin, Virgin spinedace, southwestern willow flycatcher, and yellow-billed cuckoo

5.5.3 Cumulative Effects by Alternative

Cumulative impacts to migratory birds, including raptors, could be minor to moderate under Alternatives B, C, D, and E. Cumulative impacts to native fishes and other aquatic species could be moderate under Alternatives D and E (see Sections 5.5.3.4, 5.5.3.5, 5.5.3.6, and 5.5.3.7). Hybrid sport fish and smallmouth bass are unlikely to be affected by oil and gas because they are confined to reservoirs and controlled through stocking by UDWR (see Section 4.6 for impacts to salmonid sport fish, i.e., MIS trout). There would be no cumulative impacts to these species.

5.5.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects to fish or wildlife.

5.5.3.2 Alternative B

Cumulative impacts may occur to migratory birds, due to habitat losses from connected actions. Past and present habitat losses from all activities discussed in Section 4.5.5.2 have led to declines in migratory bird populations (Parrish et al. 2002) and human-caused disturbances and degradation of habitats are considered the greatest threat to migratory bird populations (USFWS 2002c). Further declines due to connected actions on oil and gas leases would lead to cumulative impacts to migratory bird populations at a landscape scale; however, oil and gas leasing would be in compliance with the Migratory Bird Treaty Act for all connected actions. Cumulative impacts may occur because high value migratory bird habitats in Utah are currently in jeopardy due to past human disturbances and degradation. These cumulative impacts from connected actions would be minor. Cumulative impacts would be short to long term depending on the duration of the disturbance and whether restoration of the habitat is successful in the short term (less than 10 years).

The potential for effects to streams would be eliminated under Alternative B by the application of a NL option to a 300-foot buffer around streams, lakes, reservoirs, and springs and a NSO stipulation to a 500-foot buffer around these resources. Due to these stipulations, impacts to

aquatic species under Alternative B would be negligible and there would be no cumulative impacts.

5.5.3.3 Alternative C

As under Alternative B, cumulative impacts may occur to migratory birds due to habitat losses.

The potential for effects to streams would be low under Alternative C due to NSO stipulations applied in a 300-foot buffer around streams, lakes, reservoirs, and springs and a 500ft. buffer around all streams with fisheries habitat. Stream crossings and seismic activities would be allowed within these buffers, but not in fisheries Habitat. Seismic exploration would not affect aquatic species, and road crossings could result in detrimental effects to native, non-sensitive fishes (in streams not within fisheries Habitat) if sediment were introduced. These impacts would not lead to cumulative impacts to aquatic species, however, because the amount of sediment that may be introduced by a crossing would not be of sufficient magnitude to affect the aquatic habitat when past, present, and foreseeable future impacts are considered.

5.5.3.4 Alternative D1 (NSO in IRAs)

As under Alternative B, cumulative impacts may occur to migratory birds due to habitat losses.

Cumulative impacts to aquatic species would be possible under Alternative D with NSO in IRAs. Major indirect impacts to aquatic species are possible under Alternative D due to the risk of a hazardous substance spill or accident, sedimentation, or stream crossings in the vicinity of or within a stream during drilling activities. Considering the amount of past and present disturbances to streams in the CEA, and the general lack of aquatic habitat in the CEA outside of the Dixie National Forest, a spill event within a stream on the Forest could lead to a measurable cumulative impact to aquatic species because the amount of suitable aquatic habitat is limited in the region. Cumulative impacts to aquatic species could be long term because restoration and mitigation efforts in aquatic habitat are often difficult and not effective at restoring the habitat to its original condition. Successful restoration efforts can take more than ten years, thus impacts to aquatic habitats, including Blue Ribbon Fisheries, could be long term. Impacts to aquatic species would be minor to moderate, depending on the location and extent of the degradation of aquatic habitat. In some areas, populations of aquatic species could be affected by a loss of habitat on the Dixie National Forest and cumulative impacts would be moderate considering the high value of aquatic habitat on the Forest in the context of the CEA.

5.5.3.5 Alternative D2 (CSU in IRAs)

As under Alternative B, cumulative impacts may occur to migratory birds due to habitat losses. The protection of stream, lakes, reservoirs, and springs could be the same as under SLT. As described under Alternative D with NSO in IRAs, cumulative impacts to aquatic species could be minor to moderate and long term with fewer acres protected under NSO than under Alternative D1.

5.5.3.6 Alternative E1 (NSO in IRAs)

Cumulative impacts may occur to migratory birds due to habitat losses. As described under Alternative D with NSO in IRAs, cumulative impacts to aquatic species could be minor to moderate and long term.

5.5.3.7 Alternative E2 (SLT in IRAs)

As under Alternative E with NSO in IRAs, cumulative impacts may occur to migratory birds due to habitat losses. As described under Alternative D with NSO in IRAs, cumulative impacts to aquatic species could be minor to moderate and long term. There would be fewer acres protected under NSO for this alternative than E1.

Table 5.5-4 Summary of Cumulative Effects for Fish and Wildlife

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Development on private lands, fires, and the spread of invasive plants has occurred on the Pine Valley Ranger District. Sanford, Sequoia fires have degraded some streams. Degradation of riparian and aquatic habitats has occurred from grazing, fires, and recreation (see Specialist Report 8.0).	Vegetation treatments are in progress to improve fish and wildlife habitats. Trout are being reintroduced to burned aquatic habitat (Specialist Report 6.0) and other native fish populations are recovering.	Population growth (and development) and the spread of invasive plants are expected to increase in the foreseeable future. Vegetation treatments designed to improve fish wildlife habitat including chaining of shrubs and pinyon/juniper, and rehabilitation of riparian areas are expected to continue at current levels in the foreseeable future.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to fish or wildlife as a result of oil and gas activity.	There would be no cumulative effects under Alternative A.
			Alternative B Overlapping NL options would prevent direct disturbance to fish or wildlife habitat in most areas (70%). NSO would prevent permanent disturbance to habitat on (20%) of the forest. Connected actions could still occur on CSU lands (4%). No impacts to aquatic habitats.	Cumulative impacts to migratory birds are possible (habitat loss). These impacts could be moderate and long term.
			Alternative C NSO would prevent permanent disturbance to fish or wildlife habitat in most areas (76%; includes areas within IRAs). Direct and indirect impacts from seismic activities could occur in most habitats. Only crossing disturbances could occur in aquatic habitats.	Cumulative impacts to migratory birds would be the same as described under Alternative B.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative D1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 41% of the forest, which includes all IRAs. Most fish or wildlife habitat would be covered by CSU or TL. Disturbances could occur in aquatic habitats.	Cumulative impacts to migratory birds would be the same as described under Alternative B. Cumulative impacts to aquatic species are possible. These impacts, if they occurred, would be long term and minor to moderate.
			Alternative D2 (CSU in IRAs) NSO would cover 9% of the Forest. Other areas of the forest would be largely available for lease and impacts from connected actions: 80% of the forest is CSU or TL. Disturbances could occur in aquatic habitats.	Cumulative impacts would be the same as under Alternative D1. However, fewer acres would be protected under NSO than D1.
			Alternative E1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 35% of the forest. Connected actions could occur elsewhere, including all aquatic habitats.	Cumulative impacts to migratory birds are possible from habitat losses. Cumulative impacts to aquatic species are possible. These impacts, if they occurred, would be long term and minor to moderate.
			Alternative E2 (SLT in IRAs) Direct disturbance from connected actions could occur anywhere on the forest, including all aquatic habitats.	Cumulative impacts would be the same as under Alternative E1. However, fewer acres would be protected under NSO than E1.

5.6 Special Status Species

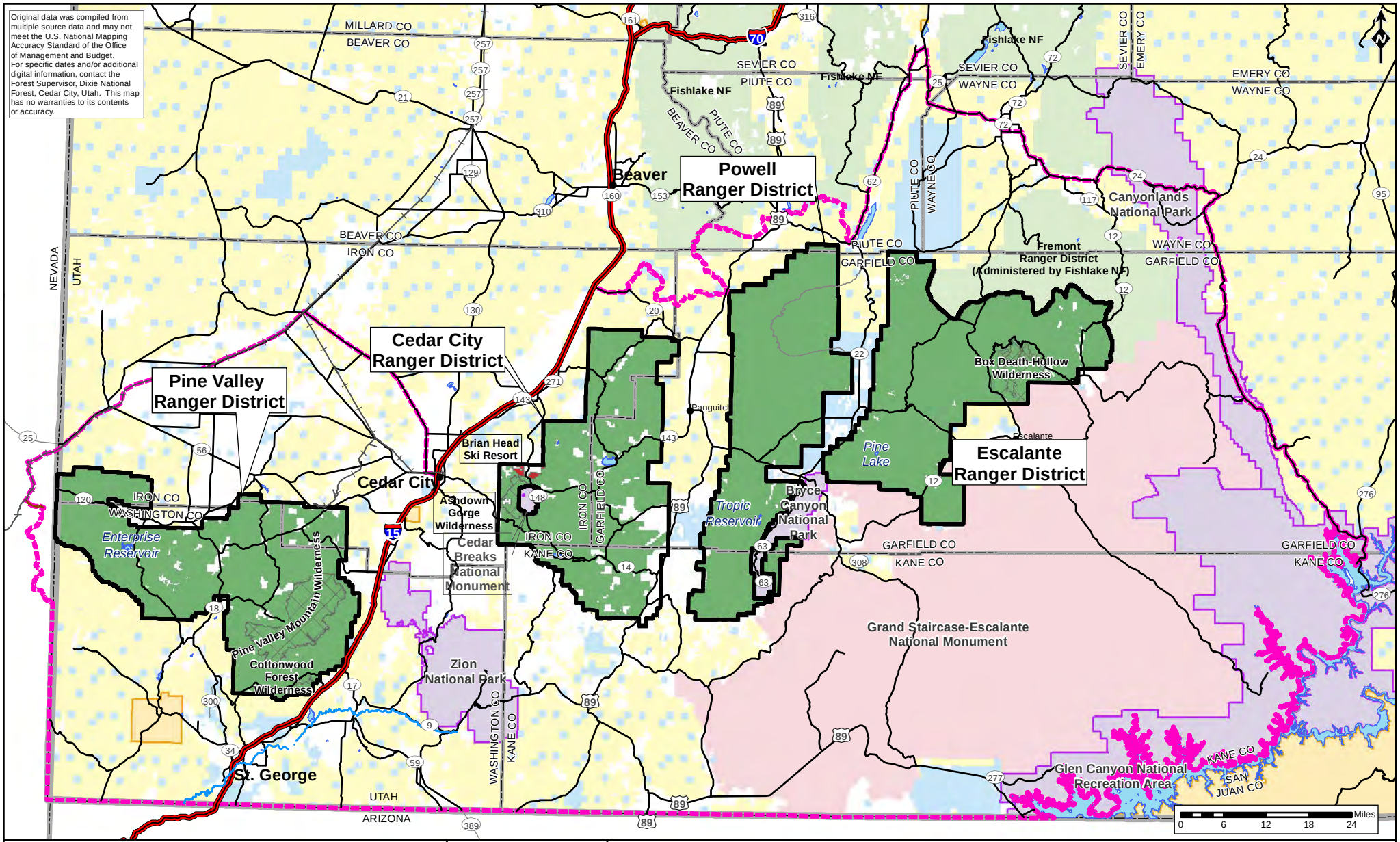
5.6.1 Description of Cumulative Effects Area

The CEA for Special Status Species includes all 6th level HUC subwatersheds occurring on the Dixie National Forest that are within the following boundaries: north of the Virgin River, east of the Union Pacific rail line located west of the Utah-Nevada border, south and east of US Highway 56 and Desert Mount Road, east of Interstate 15 north of Cedar City, and south and west of US Highway 12 on the Fremont River Ranger District. The CEA would also include areas of Designated Critical Habitat units that fall outside the Dixie National Forest boundary. These include the CP-12 unit for Mexican spotted owls (overlaps Escalante Ranger District) and Ash Creek (including the 300-ft buffer) from the boundary of the Pine Valley Ranger District to the La Verkin Creek confluence. The CEA would also include the full extent of all big game hunt units (Wildlife Management Units) located on the Dixie National Forest. No data exists for one of the subwatersheds on the west side of the Pine Valley Ranger District and a buffer was created by extending a boundary west from the nearest subwatershed (Nephi Draw HUC 160300061301) along an existing dirt road to its intersection with the Union Pacific rail line at Brown, Nevada. These boundaries were placed on the 6th level subwatersheds due to the presence of several subwatersheds that covered only very small portions of the Dixie National Forest, but extended long distances from the Dixie National Forest boundary. The portions of these watersheds eliminated are likely beyond the extent of any cumulative effects.

Lands within the CEA (Figure 5.6-1) are managed primarily by the BLM (45% of the CEA), 50 percent of which is the Grand Staircase Escalante National Monument (23% of the CEA). Twenty three percent of lands in the CEA are managed by the Dixie National Forest. Fifteen percent of the CEA is private land, ten percent in National Park Service (Cedar Breaks National Monument, Zion National Park, Bryce Canyon National Park, Canyonlands National Park, Glen Canyon National Recreation Area), and six percent is state land with five percent SITLA (remaining one percent state land includes state parks and wildlife reserves). Actions within the CEA are discussed within the various BLM districts (Richfield, Kanab, Cedar City, or St. George) and the GSENM or the Dixie National Forest since these areas make up the majority of the CEA.

5.6.1.1 Rationale

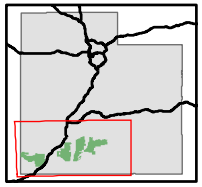
The 6th Level HUC subwatershed level was chosen as the CEA for Sensitive species and MIS because Sensitive and MIS fish discussed in this Specialist Report are unlikely to migrate beyond these boundaries. Sensitive and MIS fish are also unlikely to migrate beyond the artificial boundary placed on several of the subwatersheds due to the distance these subwatersheds extend and a general lack of large streams in these subwatersheds. The subwatershed level would cover all terrestrial wildlife movements with the exceptions of some elk and mule deer, migratory birds, and possibly migratory sage grouse populations and northern goshawk. Regarding elk and mule deer, by including the full extent of all big game hunt units most movements would occur within the CEA. This area was selected because it represents the area in which the species evaluated occur during spring, summer, fall and winter. Migratory species are not covered in this analysis because it is unknown where they go during the winter months, therefore oil and gas activities are not likely to impact these species during this time period. Including critical habitat units within the CEA for TEC species allows for evaluation of cumulative impacts in relation to specific recovery goals for endangered and threatened species.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.6-1
Cumulative Effects Area for Special Status Species

1 in = 18 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Includes extent of all Wildlife Management Units (Utah Division of Wildlife Resources) that intersect the Dixie National Forest and 6th-level HUCS.

5.6.2 Past, Present, and Reasonably Foreseeable Future Actions

As discussed in Section 5.5.2, natural disturbance and human activity has impacted habitat for species such as greater sage-grouse, goshawks, flammulated owls, and three-toed woodpeckers. BLM lands in the CEA have been affected by increasing OHV use and fire and may be affected in the foreseeable future if some of the many oil and gas leases are developed. Past and present management activities on public lands (USFS and BLM, including the Grand Staircase-Escalante National Monument, and National Park Service) continue to impact habitat by removing vegetation and altering vegetation communities by changing species composition. Recently, SITLA lands have been managed for fire rehabilitation, OHV access and closures, sage grouse habitat protection, noxious weed control, grazing management, and energy development (SITLA 2007). In general, private lands are assumed to be in various stages of increasing development, but may contain substantial amounts of MIS or Sensitive species habitat such as for big game, sage grouse, or MIS trout.

Many riparian areas in the CEA have been degraded by management and other activities. This has resulted in lowered water tables, eroded stream channels, invasive plant encroachment, removal of beaver populations, increased water temperatures, concentrated runoff, increased sediment from road construction, and changes in upland vegetation density and composition. Impacts to riparian and wetland areas on the Dixie National Forest are discussed in Section 5.7. MIS and sensitive trout, and boreal toads have been affected by the changes to riparian habitats, primarily by increased sediment levels from erosion where riparian vegetation has been altered or removed. Boreal toads in the CEA have likely been impacted by the removal of beaver populations and possibly by the infestation of chytrid fungus. Sensitive trout species have become isolated in headwater streams on the Dixie National Forest due to habitat loss from impacts such as fire and sedimentation, in addition to exotic species introductions and water diversions. BLM and other lands (i.e., private) in the CEA contains little to no habitat for sensitive trout. The desired future expansion of cutthroat trout would therefore occur on National Forest lands. Other MIS trout species can be found on many lands in the CEA, including rainbow and brown trout on BLM land (Beaver Dam Wash, Slaughter Creek, Mammoth Creek, Parowan Creek, Boulder Creek, Calf Creek, and Deer Creek) and brown, brook, rainbow, and cutthroat trout in several stream reaches on private lands (e.g., Santa Clara River at Pine Valley, Blue Springs Creek, Mammoth Creek, Panguitch Creek, Parowan Creek, East Fork Sevier River, Boulder Creek near Boulder, and portions of Deer Creek).

The following management activities have the largest impacts on special status species: fragmentation from roads and development, livestock grazing, vegetation changes, uncharacteristic fire, management responses to insect outbreaks and timber harvest, recreation, water diversions, noxious weed infestations, and mining/mineral exploration. While impacts in the CEA continue to occur, many of the activities listed have decreased or become better managed in recent years on federally-administered lands as the importance of overall ecosystem health has been recognized. The past and present levels of each type of activity on the Dixie National Forest and the expected level of future activity are presented in Section 5.1.2.1. This section describes the general impacts to special status species that have resulted and any activity on lands other than the Dixie National Forest.

DEVELOPMENT, POPULATION GROWTH, AND ROADS

As described in Section 5.1.2.1, the human population is increasing in southern Utah. Development is occurring both within the Dixie National Forest boundary and on private land. Twenty eight percent of private land on the CEA is within municipalities. In general, roads,

power lines, pipelines, and other developments remove vegetation, fragment habitat, and increase the potential for noxious weed invasion by creating permanently disturbed areas. Private lands within the Forest fragment wildlife habitat if they are developed, and developments within the Forest are assumed to be increasing. Conversion of lands to agriculture in the CEA generally reduces native shrub vegetation and decreases the amount of habitat available to sage grouse, pygmy rabbit, and big game (winter range). Agriculture development contributes to fragmentation as well as habitat loss (Bosworth 2003). Cannonville, Henrieville, and Tropic are within Mexican spotted owl Critical Habitat; however, fragmentation is not considered a major threat to this species.

The construction of roads in close proximity to streams has altered the structure and function of these areas within the CEA as described for general fish and wildlife in Section 5.5.2. See Table 5.5-1 in Section 5.5-2 for the miles of Forest Service routes that have the potential to, or are currently impacting aquatic habitat and that may affect MIS and Sensitive trout species.

Big game are also affected by road density because they move long distances between seasonal ranges and barriers such as roads can force stressed individuals with limited reserves to take alternate (i.e., longer) routes. Road density is currently high in many areas of the CEA, particularly the Cedar City Ranger District of the Dixie National Forest where some summer range occurs. According to UDWR (2003), winter range (for mule deer) in the CEA needs "improvement" mainly in the areas north of the Escalante Ranger District and between the Cedar City and Powell Ranger Districts. The area between the Cedar City and Powell Ranger Districts also contains areas with high road density that may be contributing to the decline in quality of this winter range. Implementation of route rehabilitation from Duck Swains and the MTP decision is expected to bring road density closer to Forest Plan direction.

LIVESTOCK GRAZING

Grazing on the Dixie National Forest is discussed in Section 5.1.2.1. On all BLM-administered lands, including the Grand Staircase-Escalante National Monument, grazing is allowed and is intended to be managed in accordance with BLM guidelines to protect the watershed, aquatic habitat, and water quality, and move toward or maintain properly functioning condition (BLM 1999a). Grazing on the Grand Staircase-Escalante National Monument, on surrounding BLM, and on the Dixie National Forest is managed according to Utah Standards of Rangeland Health.

In general, grazing can change the composition, structure, and function of vegetation, which can adversely affect special status animal and plant species. For Utah prairie dog, the impacts of grazing on grassland habitats are not clearly adverse or beneficial (USFWS 2007b). Grazing has also altered the species composition of grass, forb, and shrub layers of aspen forests that make up goshawk foraging habitat (Reynolds et al. 1992). Many sensitive plants, particularly those that do not occur on limestone or sandstone formations, such as sensitive paintbrushes and several *Penstemon spp.* on the Dixie National Forest, are palatable to domestic livestock and wild ungulates and have been directly affected by grazing (Rodriguez 2008).

Grazing has affected sagebrush-dependent species in the CEA such as sage-grouse and pygmy rabbit, by directly removing or modifying habitat. Livestock grazing is the most widespread land use across the sagebrush biome, and most sagebrush habitats have been grazed in the past century (Connelly et al. 2004). Grazing is one of several factors that have contributed to the degradation of sagebrush steppe through conversion to pinyon juniper (Bosworth 2003) and cheatgrass or other exotic species infestations in the CEA. Adverse impacts to sagebrush habitat from grazing can occur through 1) grazing below Forest Plan

standards that depletes the grass and forb understory, tramples soils, and disrupts macrobiotic crust cover, 2) invasions of exotic plants (due to loss of understory, altered soils, loss of macrobiotic crusts, etc), particularly cheatgrass, 3) increased fire intensity and frequency, 4) reduced water infiltration, 5) increased soil erosion (Connelly et al. 2004). Dynamics of sagebrush communities are complex, and plant species' response to grazing may not be predictable. Grazing can alter water and nutrient availability, soils, and vegetation past thresholds to which the system can return, such that some vegetation community states may be irreversible. Regarding management, assumptions about current vegetation communities vs. community 'ideal' states may not be accurate, and conversely, releasing vegetation communities from grazing may have no or unpredictable results, such as exacerbating the influence of exotic plants such as cheatgrass. For these reasons, the impacts of grazing on sagebrush habitats are unclear.

VEGETATION CHANGES

Vegetation changes on the Dixie National Forest are described in Section 5.1.2.1. These changes reduce the habitat available for Utah prairie dogs, sage grouse, pygmy rabbit, and big game (winter range). A decline in aspen to conifer encroachment has reduced the available habitat for elk, goshawk, and three-toed woodpecker, although the sensitive bird species can also use conifers. An increase in conifers has generally increased the nesting substrate available to sensitive raptors and woodpeckers. Vegetation restoration treatments on the Grand Staircase-Escalante National Monument are expected to cover approximately 20,000 acres over the next 15 years (BLM 1999a).

FIRE, SPRUCE BEETLE OUTBREAKS, AND TIMBER HARVEST

The role of fire on the Dixie National Forest is discussed in Section 5.1.2.1. In riparian areas, large, severe fires remove vegetation that provided cover and shade over streams as well as an infiltration barrier to protect against sedimentation and flood events. The Sanford Fire and Sequoia Fire (Powell and Pine Valley Ranger Districts, Dixie National Forest) that occurred in 2002 and 2004 resulted in a collapse of trout populations in Cottonwood Creek, Deep Creek, and Deer Creek watersheds on the Powell, and Upper Ash Creek tributaries on the Pine Valley Ranger District that are now in various stages of recovery after reintroductions of Bonneville cutthroat trout. Because native Bonneville and Colorado River cutthroat trout are limited to isolated headwater drainages, the risk of losing individual populations during extreme fire and flood events has increased. On the Grand Staircase-Escalante National Monument (BLM), fires have played a smaller role in the shaping of the landscape and there is little suppression activity (BLM 1999a). On the Richfield BLM District, there has been a spike in fire frequency over the past ten years.

The large-scale mortality of spruce due to bark beetle infestations on the Dixie National Forest (see Timber Harvest in Section 5.1.2.1) has contributed to reduced habitat for sensitive raptors (i.e., goshawk, flammulated owl) and three-toed woodpecker. For some sensitive species such as three-toed woodpecker, the death of large stands of spruce has increased the number of available snags and forage opportunities in the short-term. For Mexican spotted owl, fires and timber harvests within the National Forest remove foraging habitat. Potential nesting areas (i.e., steep walled canyons) on the Dixie National Forest have undergone less change than areas more accessible to timber harvest and other uses. On the Grand Staircase-Escalante National Monument, the potential for large fires that would remove foraging habitat is minimal (BLM 1999a).

INVASIVE AND NON-NATIVE PLANTS

The trend in invasive and nonnative plant introduction on the Dixie National Forest is discussed in Section 5.1.2.1. Cheatgrass is a serious problem being addressed on the Richfield BLM District and has contributed to the increased fire frequency in addition to the loss of desert scrub, sagebrush, and grasslands. The BLM, including the Grand Staircase-Escalante National Monument, works cooperatively with local governments and private landowners to identify and control invasive plants. Many MIS and Sensitive species in the CEA have been affected by the spread of invasive plants, which are often less nutritious and less functional than natives as part of wildlife habitats. Invasive plants usually deplete soil and water resources more quickly and aggressively than native plants, thus out-competing them, and reducing the diversity of the vegetation, which tends to diminish the value of wildlife habitats in general. Declines in range conditions have been attributed to weed invasions, among other factors, and have affected pygmy rabbit, sage grouse, and big game (winter range) habitats.

The impact to aquatic habitats due to the introduction of invasive plants is discussed for general fish and wildlife in Section 5.5.2. The introduction and establishment of exotic fish species has also affected fish in the CEA, particularly sensitive trout species on the Dixie National Forest. The presence of exotic fish species is one of the factors that have forced salmonids, including sensitive cutthroat trout, into isolated headwater drainages and left species more susceptible to extinction (Rieman et al. 1993). The introduction and establishment of non-native fish species also reduces the suitability of the small amount of remaining habitat for the woundfin and Virgin River chub. There are 10 known introduced fish species; however, the red shiner (*Cyprinella lutrensis*) and the black bullhead (*Ameiurus melas*) are the most abundant. Red shiners compete with woundfin for food and habitat, and possibly feed on woundfin larvae, and are both competitor and predator of Virgin River chub.

RECREATION

The levels and types of recreation (including OHV use) on the Dixie National Forest are discussed in Section 5.1.2.1. Regarding special status species, OHV use, particularly cross-country travel, has resulted in direct impacts to riparian and upland vegetation as well as noxious weed introductions. OHV use in upland areas can destroy or alter vegetation, or introduce invasive plants, which degrades wildlife habitat. Sensitive plants, including yellow-white catseye (*Cryptantha ochroleuca*), wildstoe buckwheat (*Eriogonum aretioides*), Jones golden aster (*Heterotheca jonesii*), and rock tansy (*Sphaeromeria capitata)*, may be directly affected by OHV users (Rodriguez 2008). The vast majority of the Grand Staircase-Escalante National Monument area within the CEA is classified as “primitive” or “outback” zone, where motorized and mechanized access is permitted on designated routes (“outback”) or is limited to authorized users (“primitive;” BLM 1999a). OHV use on the Grand Staircase-Escalante National Monument is restricted within habitats of TEC species (BLM 1999a). Few sensitive plants discussed in this technical report occur on the Grand Staircase-Escalante National Monument or other BLM lands, thus they have generally not been affected by OHV use outside the Dixie National Forest.

Regarding Mexican spotted owl, there is currently one recreation site and 34.2 miles of trails, in addition to off-trail foot traffic, within 0.5 miles of Mexican spotted owl nesting sites that may be affecting this species on the Grand Staircase-Escalante National Monument (BLM 1999a). The designation of climbing areas is prohibited in known Mexican spotted owl nesting sites, and in established areas where spotted owls are found, seasonal closures are implemented (BLM 1999a). Over the next 15 years within the entire Grand Staircase-Escalante National

Monument, less than 100 acres of new recreation sites, including primitive camping areas, would be established (BLM 1999a).

WATER DIVERSIONS

Building of dams and associated reservoirs, water diversion structures, canals, laterals, aqueducts, and the dewatering of streams cause loss or degradation of available habitat for endangered fish. The decline in range and population numbers is due to the physical reduction in available habitats within the various river systems caused by these water projects.

Ash Creek provides a direct connection between waters of the Dixie National Forest and the habitat of endangered fishes. Land ownership within the 300-foot buffer around South Ash Creek, from the Forest boundary, to the confluence with Ash Creek and down to the confluence with La Verkin Creek, is predominantly (68%) private land and the remainder is BLM. The Toquerville and Ash Springs diversions are both municipal water diversions for La Verkin City, located just south of the town of Toquerville. Another diversion just upstream of the town of Toquerville is for the Toquerville water department. In total, the Utah Division of Water Rights has record of 36 water rights on Ash Creek, although some of these are located upstream of the South Ash Creek confluence. There are records for five water rights on South Ash Creek, with four of them for the Pintura Irrigation Company (Pintura being the closest town downstream) and one for the Washington County Water Conservancy District, which sells water to the various towns (Utah Division of Water Rights 2007). Many of these water rights are likely inactive (A.H. Rohm, Wildlife Biologist, UDWR, Personal Communication). Woundfin and Virgin River chub are threatened by habitat loss and modification, including changes in water flow regimes (USFWS 2008).

MINERALS ACTIVITY

Past and present oil and gas activity on the Dixie National Forest, including the Upper Valley oil field, is described in Section 5.1.2.1. There are currently 230 authorized leases and 65 pending leases, with a combined total lease area of 302,700 acres (UDNR 2008b), primarily on BLM lands. The larger lease clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante Ranger District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active. The only other recent activity on these leases has been the drilling of five wildcat wells on state and private land, all of which have been plugged and abandoned (UDNR 2008a). While the lease acreage is not reflective of potential surface disturbance area, it may be likely that the larger lease areas and the lease clusters may eventually have a greater area of surface disturbance than a smaller, isolated lease. Further, it can be assumed that similar types of impacts as are described for on-Forest leases could occur on these leases as well.

Refer to Section 5.5.2 for information on BLM oil and gas development potential in the CEA.

In addition to oil and gas activity, there are currently 50 separate minerals activities, more than half of which are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are all very small operations (less than five acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, most of these are inactive or in some stage of reclamation. There are two larger mines proposed for the near future: the Alton Coal Hollow mine and the Iron Spring iron mine. These are discussed in Section 5.5.2.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Forest are in Table 5.1-1. The impacts of these projects to fish and wildlife are described in Table 5.5-2. The projects in the official planning stages on BLM, state, and private land are listed, and the impacts to fish and wildlife described, in Table 5.5-3. The projects and the impacts would be the same for special status species as described in these tables.

5.6.3 Cumulative Effects by Alternative

Cumulative impacts would not occur to the species (or habitat for) Virgin River chub, woundfin, California condor, or Western yellow-billed cuckoo. Regarding Virgin River chub and woundfin, minor and long-term impacts are possible under Alternative E due to the risk of stream contamination. However, these would not lead to cumulative impact because the main threats to the species involve dewatering and exotic fish competition and predation. Regarding California condor, cumulative impacts would not result from possible impacts to nesting birds because the Dixie National Forest is largely nonessential habitat for the condor and is at the margins of its range. Regarding Western yellow-billed cuckoo, cumulative impacts would not result for similar reasons: habitat on the Dixie National Forest is marginal for the species, thus any impacts within the Dixie National Forest from oil and gas would not register a measurable impact considering the current threats to the species and that its main range occurs south of the forest.

Cumulative impacts may occur to MIS and sensitive trout species or to sensitive plants as a result of connected actions from oil and gas leasing. Cumulative impacts are less likely but may still occur to other MIS or Sensitive species, including sensitive bats, big game, sensitive raptors, sage grouse, or three-toed woodpecker. Individual raptors, bats, or sage grouse could be affected by oil and gas activities that remove habitat or create disturbances that disrupt behavior, and populations of these sensitive species could be affected in the context of past, present, and foreseeable future threats to persistence. Because many populations of sensitive plants, and populations of sensitive trout, on the Dixie National Forest are small and isolated on the Forest and are found in few other locations, affects to persistence are more immediate and could be caused by one or a few oil and gas disturbances on the Dixie National Forest. Cumulative impacts to these species are the most likely to occur, although cumulative impacts to all Sensitive species are measurable in this analysis.

5.6.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.6.3.2 Alternative B

There would be no cumulative impacts to TEC species under Alternative B because oil and gas activities would have mostly negligible impacts. Likewise, there would be no cumulative effects to any MIS or Sensitive species because direct and indirect impacts from oil and gas activities would be negligible or minor.

5.6.3.3 Alternative C

Under Alternative C (and D and E), there would be cumulative impacts to big game. Within the CEA, existing road density and road density increases in the foreseeable future are impacts to security and other functions of suitable big game range. A further increase in road density

associated with oil and gas developments under Alternative C could diminish the effectiveness of remaining habitat areas that currently provide isolation from human disturbances (e.g., traffic, poaching, general human presence) that are essential to big game persistence. An increase in road density from oil and gas activity in the context of road density within the CEA would be a cumulative impact to big game. This impact could be long term if roads are associated with a production well, as roads would probably last for longer than ten years. Cumulative impacts would be minor to moderate, depending on where the roads occur: impacts could be moderate if road density increases in a critical habitat area (such as high value winter range) that currently provides enough isolation to be suitable but that has been impacted in the past by roads. If this area were to become unsuitable for big game then cumulative impacts could be moderate.

5.6.3.4 Alternative D1 (NSO in IRAs)

Cumulative impacts to Mexican spotted owl would be possible under this alternative. Regarding Mexican spotted owl, considering current and foreseeable future impacts in the Escalante Ranger District from oil and gas developments, vegetation changes, and increasing use for recreation, an extended noise disturbance from oil and gas activities would lead to a measurable cumulative impact on this species that would be short term and minor. Impacts would be minor because nesting Mexican spotted owls have not been confirmed on the Dixie National Forest; oil and gas developments would lead to a cumulative impact due to the loss of potential nesting habitat that is relatively isolated from human disturbances (including noise). Cumulative impacts to Mexican spotted owls would be short term because extended noise disturbances would (most likely) last less than one year.

Cumulative impacts to sage grouse may occur due to fragmentation caused by oil and gas; sage grouse move relatively long distances over land between seasonal ranges, and oil and gas disturbances may contribute to the general discontinuity of sage grouse habitat that has been occurring and is expected to continue in the foreseeable future. In addition, roads and other linear disturbances provide movement corridors for animal predators and recreationists that directly reduce sage grouse numbers and habitat, respectively. Thus fragmentation in the context of current and foreseeable adverse habitat modifications would be a cumulative impact to sage grouse; this impact could be long term and moderate in most locations. Impacts would be long term if a production well were developed in sage grouse habitat. Impacts would be moderate if a production well occurred in the vicinity of a lek or blocked a movement corridor. If a production field occurred within a vast expanse of sage-grouse habitat, such as John's Valley, Boulder Top, or the Aquarius Plateau, then cumulative impacts to sage-grouse would be major.

Cumulative impacts to MIS and sensitive fish would be possible under Alternative D1 because road crossings are allowed in Fisheries Habitat. If road crossings are improperly installed, they can pose a barrier to trout populations or otherwise affect fish habitat on the Dixie National Forest. Because sensitive fish populations are currently isolated on the Forest, connected actions to oil and gas leasing could have cumulative impacts to the species by isolating populations to the point that persistence of the species could be threatened. MIS and Sensitive fish are also affected by sedimentation, increased water temperature (from shade/vegetation removal), and dewatering that can be directly or indirectly caused by the installation and removal of stream crossings. These impacts, if they occurred, would reduce the amount of suitable habitat for trout on the Dixie National Forest. Cumulative impacts to MIS and sensitive fish could be moderate and long term. Long-term impacts to aquatic habitat are possible because restoration and mitigation efforts in aquatic habitat are often difficult and not effective at restoring the habitat to its original condition. Successful restoration efforts can take more than ten years, thus impacts to aquatic habitats could be long term. Impacts could be moderate if a

portion of aquatic habitat on the Dixie National Forest is no longer suitable for trout, because the Dixie National Forest contains the best and most valuable trout habitat in the CEA and trout have few options elsewhere (i.e., on BLM, state, or private lands). Thus, a loss of habitat on the Dixie National Forest would be more adverse in the context of the CEA, in which habitat on the Forest is essential to the persistence of MIS and Sensitive trout species.

Cumulative impacts to big game would be as described under Alternative C.

Cumulative impacts to sensitive plants would be possible under Alternative D1 because SLT stipulations may not be sufficient to avoid partial disturbance of a sensitive plant population. Many sensitive plants occurring on the Dixie National Forest are endemic to or isolated within a small area, thus a loss of a substantial number of individuals in one area could affect the persistence of a sensitive plant species. Cumulative impacts to sensitive plants could be moderate, because the persistence of sensitive plant species could be threatened by oil and gas activities and long term because sensitive plant populations of most species tend to be present in very few areas and most are not likely to recover in numbers within ten years if disturbed.

5.6.3.5 Alternative D2 (CSU in IRAs)

Cumulative impacts to Mexican spotted owl would be possible under this alternative, and would be of greater magnitude than under Alternative D1. A substantial habitat loss in a PAC or Critical Habitat would be a possibility under this alternative that could lead to additional cumulative impacts to what would be caused by noise. Habitat losses would result in long term and minor cumulative impacts to this species.

Cumulative impacts to sage grouse, MIS and sensitive fish, big game, and sensitive plants would be these same as described for Alternative D1. However, there would be fewer acres protected under NSO for this alternative, relative to D1.

5.6.3.6 Alternative E1 (NSO in IRAs)

Cumulative effects would be the same as described for Alternative D1, with the exception of Utah prairie dog. Considering the past losses of Utah prairie dog habitat and unsuccessful reintroduction program, cumulative impacts to Utah prairie dog could occur under this alternative as a result of impacts from an exploration or production well development permitted within a Utah prairie dog colony area. Impacts would be long term, because habitat would probably not be suitable for a prairie dog colony after reclamation, and minor to moderate, depending on the extent of the disturbance. Cumulative impacts could be moderate if a colony area was removed and prairie dogs were relocated. Cumulative impacts would be minor if habitat within a colony area was removed and prairie dogs were not directly affected.

Cumulative impacts to sensitive raptors would be possible under Alternative E1. Considering past, present, and foreseeable future habitat losses to sensitive raptors, connected actions on oil and gas leases may lead to cumulative impacts if a substantial number of any sensitive raptor species fails to successfully reproduce due to nest abandonment as a result of oil and gas disturbances. In the context of past, present, and foreseeable future habitat losses and modification, including from the increasing levels of timber harvest due to insect outbreaks and fire, and encroachment of recreational activities into raptor habitat, the failure of sensitive raptors to reproduce in the remaining suitable habitat could lead to a cumulative impact. Impacts would be short term because displaced raptors would find alternate sites the following

year, and would be minor because the viability of raptor species would not be threatened by oil and gas activities.

Cumulative impacts to sensitive bats and pygmy rabbit would also be possible under Alternative E1. Considering past, present, and foreseeable future disturbances to sensitive bat habitat, further removal of roosting or foraging habitat due to a production field development in the vicinity of a roost or completely within foraging habitat would constitute a cumulative impact to sensitive bats that would be short term and minor. Pygmy rabbit habitat is also decreasing due to the conversion of sagebrush to pinyon-juniper and the influx of invasive grasses, thus a large disturbance of sagebrush habitat for a production field under Alternative E1 could lead to a cumulative impact on pygmy rabbit. Cumulative impacts to both species would be short term and minor. Impacts to both species would likely be short term because habitats could be restored within ten years.

Cumulative impacts to sage grouse, MIS and sensitive fish, big game, and sensitive plants would be these same as described for Alternative D1.

5.6.3.7 Alternative E2 (SLT in IRAs)

For Mexican spotted owl, cumulative effects are likely to occur under this alternative and would be the same as described for Alternative D2. Cumulative impacts to Utah prairie dogs would be the same as under Alternative E1.

Cumulative impacts to sage grouse, MIS and sensitive fish, big game, and sensitive plants would be these same as described for Alternative D1. Cumulative impacts to sensitive raptors, sensitive bats, and pygmy rabbits would be as described under Alternative E1. However, there would be fewer acres protected under NSO for this alternative, relative to E2.

Table 5.6-1 Summary of Cumulative Effects for Special Status Species

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Past grazing, fire suppression, and spruce beetle outbreaks have led to the death of large stands of spruce fir. The greatest impacts have occurred in forests on the Cedar City and Powell Ranger Districts. Development on private lands, fires, and the spread of invasive plants has occurred on the Pine Valley Ranger District. Fires have degraded aquatic habitat for sensitive and MIS fish.	Vegetation treatments are in progress to improve wildlife habitats. Bonneville cutthroat trout populations are showing signs of recovery in degraded streams where they have been introduced.	Population growth (and development) and the spread of invasive plants are expected to increase in the foreseeable future. Vegetation treatments designed to improve wildlife habitat including chaining of shrubs and pinyon-juniper, are expected to continue at current levels in the foreseeable future. Introductions of Bonneville cutthroat trout in degraded streams would continue.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to special status species' habitat as a result of oil and gas activity.	There would be no cumulative effects under Alternative A.
			Alternative B Overlapping NL options would prevent direct disturbance to habitat in most areas (75%). NSO would prevent permanent disturbance to habitat on (20%) of the forest. Connected actions could still occur on CSU lands (4%).	There would be no cumulative effects under Alternative B.
			Alternative C NSO would prevent permanent disturbance to special status species' habitat in most areas (76%; includes areas within IRAs). Direct and indirect impacts from seismic activities could occur in most habitats.	Cumulative effects could occur as a result of oil and gas activity in areas degraded by past and future management activities. Specifically, cumulative impacts could occur to big game as a result of increased road density; this cumulative impact could be long term and moderate.
			Alternative D1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 33% of the forest, which includes all IRAs. Most special status species' habitat would be covered by CSU or TL.	Cumulative impacts to big game would be as described under Alternative C. Cumulative impacts to sage grouse could occur due to fragmentation and could be long term and moderate, or major within the largest expanses of sagebrush habitat. Cumulative impacts to sensitive plants could occur if part of a plant population were disturbed; these impacts could be moderate and long term. Cumulative impacts would also be possible to Mexican spotted owl due to noise. These impacts would be short term and minor.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative D2 (CSU in IRAs) NSO would cover 8% of the Forest. Other areas of the forest would be largely available for lease and impacts from connected actions: 80% of the forest is CSU or TL.	Cumulative impacts to spotted owl would be more adverse than under Alternative D with CSU in IRAs, due to possible habitat losses in addition to noise: cumulative impacts would be long term and minor. Cumulative impacts to Sensitive species and MIS would be as described under Alternative D with NSO in IRAs.
			Alternative E1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 33% of the forest. Connected actions could occur elsewhere.	Cumulative impacts to Mexican spotted owl would be the same as under Alternative D with NSO in IRAs. Cumulative impacts to Utah prairie dog would be possible due to habitat losses: impacts would be long term and minor to moderate. Cumulative impacts to sage grouse, MIS and sensitive fish, big game, and sensitive plants would be as described under Alternative D with NSO in IRAs. Cumulative impacts to raptors could occur if a substantial amount of nest abandonment was caused by oil and gas activities; these cumulative impacts would be short term and minor. Cumulative impacts to pygmy rabbit and sensitive bats could also occur if a production field occurred in suitable habitat for either species. Cumulative impacts to pygmy rabbit and bats would be short term and minor.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative E2 (SLT in IRAs) Direct disturbance from connected actions could occur anywhere on the forest, including all Critical Habitat and other special status species' habitat areas.	Cumulative impacts to Mexican spotted owl would be the same as under Alternative D with CSU in IRAs. Cumulative impacts to Utah prairie dog would be the same as under Alternative E with NSO in IRAs: long term and minor to moderate. Cumulative impacts to raptors, pygmy rabbit, and sensitive bats would be as described under Alternative E with NSO in IRAs. Cumulative impacts to sage grouse, MIS and sensitive fish, big game, and sensitive plants would be as described under Alternative D with NSO in IRAs.

5.7 Water and Watershed Resources

5.7.1 Description of Cumulative Effects Area

The CEA for water and watershed resources is the same CEA as for Fish and Wildlife. See Section 5.5.1 for a description and Figure 5.5-1 for a map of the CEA. Table 5.7-1 shows the land ownership within the CEA boundaries.

Table 5.7-1 Land Ownership within the Water and Watershed Cumulative Effects Area

Land Ownership	Acres	Percent of Total CEA
Bureau of Land Management (BLM)	1,000,286	28
National Park Service	40,357	1
Private	560,731	16
State Lands[1]	174,904	5
Forest Service	1,835,470	50
Water	2,907	<1
Total	**3,614,656**	**100**

[1]Includes: State Park (Nevada): 2,025 acres, State Parks and Recreation: 8,994 acres, State Trust Land: 156,955, and State Wildlife Reserve/Management Area: 6,931

5.7.1.1 Rationale

The 6th level HUC subwatershed was chosen to incorporate any impacts of oil and gas activity that could be transmitted downstream of the Dixie National Forest boundary and, in combination with off-Forest activities, result in larger impacts. Impacts to water and watershed resources from oil and gas activity are not expected to be of a magnitude large enough to be transmitted beyond the 6th level HUC subwatershed and a larger CEA does not appear justified. Also, the subwatershed boundaries that were limited by the roadways were eliminated due to the distance they extended beyond the Forest boundary and impacts are not likely to extend beyond the boundaries created. Further, assuming that all available environmental protection measures are applied correctly and that accidental events do not occur, the predicted water and watershed resources impacts should be confined to within the Dixie National Forest boundaries.

5.7.2 Past, Present, and Reasonably Foreseeable Future Actions

As shown in Table 5.7-1, approximately one-half of the CEA is National Forest land and about one-half is other lands (predominantly private and BLM). However, in regard to water and watershed resources (as measured both by quantity and by importance), National Forest lands dominate the CEA. Their position within the higher elevation, greater precipitation zone of the CEA means that Dixie National Forest lands capture, store, and release water that supports not only their proximate ecosystems, but many off-Forest ecosystems and human uses as well. For example, the 15 municipal water systems on the Dixie National Forest serve as the only (or predominant) source of culinary water for the 28 municipalities within the CEA. Thus, degradation of a water source on the Dixie National Forest may literally have a greater impact to a community outside the Forests' boundaries than degradation of a stream adjacent to - or within - the community itself. When dealing with watersheds and stream networks, the conditions at a specific point in the watershed are usually a result of local conditions at that site combined with conditions in the upstream portions of the watershed. Conditions in the lower reaches of a watershed, however, do not necessarily have an effect on upstream reaches. As noted in USFS (2006g) "it will be a continuing challenge to retain sufficient water for healthy

watersheds, streams, aquatic species, wildlife, and vegetation, while also providing water for the needs of local communities and traditional rural activities." For this reason, in the analysis of cumulative effects, the past, present, and reasonably foreseeable actions on the Dixie National Forest have a proportionally greater focus than off-Forest actions.

In addition, the potential for impacts to water resources as a result of connected actions associated with oil and gas leasing is related more to degrading water quality than to reducing water quantity. In earlier sections of this Specialist Report, potential water quality degradation was attributed to two types of occurrences related to oil and gas leasing or production: sedimentation due to surface disturbances and vegetation removal, soil compaction, and drainage pattern alteration; and isolated introduction of pollutants such as hydrocarbons or chemicals due to accidental spills. Only the former is realistically relevant to cumulative effects analysis; while the latter may represent an impact that could be locally significant, it would be limited in duration and unlikely to exacerbate or be exacerbated by other similar simultaneous impacts that would result in a cumulative effect. For this reason, past, present, and reasonably foreseeable actions that can result in erosion and sedimentation, and thus contribute to increased sediment yields in a given watershed, represent the bulk of actions discussed in this section.

In-stream sedimentation can result from various sources, activities, and land uses. Upland erosion due to generally poor watershed condition (such as due to forest fires, poorly managed timber cutting, or overgrazing) can introduce sediments via overland flow or storm runoff, as well as from mass movements due to slope destabilization. Direct surface disturbances related to industrial or construction activities (such as roads, well pads, mines, or subdivisions) often result in ground compaction and drainage pattern alteration, which in turn increase flow velocities and sediment transport capacities. Stream alterations (such as culverts, road realignments, or irrigation diversion structures) can affect a channel's stability and result in in-channel erosion that transports sediments downstream. Agriculture can also degrade water quality by introducing sediments through poor tillage practices and ill-managed irrigation systems.

Compared to historic conditions (late 1800s and early 1900s), watershed conditions have improved on many parts of the Dixie National Forest and on lands now managed by the BLM. However, recent past and present management activities have continued to impact watershed conditions. Past and present impacts to watershed resources, which in turn, relate to water quality include: road systems in riparian and wetland areas; livestock grazing of upland and riparian areas; developed and dispersed recreation – notably off-road vehicle use; water diversions and dams; uncharacteristic fire; timber harvest; and minerals activity (including oil and gas exploration and development; USFS 2009c). These activities are described in Section 5.1.2.1 for the Dixie National Forest. Note that road system impacts and off-road vehicle use impacts will be minimized through implementation of the MTP (USFS 2009c). The section below presents information relevant to water and watershed resources that was not included in Section 5.1.2.1. These activities also occur on off-Forest lands, notably on both private and BLM-administered lands, but less so on state lands within the CEA as those are predominantly associated with State Parks. Activities that occur predominantly on private lands and that can threaten water resources include agriculture and expanding municipalities.

ROADS

The construction of roads in close proximity to streams, including within wetland and riparian areas, has occurred in the past, and is still occurring in the present, within the CEA. Roads can alter the structure and function of watershed resources and channel surface water runoff directly

into streams, water that would normally travel slowly or diffusely through the watershed. Roads can also alter channel morphology due to culvert placement and straightening. The result is that sediment inputs to streams are high in some areas, which can further destabilize channels and in-turn increase sediments. Overall, as described in Section 4.7.4.6, roads represent one of the greatest sources of impacts to water quality. General information regarding roads on the Dixie National Forest is provided in Section 5.1.2.1. Table 5.7-2 shows the miles of Forest Service routes that have the potential to, or are impacting watershed resources.

Table 5.7-2 Miles of Forest Service Routes Impacting Watershed Resources.

Route Impacts[1]	Miles of Forest Service Routes			
	Pine Valley	Cedar City	Powell	Escalante
Route presents a high risk to soil and water resources	206.5	44.9	65.5	189.1
Route presents a moderate risk to soil and water resources	135.7	329.3	360.6	362.3
Route impacts stream channels, floodplains, wetlands, or riparian areas	385.1	346.9	152.8	478.0
Route crosses riparian areas	111.3	210.6	164.3	276.4
Route is in riparian areas (within banks or high water mark)	67.00	146.0	105.1	48.00
Route is within ½-mile of a riparian area	185.2	174.6	416.3	515.8
Route is within a stream channel		2.2		
Routes with stream crossing	640.5	591.7	682.7	604.3
Routes within wetlands		2.6		0.7
Routes within 200 feet of streams	700.7	670.1	815.8	710.2

Source: Dixie National Forest Route Analysis Database

[1] Motorized Travel Plan implementation (see USFS 2009c) will close some routes that are negatively impacting soil, water, and wildlife resources, and/or are not needed for future resource management activities.

Similar details on road/stream relationships are not readily available for the non-Forest portions of the CEA: however, a simple measure of road density can provide some indication about the potential for roads as a whole to impact watershed resources. This is based upon the assumption that the greater the network of roads in a watershed area (all else being the same), the greater the likelihood of channel alteration, sedimentation, etc. Throughout the CEA, there are numerous HUC 6 watershed areas with an Open Motorized Road Density (OMRD) of two miles/square mile or greater: notably these include off-Forest lands to the north of the Pine Valley Ranger District, much of the southern 2/3 of the Cedar City Ranger District, and a significant part of the Escalante Ranger District. An OMRD of two miles/square mile would also be considered high when considering road effects on a watershed. On the Escalante Ranger District, roads and recreation use on Carcass and Pleasant Creeks have impacted riparian

areas and led to stream channel widening (USFS 2004c). In addition to road density, soil type, slope steepness, geology, and other aspects of a watershed are also related to potential impacts from roads.

In recent years, some roads and trails within the Dixie National Forest have been relocated away from streams or have been obliterated. The Duck Creek – Swains Access Management Project is one project designed to lessen the impact of roads on riparian areas. This project along with the implementation of the MTP in 2009 is closing or decommissioning unneeded roads, which will potentially decrease the adverse affects to water resources. Further, in recent years, the Forest Service has placed more focus on proper road placement, design, and maintenance, all with an eye towards reducing impacts to water resources.

However, similar efforts to relocate or obliterate roads outside the Dixie National Forest boundary have not occurred, with one exception possibly being within the Grand Staircase-Escalante National Monument, where the BLM plans to implement road closure projects in the future, as funding permits. While off-Forest roads are also currently likely better managed and subject to more thought toward environmental considerations prior to construction than in the past, their numbers are increasing; more roads are constructed than are obliterated. This generally means than, in the CEA, there is an increasing network of roads and a generally increasing road density. One exception would be within the St. George Field Office, BLM where there are three wilderness study areas (Cougar Canyon, Red Mountain, and Cottonwood Creek; note the former two areas were added to the National Wilderness Preservation System by the 2009 Omnibus Public Land Management Act) that are at least partially within the CEA (BLM 1999a). Road construction in these areas would not be likely.

Ongoing road maintenance, repair, construction, and reconstruction occur in various locations throughout the CEA. For example, Bryce Canyon National Park's Tropic Canyon highway rehabilitation project involves repairing a bridge damaged by flood events. In addition, a 50-foot bridge will be constructed across Ash Creek north of Pintura as part of a road project, and will involve a significant amount of fill material to construct the bridge abutments. These types of projects often involve at least some ground disturbance, with consequent erosion; usually they are subject to sediment control practices that are intended to minimize off-site impacts. When such impacts occur, they are usually short term and decrease following construction. These types of projects can also correct poor drainage and actually improve water quality. An example of this would be the Cottonwood Wash Road (located within the Grand Staircase-Escalante National Monument and within the boundaries of the CEA), which is restricted by the BLM's management plan to maintenance for stabilization to prevent erosion and sediment loading in drainages (BLM 1999a).

Within the CEA, the impacts of roads are likely to slightly decrease in the future due to the increased awareness of the importance of maintaining stream stability quality and water quality.

LIVESTOCK GRAZING

Grazing on the Dixie National Forest is described in Section 5.1.2.1. This includes moderate impacts to watershed resources, particularly riparian areas. For example, in 2005 and 2006 only 64 and 65 percent of riparian sites sampled, respectively, attained the current Forest standards and guidelines, which are to maintain at least 70-percent of the linear distance of all riparian ecosystems in at least an upper mid-seral successional stage (USFS 2005a, 2006c). The result of over-utilization of riparian ecosystems by grazing livestock is a reduction in plant cover, decreased streambank stability, and increased soil compaction, which can decrease

surface water infiltration, increase surface water runoff, and changes in stream channel morphology (USFS 1995a). The result can be increased sediment loads and channel instability (USFS 1995a). In some areas of the Dixie National Forest, grazing activities have contributed to the conversion of riparian vegetation from the typical deep-rooted, hydric vegetation to less desirable species such as Kentucky bluegrass (USFS 2006c). Grazing also occurs on all other BLM-managed land within the CEA and is expected to continue at present levels (BLM 2008b). Impacts of grazing on riparian areas on some portions of BLM land have had similar impacts as described for the Dixie National Forest (BLM 2008b). Also, on the Grand Staircase-Escalante National Monument, grazing is currently being managed with consideration given to ensuring that water quality standards are being met (BLM 1999a). Grazing also occurs on private lands within the CEA, and may have higher levels of impacts due to a lack of oversight and monitoring.

DISPERSED RECREATION

Dispersed recreation activities, particularly camping and OHV use that is concentrated along riparian areas, can remove riparian vegetation, compact soils, and create roads and trails that interrupt flow patterns and increase sediment delivery to stream channels. Within the entire CEA, OHV use has recently experienced a dramatic increase and is likely to continue to increase (BLM 2008a, 2008b). However, in many areas of the CEA, it is anticipated that travel management projects will lead to decreased impacts as discussed for the Dixie National Forest in Section 5.1.2.1. Within the Grand Staircase-Escalante National Monument, OHV use is already limited to designated routes (BLM 1999b) and the proposed RMP (BLM 2008a) for BLM land administered by the Kanab Field Office (most areas in between and to the south of the Cedar City and Powell Ranger Districts) would similarly limit OHV use. There are also areas closed to motorized use such as on the three WSAs south of the Pine Valley Ranger District. However, there are also many areas within the CEA where cross-country motorized travel is not restricted, including private land, state land, and much of the BLM land not mentioned above. Also, regarding other types of dispersed recreation (i.e., camping); much of the CEA (including federal, state, and private land) is open to such use without regulation. Exceptions are the Grand Staircase-Escalante National Monument, which regulates all dispersed recreation.

WATER DIVERSIONS

See Section 5.1.2.1.

FIRE

Wildfire can occur over entire watersheds or over significant portions of them, and result in impacts to water quality. The fire regime of the Dixie National Forest is discussed in Section 5.1.2.1. It highlights the increased frequency of large, severe fires, which is also true for BLM land within the CEA. Large, severe fires remove vegetation and decrease infiltration rates increasing overland flow and erosion, as well as large mass movements such as debris flows, which can remove or bury riparian vegetation, alter floodplain surfaces, and alter channel morphology (Dwire and Kauffman 2003, Wondzell and King 2003). For example, the Sanford Fire that occurred in 2002 has resulted in changes to channel morphology and riparian vegetation in the Cottonwood Creek, Deep Creek, Deer Creek, and Sanford Creek watersheds (USFS 2004e).

As mentioned in Section 5.1.2.1, the use of prescribed fire is also expected to increase in the future. Because of the low intensity of prescribed fires, and the ability of riparian and wetland vegetation to recover quickly following fire, most prescribed burns have very minor, short-term effects on watershed resources (Dwire and Kauffman 2003, Wondzell and King 2003). Further,

an increase in the number of prescribed fires and mechanical fuel treatments should ultimately lead to a decrease in the number of large, uncharacteristic fires.

TIMBER HARVESTING

Within the CEA, the majority of timber harvest occurs on the Dixie National Forest as most BLM, private, and state lands are in lower elevation areas dominated by pinyon-juniper woodlands. Timber harvest on BLM, state, and private lands would be limited to fuelwood (green or dead and down) harvesting, post cutting, and Christmas tree cutting. However, on the Cedar City Field Office, BLM, there are also numerous planned thinning and fuels treatment projects (see Table 5.7-3). Timber harvest on the Dixie National Forest is summarized in Section 5.1.2.1.

MINERALS ACTIVITY

The past, present, and future minerals activity, including oil and gas activity, is described for the CEA in Section 5.5.2. The largest future developments are the Alton Coal Hollow Project and the Iron Mountain iron mine. All mines, coal and iron, are regulated to ensure that excessive erosion does not occur, that stream water quality standards are met, and that the land is ultimately reclaimed; however, there is likelihood of some occasional or short-term sediment loading in the streams within the affected watersheds.

OTHER ACTIVITIES THAT CAN AFFECT WATER QUALITY

Within private lands of the CEA, agriculture is the dominant land use (over about 502,000 acres) outside of the municipalities (about 58,000 acres). As municipalities grow, some agricultural land is being converted to subdivisions; this is expected to continue into the future. While agriculture can increase sediment loads and salinity in streams, construction activities and increased runoff rates due to development likely represent greater impacts to water quality, at least on a per-area basis.

Aside from specific land management practices or activities, water quality can also be affected by geology. A specific mention of this is given the *Kanab Field Office Resource Management Plan and Final Environmental Impact Statement* (BLM 2008a), which states that, generally, as water moves downstream and is diverted and used, water quality deteriorates due to natural sedimentation from highly erosive substrates and anthropogenic non-point sources, and increased salinity levels. This likely applies to many other areas within the CEA, as well.

One measure of how land uses, specific activities, and perhaps natural pollutant sources affect water quality is the State of Utah's 303(d) list. As described in Section 5.7.2 above, streams and lakes that the state considers impaired, and thus not able to meet their designated beneficial uses, are reported on this list, which is updated every other year. Within the CEA, there are several stream reaches on the current (2006) list:

- Escalante River and some tributaries from Boulder Creek confluence to Birch Creek confluence (temperature);
- Paria River from start of gorge to headwaters, and Paria River and tributaries from the Arizona-Utah State line to Cottonwood Creek confluence (TDS);
- Virgin River and tributaries from Santa Clara River confluence to Quail Creek Diversion, excluding Quail and Leeks Creeks (TDS);
- Sevier River and tributaries from Long Canal to Mammoth Creek confluence, Sevier River and east side tributaries from Horse Valley Bridge diversion upstream to Long

Canal, and Sevier River and tributaries from Circleville Irrigation Diversion to Horse Valley Diversion (total phosphorus and sediment); and

- East Fork Sevier River and tributaries from Sevier River to Antimony Creek confluence excluding Otter Creek and tributaries (total phosphorus and temperature).

Most relevant to this discussion of cumulative impacts is 303(d)-listed segments that are impaired due to sediment concentrations, because that is the parameter that is most likely to be exacerbated by oil and gas activities. As indicated in the above list, certain reaches of the Sevier River and selected tributaries are the only streams currently impaired for sediments within the CEA. This area is located within the east side of the Cedar City Ranger District, the west side of the Powell Ranger District, and the land between the two.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Dixie National Forest are listed in Table 5.1-1. The majority of the projects listed would involve surface disturbance and could increase erosion. Some projects, however, would improve conditions. For example, the motorized travel planning would eliminate cross-country travel by OHVs, which would reduce erosion potential. Table 5.5-3 lists projects in the official planning stages on BLM, state, and private land that may affect water and watershed resources. The overall impact of all projects in the table would be surface disturbance and vegetation removal, which can increase erosion.

5.7.3 Cumulative Effects by Alternative

5.7.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.7.3.2 Alternative B

The potential for cumulative effects to water and watershed resource would be reduced under Alternative B by the application of a NL option to a 300-foot buffer and a NSO stipulation to a 500-foot buffer around these resources. Seismic exploration could occur in the buffered areas between the 300-foot and 500-foot zones, but it is not expected to produce disturbance sufficient to contribute to cumulative effects. However, adverse cumulative effects could occur from the construction of roads, exploratory well pads, and particularly a production field in upland areas if these facilities are constructed in areas that have been impacted by past wildfires or in areas that may be impacted by future timber harvest or vegetation management. These effects would primarily be associated with the increased potential for erosion in these areas. Large fires and timber harvest can reduce the ability of precipitation to infiltrate and increase surface water runoff and erosion (Wondzell and King 2003). Building roads, well pads, and production fields in these areas would exacerbate the problem as these facilities also have the potential to reduce natural infiltration and channel surface water runoff.

Areas that may be susceptible to these types of cumulative effects are the Cottonwood, Deep, and Deer creek watersheds (Powell Ranger District) that were impacted by the Sanford Fire in 2002; the area to be affected by the Clayton Salvage Project (Escalante Ranger District); the Antimony Creek watershed that will be affected by the Pockets Vegetation Management Project (Escalante Ranger District); and the area to be affected by the Midway-Deer Valley Scenery Enhancement and Vegetation Treatment Program (Cedar City Ranger District). Further, adverse cumulative effects could occur from the construction of roads, exploratory well pads,

and particularly a production field in upland areas if these facilities are constructed in areas that have an already high drainage density, such as in the southern 2/3 of the Cedar City Ranger District and a significant part of the Escalante Ranger District. Through the application of the BMPs in Appendix C and BLM and USFS (2007), the cumulative impacts would remain in the range of minor to moderate. Impacts would be short term for exploration activities and long term for production facilities.

Other management activities such as livestock grazing, dispersed recreation, and water developments are not expected to be of a magnitude sufficient to result in cumulative effects to water resources when combined with the effects of oil and gas activity in upland areas, except perhaps in those watershed areas which drain to the portions of the Sevier River and tributaries that are listed for sediment impairment on the State's 303(d) list. Overall, due to the restrictions on locating oil and gas activity, the level of cumulative impact is probably minimal.

5.7.3.3 Alternative C

The NSO stipulation applied to the 300-foot buffer around streams, lakes, reservoirs, and springs under this Alternative would limit the likelihood of oil and gas activity directly contributing to cumulative effects, though less so than under Alternative B because of a narrower stream buffer width and perpendicular stream crossings being allowed within a portion of these buffers. Further, seismic exploration could occur in all the buffered areas. If stream crossings are properly designed, constructed, and maintained the amount of sediment introduced should also be negligible. However, given the surface disturbance required for the construction of a stream crossing (i.e., bridge construction and culvert placement) and the presence of a road in close proximity to the stream, the potential exists for the introduction of measurable amounts of sediment. Further, if the area impacted by road and bridge construction is subjected to future heavy grazing or is open to dispersed recreational use, the impacted area may be slow to re-vegetate following reclamation (for an exploratory well) or post-construction stabilization (for a production field). Increases in sediment delivery and bank erosion can result in adverse impacts to stream channels and water quality as described in Section 4.7.4.6. Given the BMPs listed in Appendix C, these impacts would be relatively minor and short term for roads associated with exploratory wells.

For a production field, the impacts may range from minor to moderate and be long term due to the length of time that roads would be present. For example, the longer the roads are present, the greater the likelihood of an event such as a severe fire occurring in the area, which would exacerbate erosion problems.

Under Alternative C, there is also the potential for cumulative effects if oil and gas activities occur in adjacent areas impacted by the management activities described in Section 5.7.2. As the amount of disturbance in adjacent areas would be the same as for Alternative B, the types of potential cumulative effects to wetlands, stream channels, floodplains, and riparian areas would be similar as described for Alternative B. However, given the narrower buffer under Alternative C, disturbance in upland areas has the potential to be located closer to wetlands, stream channels, floodplains, and riparian areas than under Alternative B. As a result, the potential for impacts to watershed resources is increased.

5.7.3.4 Alternative D1 (NSO in IRAs)

NSO applied to IRAs would prevent disturbance on 41 percent of wetlands, stream channels, floodplains, and riparian areas on the Dixie National Forest. As a result, there would be no cumulative effects resulting from disturbance directly related to oil and gas activity in these

areas. Direct disturbance to these resources not within IRAs and would consist of seismic exploration and the potential for spills due to the possibility of having oil gas facilities in increased proximity to these resources. Mechanical disturbance would be prohibited, which eliminates the potential for sediment related impacts in areas that have high road densities (these areas are described in Section 5.7.3.2) or have been degraded by grazing, dispersed recreation, or fire. As a result, the impacts would be minor and short-term as described for Alternative C.

5.7.3.5 Alternative D2 (CSU in IRAs)

Under this alternative, 13 percent of the buffered areas created for the protection of water and watershed resources would be off limits to oil and gas development (six percent would not be available for leasing and seven percent would be under NSO). The remainder of these areas would be available for leasing under CSU. Overall, potential cumulative effects under this alternative would be similar as described for Alternative D1; however, given the lesser amount of water and watershed resource components that would be under NSO, the potential for cumulative effects would be greatly increased.

5.7.3.6 Alternative E1 (NSO in IRAs)

Direct disturbance to water and watershed resources could occur in areas not within IRAs and would consist of seismic exploration, construction and reconstruction of roads, exploratory well pads and associated facilities, and production wells with their associated facilities. The construction and reconstruction of roads presents the greatest potential for cumulative impacts to water and watershed resources if construction occurs in areas that have high road densities (these areas are described in Section 5.7.3.2) or have been degraded by grazing, dispersed recreation, or fire. Furthermore, areas developed for oil and gas have an increased probability of being subjected to additional future degradation. For example, Dwire and Kaufman (2003) indicate that riparian areas are more susceptible to long-term degradation by wildfire if impacted by past human disturbance. Overall, these processes would produce cumulative effects to water quality primarily by increasing the potential for erosion and sediment deposition. Cumulative effects to wetlands and riparian areas would be more associated with the additive effect of vegetation removal, which would alter the structural integrity of these areas, and the alteration of flow paths due to roads. The impacts of altered drainage patterns on these areas are described in Section 4.7.4.6. Taken together, impacts may range from minor to major depending upon the location and amount of oil and gas activity. For example, a single exploratory well or a small amount of roads within a degraded area may only have minor cumulative impacts, but a production field or multiple wells with their associated roads would have major impacts. Impacts would be both short term and long term.

5.7.3.7 Alternative E2 (SLT in IRAs)

The cumulative effects under this alternative would be the same as described for Alternative E1.

Table 5.7-3 Summary of Cumulative Effects for Water and Watershed Resources

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Road construction and dispersed recreation in wetland and riparian areas has resulted in reduced function of these resources and increase in sediment in some locations on the Forest and impacts are likely the same in much of the CEA. Livestock grazing and fire have impacted wetland and riparian areas on the Forest. Livestock grazing is prevalent in all of the CEA. These activities have reduced the ability of the soil to naturally absorb precipitation in upland areas. The result is an increase susceptibility to additional disturbance.	The impacts of roads, grazing, development, and dispersed recreation continue to occur in many areas within the CEA.	The impacts of dispersed recreation should remain about the same. Road impacts would decrease with implementation of MTP. Grazing impacts should lessen slightly with improved management. The frequency of large, severe fires is likely to increase in the future. Several projects have the potential to impact watershed resources in the future including several timber harvests.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to wetlands, stream channels, floodplains, and riparian areas as a result of oil and gas activity.	There would be no cumulative effects of oil and gas activity due to the lack of direct and indirect effects.
			Alternative B NL and NSO leasing options would prevent direct disturbance to water and watershed resources.	Cumulative effects could occur as a result of oil and gas activity in upland areas degraded by past and future management activities. Impacts would range from minor to moderate.
			Alternative C NL and NSO stipulations would prevent most direct disturbance to water and watershed resources. However, perpendicular road crossings could occur on a portion of the designated buffers.	Cumulative effects could occur as a result of road crossings if they occur in areas with high road densities or in areas previously degraded by livestock grazing or fire. Impacts would be mostly minor and both long and short term Cumulative effects could also occur as a result of oil and gas activity in degraded upland areas as described for Alternative B.
			Alternative D1 (NSO in IRAs) NSO would prevent most direct disturbance in 41 percent of the buffered areas. Direct disturbance could occur in the remainder of the buffered areas under CSU. NSO would prevent impacts to lava fields over sensitive aquifers.	Cumulative effects would be the same as described for Alternative C.
			Alternative D2 (CSU in IRAs) Direct disturbance could occur in all but 13% of the buffered areas. NSO would prevent impacts to lava fields over sensitive aquifers	Cumulative effects would be the same as described for Alternative D2.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative E1 (NSO in IRAs) NSO would prevent most direct disturbance in 36 percent of the buffered areas. Direct disturbance could occur in the remainder of the buffered areas available for leasing.	Cumulative effects could occur both as result of direct disturbance in wetlands, stream channels, floodplains, and riparian areas, but also from disturbance in adjacent areas. The impacts would range from minor to major. Cumulative effects could also occur as a result of oil and gas activity in degraded upland areas as described for Alternative B.
			Alternative E2 (SLT in IRAs) Direct disturbance could occur in all buffered areas available for leasing.	Cumulative effects would be the same as described for Alternative E1.

5.8 Soils and Geologic Hazards

5.8.1 Description of Cumulative Effects Area

The CEA for soils resources is the Dixie National Forest boundary (see Figure 5.8-1).

5.8.1.1 Rationale

Impacts to soils and geology would not occur beyond the immediate area of disturbance (within the Dixie National Forest). Although hydrologic impacts to cave resources are possible outside the Dixie National Forest boundary, cumulative impacts to water resources are discussed in Section 5.7.

5.8.2 Past, Present, and Reasonably Foreseeable Future Actions

The CEA has been used for grazing, timber harvest, and small-scale mineral operations since the mid to late 1800s, while recreation is an increasingly popular use. Factors contributing to areas of soil resource degradation include poor grazing animal distribution, increased prevalence of noxious and undesirable plant species, fire suppression, activities related to road construction (both authorized and unauthorized), and drought. As these factors are described in Section 5.1.2.1, this section will only present the impacts of these activities relative to soils and geologic hazards.

ROADS

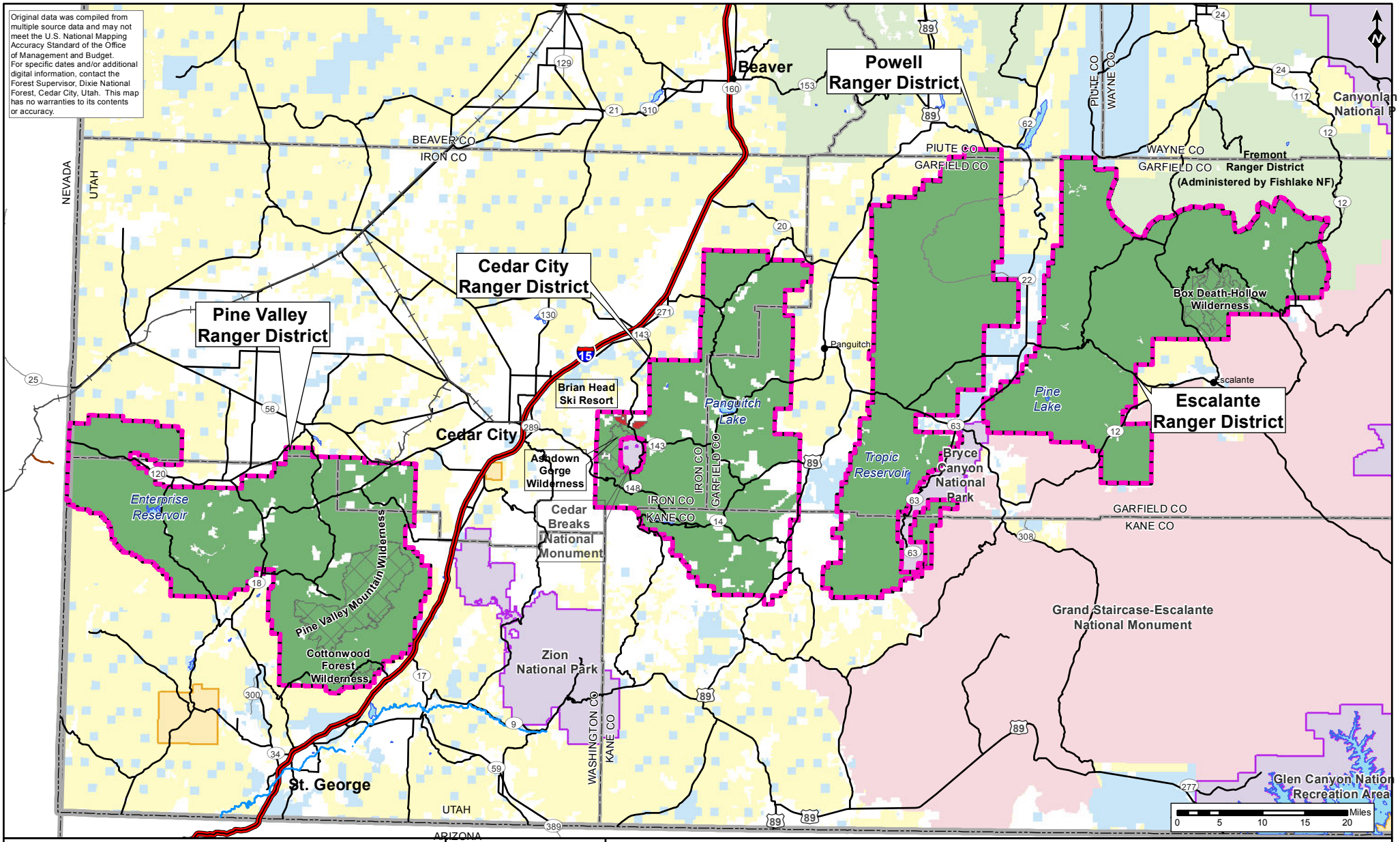
The construction of roads (described in Section 5.1.2.1) in close proximity to streams and riparian areas leads to increased erosion on sensitive and productive soils as described in Section 4.7.4.6 and 4.8.4.6. In addition, roads constructed in inherently unstable areas, such as on the North Horn or Claron formations, can increase the potential for mass failure. Roads also cause mass wasting by undercutting natural slopes where material is removed to build the road, or by overburdening slopes with heavy or overly steep road fills. Table 5.8-1 shows the miles of Forest Service routes that have the potential to, or are, impacting soil resources.

Table 5.8-1 Forest Service routes Impacting Soil Resources

Route Impacts[1]	Miles of Forest Service Routes			
	Pine Valley	Cedar City	Powell	Escalante
Routes have Soil compaction concerns				1
Routes are on areas of Erosive Soils		18		
Routes have Known Erosion Scars	30	195		
Routes Subject to Erosion Concerns	429	553	752	640
Route presents a moderate risk to soil & water resources	136	329	361	362
Route presents a high risk to soil and water resources	207	46	66	189

Source: Dixie National Forest Route Analysis Database

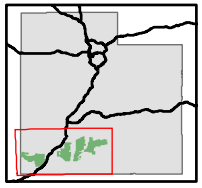
[1] Motorized Travel Plan implementation (see USFS 2009c) will close some routes that are negatively impacting soil, water, and wildlife resources, and/or are not needed for future resource management activities.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.8-1
Cumulative Effects Area for Soils & Geologic Resources

1 in = 15 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands

- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration

- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Includes Dixie National Forest Boundary

LIVESTOCK GRAZING

Overgrazing, as discussed in Section 5.1.2.1, led to changes in vegetation composition and erosion of soil resources on the Dixie National Forest.

FIRE

The fire regime on the Dixie National Forest is discussed in Section 5.1.2.1. As was noted in that section, the number of uncharacteristically large and severe wildfires is expected to increase. Large, severe fires remove vegetation, seal the soil surface in some cases, and increase overland flow and soil transport.

TIMBER HARVESTING

Timber harvest on the Dixie National Forest, as discussed in Section 5.1.2.1, has the potential to impact soils resources. Timber harvests expose forest soils to higher rain drop impact, reduce litter cover, increase soil temperature, often result in the construction of new roads, and skidding and transporting logs can create compacted paths and trails. These decrease soil productivity and can result in soil loss due to erosion.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Projects in the official planning stages on the Forest are listed in Table 5.1-1. Table 5.8-2 re-lists the projects with the greatest potential to impact soils and geologic hazards and describes the potential impacts from each.

Table 5.8-2 Potential Impacts to Soils and Geologic Hazards from Projects listed in Table 5.1-1

Project	Potential Impacts to Soil Resources
Dipping Vat Habitat Improvement Project	Surface disturbance, road construction, and cutting activities can cause soil compaction, increasing overland flow and erosion, leading to soil loss. Mechanical sagebrush treatment may open the vegetative canopy and increase erosion rates in the short term.
Duck Creek Fuels Treatment	Timber harvest could increase erosion rates due to road construction. Soil compaction occurs on road and staging areas, breaks down soil structure, and reduces natural infiltration. This can lead to erosion and soil loss. Constructed roads channelize overland flow and, where flow drains off of the road, lead to rilling of the soil surface or gullying if channelized flow is substantial.
Edward Spring Vegetation Treatment	Surface disturbance, road construction, and prescribed burning can cause soil compaction, increasing overland flow and erosion, leading to soil loss.
Midway-Deer Valley Scenery Enhancement and Vegetation Treatment	Surface disturbance and prescribed burning of riparian meadows can alter natural water infiltration rates, increase overland flow and erosion rates.
Mt. Dutton Vegetation Management Project	Soil compaction occurs on road and staging areas, breaks down soil structure, and reduces natural infiltration. This can lead to erosion and soil loss. Constructed roads channelize overland flow and, where flow drains off of the road, lead to rilling of the soil surface or gullying if channelized flow is substantial. Road de-commissioning would cause temporary impacts to soil during these activities, but would decrease soil effects once work was completed and vegetation was established.

Project	Potential Impacts to Soil Resources
Pine Valley Fuels Treatments	Surface disturbance, road construction, and cutting activities can increase overland flow and erosion, leading to soil loss.
Pockets Vegetation Management	Soil compaction occurs on road and staging areas, breaks down soil structure, and reduces natural infiltration. This can lead to erosion and soil loss. Constructed roads channelize overland flow, and, where flow drains off of the road, lead to rilling of the soil surface or gullying if channelized flow is substantial.
Upper Santa Clara River Vegetation and Fuels Project	Soil compaction occurs on road and staging areas, breaks down soil structure, and reduces natural infiltration. This can lead to erosion and soil loss. Constructed roads channelize overland flow, and, where flow drains off of the road, lead to rilling of the soil surface or gullying if channelized flow is substantial.

5.8.3 Cumulative Effects by Alternative

5.8.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects from new oil and gas leases.

5.8.3.2 Alternative B

Under Alternative B, NA (6 percent) and NL (70 percent) leasing options would prevent direct disturbance on 76 percent of the Dixie National Forest. Further 20 percent of the Forest would only be eligible for seismic exploration due to NSO leasing options. Adverse cumulative effects to soils and geologic hazards would be unlikely to occur under these restrictive leasing options. Cumulative effects to soils and geologic hazards would be more likely to occur on the remaining 4 percent of Forest lands that are open to full field development, including road and well pad construction.

Adverse effects of wells and pads located on sensitive soils/geologic hazards would be more likely to have cumulative effects if other past or planned activities were to occur in the same area. This would include past wildfires, future timber harvests, or other vegetation management. Areas infested with noxious weeds, or replaced by non-native vegetation, such as cheatgrass, would also be more vulnerable to cumulative effects due to poor vegetation cover, increased soil temperatures, decreased soil moisture levels, and decreased plant litter. Large fires can reduce the ability of precipitation to infiltrate and increase the rate of surface water runoff and soil loss. Building roads, well pads, and production fields in areas recently cleared of vegetation from fire, timber harvest, or other means would also increase erosion rates, compact soils, and break down soil structure.

Areas that may be susceptible to these types of cumulative effects are the Cottonwood, Deep, and Deer creek watersheds (Powell Ranger District) that were impacted by the Sanford Fire in 2002; the 13,700 acre Duck creek Fuels Treatment area (Cedar City District); the area to be affected by the Clayton Salvage Project (Escalante Ranger District); the Antimony Creek Watershed that will be affected by the Pockets Vegetation Management Project (Escalante Ranger District); the area affected by the Dipping Vat Habitat Improvement Project (Powell Ranger District); and the area to be affected by the Midway-Deer Valley Scenery Enhancement and Vegetation Treatment Program (Cedar City Ranger District). Other projects are listed in Table 5.1-1. Overall, due to the restrictions on locating oil and gas activity, the level of cumulative impact is probably minimal.

5.8.3.3 Alternative C

In regards to sensitive soils/geologic hazards, and as a result of the leasing options being assigned to these resource components being the same for both alternatives, cumulative effects under Alternative C would be the same as that described under Alternative B.

5.8.3.4 Alternative D1 (NSO in IRAs)

Cumulative effects under Alternative D with NSO in IRAs would be similar to those described under Alternative B, except that only 33 percent of the Dixie National Forest would be covered by the NSO leasing option and another 6 percent would by NA. The remaining 61 percent of the Forest would be subject to less restrictive leasing options. On these lands, 46 percent of areas with high erosion potential, 50 percent of marginally unstable soils, and all areas identified as having cave resources would be open to exploratory drilling and full-field development under the CSU leasing option. Potential cumulative effects would be as described for Alternative B. These impacts could be long term and minor in rockfall areas and on steep slopes, and could be long term and moderate on areas with high erosion potential, unstable soils, or cave resources.

5.8.3.5 Alternative D2 (CSU in IRAs)

Under this alternative, only eight percent of the Dixie National Forest would be protected under NSO; all rockfall areas and steep slopes fall under NSO. Six percent of the Forest would be NA. The remaining 86 percent of the Forest would be open to oil and gas exploration under less restrictive leasing options. Overall, the cumulative effects that could occur under this alternative would be similar to those described under Alternative B; however, given the decreased acreage of sensitive soils that would be covered by restrictive leasing options, the potential for cumulative effects would be increased. These impacts could be long term and minor in rockfall areas and on steep slopes, and could be long term and moderate on areas with high erosion potential, unstable soils, or cave resources.

5.8.3.6 Alternative E1 (NSO in IRAs)

Under this alternative, 33 percent of the Dixie National Forest is protected under NSO in IRAs. However, all sensitive soils/geologic features have some acreage open to oil and gas exploration and development. Approximately 20 percent of rockfall areas, 39 percent of steep slopes, 48 percent of areas with high erosion potential, and 53 percent of unstable soils are covered by SLT and open to full field development. Cave resources outside of IRAs are also covered by SLT. The cumulative effects that could occur under this alternative would be similar to those described under Alternative B but because there are fewer acres covered by restrictive leasing options, the potential for cumulative effects is larger than that described in Alternative D with CSU in IRAs. These impacts could be long term and moderate.

5.8.3.7 Alternative E2 (SLT in IRAs)

With the exception of steep slopes, no restrictive leasing options would be used to protect sensitive soils or geologic resources from cumulative effects. Further, the majority of the Dixie National Forest would be open to lease under SLT. Cumulative effects are thus more likely to occur under this alternative and would be similar to those described under Alternative B. These impacts could be long term and moderate in all soil types/geologic resources.

Table 5.8-3 Summary of Cumulative Effects for Soils and Geologic Hazards

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Past grazing has changed vegetation composition, compacted soils, increased overland flow, and decreased soil stability. Fire suppression has led to a buildup of fuels and the increased frequency of catastrophic fire that exposes the soil surface, allowing erosion and soil loss, and invasion of noxious weeds. Road construction in riparian areas leads to erosion and/or mass wasting when roadways are flooded.	Timber harvest, thinning, and range treatments are on-going to improve ecosystem health and reduce risks of fire and insect outbreaks. Healthy vegetation protects the soil surface from erosion. The impacts of roads and dispersed recreation continue to occur in many areas across the Forest Forests in the Escalante Ranger District are currently at risk of fire and noxious or undesirable weed infestations. AUMs were decreased from an average of 87,824 to 68,684 in 2003 due to drought	Population growth, housing and commercial development and the spread of invasive plants are expected to increase in the foreseeable future. Timber harvests, chaining of shrubs and pinyon/juniper, and prescribed fires are expected to continue at current levels in the foreseeable future. The impacts of roads and dispersed recreation (OHV use) should decrease with implementation of the Motorized Travel Planning Project. Grazing is expected to continue at current	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to soil resources as a result of oil and gas activity.	There would be no cumulative effects under Alternative A.
			Alternative B Overlapping NL options prevent direct disturbance on 70 percent of the forest. NSO would prevent permanent disturbance to all soil types on 20 percent of the forest. Connected actions could still occur on CSU lands (4 percent). All rockfall areas, slopes greater than 35 percent, and areas with high erosion potential are NSO. Marginally unstable areas and cave resources would be CSU.	Cumulative effects could occur as a result of oil and gas activity other than seismic work in areas degraded by past and future management activities, but would be limited to marginally unstable areas or cave resources, which are CSU. Cumulative effects could occur on unstable soils or cave resource areas in burn areas or areas with significant noxious weed issues. These impacts would be long-term and moderate.
			Alternative C NSO would prevent permanent disturbance to all soil types in most areas (76 percent; includes areas within IRAs). Direct and indirect impacts from seismic activities could occur on NSO. All rockfall areas, slopes greater than 35 percent, and areas with high erosion potential would be NA, NL, or NSO. Marginally unstable areas and cave resources would be CSU in areas outside of IRAs. Within IRAs, all sensitive soils would be NSO.	Cumulative impacts to sensitive soils/geologic impacts would be same in duration and intensity as under Alternative B. These impacts could be long term and minor.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Noxious weeds do not protect the soil as effectively as native plants	conditions.	levels for the foreseeable future.	**Alternative D1 (NSO in IRAs)** NSO would prevent disturbance from connected actions (except seismic) in 33 percent of the forest, which includes all IRAs. Exploration and development could occur on the remainder of the forest, although 6 percent would be NA. All rockfall areas and slopes greater than 35 percent would be NA, NL, or NSO. Marginally unstable areas and cave resources would be CSU in areas outside of IRAs. Within IRAs, all sensitive soils would be NSO.	Cumulative impacts to sensitive soils/geologic hazards would be the same in duration and intensity as under Alternative B and C although, in addition to unstable soils and cave resources, areas with high erosion potential would also be susceptible to cumulative effects in Alternative D. These impacts could be long term and minor in rockfall areas and on steep slopes, and could be long term and moderate on areas with high erosion potential, unstable soils, or cave resources.
			Alternative D2 (CSU in IRAs) NSO would cover 8 percent of the Forest, including rockfall areas and steep slopes. Other areas of the forest would be largely available for lease and impacts from connected actions: 80 percent of the forest is CSU. Marginally unstable areas and cave resources would be CSU	Cumulative impacts to sensitive soils/geologic hazards would be similar to Alternative D with NSO in IRAs except that more areas of high erosion potential and unstable soils would be under CSU and thus more area would be susceptible to cumulative effects. Since the location of cave resources is unknown at this time it is not possible to determine if these areas would be more at risk than under previous Alternatives. These impacts could be long term and minor in rockfall areas and on steep slopes, and could be long term and moderate on areas with high erosion potential, unstable soils, or cave resources.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative E1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 33 percent of the forest in areas designated as IRAs. Connected actions could occur elsewhere, including all sensitive soils/geologic features.	Cumulative effects to sensitive soils/geologic hazards would include those that may occur under Alternatives B, C, and D (both alternatives), and in addition would include areas of rockfall and steep slopes because 71 percent and 56 percent of the acres open to SLT leasing in these soil types. These impacts could be long term and moderate in all soil types/geologic resources.
			Alternative E2 (SLT in IRAs) Direct disturbance from connected actions could occur anywhere on the forest, including within RNAs and on all sensitive soils/geologic hazards.	Cumulative effects to sensitive soils/geologic hazards could occur on all acres of these sensitive areas. Up to 17,206 acres of rockfall areas, 382,441 acres of steep slopes, 96,638 acres of high erosion potential, and 45,358 acres of unstable soils areas would be SLT. This increases the chance that fire, weed infestation, or poorly planned or routed roads would be located on sensitive soils where oil and gas development was proposed. These impacts could be long term and moderate in all soil types/geologic resources.

5.9 Vegetation

5.9.1 Description of Cumulative Effects Area

The CEA for vegetation is the Dixie National Forest (see Section 5.8, Figure 5.8-1).

5.9.1.1 Rationale

The Dixie National Forest was selected as the CEA because vegetation impacts from the RFDS are not expected to be of a sufficient magnitude to extend beyond the Dixie National Forest.

5.9.2 Past, Present, and Reasonably Foreseeable Future Actions

Vegetation communities are always changing due to succession as well as natural and human-caused disturbance. The current distribution of vegetation on the Dixie National Forest has been shaped by both active management and natural disturbance cycles, such as fire, insect outbreaks, and climate change since the end of the Little Ice Age (mid-1800s). Natural disturbance cycles have served important functions within vegetation communities; however, due to fire suppression, development, and management activities such as grazing, these processes are cycling at a greater intensity and with lower frequency than they have in the past. The current state of vegetation on the Dixie National Forest is characterized by forest overstocking, layering, and a steady encroachment of shade-tolerant climax tree species.

Compared to historic conditions (late 1800s and early 1900s), most vegetation communities on the Dixie National Forest have changed in relative abundance. Grasslands and aspen communities have declined, having been replaced by dense coniferous forest in many areas (Kay 2002). Current vegetation trends include spruce fir and mixed conifer forests overtaking aspen, and pinyon-juniper vegetation invading grass, forb, and sagebrush communities. In general, late successional species have invaded areas where early successional species once prevailed.

Past and present management activities continue to impact vegetation resources by removing vegetation and altering communities by changing species composition. The following management activities have the largest impacts on vegetation: livestock grazing, development, uncharacteristic fire, insect outbreaks, timber harvests, and invasive plant infestations. While impacts in the CEA continue to occur, many of the activities listed have decreased or become better managed in recent years as the importance of overall ecosystem health has been recognized. The past and present levels of each type of activity on the Dixie National Forest and the expected level of future activity are presented in Section 5.1.2.1. This section described the general impacts resulting from these activities.

LIVESTOCK GRAZING

See Section 5.1.2.1.

DEVELOPMENT AND POPULATION GROWTH

Developments within and adjacent to the Forest (see Section 5.1.2.1) remove vegetation permanently, modify vegetation community composition, and increase the extent of urban-wildland interface which must be managed more intensely for fuels (e.g., Duck Creek and Pine Valley Fuels Treatments; see Table 5.1-1). Development is expected to increase and impact vegetation communities in the foreseeable future by permanently removing vegetation on private lands and increasing the wildland-urban interface.

FIRE

The impacts of fire to vegetation are discussed in Section 5.1.2.1. Regarding the impact of prescribed fires on vegetation, because of the low intensity, and the ability of vegetation to recover quickly following fire, most prescribed burns have very minor and short-term effects on vegetation resources.

SPRUCE BEETLE OUTBREAKS

See Section 5.1.2.1.

TIMBER HARVEST

See Section 5.1.2.1.

INVASIVE AND NONNATIVE PLANTS

See Section 5.1.2.1.

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Focus areas for management in the near future include Mount Dutton, East Fork Sevier River (John's Valley), Deer Valley and Duck Creek, Griffin Top, and the spruce fir forests on the Escalante Ranger District. Within the foreseeable future, thinning and salvage projects are planned on School Wash, Henrie Knolls, and Willis Creek (Cedar City Ranger District); Griffin Springs and Iron Springs (Escalante Ranger District); and East Fork, Robinson Meadow, and Kanab Creek (Powell Ranger District). Other projects in official planning stages are listed in Table 5.1-1. Table 5.9-1 re-lists the projects with the greatest potential to impact vegetation and describes the potential impacts from each on vegetation resources in the CEA.

Table 5.9-1 Potential Impacts to Vegetation from Projects listed in Table 5.1-1

Project	Potential Impacts to Vegetation Resources
Upper Santa Clara River Vegetation and Fuels Project	Some vegetation removal: 1,662 total treatment acres, of which 352 acres will be treated in 2008, and 596 acres will be treated in 2009; decreased risk of uncharacteristic wildfire.
Pine Valley Fuels Treatments	Some vegetation removal: treatments include 217 acres in 2011; decreased risk of uncharacteristic wildfire.
Duck Creek Fuels Treatment	Some vegetation removal; Phase II will treat 600 acres and Phase III 2,800 acres in 2008, 10,000+ acres in 2009, 5,000 acres 2010, and 1,500+ acres in 2011; decreased risk of uncharacteristic wildfire.
Edward Spring Vegetation Treatment	Vegetation removal and increase in early succession species: 1,108 acres to be treated in 2008.
Midway-Deer Valley Scenery Enhancement and Vegetation Treatment	Vegetation removal, including spruce, aspen, and meadow; treatments include 600 acres in 2008, 400 acres in 2009, and 200 acres in 2010.
Little Creek-Red Creek Vegetation Treatment	Removal of conifers and pinyon-juniper; long-term increase in sagebrush and aspen.
Navajo Basin Forest and Scenic Recovery	Removal of dead conifers; long-term increase in aspen and healthy conifer stands.
Red Desert	Long-term increase in aspen.

Project	Potential Impacts to Vegetation Resources
Vegetation Treatment	
Tippets Salvage	Removal of conifers.
Mt. Dutton Vegetation Management Project	Vegetation removal on approximately 870 acres, including approximately 620 acres in 2009, 200 acres in 2010, and 50 acres in 2011. Conifer and aspen trees would be established, thus creating a more diverse vegetation community than what existed before the outbreak.
Dipping Vat Habitat Improvement Project	Removal of pine stands and sagebrush: 1,132 acres in 2008.
Toad Salvage	Removal of ponderosa pine trees; improvement of stand health.
Pockets Vegetation Management	Vegetation removal, including 4,721 acres of conifers and 2,647 acres of aspen.
Bridge Fire Salvage and Restoration Project	Removal of dead conifers; long-term increase in healthy conifer stands.
Iron Springs Improvement and Salvage Project	Removal of spruce-fir; long-term increase in aspen.
Road Draw Salvage and Reforestation Project	Removal of conifers.

5.9.3 Cumulative Effects by Alternative

5.9.3.1 Alternative A

Under Alternative A, no new oil and gas activity would occur and there would be no cumulative effects.

5.9.3.2 Alternative B

Under Alternative B, the potential for cumulative effects to vegetation resources would be slight. Ninety six percent of the forest would be either legally unavailable (6%), not available for lease (70%), or not available for surface occupancy (20%). Connected actions, such as the construction of roads, exploratory well pads, or production field, occurring on the remaining 4 percent of the Forest, may lead to cumulative impacts to major vegetation types that are not protected by leasing options, in certain areas that have been impacted by past disturbance or in areas that may be impacted by future management and vegetation trends. The Pockets Vegetation Management area in the Escalante Ranger District contains old, overstocked spruce fir stands that are vulnerable to bark beetle infestations and fire. This area is largely available for leasing (CSU) under Alternative B. Despite being actively managed for timber over the next five years to reduce risks of fire and outbreaks, oil and gas activities in these areas may lead to cumulative impacts if disturbances increase the risk of fire ignition. Operating procedures would require precautionary measures such as burning only during low to moderate fire risk and having fire suppression equipment on hand. However, oil and gas activities occurring in these areas still may lead to cumulative impacts if an accident occurs. An uncharacteristic wildfire in any of these areas would be a measurable cumulative impact that would be long term, due to

the typically long recovery time from such fires, and minor to moderate, depending on the severity. Oil and gas disturbances within major vegetation types in other available areas of the Forest would not lead to cumulative impacts because other available vegetation is comprised mainly of pinyon-juniper, mountain brush, and sagebrush in locations that are not particularly sensitive.

Under Alternative B, cumulative impacts to biological soil crusts and invasive plant levels could occur within the Pine Valley Ranger District due to seismic activities allowed under NSO. Seismic activities, relative to other connected actions, have a relatively high probability of introducing invasive plants, which also leads to diminished surface area available for biological soil crusts that enhance soil conditions for native plant growth. Buggy travel for seismic activities may also directly damage soil crusts. Invasive plant levels are currently high in many areas of the Pine Valley Ranger District and further infestations caused by oil and gas activities could push these infestations closer to an epidemic that would be more difficult and costly to control. Developments in the Pine Valley Ranger District (Washington County) that are expected to increase in the foreseeable future may also increase the risk of weed infestation as more ground is disturbed on private lands.

Several fuels treatments are expected to be implemented in the foreseeable future (Table 5.1-1) around communities at risk of fire in the Pine Valley Ranger District. Cheatgrass frequency has increased along the I-15 corridor due to fire, and these areas would be highly susceptible to fire from oil and gas activities during the summer in addition to further cheatgrass invasion if a fire occurred. Cumulative impacts would result from oil and gas activities that increased the risk of fire, the spread of invasive plants, and the possible associated reduction of biological soil crusts in the Pine Valley Ranger District, where impacts have already occurred and are expected to continue in the foreseeable future; these cumulative impacts would be long term and minor.

With the exception of Red Canyon Botanical Area, which is 39 percent NL and 61 percent NSO under Alternative B, there would be no cumulative impacts within any Research Natural Area or Special Area because all areas are covered by NL stipulations under Alternative B. Buggy travel for seismic activities is not likely to lead to cumulative impacts within the Red Canyon Botanical Area because this area is not impacted by current management or actions in the foreseeable future.

5.9.3.3 Alternative C

The potential for cumulative impacts to major vegetation types in the vicinity of the Pockets Vegetation area in the Escalante Ranger District (spruce fir) would be the same as under Alternative B. Under Alternative C, more of these and surrounding areas are available for leasing, which increases the chances that the sensitive areas can be accessed and disturbed. However, if cumulative impacts occurred, they would still be short term and minor to moderate as described under Alternative B.

Cumulative impacts related to biological soil crusts, invasive plants, and fire in the Pine Valley Ranger District from seismic (buggy) travel activities would be long term and minor, as under Alternative B, although more area is available for lease so infestations could be possible in more locations than under Alternative B.

Seismic activities allowed by NSO under Alternative C could not lead to measurable cumulative impacts within Special Areas because these areas are not impacted by current management or

actions in the foreseeable future. Research Natural Areas under Alternative C are covered by NL stipulations, thus cumulative impacts in these areas would not occur

5.9.3.4 Alternative D1 (NSO in IRAs)

The potential for cumulative impacts to major vegetation types would be slightly higher under Alternative D with NSO in IRAs, relative to Alternative C, because more of these and surrounding areas are available for leasing, including the Sanford Fire area in the Powell Ranger District. Cumulative impacts to vegetation are unlikely in the Sanford Fire area, however, because most of this area is revegetated. Cumulative impacts in previously impacted areas described under Alternative B, if they occurred, would still be short term and minor to moderate as described under Alternative B.

Cumulative impacts to biological soil crusts and noxious weeds in the Pine Valley Ranger District from seismic (buggy) travel activities would be the same as under Alternative C because a similar amount of area in this Ranger District would be NSO under both alternatives, due to Inventoried Roadless Areas, and thus open to the risk of invasion.

There would be no cumulative impacts to Research Natural Areas or Special Areas from seismic activities under Alternative D, with the possible exception of noxious weed invasion within the Browse Research Natural Area. Thirty-nine acres within this Research Natural Area (2% of its area) are currently infested with scotch cottonthistle and new infestations or further spread of this noxious weed could cause a measurable cumulative impact in the area. This cumulative impact would be long term and moderate.

5.9.3.5 Alternative D2 (CSU in IRAs)

Cumulative impacts to major vegetation types, biological soil crusts, and noxious weeds would be the same duration and intensity as under Alternative B, C, and D with NSO in IRAs, although cumulative impacts would be possible over a greater area (than Alternative D with NSO in IRAs) due to the availability of Inventoried Roadless Areas for lease.

Cumulative impacts to the Browse Research Natural Area would also be the same as described under Alternative D with NSO in IRAs, although less likely to occur because all Research Natural Areas would be among the most restricted areas on the forest (i.e., NSO) and would likely be avoided. If cumulative impacts occurred with regard to noxious weeds invading the Browse Research Natural Area they would be long term and moderate.

5.9.3.6 Alternative E1 (NSO in IRAs)

The potential for cumulative impacts to major vegetation types would be slightly higher under Alternative E with NSO in IRAs relative to Alternative D (both alternatives) because more of these and surrounding areas are available for leasing, including the Duck Creek area in the Cedar City Ranger District under this alternative. Cumulative impacts are possible if a fire were to occur in this area as a result of oil and gas activities, because this area is currently at risk of fire due to fuel loads.

As under Alternatives C and D with NSO in IRAs, cumulative impacts to biological soil crusts and noxious weeds in the Pine Valley Ranger District would be the same duration and intensity as under Alternative B and would be possible over an area of similar size, due to NSO stipulations in Inventoried Roadless Areas.

Cumulative impacts to the Browse Research Natural Area would be the same as described under Alternative D with NSO in IRAs; impacts could be long term and moderate.

5.9.3.7 Alternative E2 (SLT in IRAs)

The potential for cumulative impacts to major vegetation types would be slightly higher than under Alternative E with NSO in IRAs because the entire Forest, with the exception of Wilderness and other NA lands, would be available for leasing. If impacts such as a fire occurred within major vegetation types in sensitive areas, cumulative impacts to vegetation would be short term and could be moderate.

As under Alternatives C, D (both alternatives), and E with NSO in IRAs, cumulative impacts to biological soil crusts and noxious weeds in the Pine Valley Ranger District would be the same duration and intensity as under Alternative B, but would be possible throughout the ranger district outside of the Pine Valley Mountain Wilderness Area.

Cumulative impacts to the Browse Research Natural Area would be the same as described under Alternative D with NSO in IRAs; impacts could be long term and moderate.

Table 5.9-2 Summary of Cumulative Effects for Vegetation

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
Past grazing, fire suppression, and spruce beetle outbreaks have led to a buildup of fuels and the death of large stands of spruce fir. The greatest impacts have occurred in forests on the Cedar City and Powell Ranger Districts. Development on private lands, fires, and the spread of invasive plants has occurred on the Pine Valley Ranger District.	Vegetation treatments are in progress to improve ecosystem health, increase diversity of vegetation communities, and reduce the risks of fire and insect outbreaks. Forests in the Escalante Ranger District are currently at risk of fire and insect outbreak. Cheatgrass-infested areas in the Pine Valley Ranger District are also at risk of fire.	Population growth (and development) and the spread of invasive plants are expected to increase in the foreseeable future. Vegetation treatments including timber harvests, chaining of shrubs and pinyon/juniper, and prescribed fires are expected to continue at current levels in the foreseeable future.	**Alternative A** No new leases would be authorized and there would no direct or indirect impacts to vegetation resources as a result of oil and gas activity.	There would be no cumulative effects under Alternative A.
			Alternative B Overlapping NL options would prevent direct disturbance to vegetation resources in most areas (70%). NSO would prevent permanent disturbance to major vegetation types on (20%) of the forest. Connected actions could still occur on CSU lands (4%). All RNAs and Side Hollow Study Area would be NL. Red Canyon Botanical Area would be 39% NL and 61% NSO.	Cumulative effects could occur as a result of oil and gas activity in areas degraded by past and future management activities. Regarding major vegetation types, spruce fir in the Pockets area on the Escalante Ranger District is susceptible to fire and insect outbreaks. Cumulative impacts from fire would be short term and minor to moderate. Cumulative impacts could also result from noxious weed infestations or fire on the Pine Valley Ranger District; these impacts could be long term and minor. No cumulative impacts to RNAs or Special Areas.
			Alternative C NSO would prevent permanent disturbance to major vegetation types in most areas (76%; includes areas within IRAs). Direct and indirect impacts from seismic activities could occur on NSO within Special Areas. All RNAs are covered by NL.	Cumulative impacts to major vegetation types and with regard to soil crusts and noxious weeds in the Pine Valley Ranger District would be the same in duration and intensity as under Alternative B although the area over which they could occur would be slightly larger. No cumulative impacts to RNAs or Special Areas.
			Alternative D1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 33% of the forest, which includes all IRAs. Seismic disturbance could occur in any RNA or Special Area.	Cumulative impacts to major vegetation types would be the same in duration and intensity as under Alternative B and C although the area over which they could occur would be larger. The Sanford Fire area would largely be available for lease under this alternative but cumulative impacts to vegetation there are unlikely because the area is largely revegetated. Cumulative impacts with regard to noxious weeds and soil crusts in the Pine Valley Ranger District would be the same as under Alternative C. Cumulative impacts in the Browse RNA from noxious weed invasion could be long term and moderate.

Past Actions	Present Actions	Future Actions	Alternative	Cumulative Effect
			Alternative D2 (CSU in IRAs) NSO would cover 8% of the Forest, including RNAs and Special Areas. Other areas of the forest would be largely available for lease and impacts from connected actions: 80% of the forest is CSU or TL.	Cumulative impacts to major vegetation types would be the same in duration and intensity as under Alternatives B, C, and D with NSO in IRAs although the likelihood that they would occur would be slightly higher. The Sanford Fire area would largely be available for lease under this alternative but cumulative impacts to vegetation are unlikely because the area is largely revegetated. Cumulative impacts in the Browse RNA from noxious weed invasion could be long term and moderate.
			Alternative E1 (NSO in IRAs) NSO would prevent disturbance from connected actions (except seismic) in 33% of the forest. Connected actions could occur elsewhere, including parts of the Timbered Cinder Cone, Browse, and Table Cliff RNAs; and in the Red Canyon Botanical Area.	Cumulative impacts to major vegetation types would include those that may occur under Alternatives B, C, and D (both alternatives), and in addition would include the Duck Creek area in the Cedar City Ranger District that is at risk of fire. Cumulative impacts in the Browse RNA from noxious weed invasion could be long term and moderate.
			Alternative E2 (SLT in IRAs) Direct disturbance from connected actions could occur anywhere on the forest, including within RNAs and Special Areas.	Cumulative impacts to major vegetation types would include those that may occur under Alternatives B, C, D (both alternatives), and E with NSO in IRAs. The possible area over which cumulative impacts could occur would be the greatest of any alternative because the largest area is available for lease. Cumulative impacts in the Browse RNA from noxious weed invasion could be long term and moderate.

5.10 Transportation

5.10.1 Description of Cumulative Effects Area

The CEA for Transportation would be the same as described for Recreation Resources in Section 5.4.1 (see Figure 5.4-1).

The lands within the CEA are mostly (79 percent) administered by federal agencies (49 percent US Forest Service, 29 percent BLM, and 1 percent NPS) and actions on these lands were, are, or will be subject to NEPA. The remaining lands (21 percent) are either privately owned (16 percent) or administered by the State of Utah (5 percent).

5.10.1.1 Rationale

The CEA covers all major transportation corridors accessing the Dixie National Forest.

5.10.2 Past, Present, and Reasonably Foreseeable Future Actions

ROADS

Existing miles of Forest System roads are discussed in Section 5.1.2.1. Miles of existing roads within the CEA and off the Dixie National Forest has not been calculated, but is likely higher than on the Forest. State Route 22 occurs within the CEA, but entirely off the Dixie National Forest. On BLM administered land, the Grand Staircase-Escalante National Monument predicts 3.5 miles of new road construction over the next 15 years (BLM 1999a). No planned, new road construction projects within the CEA on lands administered by the National Park Service, Cedar City Field Office, or Richfield Field Office are known.

The CEA also includes private and State of Utah lands and 28 municipalities within 5 counties. It is reasonably foreseeable that future road construction will continue on these lands and that traffic volume will increase as a result of population growth in at least some of these areas.

MINERALS ACTIVITY

Past oil and gas activity on the Forest (as discussed in Section 5.1.2.1) primarily includes the Upper Valley oil field, which is located on the southern edge of the Escalante Ranger District and occurs both on the Dixie National Forest as well as on adjacent portions of the Grand Staircase-Escalante National Monument. The field has producing wells (USFS 2006c), with total production to date of over 22 million barrels of oil. As there are no oil or gas pipelines in the region, all of the oil is trucked (3 -5 trips/week) 300 miles to refineries in Salt Lake City (UGS 1997).

In the past few years there has been a renewed interest in oil and gas within the CEA and there are currently 122 authorized leases and 14 pending leases, with a combined total lease area of 101,682 acres (BLM 2008). While these leases occur throughout the CEA, they tend to occur in clusters. Some of the larger clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active. Oil and gas potential on BLM lands in the CEA are described in Section 5.5.2. The only other recent activity on these leases has been the drilling of a few (5) wildcat wells on state and private land, all of which have been capped and abandoned (UDNR 2008a). Also, there is the possibility of unquantified drilling for coal bed methane on SITLA land within the

John's Valley area within the next 15 years. This would likely involve not only drilling but also establishment of a gas delivery system to market the gas if it occurred in paying quantities. Production would most likely be gas rather than oil. One of the 5 wells that were capped and abandoned was a coal bed methane well in this area.

In addition to oil and gas activity, there are currently 25 separate minerals activities, more than half of which are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are all very small operations (less than 5 acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, all of these are inactive or in some stage of reclamation.

The Coal Hollow Mine, described in Section 5.5.2, will operate 5 days per week (Monday-Friday). Coal would be transported from the mine via 43-ton coal trucks. Trucks would travel from Alton to Highway 89, north to US 20, west to I-15, south on I-15 to Cedar City and from Cedar City west 10 miles to a proposed rail loadout. The initial stages of mining will slowly roll out a smaller number of highway-approved tractor-trailers transporting coal from Alton to Intermountain Power Agency's plant near Delta. The number of trucks could eventually expand to as many as 300 coal trucks per day passing through Panguitch and other towns on state Route 89 (St. George Spectrum 09/20/2010).

ADDITIONAL REASONABLY FORESEEABLE FUTURE ACTIONS

Other projects in official planning stages are listed in Table 5.1-1. Of these projects, there are four on the Dixie National Forest that involve some level of road construction On the Pine Valley Ranger District, the Upper Santa Clara River Vegetation and Fuels Project would involve approximately 3.3 miles of temporary road construction, with 1.2 miles becoming part of the Forest System used to access existing campgrounds after Project completion. On the Powell Ranger District, the Mt Dutton Vegetation Management Project would improve approximately 5 miles of unauthorized roads and designate them as NFS roads. Lastly, on the Escalante Ranger District, the Pockets Vegetation Management Project would require nine miles of new roads, seven miles of unauthorized roads would be designated NFS roads, and 13.4 miles of existing NFS roads would be improved. No other new road construction projects are planned on the Dixie National Forest

5.10.3 Cumulative Effects by Alternative

Connected actions under the RFDS could result in cumulative effects related to road maintenance costs and public safety if an oil field were developed and resulted in adding additional truck traffic to those routes currently used to transport oil from the Upper Valley oil field. This impact would be long term and moderate. Similarly, cumulative effects could occur if both a production field and the potential Coal Hollow Mine were to transport product on the same routes. This impact would be long term and, given the large number of estimated trips associated with the Coal Hollow Mine, major. These impacts would also be common to all alternatives. No other transportation-related cumulative effects are expected from implementation of the RFDS.

5.11 Socioeconomic Resources

5.11.1 Description of Cumulative Effects Area

The CEA for socioeconomics is the Dixie National Forest and an eight-mile buffer around the Forest (Figure 5.11-1). This buffer contains the communities within the six-county area (Garfield, Iron, Kane, Piute, Washington, and Wayne) that are closest to the Forest boundary and most likely to be affected by the oil and gas activities within the Forest

5.11.1.1 Rationale

This area encompasses the Dixie National Forest and most of the cities and towns in the six-county area. Personnel, goods, and services associated with post-leasing activities would come from these areas.

5.11.2 Past, Present, and Reasonably Foreseeable Future Actions

PAST AND PRESENT ACTIONS

The economy of the six-county area has been mixed. As measured by percentage increase, Washington, and Iron, Counties have experienced strong employment growth over the past decade. Employment growth in Kane County has been modest in comparison, while the economies of Garfield, Piute and Wayne Counties have grown very slowly. Washington County and, to a lesser extent, Iron County have consistently exceeded growth forecasts for several decades, while employment in the remaining counties is more seasonal and dependent upon tourism and agriculture.

There are 20 active mineral sites on or near the Dixie National Forest. Despite this, the mining industry has little economic impact on the area at the present time. Total mining employment in the six-county area was 323 in 2006 compared to total employment in the area of 87,527. Of these 323 jobs, 246 were in Washington County compared to total employment in the county of 59,369. The most significant mineral activity in Washington County is in the construction aggregate industry that supplies the local construction industry.

Many of the existing mineral sites within the CEA are for landscaping and decorative materials such as sandstone, alabaster, and cinder. Mineral operations targeting such materials are often operated intermittently and seasonally as demand warrants. As such, they will have little economic impact in terms of employment and wages.

REASONABLE FORESEEABLE FUTURE ACTIONS

The proposed Alton Coal Hollow Coal Mine (discussed in Section 5.5.2 and Section 5.10.2) would be located near the town of the same name.

Other future projects with potential impacts on the social and economic resources of the Dixie National Forest are listed in Table 5.1-1. Many of these projects involve current Forest Service personnel and have no net impact on employment and wages in the area. Other projects would likely involve contract construction companies. This spending of federal resources in the area would have a positive economic impact on the six-county area. Most of the actual work associated with these projects is short term and the associated economic impacts would also be short term.

5.11.3 Cumulative Effects by Alternative

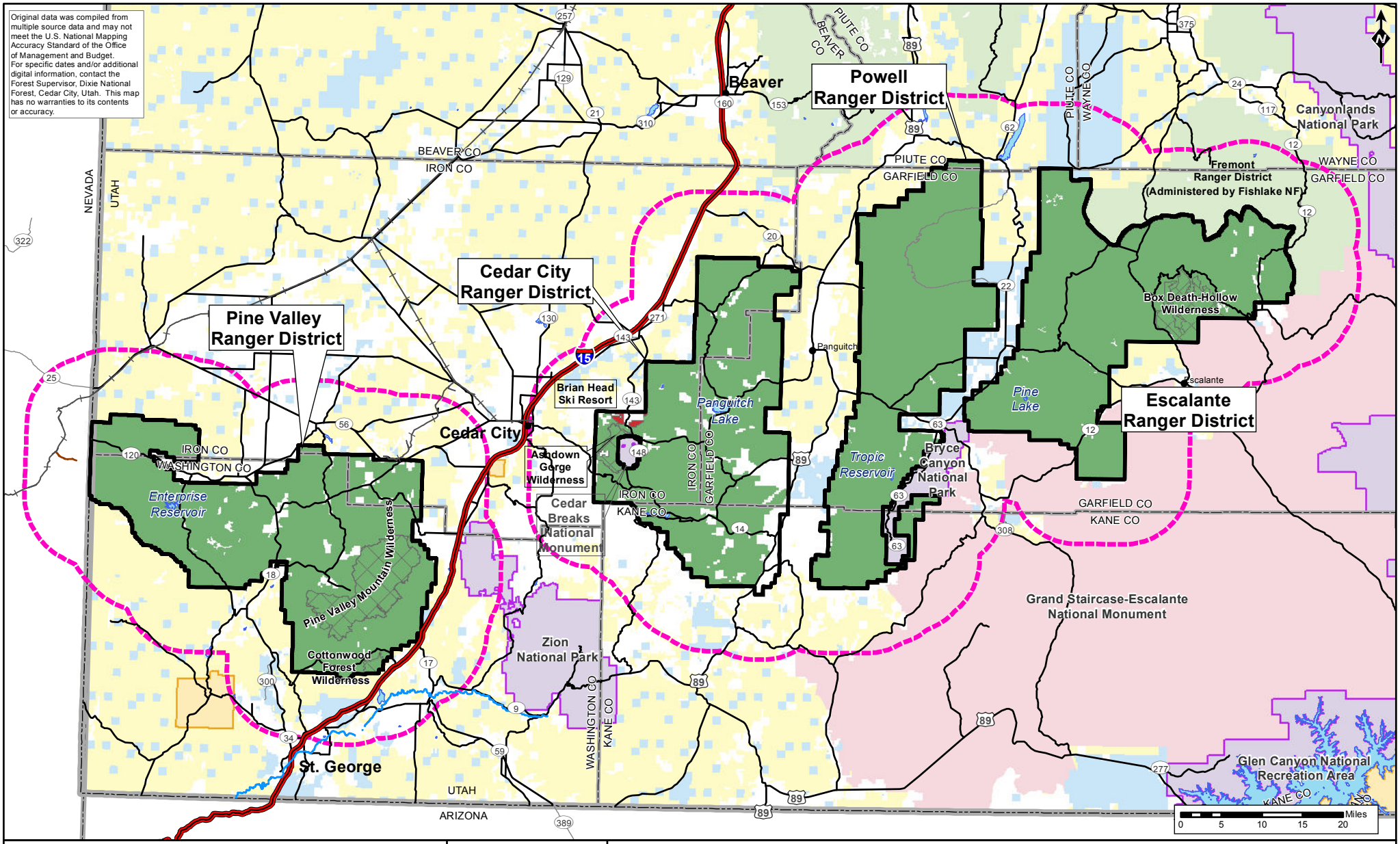
Depending on the viability of the production field, oil and gas operations on the Dixie National Forest could be long term. The associated economic impacts would also be long term. Depending on the location of the production field, the magnitude of these impacts ranges from negligible to moderate. The foreseeable future project in the CEA with the greatest potential for social and economic impacts is the Alton Coal Hollow Mine.

Employment estimates for the Alton Coal Hollow Mine were provided by Chris McCourt, project manager for Alton Coal Development. The annual production of 2 million tons of coal would require 100 miners. The operation will start up on privately owned coal and then transition onto the federal lease for which Alton Coal Development has applied. A total of 60 workers would be involved in trucking the coal to the railhead outside of Cedar City, Iron County. Wages associated with the coal mining and trucking operations were calculated using the average of the first three quarters of 2007 wage data; this yielded $58,688 for coal mining (NAICS 2121) and $39,812 for truck transportation (NAICS 484, Utah Department of Workforce Services 2008). The cumulative effect of oil and gas development on the Dixie National Forest and the Alton Coal Hollow Mine is estimated at 203 jobs and $9.6 million in annual wages for the six-county area (Table 5.11-1). These impacts would be common to all alternatives. Compared to the six-county area employment in 2006 (87,527), these employment impacts would be minor.

Table 5.11-1 Cumulative Economic Impact

	Employment	Annual Wages
Dixie NF Oil & Gas Development	43	$1,314,754
Alton Coal Mine		
Mining Jobs	100	$5,868,800
Truck Jobs	60	$2,388,720
Total Effects	203	$9,572,274

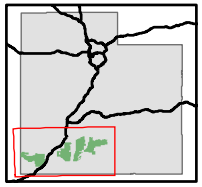
Many of the existing mineral sites in the CEA are for landscaping and decorative materials such as sandstone, alabaster, and cinder. Mineral operations targeting such materials are often operated intermittently and seasonally as demand warrants. As such, they will have little economic impact in terms of employment and wages and cumulative effects would be negligible.



Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.11-1
Cumulative Effects Area for Socioeconomic Resources

1 in = 16 miles	1:1,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



- Cities
- Railroad
- Minor Roads*
- Major Roads
- Freeways
- Virgin River
- Water Bodies
- County Boundaries
- State Lines

National Forest System Lands
- Dixie National Forest
- Wilderness Areas
- Fishlake National Forest
- Brian Head Ski Resort

Other Land Administration
- Bureau of Land Management
- GSENM**
- National Park Service
- Private
- State of Utah
- Tribal
- Cumulative Effects Area***

*Not all roads are shown. Only some roads are depicted for orientation purposes.
**Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
***Includes 8-mile buffer of Dixie National Forest Boundary.

5.12 Air Resources

5.12.1 Description of Cumulative Effects Area

The Cumulative Effects Area (CEA) for air resources is the Dixie National Forest boundary and the Dixie National Forest airsheds as described by the UDAQ, EPA, and Utah SMP as airsheds 2, 3, 4, 12, and 13 within Utah (Figure 5.12-1). Within the CEA are three Class 1 Areas (Bryce, Zion, and Capitol Reef National Parks) and 6 sensitive Class II areas (designated by the Forest Service only) that would be impacted by connected actions to leasing. Climate change effects are discussed on national, regional, and state levels (by reference, in Appendix SIR-2), although climate change effects are actually global in nature.

5.12.1.1 Rationale

Impacts to air quality would be within the immediate area of the Dixie National Forest and the Forest designated airsheds. Air Quality impacts could extend past the borders of the Forest and designated airsheds impacting regional haze and visibility.

5.12.2 Past, Present, and Reasonably Foreseeable Future Actions

The lands within the CEA are mostly (79 percent) administered by federal agencies (49 percent USFS, 29 percent BLM, and 1 percent National Park Service) and actions on these lands were, are, or will be subject to NEPA. The remaining lands (21 percent) are either privately owned (16 percent) or administered by the State of Utah (5 percent).

Existing activities on the Dixie National Forest that contribute to air quality emissions include recreational vehicle use, residential heating sources, propane-combustion electrical generators for remote cell towers, timber harvesting, and wildfires as well as prescribed burns. The residential heating sources and cell tower generators are considered minor and insignificant sources. The past, present, and reasonably foreseeable future levels of recreational vehicle use, timber harvesting, and fires (wild and prescribed) are described in Section 5.1.2.1. These activities result in emissions of NO_x, CO, VOCs, $PM_{2.5}$, and PM_{10}. Activities on the Dixie National Forest that are assumed to be contributing to emissions of GHGs, including the heating and powering of Forest buildings and facilities as well as operation of on- and off-road vehicles and equipment, also have occurred, are occurring, and will continue to occur into the foreseeable future. Foreseeable future responses to climate change are discussed Section 5 of Appendix SIR-2.

Past oil and gas activity within the CEA has been relatively low, with the Upper Valley Field being the only producing oil field. The Upper Valley oil field is described in further detail in Section 5.1.2.1 and Section 3.12.13. There has been a renewed interest in oil and gas within the CEA with the exploration and production field located north of the Dixie National Forest in the Covenant Field. As of 2008, there were 122 authorized leases and 14 pending leases, with a combined total lease area of 101,682 acres (BLM 2008). While these leases occur throughout the CEA, they tend to occur in clusters. Some of the larger clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante Ranger District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active.

As of 2008, other recent activity on these leases has been the drilling of a few wildcat wells on state and private land, including one coalbed methane well, all of which had been capped and abandoned (UDNR 2008a). Current oil and gas activities result in NO_2, SO_2, $PM_{2.5}$, PM_{10}, and CO emissions. The Upper Valley Oil Field is predominately electrified.

In addition to oil and gas activity, there are numerous small minerals activities managed on public lands; more than half are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are usually small operations (less than 5 acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, most of these are inactive or in some stage of reclamation. Mining activities result in PM_{10} emissions with lesser amounts of NO_x and CO.

All of the above types of activities and development are expected to continue to some degree on the Forest and within the CEA into the foreseeable future. ATV use will continue to trend upward. The use of prescribed fire and mechanical fuel treatments are also anticipated to increase over the next 5 to 10 years. The amount burned by prescribed fires will likely increase to over 10,000 acres per year in the near future. Most prescribed burns have minor and short-term effects on air resources in the CEA. Further, an increase in the number of prescribed fires and mechanical fuel treatments should ultimately lead to a decrease in the number of large, catastrophic fires, thus reducing the resulting PM, $PM_{2.5}$, and PM_{10} emissions associated with those fires. Wildfires may increase in frequency in the CEA, however, due in part to climate change (discussed in Section 5.12.3).

In addition, there is the possibility of unquantified drilling for coal bed methane on State land within the John's Valley area within the next 15 years. This could involve not only drilling but also establishing a gas delivery system to market the gas if it occurred in paying quantities. Production would most likely be gas rather than oil.

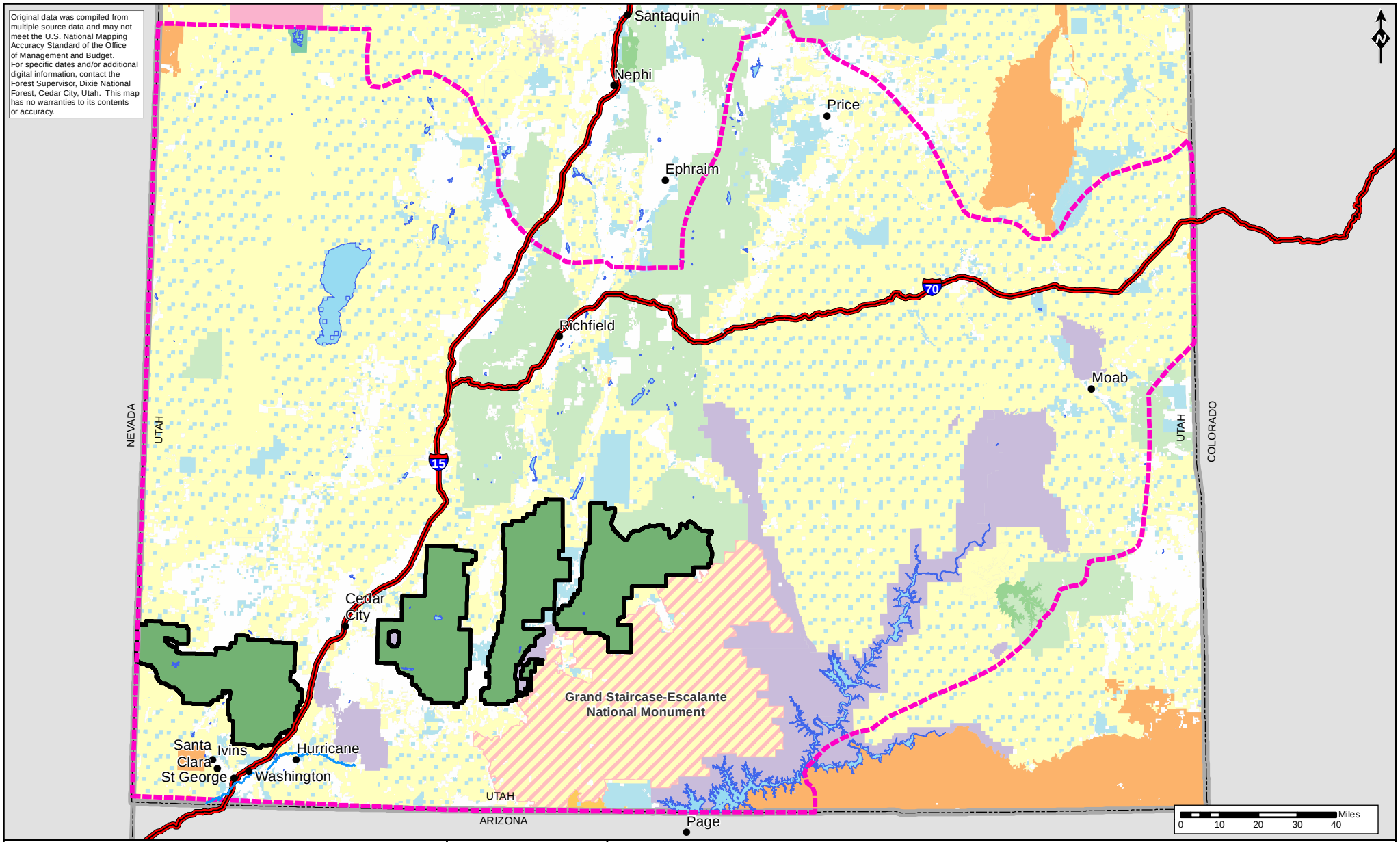
Timber harvesting will continue to be a part of the management goals of the forest. The existing mining activities are expected to continue and more exploratory wells may be drilled. Existing forests in the CEA will continue to serve as carbon dioxide sinks/storage.

Currently, there are several proposed or existing power plants or large industrial facilities within and surrounding the CEA. Multi-source, short, and long range, multi-pollutant air dispersion modeling would have to be conducted to determine cumulative effects and intensity associated with the measurement indicators. With the information provided we cannot make assumptions about existing and preexisting sources in the CEA. The proposed Intermountain Power Plant third unit and Rocky Mountain Power's Unit 4 at the Hunter Plant have been cancelled. NEVCO's Sevier Power Plant, located north of the Dixie National Forest, experienced difficulties in obtaining the necessary permits to construct and may be delayed or cancelled.

5.12.3 Cumulative Effects

Under any alternative, surrounding sources, population growth, vehicular traffic, and proposed coal-fired power plants in the general area could affect the Forest air resources now and in the foreseeable future.

Cumulative effects to air resources would not vary by alternative, except for Alternative A. Alternative A would not result in oil and gas-related emissions on the Forest. Thus, the



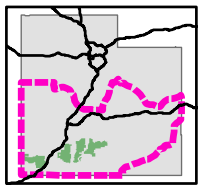
Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.12-1

Air Cumulative Effects Area

Utah Airsheds

1 in = 34 miles	1:2,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N



Legend

- Cities
- Freeways
- Water Bodies
- State Lines
- Dixie National Forest
- GSENM**
- Bureau of Land Management (BLM)
- BLM Wilderness Area
- US Forest Service (USFS)
- USFS Wilderness Area
- National Park Service (NPS)
- US Fish & Wildlife (USFW) National Wildlife Refuge
- Indian Reservation (IR)
- Military Reservations and Corps of Engineers
- State of Utah
- Private
- Cumulative Effects Area***

*Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
**Includes Utah Smoke Management Airsheds 2, 3, 12, 13, & 14. Digitized from http://www.wrh.noaa.gov/slc/projects/ifp/images/UTsheds.gif

remaining cumulative effects discussion pertains to all action alternatives (Alternatives B, C, D, and E).

Impacts of oil field development and sustainable production, if these activities occurred as predicted in the RFDS, would be long term and would vary greatly depending on how many fields are developed, the density of the field, and oil productivity. Presumably, with current air quality regulations, permitting, and periodic testing requirements, the impacts would be controlled if a source emits more than five tons per year of any Criteria Pollutant. The Modeling Report (Appendix SIR-1) is a proportional-based estimate of emission and visibility impacts that can be applied to a variety of scenarios using the tables in Appendix SIR-1A. Emissions from a proposed well field development would have to be modeled during the pre-construction permitting phase to show that all the emissions would comply with applicable regulatory standards. Air dispersion modeling, using an approved EPA model and protocol, would be used to determine whether the allowable emissions result in NAAQS or Class I visibility exceedances.

In addition, increased NO_2 and SO_2 emissions from both the predicted oil field-related activities and nearby permitted sources could contribute to acid rain deposition. Based on the emission estimates, an individual well field would not cause acid range deposition. However, numerous well fields along with regional coal-fired power plants could cumulatively impact the forests, mountain lakes, and vegetation with acid rain. Emissions from well field production also include ozone precursors ($PM_{2.5}$, PM_{10}, VOC, and NO_x) and could cumulatively contribute to regional haze and visibility issues within the Forest boundaries and Class I areas.

5.12.3.1 Ozone

Unlike other atmospheric pollutants, ozone is not primarily emitted into the atmosphere. Ozone is produced in the atmosphere as a result of combining precursor pollutants with solar radiation. These precursor pollutants can reside in the atmosphere for significant amounts of time and travel over significant distances. As a result, ozone impacts are best assessed on a regional scale, accounting for the precursor pollutant emissions from all available sources within a reasonable distance. Such an analysis should account for the emission and modeled transport of ozone and its precursors as well as the modeled atmospheric chemistry that would result from their interaction.

To complete a modeling analysis of this complexity was found to be beyond the economic limitations of this leasing EIS project. As a result, the USFS has developed an ozone analysis based on the best currently available "scientifically credible" evidence. The analysis, which was based on existing regional modeling simulations, also describes the relative completeness of the information available as well as the potential shortcomings of the available modeling data. To ensure that the requisite "hard look" was completed under NEPA, the analysis was completed in keeping with 40 CFR Section 1502.22 which reads:

"When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking...

> (b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement:

1. a statement that such information is incomplete or unavailable;
2. a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;
3. a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, and
4. the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason."

Given that a novel photochemical modeling analysis could not be reasonably completed for a cost that would not be considered exorbitant, the USFS acknowledges that the assessments of ozone impacts on both a direct and cumulative level are potentially incomplete.

With ambient ozone data indicating that regional ozone has been increasing throughout the State of Utah, particularly in regions with oil and gas development, the issue of ozone impacts is important to the determination of overall adverse impacts associated with this EIS.

As a result, the USFS has undertaken an assessment of existing scientifically credible evidence that would be able to bound the potential regional impacts associated with ozone concentrations. Given that potential future ozone impacts are best predicted by the use of a photochemical modeling analysis, the initial assessment focused on the availability of such modeling analyses. The assessment concluded that the most recent, peer-reviewed, photochemical modeling analysis which included the project area within its modeled domain was the Uinta Basin Air Quality Study. As a result, this modeling simulation was selected for use in assessing total ozone impacts for this EIS leasing project.

The Uinta Basin Air Quality Study (UBAQS) was initiated in 2008 and was completed in June 2009 (IPAMS 2009). The study, funded by the Independent Petroleum Association of the Mountain States (IPAMS), sought to assess the regional air quality impacts of oil and gas production on the Uinta Basin in Utah. Although the study was targeted to assess impacts in the Uinta Basin, the domain of the project was sufficiently large to allow assessments of air quality in regions throughout much of Utah.

UBAQS sought to assess the cumulative change in air quality from the regional expansion of oil and gas resources. In order to develop this assessment, primary and precursor emissions were developed for two modeled scenarios. These scenarios, occurring in model year 2005/2006 and 2012, included recorded (for 2005/2006) and reasonably foreseeable (for 2012) emissions from all sources that resided or would reside within the model domain. Proposed oil and gas-related sources for both modeled scenarios were sourced from regional and sub-regional emissions assessments. They utilized best available information to determine spatially representative oil and gas emissions. These emissions were then extrapolated forward in time to account for growth of oil and gas production throughout the domain for the 2012 scenario.

Emissions developed for both the base year (2005/2006) and future year (2012) were modeled utilizing the Community Multi-Scale Air Quality Model (CMAQ). EPA guidance for projecting

future 8-hour ozone concentrations recommends using the model in a relative sense to scale current observed 8-hour ozone Design Values. In order to perform this scaling operation EPA developed the Modeled Attainment Test Software (MATS) tool that uses modeling results, observed 8-hour ozone Design Values to project 8-hour ozone concentrations that reflect the change in emissions from a base case to an alternative emissions scenario.

For the UBAQS, the MATS tool was used to assess the effects of oil and gas development activities as well as regional emissions in the modeling domain on 8-hour ozone. The MATS tool performs 8-hour ozone Design Value projections at existing monitoring sites for comparison with the 8-hour ozone NAAQS. Additionally, the MATS tool has a capability to perform an Unmonitored Area Analysis (UAA) that performs a spatial interpolation of the current year observed 8-hour ozone Design Values using the ozone concentration gradients calculated from the gridded model base year outputs.

Because the nearest existing ozone monitoring location to the Dixie National Forrest is located in Canyonlands National Park, approximately 150 miles to the east, the UAA developed in the UBAQS was used to provide an assessment of impacts associated with this EIS.

Figures 5.12-2, 5.12-3, 5.12-4, and 5.12-5 below present the current and future year predicted 8-hour ozone design values for the entire UBAQS modeling domain when using modeled meteorological conditions from base years 2005 and 2006 respectively. Figures 5.12-6 and 5.12-7 present the projected increase or decrease in design value from the base to the future projection year.

Depending on the current year meteorological inputs used for the modeling simulation, the area-weighted average for the regions managed by the Dixie National Forest indicate current and future year 8-hour ozone design values that are at or near the existing 8-hour ozone NAAQS. Specifically, for the 2005 meteorological inputs, the current and future year 8-hour design values range from 70-86ppb depending on the sub-region of the forest that is analyzed. For the 2006 meteorological inputs, the current and future year 8-hour design values range from 70-75ppb depending on the sub-region of the forest that is analyzed. Given the diversity in predicted impacts associated with meteorological inputs the predicted impacts are best reviewed in relative terms, i.e. one should review the predicted change in ozone concentrations due to emissions increases rather than due to meteorological inputs. Figures 5.12-6 and 5.12-7 below quantify just such and analysis. Depending on the particular sub-region of the forest, design values associated with the impact of potential future oil and gas development, as well as regional growth, is forecast to remain stagnant for much of the Forest with only a slight increase or decrease in some regions. Both growth and contraction of the region's projected 8-hour ozone design values are constrained to less than one part per billion in ambient air.

As a result, the predicted impacts from the UBAQS suggest that regional ozone in the project area is unlikely to vary significantly from its current monitored conditions. When combined with monitored ambient ozone data from Washington County, UT. The UBAQS study suggest that the ozone impacts in the region are likely to remain below the existing ozone NAAQS. Specifically, when the most recent official annual ozone data (observation year 2008) was released for the UDEQ ozone monitoring station at 1215 N. Lava Flow Drive, Santa Clara, Washington County, UT, the closest FRM-certified monitor to the project region, the maximum 8-hour average for the entire reporting year was 68ppb. Although the monitoring station has not been in place for three years and therefore a formal design value cannot be calculated, the level of maximum 8-hour ozone would suggest that a shift of only 1ppb, as predicted by the UBAQS study would not be likely to produce ozone levels that would even approach the existing ozone

NAAQS. In addition, when data from the nearby Zion National Park ozone monitoring site is used for a similar analysis, the most recent design value (2006-2008) of 72ppb suggests that a increase or decrease of 1ppb would be unlikely to produce exceedances of the ozone NAAQS. These findings support that the connected actions to leasing described in this EIS will not result in a significant impact on regional cumulative ozone concentrations.

Although the UBAQS represents the best available peer-reviewed photochemical modeling simulation which includes the EIS project region, it should be noted that the UBAQS does have potential shortcomings that are recognized by the USFS. To ensure that all available information is provided with regard to the existing scientific evidence available for review, the following items should be noted in regards to the use of the UBAQS.

1. There is not sufficient air monitoring data in the UBAQS modeling study, because at the time the study was performed, this data was not available for the area.
2. The UBAQS primary modeling domain was subdivided into 12-km grid squares, instead of the preferred 4-km grids, for a large portion of central and eastern Utah and western Colorado. The accuracy of modeled predictions from a 12-km or greater grid spacing for areas of complex terrain has tended to be suspect.
3. The UBAQS oil and gas focus area, and associated emission inventory within that area, comprised the six-counties of the Uintah Basin. The Dixie National Forest occurs outside this focus area, but was covered within the overall UBAQS statewide modeling domain.
4. The modeling domain was subdivided into 12-km grid squares to provide additional detail on the locations of existing oil and gas emission sources. It is not clear how hypothetical emissions from the Dixie National Forest oil and gas leasing scenarios were reflected in the UBAQS study.
5. The UBAQS future modeled predictions for year 2012 are not particularly useful for project development activities occurring beyond the year 2012.

Given that the UBAQS does contain shortcomings, the USFS feels that its use is appropriate only in the limited exploration and development scenarios inherent to this EIS. Should proposed oil and gas activity exceed the bounds of the scenarios reviewed in this analysis additional ozone analyses need to be completed to affirmatively defend the finding of this EIS. The specific requirements for additional analysis are included in Appendix C of the EIS.

Figure 5.12-2 Current year 8-hour ozone Design Values (DVC) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.

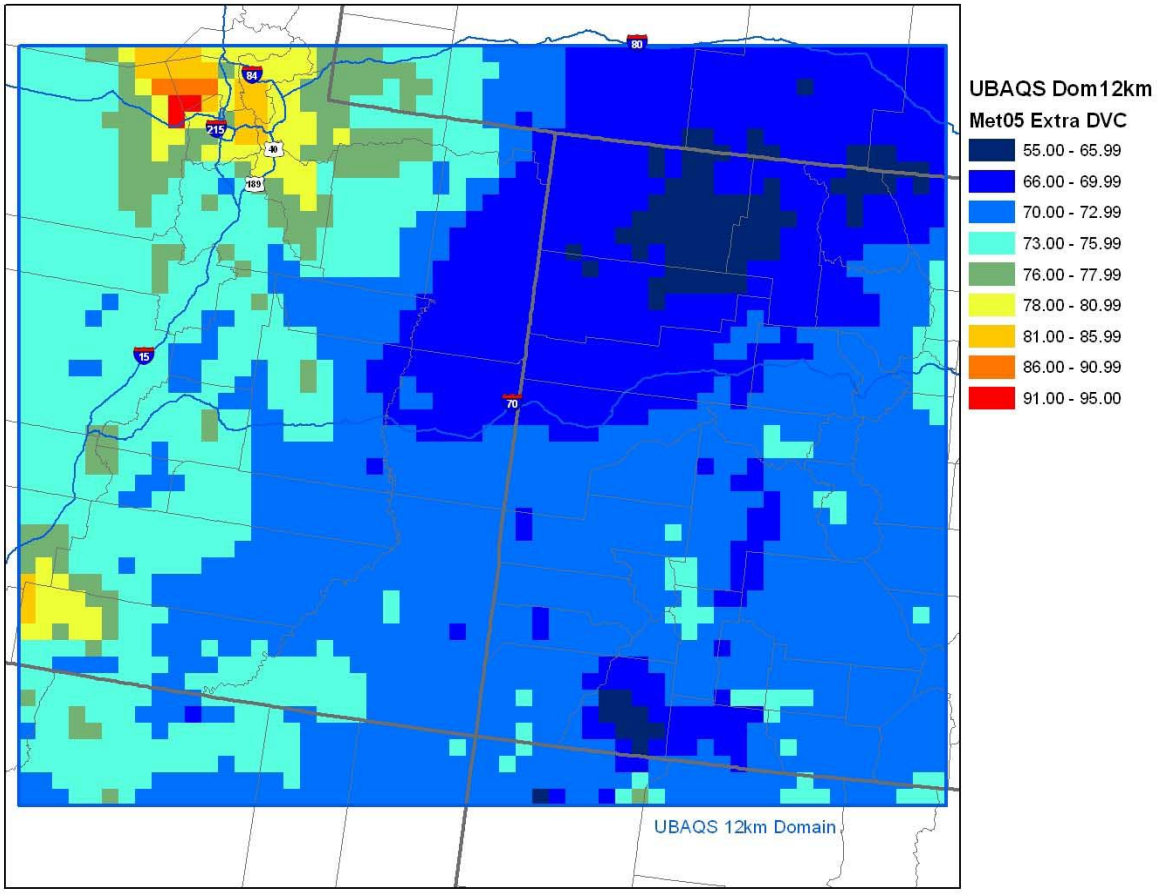


Figure 5.12-3 Current year 8-hour ozone Design Values (DVC) from the enhanced MATS unmonitored area analysis for the 2006 meteorological year.

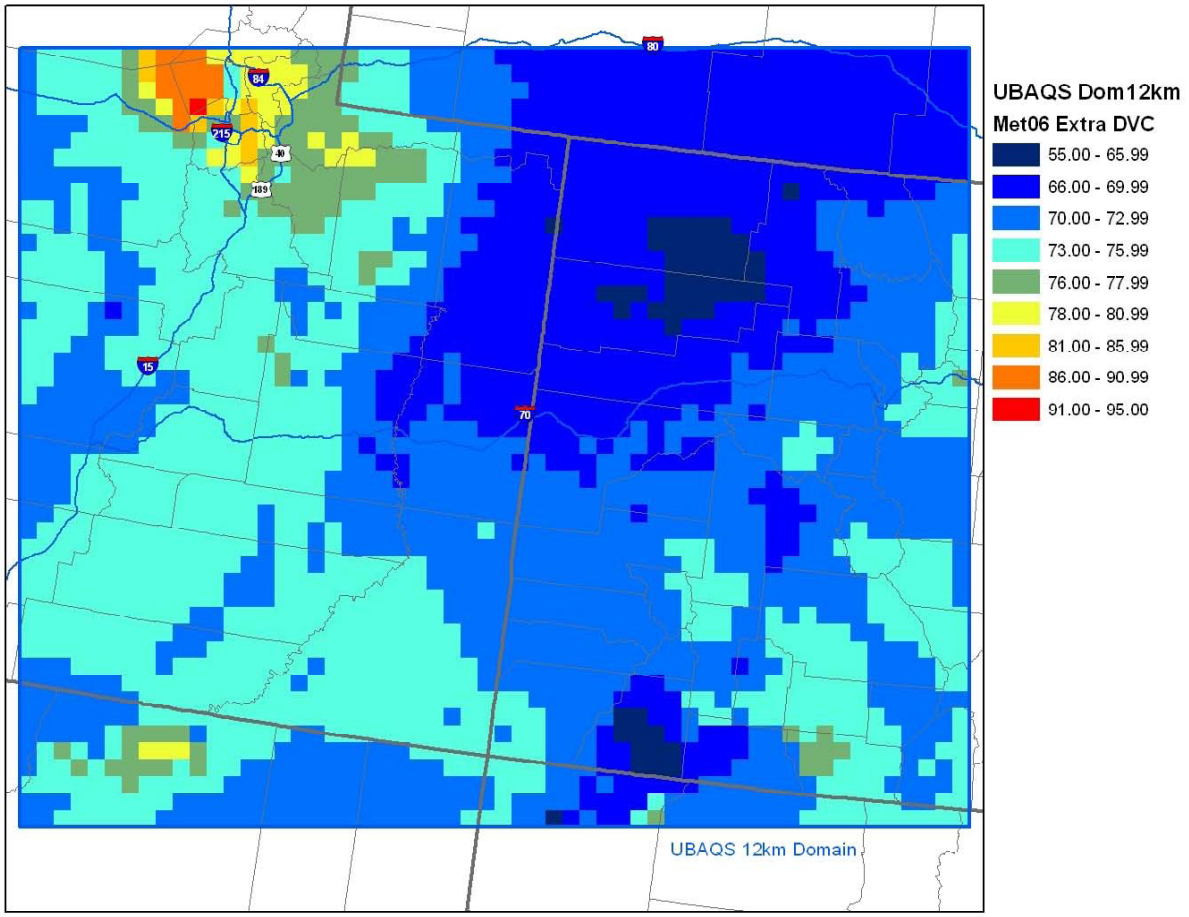


Figure 5.12-4 Projected 2012 8-hour ozone Design Values (DVF) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.

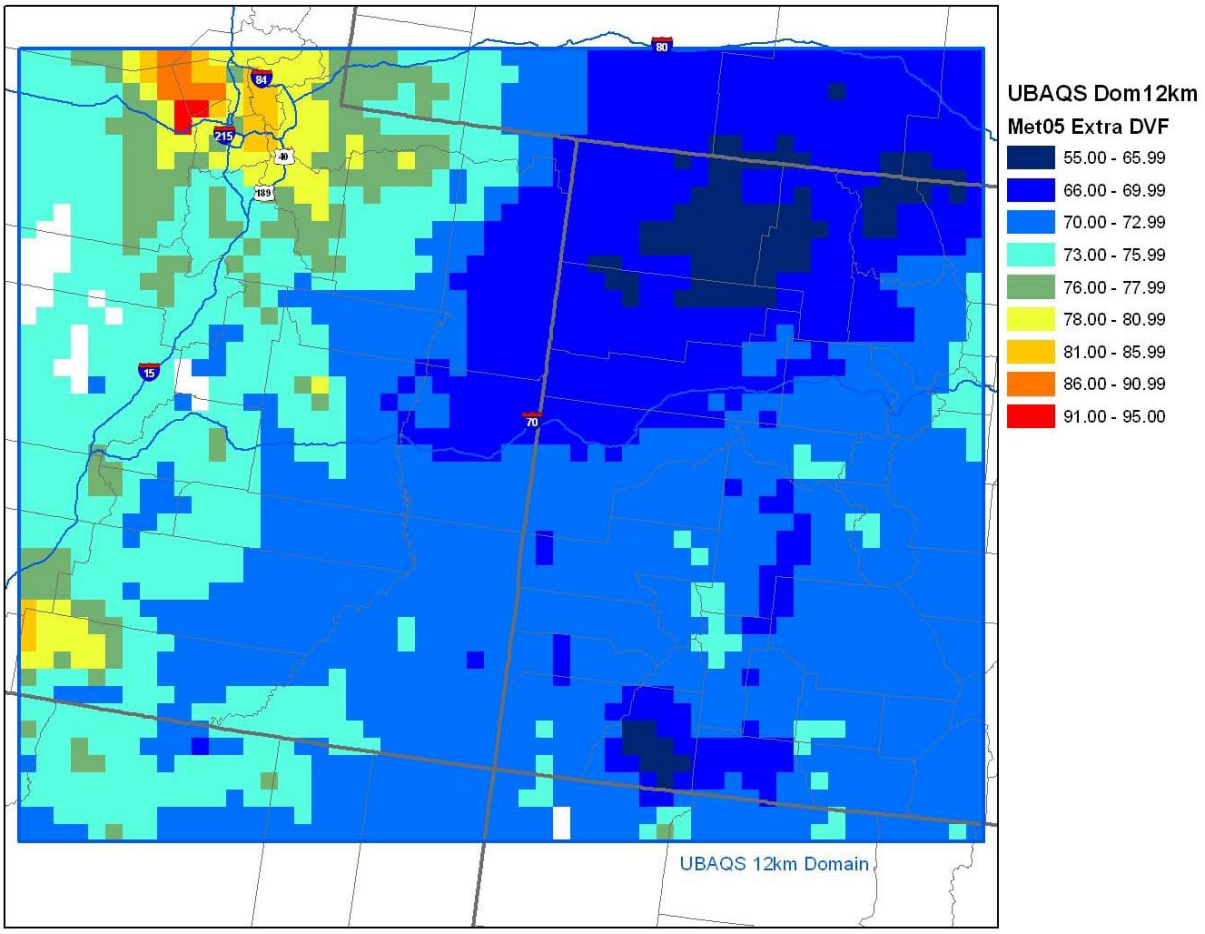


Figure 5.12-5 Projected 2012 8-hour ozone Design Values (DVF) from the enhanced MATS unmonitored area analysis for the 2006 meteorological year.

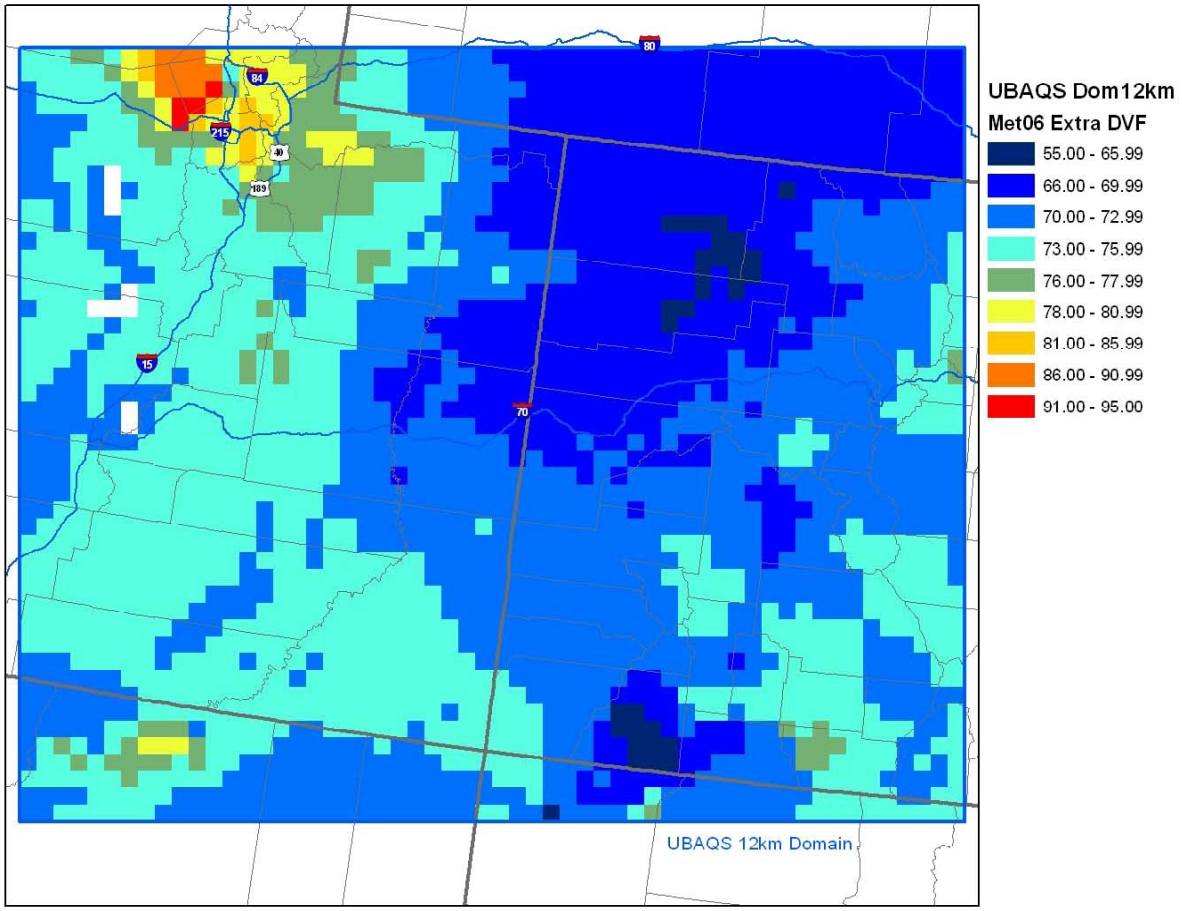


Figure 5.12-6 Differences in the projected 2012 (DVF) and current year (DVC) 8-hour ozone Design Values from the enhanced MATS unmonitored area analysis for the 2005 meteorological year (DVF-DVC).

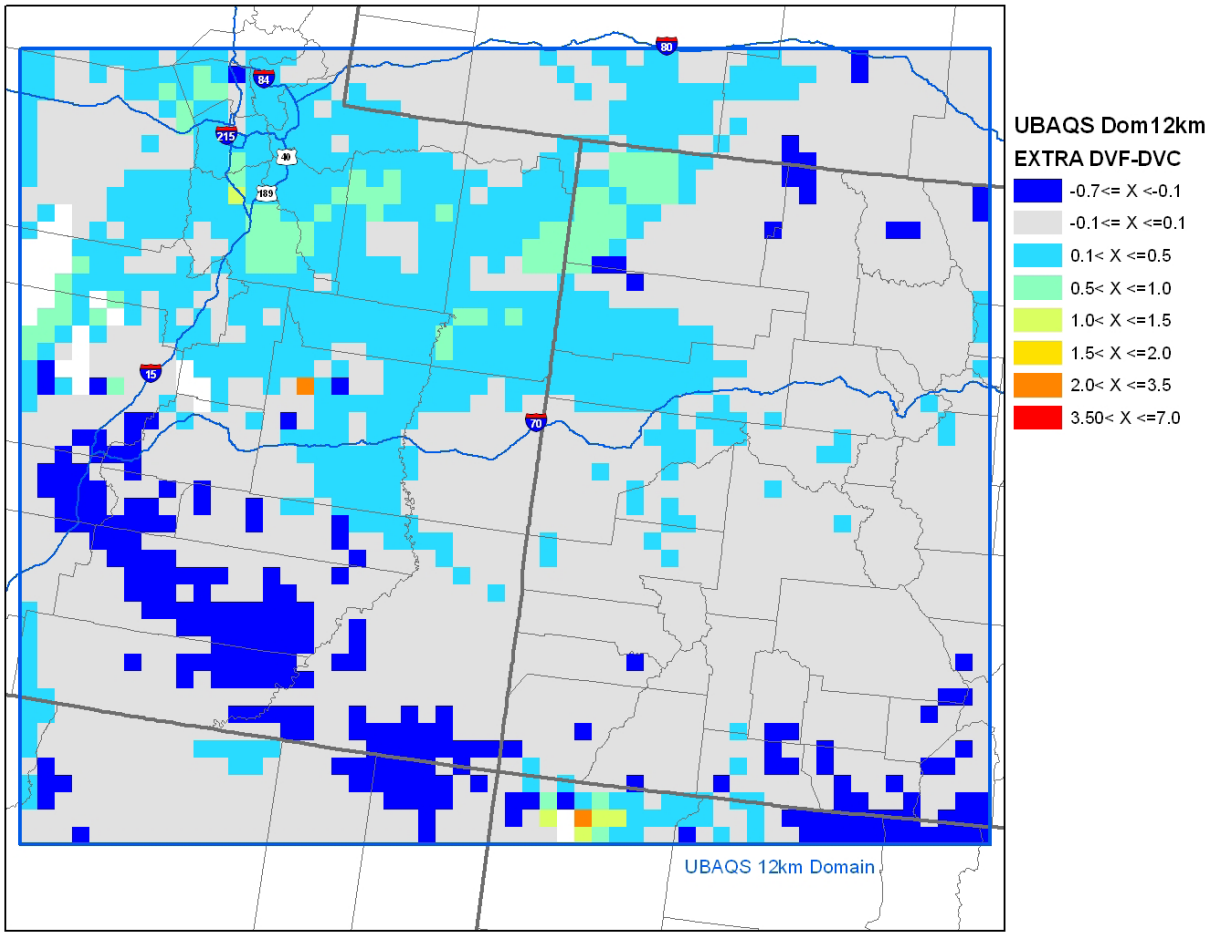
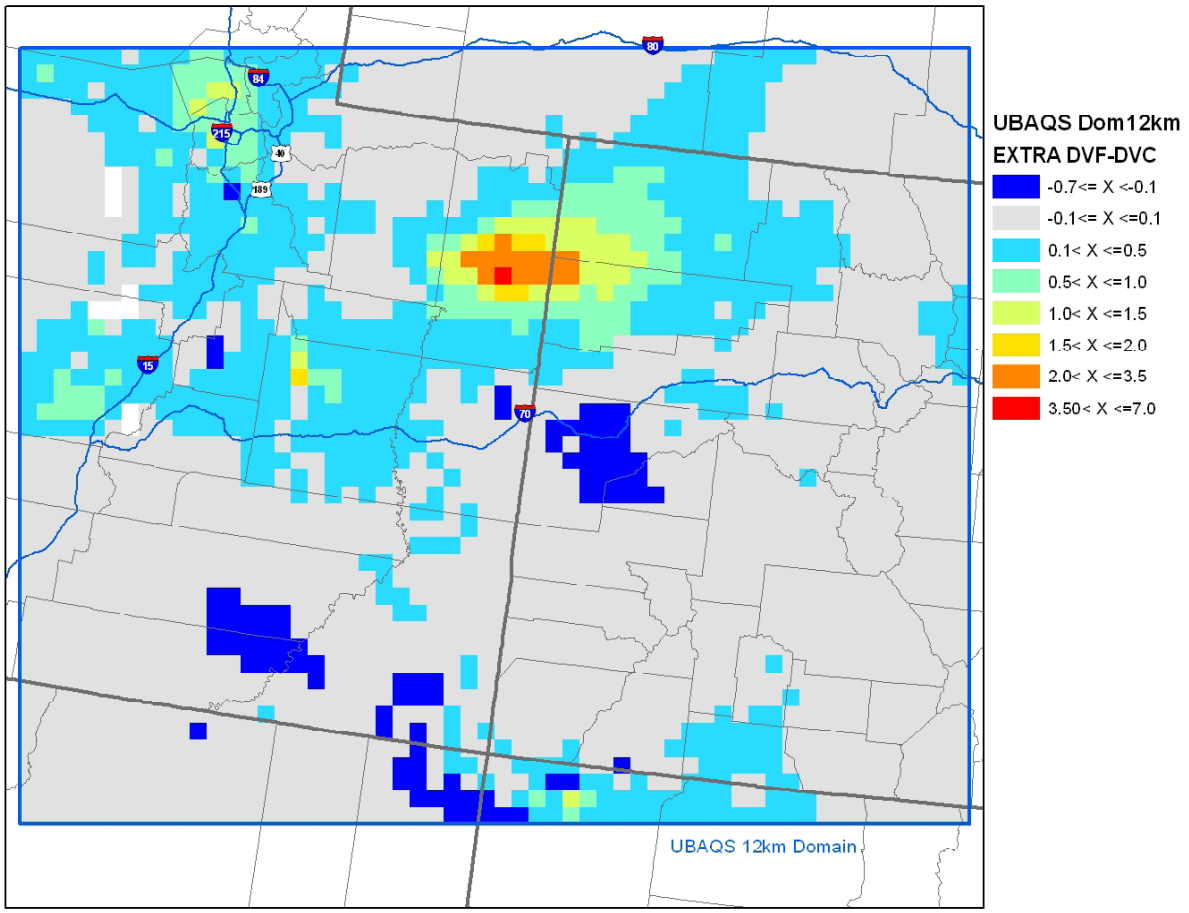


Figure 5.12-7 Differences in the projected 2012 (DVF) and current year (DVC) 8-hour ozone Design Values from the enhanced MATS unmonitored area analysis for the 2006 meteorological year (DVF-DVC).



5.12.3.2 Secondary $PM_{2.5}$

As with ozone, secondary $PM_{2.5}$ is not directly emitted into the atmosphere. Instead, secondary $PM_{2.5}$ is formed through the chemical combination of precursor pollutants that have been released into the ambient atmosphere. As a result, $PM_{2.5}$ must be assessed utilizing a regional photochemical modeling simulation. As with ozone, based on a review of the costs associated with completing such an analysis, the USFS was compelled to develop the secondary $PM_{2.5}$ analysis utilizing existing scientifically credible information. Based on the reliance on the Uinta Basin Air Quality Study (UBAQS) for the ozone portion of this EIS, that study was once again selected as the most representative and recently produced assessment of $PM_{2.5}$ for the Dixie EIS region.

Although the UBAQS contains the shortcoming previously mentioned in Section 5.12.3.1, it remains the most recently developed and technically defensible assessment of region-wide total (primary and secondary) $PM_{2.5}$ impacts for the Dixie National Forest region.

The UBAQS produced an assessment of absolute modeled $PM_{2.5}$ concentrations. These values were generated for the entire 12km modeling domain and can be used for direct comparison to the NAAQS, which are 35 µg/m^3 for the 24-hour average and 15 µg/m^3 for the annual average. As with the ozone modeling described in Section 5.12.3.1, the absolute modeled $PM_{2.5}$ concentrations were calculated based upon "current" and "future" year emissions assessments. The current year emissions were based on assessments of emissions as they occurred during calendar year 2006 while the future year emissions where based on forecasted emissions growth for all emissions sources to the future year of 2012. Each of these emissions scenarios were modeled utilizing two sets of meteorological conditions. Those observed in calendar year 2005 and those observed in calendar year 2006. These simulations were then used to calculate the absolute modeled $PM_{2.5}$ impacts.

Annual average and 24-hour average $PM_{2.5}$ plots for both meteorological years are shown below in Figures 5.12-8 and 5.12-9, respectively.

For the 2005 meteorological year, the current and future year emissions scenarios show $PM_{2.5}$ annual average values that are less than 15 µg/m^3 everywhere in the 12 km domain including throughout the entire Dixie EIS study region, indicating compliance with the NAAQS. In both the current and future year emissions scenarios, the maximum annual average $PM_{2.5}$ value within the 12 km domain is 14 µg/m^3 which occurs in the Salt Lake City region. Values within the Dixie EIS study region are not predicted to exceed approximately 6 µg m-3.

For the 2006, meteorological year, the annual $PM_{2.5}$ is within the NAAQS everywhere within the 12 km domain except in the Salt Lake City area, where the maximum value is 17 µg/m^3 in both the current and future year emissions scenarios. In both the 2005 and 2006 meteorological years, there is a secondary $PM_{2.5}$ maximum extending from the center of the modeling domain southwest toward the Utah-Arizona border, but this region of elevated PM2.5 does not exceed the annual average standard. The annual average $PM_{2.5}$, impacts are greater in the 2006 meteorological year than in 2005, however in no modeled scenario does absolute $PM_{2.5}$ impacts exceed 9 µg/m^3 in the Dixie EIS study region

5.12-9 shows that the 98th percentile of the 24-hour $PM_{2.5}$ (8th highest 24-hour average) is less than the 35 µg/m^3 standard over much the domain for both the current and future year emissions scenario, but exceeds 35 µg/m^3 in the Salt Lake City area and in the Uinta/Pinceance Basin in east-central Utah/west-central Colorado for both meteorological years. However, in

both meteorological years, the Dixie EIS study region is predicted to remain below the 35 μg/m^3 standard, and in most locations of the forest the impacts are predicted to be significantly below that value.

The pattern of changes in annual and 24-hour average $PM_{2.5}$ going from current to the future year emissions scenarios are similar in the 2005 and 2006 meteorological years. Maximum increases occur in northeastern Utah in the Uinta Basin and along the Arizona-Utah border and maximum decreases occur in western Colorado in the Piceance Basin, in Southwest Wyoming, and around Salt Lake City. In the Dixie EIS study region, $PM_{2.5}$ impacts are projected to remain relatively constant and will not posed a threat to exiting $PM_{2.5}$ NAAQS on either an annual or 24-hr timescale.

Figure 5.12-8 Modeled annual average PM2.5 for comparison to NAAQS for the 2005 meteorological year (left column) and 2006 meteorological year (right column).

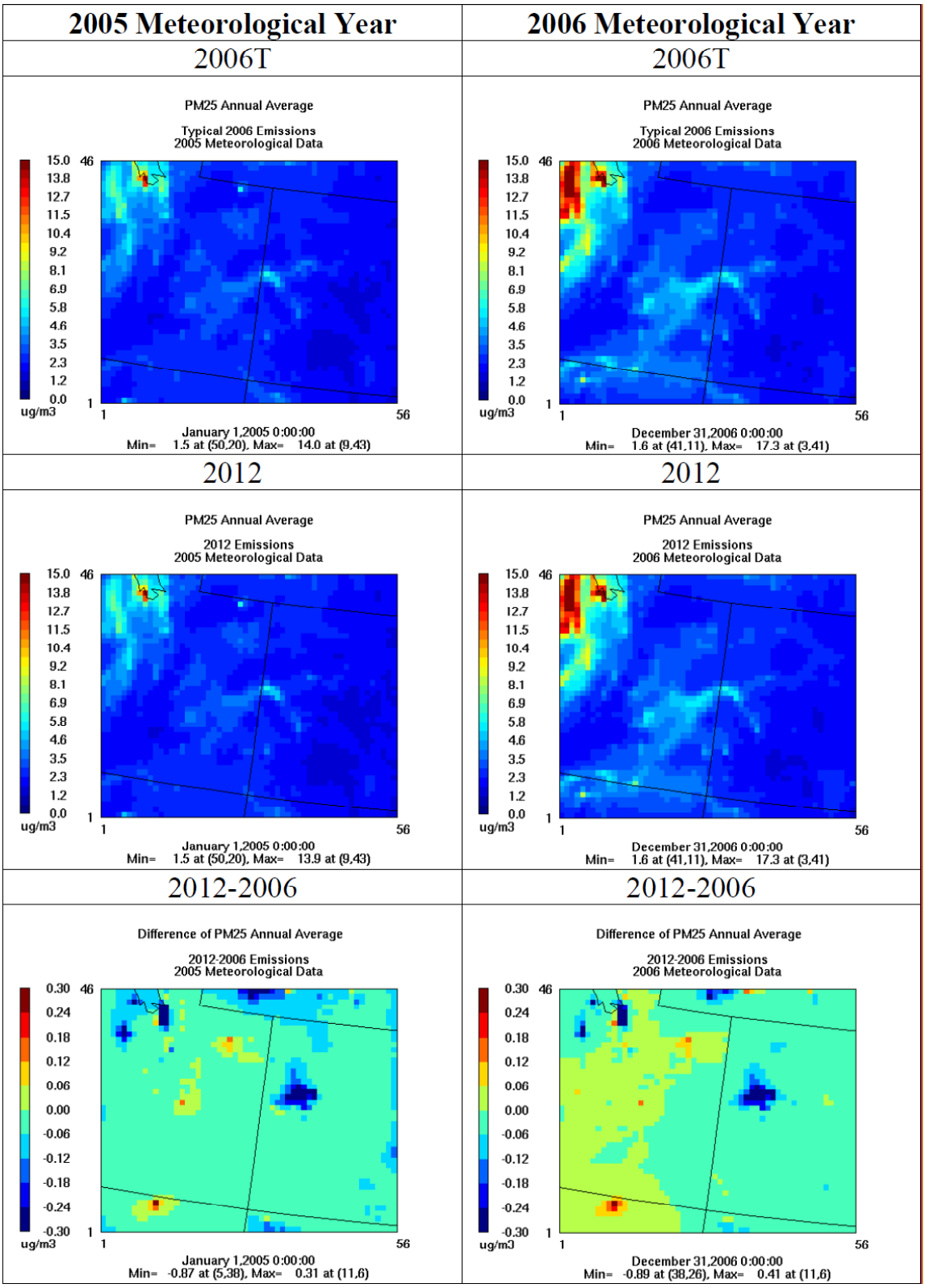
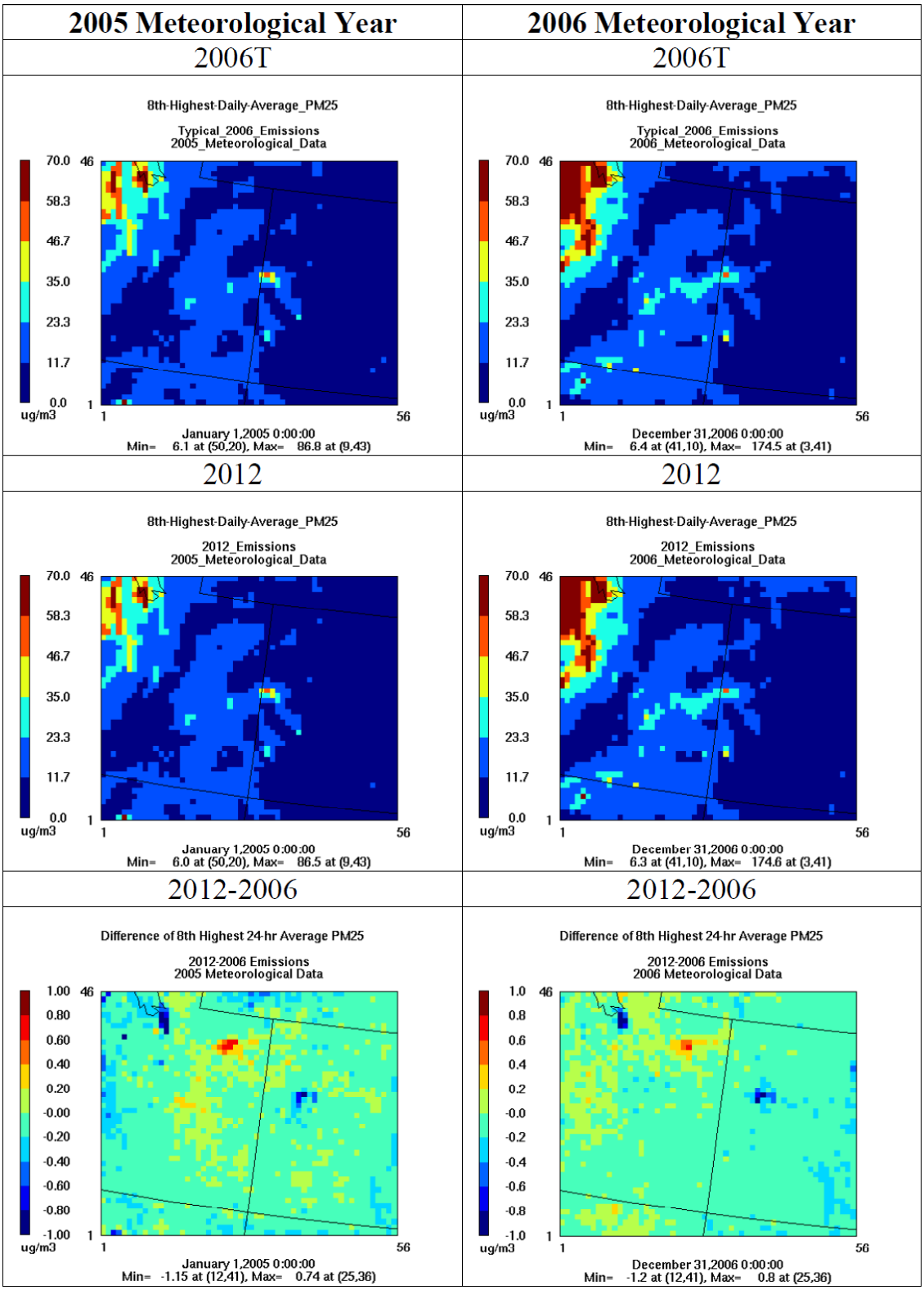


Figure 5.12-9 Modeled 24-hour average PM2.5 for comparison to NAAQS for the 2005 meteorological year (left column) and 2006 meteorological year (right column).



5.12.3.3 Climate Change

Climatic conditions described in Section 3.12.1 have, to some degree, already been affected by climate change and thus these past and current climate change effects are already included in the impact analysis of the EIS. Future climate change has the potential to further impact many of the same environmental resources in ways that are described in Appendix SIR-2 (Section 2). It is difficult to predict with any certainty the cumulative effects of future climate change along with the environmental impacts already described in the EIS.

The IPCC continental-scale modeling conducted for North America indicates warmer temperatures and generally less precipitation in the southwest U.S. on an annual basis (Christensen et al. 2007, p.850, p.887-888). For the western U.S., the IPCC modeling suggests modest changes in average annual precipitation ranging from slightly less than normal in the south to slightly greater than normal in the north. Change in winter precipitation is predicted to be variable with more winter precipitation in the northern part of the western U.S. and less in the Southwest. Summer precipitation is predicted to be less throughout the West. However, it is also noted that the continental-scale regions encompass a broad range of climates and are too large to be used as a basis for conveying quantitative regional climate change information.

The IPCC projection of less warming over the ocean than the land, and amplification and northward displacement of the subtropical anticyclone is likely to cause a decrease in annual precipitation in the southwestern U.S. (Christensen et al. 2007). According to the Fourth Assessment Report of the IPCC (Christensen et al. 2007), the following general climate change projections were made for the southwest U.S.:

- Seasonally, warming is *likely* to be largest in summer.
- Maximum summer temperatures are *likely* to increase more than the average summer temperature.
- Annual mean precipitation is *likely* to decrease.
- Snow season length and snow depth are *very likely* to decrease.

Wagner et al. (2003) reviewed the work of a number of climatologists, evaluated 20th century climate records for trends, and conducted two large computer models with the assumption that CO_2 concentrations would double in the 21st century to predict climate change effects in the Great Basin/Rocky Mountain region. They noted that use of global-scale models cannot be expected to project climate changes at localized areas with highly variable climates and great topographic variation like the Great Basin/Rocky Mountain area. Their modeling results showed year-round increases in temperature with the greatest increases occurring in winter. They also showed that annual precipitation was predicted to increase with the greatest increase occurring in winter.

Most of Utah's water resources originate in mountainous areas above 6,500 feet in elevation, which cover about 19 percent of the state (BRAC 2007). The primary source of this water is snowpack, which releases months of stored precipitation in about 4 to 8 weeks during spring and summer, as described in Section 2.3.2 of Appendix SIR-2. Clear and robust long-term snowpack declines have yet to emerge in Utah's mountains, as they have in low-elevation mountains in other states (i.e., in the Pacific Northwest and California). In addition, recent temperature increases in Utah appear to have had little impact on snowpack in the high mountains of the Intermountain West. However, studies of precipitation and runoff over the past

several centuries and climate model projections for the next century indicate that ongoing GHG emissions at or above current levels will likely result in a decline in Utah's mountain snowpack, thus the threat of severe and prolonged episodic drought in Utah is real (BRAC 2007). In addition, changes in snowpack will result in a declining water supply. Current climate models project a decline in summer precipitation across all of Utah (BRAC 2007).

The population of the Intermountain West (eight states including Utah) is projected to increase by 65 percent from 2000 to 2030, representing one-third of all U.S. population growth (USGCRP 2009). Between 2000 and 2005, Utah was among the five fastest growing states in the U.S. (US GCRP 2008). Projections of decreased snowpack and earlier spring melting suggest lower stream flows in the future, particularly during the high-demand period of summer (USGCRP 2008). There is a high likelihood that water shortages will limit power plant electricity production in many regions, and constraints in production by 2025 are projected in ten states including Utah (USGCRP 2009).

Forests are generally adapted to recent climatic conditions and variability (Hamrick 2004), but the rate of temperature change expected during the next century will greatly exceed that produced naturally over the past several thousand years. Apart from other human-related factors such as forest management practices and land-use changes, future climate change is likely to contribute to drier conditions in Utah forests as well as increased wildfire intensity, more insect outbreaks, and reduced forest health.

Droughts in Utah have exacerbated declining forest health across the state, and consequently Utah's forests have become more susceptible to intense wildfire, insects, and disease (UDNR 2003). The ecological impacts of wildfires as well as forest pests and diseases are expected to rise with climate warming, with extended periods of high fire risk and large increases in area burned (IPCC 2007b; USGCRP 2009). A study of historical spruce beetle outbreaks on the Markagunt Plateau revealed that small-scale disturbances have been the norm over the past century, and that large-scale outbreaks occurring in recent history (in the early 1990s, in this study) are an unprecedented phenomenon (DeRose and Long 2007).

The extent of sagebrush habitat is expected to decline in the future due to climate change, if current predictions are realized, due in large part to the expansion of cheatgrass (*Bromus tectorum)* under increased carbon dioxide conditions, which would fragment sagebrush habitat and lead to more frequent wildfires (FR 75(55):13910-14014, published 23 March 2010). A decline in sagebrush would indirectly affect wildlife, including special status species that depend on sagebrush, such as greater sage-grouse (Candidate) and pygmy rabbit (Sensitive).