No. 15-17031

UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

WESTERN WATERSHEDS PROJECT,
Plaintiff-Appellant,

vs.

AMY LUEDERS, *et al*.,
Defendants-Appellees

ON APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEVADA
(District Judge Howard D. McKibben)

OPENING BRIEF OF APPELLANT

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CORPORATE DISCLOSURE STATEMENT

Appellant Western Watersheds Project (Western Watersheds) is a non-profit corporation and has no parent companies, subsidiaries, or affiliates that have issued shares to the public.

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STATEMENT OF JURISDICTION

Appellant Western Watersheds invoked district court jurisdiction under 28 U.S.C. § 1331 and 5 U.S.C. § 702. Excerpts of Record (ER) at 32-33. The District Court entered final judgment on August 13, 2015. ER 28. Western Watersheds timely filed its Notice of Appeal on October 9, 2015. ER 29-30; Fed. R. App. P. 4(a)(1)(B). This Court has jurisdiction under 28 U.S.C. § 1291.

INTRODUCTION

Greater sage-grouse habitat within the Cave Valley and Lake Valley watersheds in central Nevada suffers from over-grazing and fragmentation. Native grasses and forbs (wildflowers) in the sagebrush uplands – key components in the diets of sage-grouse and other indigenous species – are vanishing, and many of the riparian areas that once provided critical wildlife rearing and hiding cover have been desiccated, denuded and trampled. Non-native and noxious weeds are exploding, fires are getting hotter and bigger, and the Bureau of Land Management (BLM) has carved up the habitat with hundreds of miles of fences, roads, pipelines and other infrastructure to support livestock grazing. It is no coincidence that wildlife populations are dwindling, and sage-grouse – perhaps the most spectacular desert dweller with its iconic mating display – is no exception. Indeed, the sagebrush habitat of the Cave and Lake Valley watersheds is one of the most imperiled ecosystems in North America.

For decades, BLM has been purposefully manipulating the sagebrush habitats within these watersheds to increase forage for livestock, including through mechanical methods (mowing, chopping, chipping, chaining, etc.), poisoning (using herbicides), and prescribed fires. Many of these projects have occurred within sage-grouse habitat, including two recent projects BLM approved and implemented in 2008 (the Lincoln County and the Spring Valley projects), which "reduced to dust" thousands of acres of sage-grouse habitat. *See* ER 13.

This case challenges 21 new sagebrush and woodland projects BLM approved on the public lands within the Cave and Lake valley watersheds (collectively, the Cave Lake project), including plans to mow, chop, burn and poison over 121,000 acres of sagebrush habitat; and construct or reconstruct fences, pipelines, reservoirs, and wells within key sage-grouse habitat.

Like its prior projects, BLM has approved the Cave Lake project without first preparing an environmental impact statement, and, instead, has relied on a less intensive environmental assessment (EA) and finding of no significant impact (FONSI). But, BLM's EA and FONSI fail to collect adequate baseline data in the affected areas, and BLM also failed to conduct a comprehensive analysis of the direct, indirect and cumulative impacts of the Cave Lake project, together with the Lincoln County and Spring Valley projects and another project in the neighboring watershed. The result is a significant failure to comply with the National Environmental Policy Act (NEPA).

For these reasons, this Court should remand the matter to BLM to prepare a comprehensive cumulative impacts analysis – and environmental impact statement, if needed – and to reconsider its approval of the Cave Lake project.

ISSUES PRESENTED ON APPEAL

NEPA requires a federal agency to consider the direct, indirect and cumulative impacts of its actions – together with other past, present and reasonably foreseeable agency actions – on the quality of the human environment.

1. Did BLM violate NEPA by failing to examine the cumulative impacts of past and reasonably foreseeable future actions in the same area?

2. Did BLM violate NEPA by approving fencing, pipelines and other range projects without any review of the direct and indirect impacts on sage-grouse?

STATEMENT OF THE CASE

Cave Valley and Lake Valley are adjacent watersheds in east-central Nevada, and serve as important habitat for Rocky Mountain elk, mule deer, pronghorn antelope, desert bighorn sheep, and scores of other birds, mammals and bats. ER 0113, 0174-180. According to BLM, this area provides important breeding, rearing and winter habitat for the Greater sage-grouse, an imperiled wildlife species that relies upon undisturbed expanses of sagebrush to survive. ER 334, 381; Add. 64-66.

In November 2012, BLM adopted a plan to mow, chop, burn and poison over 121,000 acres of sagebrush habitat within Cave and Lake valleys and construct or reconstruct over 400 miles of fences, pipelines, reservoirs, and wells in this same area (collectively, the Cave Lake project). ER 0105-07. Instead of preparing an environmental impact statement, BLM issued an EA and FONSI. ER 0112-280, 0100-104.

BLM identified a broad cumulative effect analysis area, but ignored the overlapping impacts on sage-grouse of its Cave Lake project together with two recent vegetation projects within the same area, even though these prior projects "reduced to dust" thousands of acres of sagebrush habitat. ER 13. BLM also failed to assess the overlapping impacts of its Cave Lake project together with another project in an adjacent watershed, although this project fell within BLM's own cumulative effects analysis area and similarly targeted sage-grouse habitat. ER 0213.

Appellant Western Watersheds Project (Western Watersheds) administratively appealed BLM's decision and petitioned for a stay, which the Department of Interior's Office of Hearings and Appeal denied. ER 0289, 0099. Western Watersheds dismissed its administrative challenge, and on June 14, 2013, filed this lawsuit challenging the EA and FONSI for violating the National Environmental Policy Act (NEPA), 42 U.S.C. § 4332(2)(C). ER 095-98, 0031-72. After summary judgment briefing and a hearing, the district court denied Western Watersheds' summary judgment motion, granted Federal Defendants' cross-motion for summary judgment, and issued judgment on August 13, 2015. ER 0001-28. Western Watersheds filed this appeal. ER 0029-30.

I. GREATER SAGE-GROUSE

A. Populations and Habitat

Greater sage-grouse (*Centrocercus urophasianus*) is a large, ground-dwelling species of grouse found only in sagebrush habitats of western North America. ER 0572. Sagebrush habitat features sagebrush in the overstory; native grasses and forbs in the understory; and biological soil crusts filling interspaces between vegetation. ER 0038, 0077, 0572-86.

Sagebrush habitat is one of the most imperiled ecosystems in North America; roads, powerlines and other infrastructure, wildfire, incursion of invasive plants, livestock grazing and energy development fragment and degrade these areas. Add. 0066, 0073.

Sage-grouse typically inhabit large, interconnected expanses of sagebrush habitat, and thus are characterized as a landscape-scale species. ER 0521. Sage-grouse use different features of the landscape to meet its seasonal habitat needs, and are known to migrate over 75 kilometers between seasonal habitats. ER 0573.

Sage-grouse winter habitat is dominated by sagebrush, which provides shelter and food; during winter sage-grouse rely almost exclusively on sagebrush exposed above snow for forage. ER 0519-20; Add. 0064-65.

In early March, sage-grouse move from winter habitat to breeding areas (or leks). ER 0499, 0503. After mating, the females leave the lek to establish a nest. ER 0038, 0077. The nest is a shallow depression on the ground, usually under sagebrush. ER 0039, 0077. The nests established under sagebrush are more successful than nests under other shrub species, because taller sagebrush and grasses provide scent, visual, and physical barriers to potential predators. ER 0039, 0077. The nesting season lasts from early April to mid-June. ER 0038-39, 0077.

Sage-grouse depart nests in the sagebrush uplands to more mesic areas (seeps, springs and wet meadows) during the late brood-rearing season, typically summer and early fall. ER 0576; Add. 0065.

B. Threats to Sage-Grouse Populations and Habitat

The abundance and distribution of Greater sage-grouse have declined dramatically in North America. ER 0528, 0531-32; Add. 0069-72. The same threats causing declines in sagebrush habitat (i.e., livestock grazing and grazing-related infrastructure, vegetation treatments, and energy and oil and gas development and associated infrastructure) – have caused declines in sage-grouse populations and about a 44% range reduction. ER 0528; Add. 0066-67, 0073-0111. In Nevada, local sage-grouse populations have declined nearly 25 percent between 1965-2007. Add. 0072, Table 6 (showing 24% decline in Management Zone III); *id.* at 0068, Table 1 and Figure 2 (showing location of Management Zone III).

Fences and other developments for livestock harm sage-grouse habitat by providing additional perches for predators of sage-grouse, and fences modify access and movements by humans and livestock, "thus exerting a new mosaic of disturbance and use on the landscape." ER 0489; Add. 0078-80. Fences and other linear features also promote the spread of exotic invasive species (like cheatgrass), increasing fire risks and isolating wildlife populations. ER 0493, 0563-64.

Wildfires and prescribed fires result in "direct, long-term habitat loss," and even small increases in the amount of burned habitat surrounding a lek may increase the probability of lek abandonment. Add. 0080-84. Fire is particularly harmful to sagebrush habitats, which may take decades to recover. *Id.* Full recovery may take between 25-120 years, and studies have documented that 25 years after a fire, the sagebrush community had less than 5 percent of pre-fire canopy cover. *Id.* at 0083. The U.S. Fish and Wildlife Service (the Service) is skeptical of using fires to benefit sage-grouse, explaining that the "preponderance of evidence . . . suggests [that] these treatments are not beneficial to sage-grouse." *Id*. at 0082.

The explosion of non-native, invasive weeds across the sagebrush-steppe ecosystem is also a "serious rangewide threat" to sage-grouse. Add. 0084-86. Cheatgrass and other non-native annual grasses have caused "extensive sagebrush loss" in the Great Basin and elsewhere. *Id.* at 0084. Cheatgrass outcompetes sagebrush, native grasses and forbs for water and nutrients, and remain free from any effective control methods. *Id.* In turn, increases in cheatgrass are associated with increased fire intervals and severity. ER 0488, 0493. Approximately 80 percent of the land in the Great Basin is susceptible to invasion by cheatgrass within 30 years, and the invasion of non-native weeds is increasing an at annual rate of 8 to 20 percent annually. Add. 0084-85. Local invasions are associated with ground disturbances, including fire, grazing, infrastructure and other activities. *Id.* at 0085.

Mechanical vegetation treatments are also a key threat to sage-grouse, and according to the Service, the one "immediate and potentially long-term result" of vegetation treatments is "the loss of habitat." *Id.* at 0082. Mechanical treatments in blocks greater than 100 hectares (247 acres) degrade sage-grouse habitat by altering the structure and composition of the vegetative community. *Id.* at 0089.

Chemical control of sagebrush has similarly caused declines in sage-grouse breeding populations through reducing sagebrush cover, leading to sage-grouse abandonment of treated areas. *Id.* Herbicide treatments are associated with negative effects on nesting, brood rearing, and winter shrub cover essential for food and thermal cover. *Id.*

II. HABITATS OF CAVE VALLEY AND LAKE VALLEY

Cave and Lake valleys are adjacent watersheds located southeast of Ely, Nevada. ER 0113. The watersheds consist of nearly 600,000 acres of mostly (96%) public lands, and are characterized by north to south trending mountains, gently to steeply sloping benches, and valley bottoms. *Id.* Elevations range from between 5,900 feet in the valley bottoms to 11,735 feet in the Schell Creek Range, and annual precipitation ranges from 6-20 inches. *Id.*

These watersheds consist of sagebrush communities and established stands of singleleaf pinyon pine and Utah juniper, with small areas of aspen forests, mixed conifer forests, ponderosa and limber pine forests, and mountain mahogany woodlands. ER 0113, 0354. These watersheds also contain over 100 riparian areas (including seeps, springs and wet meadows), which play a critical role in providing late brood-rearing habitat for sage-grouse. ER 0290-91, 0572-86.

Cave and Lake valleys provide important habitat for a range of wildlife species, including 31 BLM sensitive species as well as Rocky Mountain elk, mule deer, pronghorn antelope, and desert bighorn sheep. ER 0174-77. These valleys also provide a full range of seasonal habitats for sage-grouse, including breeding, late-brood rearing, and winter habitat. ER 0177-79, 0334, 0381.

Cave Valley includes 94,174 acres of sage-grouse nesting habitat; 195,615 acres of late brood-rearing habitat; 84,100 acres of winter habitat; and 109,989 acres of key yearlong habitat. ER 0381. Lake Valley includes 156,819 acres of nesting habitat; 201,850 acres of late brood-rearing habitat; 2,215 acres of winter habitat; and 206,352 acres of key yearlong habitat. ER 334. There are 22 known leks (or breeding areas) within the watersheds. ER 0179, 0334, 0381. BLM considers much of these watersheds "priority habitat," which means these areas are identified as having the highest conservation value to maintaining sustainable sage-grouse populations. ER 0050, 0082, 0177.

The same population of sage-grouse occurs across Cave and Lake valleys, as well as the South Spring Valley and Hamblin Valley. ER 0051, 0082. Sage-grouse migrate between these watersheds depending on the physiological and habitat needs of the sage-grouse. *Id*.

BLM has carved up these watersheds into 12 separate livestock grazing allotments and constructed an extensive array of infrastructure to support grazing, including over 400 miles of fences and approximately 37 troughs, 40 wells, 10 spring developments, eight reservoirs and dozens of miles of pipelines. ER 0052, 0083, 0137-41, 0180-83.

III. CONDITIONS WITHIN CAVE VALLEY AND LAKE VALLEY

In August 2008, BLM issued its Cave Valley Watershed Evaluation Report (Cave Valley watershed report), which concluded that the public lands in the Cave Valley were violating three of the four minimum rangeland health standards, including for soils, watersheds and wildlife habitat. ER 0358-67, 0368-78, 0379-84. *See also* 0440-455. Specifically, BLM determined that the lack of grasses and forbs, the lack of biological soil crusts, and the "very high" percentage of cheatgrass caused violations of these minimum requirements. ER 0358-87.

BLM also found that upland seeps, springs, and wet meadows were degraded, with only 8 of 25 (32%) meeting the standard of proper functioning condition. ER 0374-76. Fully 44% were functioning at risk with a downward trend, and 20% were non-functional. *Id. See also* ER 0472-73 (condition rating for springs). BLM found that "[m]ost of the springs have been nearly or completely denuded from overgrazing as they are probably being targeted by livestock and wildlife in landscapes largely devoid of upland forage." ER 0375. BLM concluded that these conditions were causing violations of the wildlife habitat standards because "[m]any sagebrush habitats exhibit minimal herbaceous understory." ER 0379-83.

The Cave Valley watershed report also documented 21 noxious weed infestations. ER 0383-84, 0389. And BLM documented cheatgrass prevalence across the watershed, too. ER 0383, 0359, 0369-70 (cheatgrass at 16-20 percent of all understory vegetation in pinyon-juniper woodlands); ER 0370, Table 2.1; ER 0359, 371 (cheatgrass at 18.5 percent of all understory vegetation in mountain mahogany communities); ER 0372, Table 2.4 (cheatgrass present in all sagebrush communities); ER 0363, Table 1.5 (noting cheatgrass compositions).

BLM documented similar conditions in the Lake Valley watershed. ER 0312-41. In its Lake Valley watersheds report, BLM concluded that the standards for soils, uplands and riparian areas, and wildlife habitat were not being met. *Id;* ER 0297-311, 0312-52. BLM again attributed these violations to the lack of diverse, native herbaceous grasses and forbs, and the prevalence of cheatgrass, among other causes. *Id.*

BLM's assessment of the condition of upland seeps, springs and wet meadows in Lake Valley – which provide critical late brood-rearing habitat for sage-grouse – established that these areas were in poor condition. ER 0328-31. For example, only seven of 39 (18%) assessed areas were in properly functioning condition, 51% were functioning at risk with a downward trend, and 18% were nonfunctional. ER 0328-29, 0472-73.

BLM also documented 151 weed infestations across the Lake Valley watershed, and BLM again documented cheatgrass across the watershed. ER 0313-26; ER 0316, Table 1.5 (identifying cheatgrass concentrations); ER 0318 (cheatgrass present in greasewood communities); ER 0323 (cheatgrass discovered in pinyon-juniper woodlands); ER 0324-25 (cheatgrass located in all sagebrush communities); ER 0330-31, 0337-39, 0341.

IV. PRIOR SAGEBRUSH TREATMENT PROJECTS

BLM has conducted several similar vegetation removal projects in the Cave and Lake Valleys. In 2008, BLM approved the Lincoln County Sage Grouse Habitat Restoration Project (Lincoln County project), which authorized mechanical treatments, chopping and poisoning sagebrush across almost 10,000 acres of sage-grouse habitat within the Cave and Lake valleys and surrounding watersheds. ER 0414-418, 0419-439. Under this plan, BLM targeted areas immediately adjacent to sage-grouse leks. ER 420.

The stated purpose of the Lincoln County project was to "restore dynamic sagebrush plant communities" and improve sage-grouse habitat. ER 420. However, BLM recognized that its treatments could lead to the establishment of cheatgrass and other non-native and noxious weeds in and around the treatment areas. ER 0428. BLM was particularly concerned that its project would encourage the explosion of cheatgrass, warning:

> Cheatgrass density may increase following mechanical treatments in the absence of existing native perennial understory grasses and forbs. The major concern is its widespread geographic distribution and its ability to form monoculture stands in disturbed areas. This is a problem for wildlife and livestock due to its low nutrient value (compared to native perennial grasses) and ability to increase the fire frequency of an area that is heavily infested.

Id. BLM also acknowledged that "habitat and dispersal corridors for special status species could be lost or drastically altered" through this project, and BLM recognized that its Lincoln County project – together with other past, present and future projects – has the "potential to impact wildlife through direct mortality, displacement, habitat loss or alteration, and increased habitat fragmentation." ER 0429, 0431.

Ultimately, BLM admitted that the positive impacts of the project did not offset the likely adverse impacts to sage-grouse, concluding:

> Impacts related to the proposed actions may offset a portion of negative impacts from the interrelated projects by improving habitat conditions for some special status species. However, local populations of sage grouse may still be reduced in numbers because of development in and around breeding habitat of adjacent areas regardless of the habitat improvements of the proposed actions.

ER 0431.

The Lincoln County plan included a monitoring regime requiring BLM to conduct annual vegetation monitoring and photographic documentation of the results of the treatments, and collect detailed livestock grazing use data. ER 0426. BLM also required monitoring of weed populations to determine the "response of invasive species and noxious weeds to the various treatments." *Id.* BLM agreed that it would continue to monitor "[s]age grouse populations and movements . . . following treatment implementation," in an effort to determine whether the project was successful. *Id.*

BLM implemented the Lincoln County project, which "reduced to dust" thousands of acres of critical sage-grouse habitat. ER 13. Because of the growth rate of sagebrush, it may take as long as 125 years to fully recover the sagebrush canopy in the treated areas, and sage-grouse will likely avoid this area for decades. Add. 083; ER 0565.

In 2008, BLM authorized another vegetation removal project in the adjacent South Spring Valley watershed. ER 0401-413. This project authorized the chaining – *i.e.*, the use of two bulldozers or heavy tractors to pull a 100-200 foot large anchor chain in a "U" shape through sagebrush habitat, ripping up vegetation – of 4,000 acres of habitat immediately adjacent to the Lake Valley watershed. ER 0403-04. Like the Lincoln County project, this plan authorized treatment of sagebrush and other vegetation communities within important sage-grouse seasonal habitat – including yearlong, summer, winter, and breeding habitat – and treatments specifically focused on areas within five kilometers of active sage-grouse leks. ER 0402, 0407, 0409.

BLM recognized that the project could promote noxious and non-native invasive weed establishment in the project area, including cheatgrass. ER 0412. Like the Lincoln County project, BLM also adopted monitoring requirements. ER 0405-06.

In 2008, BLM implemented the mechanized projects authorized under Spring Valley Project, and chained approximately 3,104 acres of sagebrush habitat. ER 066, 088.

V. CAVE LAKE PROJECT AND ENVIRONMENTAL ASSESSMENT

On November 5, 2012, BLM issued its EA and FONSI for the Cave Lake project. ER 0112-280 (EA), 0100-104 (FONSI). The project authorized treatments to mow, chop, burn, and poison sagebrush expanses and juniper woodlands in 21 separate areas covering 199,000 of public lands across the Cave and Lake valleys. ER 0150, 0151-157, 0216-73.

The project includes five different types of sagebrush projects to eliminate or reduce native sagebrush, including three types of mechanical treatments (Dixie harrow, roller chopper, and mowing), poisoning sagebrush with an herbicide known as Tebuthiuron, and prescribed fire. ER 0128-131. *See also id.* at 0128-29 (describing Dixie harrow); *id.* at 0129 (describing roller chopper); *id.* at 0129-30 (describing mowing); *id.* at 0130-31, 0482 (describing Tebuthiuron poisoning). The project also calls for the chaining, mastication, hand-cutting, and poisoning of trees across Cave and Lake valleys. ER 0126-28. *See also* ER 0126-27 (describing chaining); *id.* at 0127-28 (describing mastication). BLM similarly approved using Tebuthiuron (at a stronger concentration than used for sagebrush poisoning) to poison trees, which BLM expects to cause near 100% mortality of all vegetation in the treatment area. ER 0131.

BLM's approved projects occur within priority habitat for Greater sage-grouse, and across all major vegetation communities in the Cave and Lake valley watersheds including mountain mahogany, pinyon juniper woodlands, black sagebrush, low sagebrush and mountain big sagebrush vegetation communities. ER 0150 (map of all projects); ER 0179 (map of sage-grouse habitat); ER 0340, 0388 (maps of vegetation communities in Cave and Lake valley); ER 216-273 (maps of individual projects).

In addition to these vegetation projects, BLM also approved building or rebuilding approximately 400 miles of allotment and pasture fences, eight reservoirs and one well; redeveloping 12 upland springs; and laying many miles of new and modified water pipelines for livestock. ER 0139-48, 0157-61, 0274-80.

In its EA, BLM admits that the projects could lead to increased wind and water erosion, and that its use of Tebuthiuron would kill "nearly all trees" in some treatment areas, and lead to "near 100% mortality of sagebrush." ER 0131, 0188-89, 0192-93. BLM also concluded that its treatments could spread noxious and invasive weeds across the treatment areas, and found that its range developments may permit non-native weeds to invade newly disturbed areas, too. ER 0195.

The EA adopted a cumulative effects study area that included the public lands and wildlife habitat subject to the Lincoln County and the Spring Valley projects, and the surrounding valleys and watersheds. ER 0212.

VI. REASONABLY FORESEEABLE FUTURE PROJECTS

In March 2012, nearly nine months before BLM adopted the Cave Lake EA and FONSI, BLM issued a scoping notice and maps identifying specific areas targeted for vegetation treatment across the neighboring Hamblin Valley and South Spring Valley watersheds (Hamblin Valley project). ER 0281-88. The public lands subject to the Hamblin Valley project lie immediately east of the Cave Lake project, and fall within the same cumulative impacts study area. *Id. See also* ER 0212.

Like the Cave Lake project, the Hamblin Valley project is a vegetation project that will use mechanical methods (*e.g.*, chaining, mowing, chopping), herbicides, prescribed fire and other methods to suppress and eliminate sagebrush and pinyon-juniper forests across 12 separate treatment areas. ER 0281-88. This project also proposes to construct and reconstruct miles of pipelines, fences and other livestock infrastructure. ER 285.

VII. FINAL DECISIONS AND PROCEDURAL HISTORY

On November 5, 2012, BLM issued decisions approving the Cave Lake vegetation and range projects. ER 0105-07. Western Watersheds timely appealed these decisions, and sought to stay implementation of the decision. ER 0289. The Department of Interior's Office of Hearings and Appeals denied these petitions, and Western Watersheds dismissed its administrative appeals. ER 0092, 0095, 0099.

On June 14, 2013, Western Watersheds filed its complaint in this action, which raised claims under NEPA and the Federal Lands Policy and Management Act. ER 0031-72. The parties fully briefed Western Watersheds' NEPA claims below, after Western Watersheds dismissed its FLPMA claims. The district court denied Western Watersheds' motion for summary judgment, granted BLM's cross motion, and issued judgment against Western Watersheds. ER 1-27, 28. Western Watersheds appeals from the district court's resolution of the NEPA claim.

LEGAL FRAMEWORK

NEPA is our basic national charter for protection of the environment, and it has twin aims: it obligates federal agencies to consider every significant aspect of the environmental impact of a proposed action before proceeding with the proposed action, and ensures the agency will inform the public that it has considered environmental concerns in its decisionmaking process. *Balt. Gas &*

Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87, 97 (1983). NEPA requires federal agencies to "take seriously the potential environmental consequences of a proposed action" by taking a "hard look" at the direct, indirect and cumulative impacts of their proposed actions. *Ocean Advocates v. U.S. Army Corps of Eng'rs*, 402 F.3d 846, 864 (9th Cir. 2005). *See also* 40 C.F.R. §§ 1500.1(a), 1508.7, 1508.8.

Under NEPA, an agency is required to prepare an environmental impact statement (EIS) for "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). "As a preliminary step, an agency may prepare an [environmental assessment] to decide whether the environmental impacts of a proposed action is significant enough to warrant preparation of an EIS." *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1212 (9th Cir. 1998).

An agency's NEPA analysis must "fully address cumulative environmental effects or cumulative impacts." *Te-Moak Tribe of Western Shoshone of Nev. v. U.S. Dep't of the Interior,* 608 F.3d 592, 602 (9th Cir. 2010). A cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions . . . [and] can result from individually minor but collectively significant actions taking place over a period of time." *Id.* (quoting 40 C.F.R. § 1508.7). This Court has found a cumulative impact analysis critical, because "[s]ometimes the total impact from a set of actions may be greater than the sum of the parts . . . the addition of a small amount here, a small amount there, and still more at another point could add up to something with a much greater impact." *Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Management*, 387 F.3d 989, 994 (9th Cir. 2004).

An EA must include "a sufficiently detailed catalogue of past, present, and future projects, and provide adequate analysis about how these projects, and differences between the projects" might impact the environment. *Te-Moak Tribe*, 608 F.3d at 603. "General statements about possible effects and some risk do not constitute a hard look absent a justification regarding why more definitive information could not be provided." *Klamath-Siskiyou,* 387 F.3d at 993 (internal quotations omitted). "[V]ague and conclusory statements," without supporting data, are not adequate. *Great Basin Mine Watch v. Hankins*, 456 F.3d 955, 972-73 (9th Cir. 2006). Rather, the analysis must explain "how individual impacts might combine or synergistically interact with each other to affect the environment." *Klamath-Siskiyou*, 387 F.3d at 994. This requirement extends with equal force to EAs and EISs. *Te-Moak Tribe*, 608 F.3d at 603.

SUMMARY OF THE ARGUMENT

BLM failed to take a "hard look" at the cumulative impacts on sage-grouse of the Cave Lake project, together with additional vegetation projects authorized within the Cave and Lake Valley watersheds and other nearby public lands. Instead, BLM relied on little more than general statements and conclusory assertions to support its cumulative impacts analysis, which are insufficient to support a determination that the impacts of the Cave Lake project will not be significant.

The district court erred in holding that BLM adequately considered the cumulative impacts of the Lincoln County and Spring Valley projects in the "aggregate," because the EA lacked any information (such as monitoring data) on the present effects of these projects on sage-grouse or its habitat. The district court further erred in holding, in the alternative, that BLM was free to ignore the cumulative impacts of these projects because they were not identical in magnitude and scope. But NEPA's cumulative impacts analysis requirements are not limited to considering only projects having identical magnitude and scope, and the entire purpose of cumulative impact analysis is to ensure that an agency considers the impacts that can result from individually minor but collectively significant actions taking place over a period of time.

BLM also violated NEPA by delaying its review of the potential cumulative impacts from BLM's Hamblin Valley project. It is unlawful to defer consideration of cumulative impacts to a future date when meaningful consideration can be given now, including when the contours of a future action are sufficiently clear. Here, BLM has already selected locations and methods for implementing the Hamblin Valley project and BLM prepared detailed maps illustrating its projects. Accordingly, BLM was not permitted to delay its cumulative impacts analysis, and BLM violated NEPA in doing so.

Tiering to prior programmatic environmental reviews did not rescue BLM's inadequate cumulative impacts assessment because the programmatic reviews cited lacked any site-specific analysis of the impacts of BLM's vegetation projects. Indeed, in those prior reviews, BLM admitted that site-specific information was lacking, and BLM committed to collecting this data during a future decision-making process. Because BLM failed to collect this missing data during the approval process here, tiering cannot backfill the inadequacies of the EA.

Finally, BLM's environmental review of its range developments violated NEPA. The EA lacked any analysis of the impacts on sage-grouse of building and rebuilding over 400 miles of fences, reservoirs, pipelines and water troughs right through the heart of sage-grouse habitat. Instead of preparing a coherent, comprehensive environmental review of the impacts of its planned range developments, as NEPA requires, BLM substituted generalized statements and conclusory assertions.

ARGUMENT

I. STANDARD OF REVIEW

This Court reviews a district court's decision to grant summary judgment de novo and may direct summary judgment for either party based on its de novo review of the administrative record. *Lands Council v. Powell*, 395 F.3d 1019, 1026 (9th Cir. 2005). The Administrative Procedure Act requires a reviewing Court to hold unlawful and set aside an agency decision that is arbitrary, capricious, an abuse of discretion, or not otherwise in accordance with law. 5 U.S.C. § 706(2); *Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 960 (9th Cir. 2005).

A decision is arbitrary and capricious if the agency has "relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise." *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983).

In sum, a court's inquiry must be "searching and careful," and an agency must articulate a rational connection between the facts found and the conclusions made. *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 378 (1989).

II. PRESERVATION OF ISSUES ON APPEAL

Western Watersheds Project raised in the court below each issue subject to this appeal and the district court ruled on each issue, save one, as identified below: (1) failure to adequately review the cumulative impacts of the Cave Lake project together with all past, present and reasonably foreseeable projects, D.C. ECF # 45-2 at 12-19 (opening summary judgment brief), D.C. ECF # 64 at 1-19 (reply summary judgment brief), and ER 14-25 (summary judgment order); (2) inadequate review of the direct and indirect impacts of the BLM's rangeland projects on greater sage-grouse habitat and populations, D.C. ECF # 45-2 at 31-34, D.C. ECF # 64 at 19-20, and ER 25-26.

As is discussed in more detail below, although the parties raised and fully briefed the issue regarding BLM's inadequate review of the overlapping impacts from the Hamblin Valley project, the district court did not rule on this issue. *See* D.C. ECF # 45-2 at 12-19, Dt. Ct. ECF # 64 at 4-7, and ER 18. Because this issue was properly raised in the district court and this Court will review de novo the district court's decision, this Court may decide the issue on appeal. *Akootchook v. United States*, 271 F.3d 1160, 1165-66 (9th Cir. 2001).

III. BLM'S CUMULATIVE IMPACTS ANALYSIS WAS UNLAWFUL BECAUSE IT IGNORED SIMILAR PAST AND REASONABLY FORESEEABLE PROJECTS.

BLM violated NEPA by failing to examine the overlapping impacts on sage-grouse populations and habitat from the Cave Lake, Lincoln County, Spring Valley and Hamblin Valley projects.

A. BLM's Cumulative Impacts Analysis Lacks Site-Specific Data, Analysis and Review.

BLM failed to adequately consider the cumulative impacts on sage-grouse of BLM's prior, current and foreseeable future projects. As noted above, an EA must include a sufficiently detailed catalogue of past, present and future projects, and provide adequate analysis about how these projects might impact the environment. *Te-Moak Tribe*, 608 F.3d at 603. The agency must explain "how individual impacts might combine or synergistically interact with each other to affect the environment." *Id*. at 994. Importantly, a party challenging an EA need only show a potential for unexamined cumulative impacts, which can be established by showing the projects may impact the same resource. *Te-Moak Tribe*, 608 F.3d at 605.

The EA here failed to adhere to these standards. As noted above, the same population of sage-grouse occurs across Cave and Lake valleys, as well as the South Spring Valley and Hamblin Valley, and sage-grouse migrate between these watersheds based on physiological and habitat needs. ER 0051, 0082. Based on these ecological connections, BLM identified a cumulative effects study area that included the Cave Valley and Lake Valley watersheds, together with South Spring Valley, Hamblin Valley, and other surrounding watersheds. ER 0212.

However, BLM never actually examined the cumulative impacts of its Cave Lake project together with the other projects in those watersheds. ER 0212-15. As noted above, in 2008 BLM approved and implemented the Lincoln County project, which "reduced to dust" nearly 10,000 acres of sage-grouse habitat. ER 13. Also in 2008, BLM similarly approved and implemented the Spring Valley project, destroying an additional 3,104 acres of sagebrush habitat. ER 0401-13. And, at the same time BLM was planning the Cave Valley project, it was also planning the Hamblin Valley project, another project targeting hundreds of thousands of acres of sage-grouse habitat in the adjacent South Spring Valley and Hamblin Valley watersheds. *See supra.* ER 281-88.

Thus, BLM had recently completed two vegetation projects, and had concrete plans for a third, larger one, within its own designated cumulative effects study area. While the EA "mentions" these projects, ER 18, it never took a "hard look" at their synergistic impacts. ER 0212-15.

For example, the Cave Lake project authorizes Tebuthiuron poisoning in four treatment units (S-1, S-2, S-10, S-13); mechanical vegetation removal/suppression in seven treatment units (S-1, S-2, S-3, S-4, S-13, S-14, S-15); and burning in four treatment units (W-1, W-2, C-1 and C-2). ER 0148-57 (describing treatments), 0216-59 (maps and descriptions of each treatment units). These projects occur within sage-grouse habitat. *Compare* ER 0150 (map of projects), *and* ER 0179 (map of sage-grouse leks and habitat).

The Cave Lake EA included a two-paragraph impact analysis, concluding that "impacts to Special Status Species would be minimal." ER 0199-200. BLM never supports this conclusion with a discussion or analysis, however, and the EA never discusses these projects in the context of the other three projects and the collective impact on sage-grouse. *Id.* *See* ER 0212-15 (cumulative impacts analysis).

BLM's failure to provide a useful analysis of the impacts of its projects on sage-grouse was not a harmless oversight, especially because the scientific information in the record demonstrates that BLM's projects will harm sage-grouse. For example, a leading scientific reference on sage-grouse – the 2004 Sage-Grouse Conservation Assessment (conservation assessment) – noted that prescribed fires kill, eliminate, or reduce the density of most sagebrush species, and sage-grouse will avoid these areas for decades. ER 0565; Add. 083.

Another leading publication also explained that in virtually "all documented cases, herbicide application to . . . sage-brush rangeland resulted in major declines in sage grouse breeding populations." ER 0577. Indeed, the conservation assessment warns, "[r]ehabilitation and restoration techniques to transform land currently dominated by invasive annual grasses into quality sage-grouse habitat have been largely unproven and experimental." ER 0570.

The U.S. Fish and Wildlife Service (the Service) also warned that "[w]e are not aware of any study documenting a direct correlation between [] treatments and increased greater sage-grouse productivity." Add. 0087. In fact, the Service considered these measures to be threats to sage-grouse survival. *Id.* at 0080 (threats from fire); *id.* at 0081 (threats from prescribed fire); *id.* at 0089 (threats from chemical control). Indeed, in concluding that sage-grouse warranted protection under the Endangered Species Act, the Service noted,

> in addition to wildfire, land managers are using prescribed fire as well as mechanical and chemical treatments to obtain desired management objectives for a variety of wildlife species and domestic ungulates in sagebrush habitats throughout the range of the greater sage-grouse. While the efficacy of treatments in sagebrush habitats to enhance sage-grouse populations is questionable, as with wildland fire, an immediate and potentially long-term result is the loss of habitat.

Id. at 0082 (internal citations omitted). Although this information was before BLM, BLM failed to explain its conclusion that the impacts on sage-grouse would be "minimal." ER 0199.

The Ninth Circuit has repeatedly held that failure to discuss and consider record evidence of this nature renders an agency's EA and FONSI inadequate. *Blackwood*, 161 F.3d at 1213 (agency's failure in an EA to "discuss and consider" evidence contrary to the agency's position suggests the agency "did not take the requisite hard look at the environmental consequences" of its proposed action).

Instead of looking at the synergistic impact of these projects on sage-grouse populations and habitat, the Cave Lake EA claimed only that "the results of these treatments have been monitored and a range of potential outcomes is understood." ER 0120. But BLM never examined or discussed the data or outcomes from these projects, and BLM may not rely on these vague, conclusory opinions in the absence of hard data. "[A]llowing [an agency] to rely on expert opinion without hard data either vitiates a plaintiff's ability to challenge an agency action or results in the courts second guessing an agency's scientific conclusions. As both of these results are unacceptable, we conclude that NEPA requires that the public receive the underlying environmental data from which the [agency] derived [its] opinion." *Idaho Sporting Cong. v. Thomas,* 137 F.3d 1146, 1150 (9th Cir. 1998).

The cumulative impact analysis in BLM's FONSI is similarly vacant. ER 0100-04. A FONSI is required to include a "convincing statement of reasons" explaining why BLM's projects will cause no significant cumulative impact on the environment. *Ctr. for Biol. Diversity v. NHTSA*, 538 F.3d 1172, 1220 (9th Cir. 2008). In total, the Cave Lake FONSI states the following on cumulative impacts:

> All resources have been considered for cumulative effects and any potential impacts have been documented in the EA. No significant impacts were identified. Other fuels reduction projects, habitat improvement projects, or range improvement projects may be proposed in the future in the Cave Valley and Lake Valley Watersheds based upon monitoring and future assessments. As standard procedure, future projects will be subject to their own cumulative impact analysis and reviewed on a site-specific case-by-case basis.

ER 0103. Thus, BLM's FONSI – like its EA – provided no analysis at all, and instead relied on BLM's speculations about the outcomes of future NEPA analyses. This Court has routinely rejected similarly truncated cumulative impacts conclusions.

For example, in *Te-Moak Tribe*, this Court held unlawful a cumulative impact analysis when the agency failed to examine the overlapping impacts on the same resource of different projects within the agency's cumulative impacts area. 608 F.3d at 606. Similarly, in *Klamath-Siskiyou*, this Court rejected an agency's "generalized conclusory statements" in a cumulative impacts analysis. 387 F.3d at 996. In *Great Basin Mine Watch,* 456 F3d at 973, this Court held that "vague and conclusory statements, without any supporting data, do not constitute a "hard look" at the environmental consequences of the action as required by NEPA."

The EA and FONSI fail to adhere to these well-established standards, and this Court should hold BLM's perfunctory cumulative impact analysis violates NEPA.

B. BLM Failed to Consider Cumulative Impacts on Sage-Grouse in the Aggregate Because it Never Considered Present Effects of Prior Projects.

BLM did not consider cumulative impacts on the aggregate because BLM lacked any data on the present effects of its prior vegetation projects. An agency may consider cumulative impacts in the aggregate when the cumulative effects of past projects have been incorporated into the environmental baseline. *League of Wilderness Defenders v. U.S. Forest Service*, 549 F.3d 1211, 1216 (9th Cir. 2008); *Ecology Center v. Castaneda*, 574 F.3d 652, 666-67 (9th Cir. 2009) (affirming agency's cumulative impacts analysis). According to the Council on Environmental Quality, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." Council on Environmental Quality, Guidance on the Consideration of Past Actions in Cumulative Effects Analysis, p. 2 (2005) (2005 CEQ Guidance)[1]. *See also League of Wilderness Defenders*, 549 F.3d at 1218-19 (holding 2005 CEQ Guidance entitled to deference). However, key to an aggregated analysis is a full examination of the "present effects of past actions." 2005 CEQ Guidance at 3.

The district court's holding erred because the EA failed to examine the present effects of the Lincoln County and Spring Valley projects on sage-grouse. In fact, BLM did not consider any data on the "present effects" of these projects, despite BLM's commitments to strict monitoring and data collection requirements adopted in its decisions for those projects. *See* ER 0405-06, 0426 (describing monitoring requirements). For example, there is no dispute that upland riparian

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[1] Located at http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-PastActsCumulEffects.pdf (last visited April 22, 2016) (filed herewith in Add. 43-46).

areas (including seeps, springs, and wet meadows) play a critical role in providing key sage-grouse late brood-rearing habitat, and these riparian areas are located across the Cave and Lake Valley watersheds. Add. 0065; ER 0576, ER 0290-91. In fact, these valleys contain almost 400,000 acres of late brood-rearing habitat. ER 334, 381. Yet, BLM's most recent data on riparian areas in and around Cave and Lake valleys – including areas subject to the Lincoln County and Spring Valley projects – date from 2007 or before. ER 0472-73 (data collected October and November, 2007), ER 0374 (Cave Valley watershed evaluation) (data collected in 2007); ER 0328 (Lake Valley watershed evaluation) (data collected in 2004 and 2007).

BLM lacked current data on uplands, too. Upland habitats provide sage-grouse mating, nesting, and early brood-rearing habitats, and Cave and Lake valleys include over 200,000 and 260,000 acres of nesting and key yearlong habitat, respectively. ER 0334, 0381. Yet, BLM's most recent data on upland vegetation conditions in and around these areas is dated sometime before April 2008 – more than a year *before* BLM approved the Lincoln County and Spring Valley projects. ER 0321-28, 0368-74. BLM's data on cheatgrass and other non-native weeds – a key threat to sage-grouse populations and habitat – also pre-dates these projects, dating from 2004 and 2007. ER 0330, 0376; Add. 0084-86.

In sum, the administrative record – and in turn the EA – lacked any information on the present effect of the Lincoln County and Spring Valley projects on sage-grouse habitat, populations, and trends. ER 0212-14.[2] The absence of information is especially problematic here because according to science in the record, the effects of "reducing to dust" thousands of acres of sagebrush habitat was almost certainly negative. ER 13. As noted, sage-grouse avoid treated areas for decades, and it may take up to 125 years for habitat to fully recover. Add. 0083; ER 0565.

In the absence of data on the present effects of the past treatments, there was no way for BLM to prepare an aggregated cumulative effect analysis. Add. 0043-46. For example, in *League of Wilderness Defenders v. Allen*, 615 F.3d 1122 (9th Cir. 2010), this Court affirmed an aggregated cumulative effects analysis, which included a lengthy discussion of the environmental baseline, identified and discussed other projects in the area, provided a detailed review of the possible overlapping effects resulting from these projects, and included a twenty-three page discussion of declines, trends, and threats of an imperiled wildlife species affected by the agency action. *Id.* at 1136.

Similarly, in *Castaneda*, this Court affirmed an aggregated cumulative effects analysis examining the existing condition of each area, providing data on the cumulative effects with other pending proposals, and including a detailed aggregated discussion of existing conditions. 574 F.3d at 667. *See also Ctr. for*

[2] BLM's failure to collect and analyze any data on the present effects of these projects stands in stark contrast to BLM's monitoring commitments in the respective EAs for these projects. *See supra* at pp.14-16 (outlining monitoring regime). *See also* ER 0405-06, 0426 (same).

Envtl. Law and Policy v. Bureau of Reclamation, 655 F.3d 1000, 1009 (9th Cir. 2011) (*CELP)* (affirming aggregated analysis that included "detailed scrutiny" of present effects of prior river management in Columbia River basin).

Unlike *Allen*, *Castaneda*, and *CELP*, BLM's EA here contains no detailed analysis on the actual effects of the Lincoln County and Spring Valley projects on the ground. Indeed, it is not even clear if BLM conducted any monitoring or assessment on the past projects. For this reason, this Court should follow these cases, reverse the district court summary judgment decision, and hold that BLM's EA failed to consider the cumulative impacts of prior projects in the aggregate.

C. BLM Was Required to Analyze the Prior Treatments Despite Their Smaller Size.

The district court erred in alternatively finding that BLM's failure to consider the other treatments was insufficient to invalidate the EA because those projects were "smaller in size and scope" than the Cave Lake project. ER 19. NEPA's cumulative impacts analysis is not limited to considering only projects having similar magnitudes and scope. Indeed, the entire purpose of NEPA's cumulative impact analysis is to ensure that an agency considers ecological impacts that "can result from *individually minor* but collectively significant actions taking place over a period of time." 40 C.F.R. § 1508.7 (emphasis added). This Court has explained that "[s]ometimes the total impact from a set of actions may be greater than the sum of the parts . . . [T]he addition of a small amount here, a small amount there, and still more at another point could add up to something with a much greater impact." *Klamath-Siskiyou*, 387 F.3d at 994.

The record in this case shows that BLM had already approved and implemented the Lincoln County and Spring Valley projects within the same area subject to the Cave Lake project, and BLM's own maps illustrate that much of the public lands subject to mowing, burning and poisoning in the Lincoln County project are further targeted by the Cave Lake project. *Compare* ER 150 (map of Cave Lake project areas), *with* ER 0292-93, 0296 (map of lands subject to prior treatments, including Lincoln County project).

In the Cave Lake project, BLM is also using identical techniques to target sagebrush habitat (and pinyon-juniper woodlands) – including mowing, chopping, other mechanized methods and poisoning – as it approved in these other projects. *Compare* ER 0126-32 (describing methods in Cave Lake project), *with* ER 0421, Table 2 (describing methods in Lincoln County project), *and* ER 0403-06 (describing methods in Spring Valley project).

Under these circumstances, BLM must conduct a full cumulative impacts analysis examining these overlapping projects. *Klamath-Siskiyou*, 387 F.3d at 994-95; *Te-Moak Tribe*, 608 F.3d at 603 (holding BLM was required to analyze cumulative impacts of mining projects occurring within same cumulative effects area). In *Klamath-Siskiyou*, plaintiffs challenged two Forest Service environmental assessments prepared for two timber sales, arguing the EAs failed to adequately consider the cumulative impacts on northern spotted owl (NSO) and coho salmon of the challenged timber sales and two other sales in the same watershed. There, the four timber sales were vastly different sizes (with the one timber sale being just one-fifth the size of the another) and had dissimilar magnitudes of impacts on NSO habitat (with one sale impacting only 2 percent of the NSO habitat impacted by another). *Id.* at 997. *See also Klamath-Siskiyou Wildlands v. Bureau of Land Management*, Case No. 03-35461, 2003 WL 22724446, pp. 5-6 (October 1, 2003) (Opening Br. of Appellant) (describing timber sales). Despite these differences in size and magnitude of impact, this Court held that BLM was obligated to consider together the cumulative impacts of these four sales on NSO and coho salmon. 387 F.3d at 997.

Klamath-Siskiyou controls this case, and this Court should likewise find that BLM was obligated to consider the overlapping impacts of the Cave Lake, Lincoln County and Spring Valley projects. Indeed, like in *Klamath-Siskiyou*, the projects here all employ the same or similar methods for altering the public lands; and, like in *Klamath-Siskiyou*, there is no doubt that the overlapping projects will impact the same imperiled wildlife. In fact, this case presents an even stronger circumstance for requiring a comprehensive cumulative impacts analysis, because unlike in *Klamath-Siskiyou* – where the projects were all in the same watershed but did not overlap – here, the public lands subject to the Cave Lake project are some of the *same lands* previously reduced to "dust" by BLM's Lincoln County project. ER 13.

The district court erred in relying upon *Bering Strait Citizens for Responsible Res. Dev. v. U.S. Army Corps of Eng'rs*, 524 F.3d 938, 954-55 (9th Cir. 2008) to support its novel bright-line rule. There, the plaintiff challenged an environmental assessment prepared for a large open-pit gold mining project, arguing the EA failed to adequately consider the cumulative impacts of the gold mine together with other projects across the entire western Alaska region. *Id.* The court rejected this argument, holding defendants adequately considered the cumulative impacts of mining in the region – including other, small-scale "placer mining in the region." *Id.* at 955. By way of explanation, the Court noted:

> To be sure, the EA does not discuss at length other projects taking place in the Nome region. However, the record indicates – and we were assured at oral argument – that this is because there are no projects of similar magnitude at this time. Also, [plaintiff] has pointed to no past, present or reasonably foreseeable future projects comparable in environmental impact to the [challenged mine project].

Id. Based on the absence of "comparable" projects in the area, the *Bering Strait* court explicitly "distinguishe[d] *Klamath-Sikiyou*, because there the agency failed to consider four known and comparable projects" in the same area. *Id.*

This case is easily distinguishable from *Bering Strait.* As noted, there plaintiffs could not identify a single "comparable" project in the entire region of western Alaska, but here Western Watersheds has identified two projects that employ identical vegetation treatments as the Cave Lake project, which will affect the identical sage-grouse populations and habitat impacted by the Cave Lake project, and which occur within the same cumulative impacts study area. ER 0213, 0401-13, 0419-39. Nothing in *Bering Strait* permits an agency to ignore similar projects within the same cumulative impacts study area.

Under these facts, BLM was required to consider the cumulative impacts of the Cave Lake project together with these other related projects, and its failure to do so requires reversal. *Klamath-Siskiyou*, 387 F.3d at 994-97; *Te-Moak Tribe*, 608 F.3d at 606.

D. BLM's Cumulative Impacts Analysis Was Unlawful Because it Failed to Consider the Impacts of the Future Hamblin Project.

The Cave Lake EA's cumulative impacts analysis is further unlawful because it failed to analyze the foreseeable cumulative impacts on sage-grouse from its impending Hamblin Valley project. In the Ninth Circuit, it is "firmly establish[ed]" that a cumulative impacts analysis must provide "a useful analysis of the cumulative impacts of past, present and future projects." *Oregon Nat. Res. Fund v. Brong*, 492 F.3d 1120, 1133 (9th Cir. 2007); 40 C.F.R. § 1508.7 (cumulative impacts includes those from "reasonably foreseeable future actions"). CEQ guidance affirms this requirement, explaining that foreseeable future projects can only be excluded from a cumulative impacts analysis if the project is outside of the geographic range or time frame established for the cumulative effects analysis, if the action will not affect resources that are the subject of the cumulative effects analysis, or if including the action in a cumulative impacts analysis would be arbitrary. Council on Environmental Quality, Considering Cumulative Effects Under the National Environmental Policy Act (1997), p. 19 (1997 CEQ Guidance).[3]

"Projects need not be finalized before they are reasonably foreseeable." *N. Plains Resource Council v. Surface Transp. Board*, 668 F.3d 1067, 1079 (9th Cir. 2011). This Court has noted "NEPA requires that an [environmental review] engage in reasonable forecasting. Because speculation is . . . implicit in NEPA, [ ] we must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as crystal ball inquiry." *Selkirk Conservation Alliance v. Forsgren,* 336 F.3d 944, 962 (9th Cir. 2003). Indeed, "it is not appropriate to defer consideration of cumulative impacts to a future date when meaningful consideration can be given now." *N. Plains Resource Council*, 668 F.3d at 1078 (quoting *Envtl. Prot. Info. Ctr. v. U.S. Forest Serv.*, 451 F.3d 1005, 1014 (9th Cir. 2006)).

In *Northern Plains Resource Council*, plaintiffs challenged an agency's environmental assessment prepared to assess a railroad line, arguing that the

[3] Located at (http://ceq.hss.doe.gov/publications/cumulative_effects.html) (last visited April 22, 2016) (filed herewith at Add. 47-62).

cumulative impacts analysis failed to consider the impacts from reasonably expected coal-bed methane (CBM) development in the same analysis area. 668 F.3d at 1078-79. In response, the agency argued for a delay in completing a cumulative impacts analysis until it prepared subsequent NEPA on the foreseeable CBM development. *Id*. This Court rejected the agency's approach, noting that since the agency was aware of the general parameters of expected CBM development – including a time frame and a reasonably foreseeable development plan – and, thus, "an adequate cumulative impact analysis necessarily requires that such information be included." *Id*. at 1079.

Under *Northern Plains Resource Council*, BLM was required to consider the cumulative impacts of the Hamblin Valley project in the Cave Lake EA. BLM admits that the Hamblin Valley project is "reasonably foreseeable," and the project falls within the Cave Lake analysis area. ER 0213-14, 281-88. There is equally no dispute that the Hamblin Valley project will affect the same sage-grouse habitat and populations as the Cave Lake, Lincoln County and Spring Valley projects. ER 0051, 0082.

Moreover, the contours of the Hamblin Valley project were clear prior to BLM's approval of the Cave Lake project. In fact, by March 22, 2012 – almost eight months before BLM issued the Cave Lake EA – BLM had already "selected" public lands for chaining, mastication, mowing, roller chopping, burning and poisoning in the Hamblin Valley project, and had prepared detailed maps of the projects. ER 0281-88. Similarly, months before issuing the Cave Lake EA, BLM had already identified fences, corrals, pipelines, through, well, springs, reservoirs and other range developments to be built or rebuilt. *Id.*

Accordingly, BLM was required to consider the cumulative effects of its Hamblin Valley project together with the Cave Lake EA, and BLM violated NEPA in "defer[ring] consideration of cumulative impacts to a future date when meaningful consideration can be given now." *N. Plains Resource Council*, 668 F.3d at 1078.

While agencies may, in unusual circumstances, delay a cumulative impacts analysis of a future project until that future project's analysis, those circumstances are not present here. *Ctr. for Envt. Law and Policy*, 655 F.3d 1000 (9th Cir. 2011) (*CELP*); *N. Alaska Envtl. Ctr. v. Kempthorne*, 457 F.3d 969 (9th Cir. 2005).

In *CELP*, plaintiff challenged an EA for an agency plan to divert nearly 82,500 acre-feet per year from Lake Roosevelt, arguing the agency was required to consider the cumulative impacts of its drawdown with another foreseeable project to divert an additional 300,000 acre-feet per year from the same lake (Odessa project). 655 F.3d at 1005, 1011. The Ninth Circuit held the Odessa project was reasonably foreseeable, but did not order the consideration of the Odessa project in the drawdown EA, noting that

> the drawdown project discussed in the EA involves a much smaller diversion of water than the [Odessa project] . . . . To direct that [the agency] must account for the cumulative effects of the drawdown project and the [Odessa project] in the drawdown project EA would thus be to direct the agency to wag the dog by the tail.

Id. at 1011. Thus, because of the larger size of the future project, the Court held the agency was justified in deferring its cumulative impacts analysis until it completed its environmental review of the larger Odessa project. *Id.*

The Ninth Circuit permitted a similar deferral of a cumulative impacts analysis in *Northern Alaska Environmental Center v. Kempthorne*, 457 F.3d at 969. In that case, plaintiff challenged an agency EIS for opening areas to oil and gas leasing within the Northwest Planning Area in northern Alaska. *Id.* at 974-75. Plaintiff argued the EIS unlawfully failed to include an analysis of the cumulative effects of the leasing together with potential revisions to oil and gas leasing in the adjacent Northeast Planning Area, which the agency had recently suggested might happen in the future. *Id*. The Ninth Circuit held the proposed revisions were reasonably foreseeable actions, but, like in *CELP*, the court permitted the agency to defer consideration of the cumulative impacts because the agency was preparing a comprehensive EIS on the Northeast Planning Area. *Id.* at 980.

CELP and *Northern Alaska Environmental Center* do not create an exception to the requirement that agencies prepare a comprehensive cumulative impact analysis. Indeed, in the Ninth Circuit, it is "firmly establish[ed]" that a cumulative impacts analysis must consider past, present and future projects." *Brong*, 492 F.3d at 1133.

Instead, read together, *CELP* and *Northern Alaska Environmental Center* indicate that when the contours of an agency's future decision remain undeveloped and the agency has committed to a full environmental review process, the agency enjoys some discretion in determining how and when to consider cumulative impacts. This discretion is not unbounded, however, and when the agency has identified the general outlines of the future decision, "it is not appropriate to defer consideration of cumulative impacts." *N. Plains Resource Council*, 668 F.3d at 1078.

This case is also distinguishable from *Northern Alaska Environmental Center*, where the future federal action remained in its infancy, because, as noted, the contours of the Hamblin Valley project were sufficiently certain before BLM issued the Cave Valley EA.

Moreover, none of the concerns about inefficiencies and uncertainties that animated the decisions in *CELP* and *Northern Alaska Environmental Center* are present here. For example, there is no great disparity in the size and scope of the Cave Lake and Hamblin Valley projects like those that informed the court's decision in *CELP*, and requiring BLM to consider the cumulative impacts of the

Hamblin Valley project in the Cave Lake EA does not run the risk of allowing a smaller project to control a larger project. *CELP*, 655 F.3d at 1011.

This Court should reject this approach for two additional reasons. First, creating an exception to NEPA's requirement that an agency timely consider the cumulative impacts of reasonably foreseeable future actions would thwart both of NEPA's "twin aims" – *i.e.*, the obligation of an agency to consider every significant aspect of the environmental impact of a proposed action before proceeding, and ensuring the agency will inform the public that it has considered environmental concerns in its decisionmaking process. *Balt. Gas & Elec. Co. v. Natural Res. Def. Council,* 462 U.S. 87, 97 (1983).

Under BLM's preferred approach, moreover, neither the agency nor the public will be informed of the potential overlapping impacts of these projects until after the agency's decision has already been approved, and there is no support – not in statute, regulation, rule or otherwise – for turning NEPA's "forward-looking" analysis into a remedial scheme for past federal actions. *See Metro. Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766, 779 (1983) (holding that NEPA "does not create a remedial scheme for past federal actions," instead "[i]t was enacted to require agencies to assess the future effects of future actions"); Add. 0043 (2005 CEQ Guidance) ("The environmental analysis required under NEPA is forward-looking, in that it focuses on the potential impacts of the proposed action that an agency is considering."); *Ctr. for Biol. Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1166 (9th Cir. 2003) (NEPA requires federal agencies to prepare an up-front, coherent, and comprehensive environmental review).

Relatedly, this Court has repeatedly noted that "[p]roper timing is one of NEPA's central themes," and this Court requires that an evaluation of cumulative and other impacts must be "prepared early enough so that it can serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made." *Metcalf v. Daley*, 214 F.3d 1135, 1142 (9th Cir. 2000) (internal quotations omitted) (quoting *Save the Yaak Comm. v. Block*, 840 F.2d 714, 718 (1988)).

Yet, BLM's approach would delay the cumulative impacts review process until after its makes the decision to move forward. Thus, BLM would turn EAs (and EISs) into little more than a subterfuge designed to rationalize decisions already made, which this Court has rejected. *Metcalf v. Daley*, 214 F.3d 1135, 1142 (9th Cir. 2000).

For these reasons, BLM's cumulative impacts analysis is further unlawful for its failure to consider the reasonably foreseeable Hamblin Valley project.

IV. BLM IMPROPERLY RELIED ON TIERING TO AVOID SITE-SPECIFIC ANALYSIS.

BLM did not cure its inadequate cumulative impact analysis by relying on the generalized statements and conclusory analyses from its Ely RMP EIS and

Vegetation PEIS. Although an agency may "tier" one NEPA document to another, tiering does not eliminate the need to analyze site-specific effects. *See Blackwood*, 161 F.3d at 1214) ("Nothing in the tiering regulations suggests that the existence of a programmatic EIS . . . obviates the need for any future project-specific [analysis] . . . ."). Indeed, tiering is only permissible if the tiered-to document actually analyzed the impacts in question and is current. *See Te-Moak Tribe*, 608 F.3d at 605; *S. Fork Band Council of W. Shoshone of Nev. v. U.S. Dep't of Interior*, 588 F.3d 718, 726 (9th Cir. 2009); *Klamath-Siskiyou*, 387 F.3d at 989.

The district court misapplied the concept of "tiering" by allowing the BLM to supplement the minimal site-specific cumulative effects analysis in its EA by reference to the vague generalities of the RMP EIS and Vegetation PEIS. As explained by this Court:

> Tiering enables an agency to cover general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

Churchill County v. Norton, 276 F.3d 1060, 1074 (9th Cir. 2001) (internal citations omitted). Thus, tiering is a process designed to avoid repetition, not one permitting an agency to avoid providing site-specific cumulative impacts analysis altogether by tiering one document lacking the required analysis to another. For this reason, BLM's tiering to the Ely RMP EIS and Vegetation PEIS cannot rescue the Cave Lake EA because these programmatic documents lack any quantitative and site-specific analysis of the impacts of the Lincoln County and Spring Valley projects on sage-grouse habitat and populations, let alone specific discussion of the cumulative impacts to the environmental from the Cave Lake project.

For example, in the Environmental Consequences chapter of the RMP EIS, BLM admitted that "[s]ite-specific information is lacking for many . . . special status species," and "[d]uring implementation of this RMP, site-specific information is necessary for accurate impacts analysis in support of proper habitat management for special status species." ER 0458. Because BLM lacked information, it made a general conclusion concerning the cumulative impacts of its RMP on sage-grouse populations and habitat. ER 0461-62 (listing cumulative impacts of "past actions," and excluding any discussion of sage-grouse); ER 0463 (listing cumulative impacts of "present actions," and including one paragraph discussion); ER 0467 (listing of cumulative impacts of "reasonably foreseeable future actions," and citing back to one-paragraph analysis).

BLM followed this same approach in the RMP EIS's Cumulative Impacts assessment, which lacks any analysis. ER 0469-71. Again, BLM avoided a detailed analysis of cumulative impacts, because in its RMP EIS, "[a]n assumption was made . . . that the site-specific information would be collected during implementation of this RMP. Impacts to special status species would be evaluated during the watersheds analysis process and through project-specific NEPA analysis." ER 0458.

The same is true for BLM's Vegetation PEIS, which similarly lacks a substantive cumulative impact analysis. The Vegetation PEIS specifically notes that it "is a programmatic document that addresses the broad impacts associated with the proposed action . . . . Site-specific impacts would be assessed in NEPA documents prepared by local BLM offices and tiered to this document." ER 0475-76. *See also* ER 0477-80, 0483. BLM applied this same programmatic approach to its cumulative impacts analysis, which "addresses large, regional-scale trends and issues . . . and does not identify site-specific effects." ER 0483, 0484 ("During subsequent analysis for site-specific activities, local cumulative effects should be thoroughly considered when designing site-specific alternatives and mitigation measures.").

As explained in detail *supra*, BLM never followed up these broad, vague programmatic statements with sufficient site-specific information on the cumulative effects of BLM's vegetation treatments on sage-grouse habitat and populations. And, the sections of the Ely RMP EIS and Vegetation PEIS that the district court cited to support BLM's claim that it fully analyzed site-specific cumulative impacts merely provided generalized statements about the broad implications of implementing various programmatic plans. See ER 14-17. These vague statements, devoid of any data or objective quantifications, cannot overcome the lack of site-specific cumulative impacts analysis in the EAs.

The lack of site-specific information is particularly problematic for BLM here, because the district court held that BLM considered the cumulative impacts of past actions in the "aggregate." ER 19. As noted above, an agency may consider cumulative impacts in the aggregate only when the agency first prepares a complete examination of the "present effects of past actions." Add. 0045 (2005 CEQ Guidance). But, neither the Ely RMP EIS, Vegetation PEIS nor the Cave Lake EA provide any substantive information on the present effects of the Lincoln County and Spring Valley projects on sage-grouse populations and habitat. In the absence of site-specific analysis, tiering fails.

For example, in *Te-Moak Tribe*, plaintiffs challenged BLM's approval of an amended plan of operations for a mining project. 608 F.3d at 605. Plaintiffs claimed BLM's EA failed to adequately examine the cumulative impacts of the mining expansion, and BLM sought to undergird the EA's cumulative impact analysis by tiering to a number of other EAs and EIS. This Court rejected this approach, holding that tiering to other analyses was inappropriate because "these documents do not supplement the EA's incomplete [cumulative impacts] analysis.

Like the EA, the [tiered document] did not discuss cumulative effects." *Id*. at 605 n. 13.

Similarly, in *South Fork Band*, this Court again rejected BLM's efforts to tier to another EIS lacking detail. 588 F.3d at 726. In that case, the court rejected tiering because the effects of the proposed action were never considered in the earlier EIS, and the Court noted that "[t]hough 'tiering' to a previous EIS is sometimes permissible, the previous document must actually discuss the impacts of the project at issue." *Id.*

Thus, tiering fails because BLM's prior documents do not themselves examine the cumulative impacts of BLM's past and reasonably foreseeable vegetation treatments on sage-grouse habitat and populations across the Ely Field Office. ER 0456-71, 0474-85.

V. BLM'S ANALYSIS OF RANGE PROJECTS WAS UNLAWFUL BECAUSE IT IGNORED IMPACTS ON PUBLIC LANDS AND SAGE-GROUSE HABITAT.

BLM additionally violated NEPA in approving a series of range projects without first taking a "hard look" at the direct ecological consequences on sage-grouse of building the projects. *Ocean Advocates*, 402 F.3d at 864 (NEPA requires federal agencies to "take seriously the potential environmental consequences of a proposed action" by taking a "hard look" at the ecological impacts of their proposed actions"). Pursuant to NEPA's "hard look" requirement, an agency must prepare an up-front, coherent, comprehensive environmental review. *Ctr. for Biol. Diversity*, 349 F.3d at 1166.

In the Cave Lake EA, BLM describes its proposed action as constructing new spring developments, pipelines, and water developments (wells and reservoirs), as well as authorizing the maintenance and construction of 400 miles of fences within the valleys. ER 0139-147 (describing projects); ER 0158-161 (discussing pipelines); ER 158, Map 2.8 (map of pipeline extensions).

The EA provides some data on the location of the range projects, and construction is proposed within priority sage-grouse habitat. For example, BLM has authorized a new well in the northwest corner of the Lake Valley watershed, which also contains "priority habitat," according to BLM. *Compare* ER 143, Map 2.4 (map of new well), *with* ER 179, Map 3.1 (map of sage-grouse preliminary priority habitat). BLM has also authorized three new pipelines in what appears to be sage-grouse priority habitat, including the Cave Valley Seeding, Cave Valley Well No. 2, and North Eldridge pipelines. ER 158, Map 2.8 (map of three new pipelines); ER 0274, Map A.38 (map of Cave Valley Seeding pipeline); ER 0275, Map A.39 (map of Cave Valley Well No. 2 pipeline); ER 0276, Map A.40 (map of North Eldridge pipeline), and ER 179, Map 3.1. Moreover, many of the fences slated for reconstruction appear to be within priority sage-grouse habitat. *Compare* ER 0141, Map 2.3 (map of existing fences), *with* ER 0179, Map 3.1.

However, the EA lacks any discussion or analysis of the potential impacts on sage-grouse populations and habitat. For example, BLM included no information on the condition of the areas in and around the projects, including the presence/absence of invasive and noxious weeds; whether these areas contains sage-grouse leks, breeding habitat or other high value wildlife habitat; or any other features of these areas. ER 0140-147, 0158-161. BLM also failed to prepare any analysis on the potential environmental effects of constructing these range projects, such as the potential for invasive and/or noxious weed establishment or increase following construction. *Id.*

Instead of preparing a "coherent comprehensive environmental review" of the impacts of its planned range developments, as NEPA requires, the EA substitutes conclusory assertions and *ipse dixit*. *Ctr. for Biol. Diversity*, 349 F.3d at 1166. For example, BLM admits that the "projects could disturb existing vegetation and weeds could spread into the newly disturbed areas," but then BLM concludes, "[t]his increase in weeds is expected to be minimal." ER 195. BLM provides no explanation or analysis supporting this conclusion, however, and never discusses whether cheatgrass infestations already occur in the project areas, or how the construction will affect the infestations of noxious weeds already located throughout Cave and Lake valleys. *Id.*

This last oversight is particularly problematic because BLM's own data shows that it has discovered almost 200 incidences of noxious weed infestations in Lake and Cave valleys, and cheatgrass is exploding through the valleys, including in areas targeted for new range projects. ER 0330-31, 0376-77. *Compare* ER 141, Map 2.3 (map of existing fences to be rebuilt); ER 158, Map 2.8 (map of new pipelines); *and* ER 0341, 0389 (maps of weeds located within Cave and Lake valleys). *See also supra* at 12-13 (discussing cheatgrass concentrations in valleys). The record here establishes that increasing ground disturbance – through building and rebuilding fences, pipelines and other infrastructure – within areas susceptible to (or already experiencing) weed invasion exacerbates the threats, including increasing fire intervals and severity. Add. 0084-86; ER 488, 493. And, yet, BLM prepared no analysis or discussion of the potential adverse impacts on sage-grouse of building range projects within areas already infested with noxious and invasive weeds.

BLM relies on similarly unmoored conclusions regarding the direct and indirect impacts of its construction and reconstruction of these range projects on sage-grouse. In its EA, BLM claims only that "[t]here would be loss of some habitat due to well development and pipeline construction; however this will not affect [sage-grouse] population[s]." ER 0200. But, BLM provides no explanation or justification for its conclusions, and the evidence in the record shows that several of BLM's new pipelines will be within "priority" sage-grouse habitat, and immediately adjacent to sage-grouse leks. *Compare* ER 0158, Map 2.8 (map of new pipelines), *and* ER 179, Map 3.1 (map of sage-grouse leks and priority habitat). BLM assertions are also at odds with the science in the record, especially because range projects and other grazing infrastructure represent a threat to sage-grouse populations and habitat. Add. 0076-78, 0084-86, 0088-90.

BLM cannot meet its NEPA obligations in this manner, and this Court has routinely reversed similarly vacant environmental reviews. In *Great Basin Mine Watch,* the Ninth Circuit reversed a BLM environmental review that similarly offered conclusions instead of analysis, holding that "vague and conclusory statements, without any supporting data, do not constitute a 'hard look' at the environmental consequences of the action as required by NEPA." 456 F.3d at 973 (BLM "cannot simply offer conclusions. Rather, it must identify and discuss the impacts that will be caused" by the project).

Like in *Great Basin Mine Watch*, BLM here has refused to undertake any review of adverse impacts of its range developments on weeds and sage-grouse, which the science in the record explained is likely. Instead, BLM offers conclusions but no analysis. This Court should follow *Great Basin Mine Watch*, and hold that BLM violated NEPA by failing to adequately examine the ecological impacts on sage-grouse of its range developments.

CONCLUSION

For the foregoing reasons, Western Watersheds respectfully requests the Court reverse the district court's grant of summary judgment to BLM, and hold that BLM violated NEPA in approving the Cave Lake project without a comprehensive analysis examining the direct, indirect and cumulative impacts of its project on sage-grouse.

Dated this 5th day of May, 2016

Respectfully submitted,

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STATEMENT OF RELATED CASE

Counsel for Western Watersheds Project is unaware of any related cases pending in this Court.

CERTIFICATE PURSUANT TO CIRCUIT RULE 32-1

I hereby certify that, pursuant to Fed. R. App. P. 32(a)(7)(C), and Ninth Circuit Rules 28-4 and 32-1, the foregoing Appellant's Opening Brief is proportionately spaced, has a typeface of 14 points or more, and contains 12,272 words (calculated using "word count" tool in Microsoft Word).

Dated: May 5, 2016

/s/ Todd C. Tucci
Todd C. Tucci (ISB # 6526)

CERTIFICATE OF SERVICE

I hereby certify that on May 5, 2016, I electronically filed the foregoing with the Clerk of the Court for the United States Court of Appeals for the Ninth Circuit y using the appellate CM/ECF system. I certify that all participants in the case are registered CM/ECF users and that service will be accomplished by the appellate CM/ECF system.

/s/ Todd C. Tucci
Todd C. Tucci (ISB # 6526)

ADDENDUM

ADDENDUM
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The National Environmental Policy Act of 1969

The National Environmental Policy Act of 1969, as amended

(Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, § 4(b), Sept. 13, 1982)

An Act to establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969."

Purpose

Sec. 2 [42 USC § 4321].

The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

CONGRESSIONAL DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

Sec. 101 [42 USC § 4331].

(a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consist with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may --

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
5. achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

Sec. 102 [42 USC § 4332].

The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall --

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on --

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(D) Any detailed statement required under subparagraph (C) after January 1, 1970, for any major Federal action funded under a program of grants to States shall not be deemed to be legally insufficient solely by reason of having been prepared by a State agency or official, if:

(i) the State agency or official has statewide jurisdiction and has the responsibility for such action,

(ii) the responsible Federal official furnishes guidance and participates in such preparation,

(iii) the responsible Federal official independently evaluates such statement prior to its approval and adoption, and

(iv) after January 1, 1976, the responsible Federal official provides early notification to, and solicits the views of, any other State or any Federal land management entity of any action or any alternative thereto which may have significant impacts upon such State or affected Federal land management entity and, if there is any disagreement on such impacts, prepares a written assessment of such impacts and views for incorporation into such detailed statement.

The procedures in this subparagraph shall not relieve the Federal official of his responsibilities for the scope, objectivity, and content of the entire statement or of any other responsibility under this Act; and further, this subparagraph does not affect the legal sufficiency of statements prepared by State agencies with less than statewide jurisdiction.

(E) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(F) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(G) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(H) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(I) assist the Council on Environmental Quality established by title II of this Act.

Sec. 103 [42 USC § 4333].

All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

Sec. 104 [42 USC § 4334].

Nothing in section 102 [42 USC § 4332] or 103 [42 USC § 4333] shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

Sec. 105 [42 USC § 4335].

The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

Sec. 201 [42 USC § 4341].

The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban an rural environment; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

Sec. 202 [42 USC § 4342].

There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, aesthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

Sec. 203 [42 USC § 4343].

(a) The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5, United States Code (but without regard to the last sentence thereof).

(b) Notwithstanding section 1342 of Title 31, the Council may accept and employ voluntary and uncompensated services in furtherance of the purposes of the Council.

Sec. 204 [42 USC § 4344].

It shall be the duty and function of the Council --

1. to assist and advise the President in the preparation of the Environmental Quality Report required by section 201 [42 USC § 4341] of this title;

2. to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

3. to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement

of such policy, and to make recommendations to the President with respect thereto;

4. to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;
5. to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;
6. to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;
7. to report at least once each year to the President on the state and condition of the environment; and
8. to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

Sec. 205 [42 USC § 4345].

In exercising its powers, functions, and duties under this Act, the Council shall --

1. consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order No. 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and
2. utilize, to the fullest extent possible, the services, facilities and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

Sec. 206 [42 USC § 4346].

Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates [5 USC § 5313]. The other members of the Council shall be compensated at the rate provided for Level IV of the Executive Schedule Pay Rates [5 USC § 5315].

Sec. 207 [42 USC § 4346a].

The Council may accept reimbursements from any private nonprofit organization or from any department, agency, or instrumentality of the Federal Government, any State, or local government, for the reasonable travel expenses incurred by an officer or employee of the Council in connection with his attendance at any conference, seminar, or similar meeting conducted for the benefit of the Council.

Sec. 208 [42 USC § 4346b].

The Council may make expenditures in support of its international activities, including expenditures for: (1) international travel; (2) activities in implementation of international agreements; and (3) the support of international exchange programs in the United States and in foreign countries.

Sec. 209 [42 USC § 4347].

There are authorized to be appropriated to carry out the provisions of this chapter not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter.

The Environmental Quality Improvement Act, as amended (Pub. L. No. 91- 224, Title II, April 3, 1970; Pub. L. No. 97-258, September 13, 1982; and Pub. L. No. 98-581, October 30, 1984.

42 USC § 4372.

(a) There is established in the Executive Office of the President an office to be known as the Office of Environmental Quality (hereafter in this chapter referred to as the "Office"). The Chairman of the Council on Environmental Quality established by Public Law 91-190 shall be the Director of the Office. There shall be in the Office a Deputy Director who shall be appointed by the President, by and with the advice and consent of the Senate.

(b) The compensation of the Deputy Director shall be fixed by the President at a rate not in excess of the annual rate of compensation payable to the Deputy Director of the Office of Management and Budget.

(c) The Director is authorized to employ such officers and employees (including experts and consultants) as may be necessary to enable the Office to carry out its functions ;under this chapter and Public Law 91-190, except that he may employ no more than ten specialists and other experts without regard to the provisions of Title 5, governing appointments in the competitive service, and pay such specialists and experts without regard to the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates, but no such specialist or expert shall be paid at a rate in excess of the maximum rate for GS-18 of the General Schedule under section 5332 of Title 5.

(d) In carrying out his functions the Director shall assist and advise the President on policies and programs of the Federal Government affecting environmental quality by --

1. providing the professional and administrative staff and support for the Council on Environmental Quality established by Public Law 91- 190;

2. assisting the Federal agencies and departments in appraising the effectiveness of existing and proposed facilities, programs, policies, and activities of the Federal Government, and those specific major projects designated by the President which

do not require individual project authorization by Congress, which affect environmental quality;

3. reviewing the adequacy of existing systems for monitoring and predicting environmental changes in order to achieve effective coverage and efficient use of research facilities and other resources;

4. promoting the advancement of scientific knowledge of the effects of actions and technology on the environment and encouraging the development of the means to prevent or reduce adverse effects that endanger the health and well-being of man;

5. assisting in coordinating among the Federal departments and agencies those programs and activities which affect, protect, and improve environmental quality;

6. assisting the Federal departments and agencies in the development and interrelationship of environmental quality criteria and standards established throughout the Federal Government;

7. collecting, collating, analyzing, and interpreting data and information on environmental quality, ecological research, and evaluation.

(e) The Director is authorized to contract with public or private agencies, institutions, and organizations and with individuals without regard to section 3324(a) and (b) of Title 31 and section 5 of Title 41 in carrying out his functions.

42 USC § 4373. Each Environmental Quality Report required by Public Law 91-190 shall, upon transmittal to Congress, be referred to each standing committee having jurisdiction over any part of the subject matter of the Report.

42 USC § 4374. There are hereby authorized to be appropriated for the operations of the Office of Environmental Quality and the Council on Environmental Quality not to exceed the following sums for the following fiscal years which sums are in addition to those contained in Public Law 91- 190:

(a) $2,126,000 for the fiscal year ending September 30, 1979.

(b) $3,000,000 for the fiscal years ending September 30, 1980, and September 30, 1981.

(c) $44,000 for the fiscal years ending September 30, 1982, 1983, and 1984.

(d) $480,000 for each of the fiscal years ending September 30, 1985 and 1986.

42 USC § 4375.

(a) There is established an Office of Environmental Quality Management Fund (hereinafter referred to as the "Fund") to receive advance payments from other agencies or accounts that may be used solely to finance --

1. study contracts that are jointly sponsored by the Office and one or more other Federal agencies; and

2. Federal interagency environmental projects (including task forces) in which the Office participates.

(b) Any study contract or project that is to be financed under subsection (a) of this section may be initiated only with the approval of the Director.

(c) The Director shall promulgate regulations setting forth policies and procedures for operation of the Fund.

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Council on Environmental Quality
Executive Office of the President

REGULATIONS

For Implementing The Procedural Provisions Of The

NATIONAL ENVIRONMENTAL POLICY ACT

Reprint
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AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609) and E.O. 11514, Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 55990, Nov. 28, 1978, unless otherwise noted.

§1500.1 Purpose.

(a) The National Environmental Policy Act (NEPA) is our basic national charter for protection of the environment. It establishes policy, sets goals (section 101), and provides means (section 102) for carrying out the policy. Section 102(2) contains "action-forcing" provisions to make sure that federal agencies act according to the letter and spirit of the Act. The regulations that follow implement section 102(2). Their purpose is to tell federal agencies what they must do to comply with the procedures and achieve the goals of the Act. The President, the federal agencies, and the courts share responsibility for enforcing the Act so as to achieve the substantive requirements of section 101.

(b) NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA. Most important, NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.

(c) Ultimately, of course, it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. These regulations provide the direction to achieve this purpose.

§1500.2 Policy.

Federal agencies shall to the fullest extent possible:

(a) Interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in the Act and in these regulations.

(b) Implement procedures to make the NEPA process more useful to decisionmakers and the public; to reduce paperwork and the accumulation of extraneous background data; and to emphasize real environmental issues and alternatives. Environmental impact statements shall be concise, clear, and to the point, and shall be supported by evidence that agencies have made the necessary environmental analyses.

(c) Integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively.

(d) Encourage and facilitate public involvement in decisions which affect the quality of the human environment.

(e) Use the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment.

(f) Use all practicable means, consistent with the requirements of the Act and other essential considerations of national policy, to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of their actions upon the quality of the human environment.

§1500.3 Mandate.

Parts 1500 through 1508 of this title provide regulations applicable to and binding on all federal agencies for implementing the procedural provisions of the National Environmental Policy Act of 1969, as amended (Pub. L. 91–190, 42 U.S.C. 4321 *et seq.*) (NEPA or the Act) except where compliance would be inconsistent with other statutory requirements. These regulations are issued pursuant to NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*) section 309 of the Clean Air Act, as amended (42 U.S.C. 7609) and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977). These regulations, unlike the predecessor guidelines, are not confined to sec. 102(2)(C) (environmental impact statements). The regulations apply to the whole of section 102(2). The provisions of the Act and of these regulations must be read together as a whole in order to comply with the spirit and letter of the law. It is the Council's intention that judicial review of agency compliance with these regulations not occur before an agency has filed the final environmental impact statement, or has made a final finding of no significant impact (when such a finding will result in action affecting the environment), or takes action that will result in irreparable injury. Furthermore, it is the Council's intention that any trivial violation of these regulations not give rise to any independent cause of action.

§1500.4 Reducing paperwork.

Agencies shall reduce excessive paperwork by:

(a) Reducing the length of environmental impact statements (§1502.2(c)), by means such as setting appropriate page limits (§§1501.7(b)(1) and 1502.7).

(b) Preparing analytic rather than encyclopedic environmental impact statements (§1502.2(a)).

(c) Discussing only briefly issues other than significant ones (§1502.2(b)).

(d) Writing environmental impact statements in plain language (§1502.8).

(e) Following a clear format for environmental impact statements (§1502.10).

(f) Emphasizing the portions of the environmental impact statement that are useful to decisionmakers and the public (§§1502.14 and 1502.15) and reducing emphasis on background material (§1502.16).

(g) Using the scoping process, not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly (§1501.7).

(h) Summarizing the environmental impact statement (§1502.12) and circulating the summary instead of the entire environmental impact statement if the latter is unusually long (§1502.19).

(i) Using program, policy, or plan environmental impact statements and tiering from statements of broad scope to those of narrower scope, to eliminate repetitive discussions of the same issues (§§1502.4 and 1502.20).

(j) Incorporating by reference (§1502.21).

(k) Integrating NEPA requirements with other environmental review and consultation requirements (§1502.25).

(l) Requiring comments to be as specific as possible (§1503.3).

(m) Attaching and circulating only changes to the draft environmental impact statement, rather than rewriting and circulating the entire statement when changes are minor (§1503.4(c)).

(n) Eliminating duplication with state and local procedures, by providing for joint preparation (§1506.2), and with other federal procedures, by providing that an agency may adopt appropriate environmental documents prepared by another agency (§1506.3).

(o) Combining environmental documents with other documents (§1506.4).

(p) Using categorical exclusions to define categories of actions which do not individually or cumulatively have a significant effect on the human environment and which are therefore exempt from requirements to prepare an environmental impact statement (§1508.4).

(q) Using a finding of no significant impact when an action not otherwise excluded will not have a significant effect on the human environment and is therefore exempt from requirements to prepare an environmental impact statement (§1508.13).

[43 FR 55990, Nov. 29, 1978; 44 FR 873, Jan. 3, 1979]

§1500.5 Reducing delay.

Agencies shall reduce delay by:

(a) Integrating the NEPA process into early planning (§1501.2).

(b) Emphasizing interagency cooperation before the environmental impact statement is prepared, rather than submission of adversary comments on a completed document (§1501.6).

(c) Insuring the swift and fair resolution of lead agency disputes (§1501.5).

(d) Using the scoping process for an early identification of what are and what are not the real issues (§1501.7).

(e) Establishing appropriate time limits for the environmental impact statement process (§§1501.7(b)(2) and 1501.8).

(f) Preparing environmental impact statements early in the process (§1502.5).

(g) Integrating NEPA requirements with other environmental review and consultation requirements (§1502.25).

(h) Eliminating duplication with state and local procedures by providing for joint preparation (§1506.2), and with other federal procedures by providing that an agency may adopt appropriate environmental documents prepared by another agency (§1506.3).

(i) Combining environmental documents with other documents (§1506.4).

(j) Using accelerated procedures for proposals for legislation (§1506.8).

(k) Using categorical exclusions to define categories of actions which do not individually or cumulatively have a significant effect on the human environment (§1508.4) and which are therefore exempt from requirements to prepare an environmental impact statement.

(l) Using a finding of no significant impact when an action not otherwise excluded will not have a significant effect on the human environment (§1508.13) and is therefore exempt from requirements to prepare an environmental impact statement.

§1500.6 Agency authority.

Each agency shall interpret the provisions of the Act as a supplement to its existing authority and as a mandate to view traditional policies and missions in the light of the Act's national environmental objectives. Agencies shall review their policies, procedures, and regulations accordingly and revise them as necessary to insure full compliance with the purposes and provisions of the Act. The phrase "to the fullest extent possible" in section 102 means that each agency of the federal government shall comply with that section unless existing law applicable to the agency's operations expressly prohibits or makes compliance impossible.

PART 1501—NEPA AND AGENCY PLANNING

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609, and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 55992, Nov. 29, 1978, unless otherwise noted.

§1501.1 Purpose.

The purposes of this part include:

(a) Integrating the NEPA process into early planning to insure appropriate consideration of NEPA's policies and to eliminate delay.

(b) Emphasizing cooperative consultation among agencies before the environmental impact statement is prepared rather than submission of adversary comments on a completed document.

(c) Providing for the swift and fair resolution of lead agency disputes.

(d) Identifying at an early stage the significant environmental issues deserving of study and deemphasizing insignificant issues, narrowing the scope of the environmental impact statement accordingly.

(e) Providing a mechanism for putting appropriate time limits on the environmental impact statement process.

§1501.2 Apply NEPA early in the process.

Agencies shall integrate the NEPA process with other planning at the earliest possible time to insure that planning and decisions reflect environmental values, to avoid delays later in the process, and to head off potential conflicts. Each agency shall:

(a) Comply with the mandate of section 102(2)(A) to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment," as specified by §1507.2.

(b) Identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses. Environmental documents and appropriate analyses shall be circulated and reviewed at the same time as other planning documents.

(c) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by section 102(2)(E) of the Act.

(d) Provide for cases where actions are planned by private applicants or other non-federal entities before federal involvement so that:

(1) Policies or designated staff are available to advise potential applicants of studies or other information foreseeably required for later federal action.

(2) The federal agency consults early with appropriate state and local agencies and Indian tribes and with interested private persons and organizations when its own involvement is reasonably foreseeable.

(3) The federal agency commences its NEPA process at the earliest possible time.

§1501.3 When to prepare an environmental assessment.

(a) Agencies shall prepare an environmental assessment (§1508.9) when necessary under the procedures adopted by individual agencies to supplement these regulations as described in §1507.3. An assessment is not necessary if the agency has decided to prepare an environmental impact statement.

(b) Agencies may prepare an environmental assessment on any action at any time in order to assist agency planning and decisionmaking.

§1501.4 Whether to prepare an environmental impact statement.

In determining whether to prepare an environmental impact statement the federal agency shall:

(a) Determine under its procedures supplementing these regulations (described in §1507.3) whether the proposal is one which:

(1) Normally requires an environmental impact statement, or

(2) Normally does not require either an environmental impact statement or an environmental assessment (categorical exclusion).

(b) If the proposed action is not covered by paragraph (a) of this section, prepare an environmental assessment (§1508.9). The agency shall involve environmental agencies, applicants, and the public, to the extent practicable, in preparing assessments required by §1508.9(a)(1).

(c) Based on the environmental assessment make its determination whether to prepare an environmental impact statement.

(d) Commence the scoping process (§1501.7), if the agency will prepare an environmental impact statement.

(e) Prepare a finding of no significant impact (§1508.13), if the agency determines on the basis of the environmental assessment not to prepare a statement.

(1) The agency shall make the finding of no significant impact available to the affected public as specified in §1506.6.

(2) In certain limited circumstances, which the agency may cover in its procedures under §1507.3, the agency shall make the finding of

no significant impact available for public review (including state and areawide clearinghouses) for 30 days before the agency makes its final determination whether to prepare an environmental impact statement and before the action may begin. The circumstances are:

(i) The proposed action is, or is closely similar to, one which normally requires the preparation of an environmental impact statement under the procedures adopted by the agency pursuant to §1507.3, or

(ii) The nature of the proposed action is one without precedent.

§1501.5 Lead agencies.

(a) A lead agency shall supervise the preparation of an environmental impact statement if more than one federal agency either:

(1) Proposes or is involved in the same action; or

(2) Is involved in a group of actions directly related to each other because of their functional interdependence or geographical proximity.

(b) Federal, state, or local agencies, including at least one federal agency, may act as joint lead agencies to prepare an environmental impact statement (§1506.2).

(c) If an action falls within the provisions of paragraph (a) of this section the potential lead agencies shall determine by letter or memorandum which agency shall be the lead agency and which shall be cooperating agencies. The agencies shall resolve the lead agency question so as not to cause delay. If there is disagreement among the agencies, the following factors (which are listed in order of descending importance) shall determine lead agency designation:

(1) Magnitude of agency's involvement.

(2) Project approval/disapproval authority.

(3) Expertise concerning the action's environmental effects.

(4) Duration of agency's involvement.

(5) Sequence of agency's involvement.

(d) Any federal agency, or any state or local agency or private person substantially affected by the absence of lead agency designation, may make a written request to the potential lead agencies that a lead agency be designated.

(e) If federal agencies are unable to agree on which agency will be the lead agency or if the procedure described in paragraph (c) of this section has not resulted within 45 days in a lead agency designation, any of the agencies or persons concerned may file a request with the Council asking it to determine which Federal agency shall be the lead agency. A copy of the request shall be transmitted to each potential lead agency. The request shall consist of:

(1) A precise description of the nature and extent of the proposed action.

(2) A detailed statement of why each potential lead agency should or should not be the lead agency under the criteria specified in paragraph (c) of this section.

(f) A response may be filed by any potential lead agency concerned within 20 days after a request is filed with the Council. The Council shall determine as soon as possible but not later than 20 days after receiving the request and all responses to it which federal agency shall be the lead agency and which other federal agencies shall be cooperating agencies.

[43 FR 55992, Nov. 29, 1978; 44 FR 873, Jan. 3, 1979]

§1501.6 Cooperating agencies.

The purpose of this section is to emphasize agency cooperation early in the NEPA process. Upon request of the lead agency, any other federal agency which has jurisdiction by law shall be a cooperating agency. In addition any other federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency. An agency may request the lead agency to designate it a cooperating agency.

(a) The lead agency shall:

(1) Request the participation of each cooperating agency in the NEPA process at the earliest possible time.

(2) Use the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, to the maximum extent possible consistent with its responsibility as lead agency.

(3) Meet with a cooperating agency at the latter's request.

(b) Each cooperating agency shall:

(1) Participate in the NEPA process at the earliest possible time.

(2) Participate in the scoping process (described below in §1501.7).

(3) Assume on request of the lead agency responsibility for developing information and preparing environmental analyses including portions of the environmental impact statement concerning which the cooperating agency has special expertise.

(4) Make available staff support at the lead agency's request to enhance the latter's interdisciplinary capability.

(5) Normally use its own funds. The lead agency shall, to the extent available funds permit, fund those major activities or analyses it requests from cooperating agencies. Potential lead agencies shall include such funding requirements in their budget requests.

(c) A cooperating agency may in response to a lead agency's request for assistance in preparing the environmental impact statement (described in paragraph (b) (3), (4), or (5) of this section) reply that other program commitments preclude any involvement or the degree of involvement requested in the action that is the subject of the environmental impact statement. A copy of this reply shall be submitted to the Council.

§1501.7 Scoping.

There shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process shall be termed scoping. As soon as practicable after its decision to prepare an environmental impact statement and before the scoping process the lead agency shall publish a notice of intent (§1508.22) in the FEDERAL REGISTER except as provided in §1507.3(e).

(a) As part of the scoping process the lead agency shall:

(1) Invite the participation of affected federal, state, and local agencies, any affected Indian tribe, the proponent of the action, and other interested persons (including those who might not be in accord with the action on environmental grounds), unless there is a limited exception under §1507.3(c). An agency may give notice in accordance with §1506.6.

(2) Determine the scope (§1508.25) and the significant issues to be analyzed in depth in the environmental impact statement.

(3) Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (§1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere.

(4) Allocate assignments for preparation of the environmental impact statement among the lead and cooperating agencies, with the lead agency retaining responsibility for the statement.

(5) Indicate any public environmental assessments and other environmental impact statements which are being or will be prepared that are related to but are not part of the scope of the impact statement under consideration.

(6) Identify other environmental review and consultation requirements so the lead and cooperating agencies may prepare other required analyses and studies concurrently with, and integrated with, the environmental impact statement as provided in §1502.25.

(7) Indicate the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and decisionmaking schedule.

(b) As part of the scoping process the lead agency may:

(1) Set page limits on environmental documents (§1502.7).

(2) Set time limits (§1501.8).

(3) Adopt procedures under §1507.3 to combine its environmental assessment process with its scoping process.

(4) Hold an early scoping meeting or meetings which may be integrated with any other early planning meeting the agency has. Such a scoping meeting will often be appropriate when the impacts of a particular action are confined to specific sites.

(c) An agency shall revise the determinations made under paragraphs (a) and (b) of this section if substantial changes are made later in the proposed action, or if significant new circumstances or information arise which bear on the proposal or its impacts.

§1501.8 Time limits.

Although the Council has decided that prescribed universal time limits for the entire NEPA process are too inflexible, federal agencies are encouraged to set time limits appropriate to individual actions (consistent with the time intervals required by §1506.10). When multiple agencies are involved the reference to agency below means lead agency.

(a) The agency shall set time limits if an applicant for the proposed action requests them: *Provided*, That the limits are consistent with the purposes of NEPA and other essential considerations of national policy.

(b) The agency may:

(1) Consider the following factors in determining time limits:

(i) Potential for environmental harm.

(ii) Size of the proposed action.

(iii) State of the art of analytic techniques.

(iv) Degree of public need for the proposed action, including the consequences of delay.

(v) Number of persons and agencies affected.

(vi) Degree to which relevant information is known and if not known the time required for obtaining it.

(vii) Degree to which the action is controversial.

(viii) Other time limits imposed on the agency by law, regulations, or executive order.

(2) Set overall time limits or limits for each constituent part of the NEPA process, which may include:

(i) Decision on whether to prepare an environmental impact statement (if not already decided).

(ii) Determination of the scope of the environmental impact statement.

(iii) Preparation of the draft environmental impact statement.

(iv) Review of any comments on the draft environmental impact statement from the public and agencies.

(v) Preparation of the final environmental impact statement.

(vi) Review of any comments on the final environmental impact statement.

(vii) Decision on the action based in part on the environmental impact statement.

(3) Designate a person (such as the project manager or a person in the agency's office with NEPA responsibilities) to expedite the NEPA process.

(c) State or local agencies or members of the public may request a federal agency to set time limits.

PART 1502—ENVIRONMENTAL IMPACT STATEMENT

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 55994, Nov. 29, 1978, unless otherwise noted.

§1502.1 Purpose.

The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the federal government. It shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. Agencies shall focus on significant environmental issues and alternatives and shall reduce paperwork and the accumulation of extraneous background data. Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses. An environmental impact statement is more than a disclosure document. It shall be used by federal officials in conjunction with other relevant material to plan actions and make decisions.

§1502.2 Implementation.

To achieve the purposes set forth in §1502.1 agencies shall prepare environmental impact statements in the following manner:

(a) Environmental impact statements shall be analytic rather than encyclopedic.

(b) Impacts shall be discussed in proportion to their significance. There shall be only brief discussion of other than significant issues. As in a finding of no significant impact, there should be only enough discussion to show why more study is not warranted.

(c) Environmental impact statements shall be kept concise and shall be no longer than absolutely necessary to comply with NEPA and with these regulations. Length should vary first with potential environmental problems and then with project size.

(d) Environmental impact statements shall state how alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of the Act and other environmental laws and policies.

(e) The range of alternatives discussed in environmental impact statements shall encompass those to be considered by the ultimate agency decisionmaker.

(f) Agencies shall not commit resources prejudicing selection of alternatives before making a final decision (§1506.1).

(g) Environmental impact statements shall serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made.

§1502.3 Statutory requirements for statements.

As required by sec. 102(2)(C) of NEPA environmental impact statements (§1508.11) are to be included in every recommendation or report.

On proposals (§1508.23).

For legislation and (§1508.17).

Other major federal actions (§1508.18).

Significantly (§1508.27).

Affecting (§§1508.3, 1508.8).

The quality of the human environment (§1508.14).

§1502.4 Major Federal actions requiring the preparation of environmental impact statements.

(a) Agencies shall make sure the proposal which is the subject of an environmental impact statement is properly defined. Agencies shall use the criteria for scope (§1508.25) to determine which proposal(s) shall be the subject of a particular statement. Proposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement.

(b) Environmental impact statements may be prepared, and are sometimes required, for broad federal actions such as the adoption of new agency programs or regulations (§1508.18). Agencies shall prepare statements on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in agency planning and decisionmaking.

(c) When preparing statements on broad actions (including proposals by more than one agency), agencies may find it useful to evaluate the proposal(s) in one of the following ways:

(1) Geographically, including actions occurring in the same general location, such as body of water, region, or metropolitan area.

(2) Generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter.

(3) By stage of technological development including federal or federally assisted research, development or demonstration programs for new technologies which, if applied, could significantly affect the quality of the human environment. Statements shall be prepared on such programs and shall be available before the program has reached a stage of investment or commitment to implementation likely to determine subsequent development or restrict later alternatives.

(d) Agencies shall as appropriate employ scoping (§1501.7), tiering (§1502.20), and other methods listed in §§1500.4 and 1500.5 to relate broad and narrow actions and to avoid duplication and delay.

§1502.5 Timing.

An agency shall commence preparation of an environmental impact statement as close as possible to the time the agency is developing or is presented with a proposal (§1508.23) so that preparation can be completed in time for the final statement to be included in any recommendation or report on the proposal. The statement shall be prepared early enough so that it can serve practically as an important contribution to the decisionmaking process and will not be used to rationalize or justify decisions already made (§§1500.2(c), 1501.2, and 1502.2). For instance:

(a) For projects directly undertaken by federal agencies the environmental impact statement shall be prepared at the feasibility analysis (go-no go) stage and may be supplemented at a later stage if necessary.

(b) For applications to the agency appropriate environmental assessments or statements shall be commenced no later than immediately after the application is received. Federal agencies are encouraged to begin preparation of such assessments or statements earlier, preferably jointly with applicable state or local agencies.

(c) For adjudication, the final environmental impact statement shall normally precede the final staff recommendation and that portion of the public hearing related to the impact study. In appropriate circumstances the statement may follow preliminary hearings designed to gather information for use in the statements.

(d) For informal rulemaking the draft environmental impact statement shall normally accompany the proposed rule.

§1502.6 Interdisciplinary preparation.

Environmental impact statements shall be prepared using an inter-disciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts (section 102(2)(A) of the Act). The disciplines of the preparers shall be appropriate to the scope and issues identified in the scoping process (§1501.7).

§1502.7 Page limits.

The text of final environmental impact statements (e.g., paragraphs (d) through (g) of §1502.10) shall normally be less than 150 pages and for proposals of unusual scope or complexity shall normally be less than 300 pages.

§1502.8 Writing.

Environmental impact statements shall be written in plain language and may use appropriate graphics so that decisionmakers and the public can readily understand them. Agencies should employ writers of clear prose or editors to write, review, or edit statements, which will be based upon the analysis and supporting data from the natural and social sciences and the environmental design arts.

§1502.9 Draft, final, and supplemental statements.

Except for proposals for legislation as provided in §1506.8 environmental impact statements shall be prepared in two stages and may be supplemented.

(a) Draft environmental impact statements shall be prepared in accordance with the scope decided upon in the scoping process. The lead agency shall work with the cooperating agencies and shall obtain comments as required in part 1503 of this chapter. The draft statement must fulfill and satisfy to the fullest extent possible the requirements established for final statements in section 102(2)(C) of the Act. If a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion. The agency shall make every effort to disclose and discuss at appropriate points in the draft statement all major points of view on the environmental impacts of the alternatives including the proposed action.

(b) Final environmental impact statements shall respond to comments as required in part 1503 of this chapter. The agency shall discuss at appropriate points in the final statement any responsible opposing view which was not adequately discussed in the draft statement and shall indicate the agency's response to the issues raised.

(c) Agencies:

(1) Shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or

(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

(2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.

(3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.

(4) Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council.

§1502.10 Recommended format.

Agencies shall use a format for environmental impact statements which will encourage good analysis and clear presentation of the alternatives including the proposed action. The following standard format for environmental impact statements should be followed unless the agency determines that there is a compelling reason to do otherwise:

(a) Cover sheet.

(b) Summary.

(c) Table of contents.

(d) Purpose of and need for action.

(e) Alternatives including proposed action (sections 102(2)(C)(iii) and 102(2)(E) of the Act).

(f) Affected environment.

(g) Environmental consequences (especially sections 102(2)(C)(i), (ii), (iv), and (v) of the Act).

(h) List of preparers.

(i) List of agencies, organizations, and persons to whom copies of the statement are sent.

(j) Index.

(k) Appendices (if any).

If a different format is used, it shall include paragraphs (a), (b), (c), (h), (i), and (j), of this section and shall include the substance of paragraphs (d), (e), (f), (g), and (k) of this section, as further described in §§1502.11 through 1502.18, in any appropriate format.

§1502.11 Cover sheet.

The cover sheet shall not exceed one page. It shall include:

(a) A list of the responsible agencies including the lead agency and any cooperating agencies.

(b) The title of the proposed action that is the subject of the statement (and if appropriate the titles of related cooperating agency actions), together with the state(s) and county(ies) (or other jurisdiction if applicable) where the action is located.

(c) The name, address, and telephone number of the person at the agency who can supply further information.

(d) A designation of the statement as a draft, final, or draft or final supplement.

(e) A one paragraph abstract of the statement.

(f) The date by which comments must be received (computed in cooperation with EPA under §1506.10). The information required by this section may be entered on Standard Form 424 (in items 4, 6, 7, 10, and 18).

§1502.12 Summary.

Each environmental impact statement shall contain a summary which adequately and accurately summarizes the statement. The summary shall stress the major conclusions, areas of controversy (including issues raised by agencies and the public), and the issues to be resolved (including the choice among alternatives). The summary will normally not exceed 15 pages.

§1502.13 Purpose and need.

The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action.

§1502.14 Alternatives including the proposed action.

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§1502.15) and the Environmental Consequences (§1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.

(d) Include the alternative of no action.

(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.

(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

§1502.15 Affected environment.

The environmental impact statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The description shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues. Verbose descriptions of the affected environment are themselves no measure of the adequacy of an environmental impact statement.

§1502.16 Environmental consequences.

This section forms the scientific and analytic basis for the comparisons under §1502.14. It shall consolidate the discussions of those elements required by sections 102(2)(C)(i), (ii), (iv), and (v) of NEPA which are within the scope of the statement and as much of section 102(2)(C)(iii) as is necessary to support the comparisons. The discussion will include the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented. This section should not duplicate discussions in §1502.14. It shall include discussions of:

(a) Direct effects and their significance (§1508.8).

(b) Indirect effects and their significance (§1508.8).

(c) Possible conflicts between the proposed action and the objectives of federal, regional, state, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned. (See §1506.2(d).)

(d) The environmental effects of alternatives including the proposed action. The comparisons under §1502.14 will be based on this discussion.

(e) Energy requirements and conservation potential of various alternatives and mitigation measures.

(f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.

(g) Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.

(h) Means to mitigate adverse environmental impacts (if not fully covered under §1502.14(f)).

[43 FR 55994, Nov. 29, 1978; 44 FR 873, Jan. 3, 1979]

§1502.17 List of preparers.

The environmental impact statement shall list the names, together with their qualifications (expertise, experience, professional disciplines), of the persons who were primarily responsible for preparing the environmental impact statement or significant background papers, including basic components of the statement (§§1502.6 and 1502.8). Where possible the persons who are responsible for a particular analysis, including analyses in background papers, shall be identified. Normally the list will not exceed two pages.

§1502.18 Appendix.

If an agency prepares an appendix to an environmental impact statement the appendix shall:

(a) Consist of material prepared in connection with an environmental impact statement (as distinct from material which is not so prepared and which is incorporated by reference (§1502.21)).

(b) Normally consist of material which substantiates any analysis fundamental to the impact statement.

(c) Normally be analytic and relevant to the decision to be made.

(d) Be circulated with the environmental impact statement or be readily available on request.

§1502.19 Circulation of the environmental impact statement.

Agencies shall circulate the entire draft and final environmental impact statements except for certain appendices as provided in §1502.18(d) and unchanged statements as provided in §1503.4(c). However, if the statement is unusually long, the agency may circulate the summary instead, except that the entire statement shall be furnished to:

(a) Any federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved and any appropriate federal, state or local agency authorized to develop and enforce environmental standards.

(b) The applicant, if any.

(c) Any person, organization, or agency requesting the entire environmental impact statement.

(d) In the case of a final environmental impact statement any person, organization, or agency which submitted substantive comments on the draft. If the agency circulates the summary and thereafter receives a timely request for the entire statement and for additional time to comment, the time for that requestor only shall be extended by at least 15 days beyond the minimum period.

§1502.20 Tiering.

Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review (§1508.28). Whenever a broad environmental impact statement has been prepared (such as a program or policy statement) and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy (such as a site specific action) the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action. The subsequent document shall state where the earlier document is available. Tiering may also be appropriate for different stages of actions. (Section 1508.28).

§1502.21 Incorporation by reference.

Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference.

§1502.22 Incomplete or unavailable information.

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.

(a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

(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.

(c) The amended regulation will be applicable to all environmental impact statements for which a Notice of Intent (40 CFR 1508.22) is published in the FEDERAL REGISTER on or after May 27, 1986. For environmental impact statements in progress, agencies may choose to comply with the requirements of either the original or amended regulation.

[51 FR 15625, Apr. 25, 1986]

§1502.23 Cost-benefit analysis.

If a cost-benefit analysis relevant to the choice among environmentally different alternatives is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. To assess the adequacy of compliance with section 102(2)(B) of the Act the statement shall, when a cost-benefit analysis is prepared, discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities. For purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations. In any event, an environmental impact statement should at least indicate those considerations, including factors not related to environmental quality, which are likely to be relevant and important to a decision.

§1502.24 Methodology and scientific accuracy.

Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement. An agency may place discussion of methodology in an appendix.

§1502.25 Environmental review and consultation requirements.

(a) To the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with environmental impact analyses and related surveys and studies required by the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*), the National Historic Preservation Act of 1966 (16 U.S.C. 470 *et seq.*), the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), and other environmental review laws and executive orders.

(b) The draft environmental impact statement shall list all federal permits, licenses, and other entitlements which must be obtained in implementing the proposal. If it is uncertain whether a federal permit, license, or other entitlement is necessary, the draft environmental impact statement shall so indicate.

PART 1503—COMMENTING

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 55997, Nov. 29, 1978, unless otherwise noted.

§1503.1 Inviting comments.

(a) After preparing a draft environmental impact statement and before preparing a final environmental impact statement the agency shall:

(1) Obtain the comments of any federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved or which is authorized to develop and enforce environmental standards.

(2) Request the comments of:

(i) Appropriate state and local agencies which are authorized to develop and enforce environmental standards;

(ii) Indian tribes, when the effects may be on a reservation; and

(iii) Any agency which has requested that it receive statements on actions of the kind proposed. Office of Management and Budget Circular A–95 (Revised), through its system of clearinghouses, provides a means of securing the views of state and local environmental agencies. The clearinghouses may be used, by mutual agreement of the lead agency and the clearinghouse, for securing state and local reviews of the draft environmental impact statements.

(3) Request comments from the applicant, if any.

(4) Request comments from the public, affirmatively soliciting comments from those persons or organizations who may be interested or affected.

(b) An agency may request comments on a final environmental impact statement before the decision is finally made. In any case other agencies or persons may make comments before the final decision unless a different time is provided under §1506.10.

§1503.2 Duty to comment.

Federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved and agencies which are authorized to develop and enforce environmental standards shall comment on statements within their jurisdiction, expertise, or authority. Agencies shall comment within the time period specified for comment in §1506.10. A Federal agency may reply that it has no comment. If a cooperating agency is satisfied that its views are adequately reflected in the environmental impact statement, it should reply that it has no comment.

§1503.3 Specificity of comments.

(a) Comments on an environmental impact statement or on a proposed action shall be as specific as possible and may address either the adequacy of the statement or the merits of the alternatives discussed or both.

(b) When a commenting agency criticizes a lead agency's predictive methodology, the commenting agency should describe the alternative methodology which it prefers and why.

(c) A cooperating agency shall specify in its comments whether it needs additional information to fulfill other applicable environmental reviews or consultation requirements and what information it needs. In particular, it shall specify any additional information it needs to comment adequately on the draft statement's analysis of significant site-specific effects associated with the granting or approving by that cooperating agency of necessary federal permits, licenses, or entitlements.

(d) When a cooperating agency with jurisdiction by law objects to or expresses reservations about the proposal on grounds of environmental impacts, the agency expressing the objection or reservation shall specify the mitigation measures it considers necessary to allow the agency to grant or approve applicable permit, license, or related requirements or concurrences.

§1503.4 Response to comments.

(a) An agency preparing a final environmental impact statement shall assess and consider comments both individually and collectively, and shall respond by one or more of the means listed below, stating its response in the final statement. Possible responses are to:

(1) Modify alternatives including the proposed action.

(2) Develop and evaluate alternatives not previously given serious consideration by the agency.

(3) Supplement, improve, or modify its analyses.

(4) Make factual corrections.

(5) Explain why the comments do not warrant further agency response, citing the sources, authorities, or reasons which support the agency's position and, if appropriate, indicate those circumstances which would trigger agency reappraisal or further response.

(b) All substantive comments received on the draft statement (or summaries thereof where the response has been exceptionally voluminous), should be attached to the final statement whether or not the comment is thought to merit individual discussion by the agency in the text of the statement.

(c) If changes in response to comments are minor and are confined to the responses described in paragraphs (a)(4) and (5) of this section, agencies may write them on errata sheets and attach them to the statement instead of rewriting the draft statement. In such cases only the comments, the responses, and the changes and not the final statement need be circulated (§1502.19). The entire document with a new cover sheet shall be filed as the final statement (§1506.9).

PART 1504—PREDECISION REFERRALS TO THE COUNCIL OF PROPOSED FEDERAL ACTIONS DETERMINED TO BE ENVIRONMENTALLY UNSATISFACTORY

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

Source: 43FR 55998, Nov. 29, 1978 unless otherwise noted.

§1504.1 Purpose.

(a) This part establishes procedures for referring to the Council federal interagency disagreements concerning proposed major federal actions that might cause unsatisfactory environmental effects. It provides means for early resolution of such disagreements.

(b) Under section 309 of the Clean Air Act (42 U.S.C. 7609), the Administrator of the Environmental Protection Agency is directed to review and comment publicly on the environmental impacts of federal activities, including actions for which environmental impact statements are prepared. If after this review the Administrator determines that the matter is "unsatisfactory from the standpoint of public health or welfare or environmental quality," section 309 directs that the matter be referred to the Council (hereafter "environmental referrals").

(c) Under section 102(2)(C) of the Act other federal agencies may make similar reviews of environmental impact statements, including judgments on the acceptability of anticipated environmental impacts. These reviews must be made available to the President, the Council and the public.

[43 FR 55998, Nov. 29, 1978]

§1504.2 Criteria for referral.

Environmental referrals should be made to the Council only after concerted, timely (as early as possible in the process), but unsuccessful attempts to resolve differences with the lead agency. In determining what environmental objections to the matter are appropriate to refer to the Council, an agency should weigh potential adverse environmental impacts, considering:

(a) Possible violation of national environmental standards or policies.

(b) Severity.

(c) Geographical scope.

(d) Duration.

(e) Importance as precedents.

(f) Availability of environmentally preferable alternatives.

[43 FR 55998, Nov. 29, 1978]

§1504.3 Procedure for referrals and response.

(a) A federal agency making the referral to the Council shall:

(1) Advise the lead agency at the earliest possible time that it intends to refer a matter to the Council unless a satisfactory agreement is reached.

(2) Include such advice in the referring agency's comments on the draft environmental impact statement, except when the statement does not contain adequate information to permit an assessment of the matter's environmental acceptability.

(3) Identify any essential information that is lacking and request that it be made available at the earliest possible time.

(4) Send copies of such advice to the Council.

(b) The referring agency shall deliver its referral to the Council not later than twenty-five (25) days after the final environmental impact statement has been made available to the Environmental Protection Agency, commenting agencies, and the public. Except when an extension of this period has been granted by the lead agency, the Council will not accept a referral after that date.

(c) The referral shall consist of:

(1) A copy of the letter signed by the head of the referring agency and delivered to the lead agency informing the lead agency of the referral and the reasons for it, and requesting that no action be taken to implement the matter until the Council acts upon the referral. The letter shall include a copy of the statement referred to in (c)(2) of this section.

(2) A statement supported by factual evidence leading to the conclusion that the matter is unsatisfactory from the standpoint of public health or welfare or environmental quality. The statement shall:

(i) Identify any material facts in controversy and incorporate (by reference if appropriate) agreed upon facts,

(ii) Identify any existing environmental requirements or policies which would be violated by the matter,

(iii) Present the reasons why the referring agency believes the matter is environmentally unsatisfactory,

(iv) Contain a finding by the agency whether the issue raised is of national importance because of the threat to national environmental resources or policies or for some other reason,

(v) Review the steps taken by the referring agency to bring its concerns to the attention of the lead agency at the earliest possible time, and

(vi) Give the referring agency's recommendations as to what mitigation alternative, further study, or other course of action (including abandonment of the matter) are necessary to remedy the situation.

(d) Not later than twenty-five (25) days after the referral to the Council the lead agency may deliver a response to the Council, and the referring agency. If the lead agency requests more time and gives assurance that the matter will not go forward in the interim, the Council may grant an extension. The response shall:

(1) Address fully the issues raised in the referral.

(2) Be supported by evidence.

(3) Give the lead agency's response to the referring agency's recommendations.

(e) Interested persons (including the applicant) may deliver their views in writing to the Council. Views in support of the referral should be delivered not later than the referral. Views in support of the response shall be delivered not later than the response.

(f) Not later than twenty-five (25) days after receipt of both the referral and any response or upon being informed that there will be no response (unless the lead agency agrees to a longer time), the Council may take one or more of the following actions:

(1) Conclude that the process of referral and response has successfully resolved the problem.

(2) Initiate discussions with the agencies with the objective of mediation with referring and lead agencies.

(3) Hold public meetings or hearings to obtain additional views and information.

(4) Determine that the issue is not one of national importance and request the referring and lead agencies to pursue their decision process.

(5) Determine that the issue should be further negotiated by the referring and lead agencies and is not appropriate for Council consideration until one or more heads of agencies report to the Council that the agencies' disagreements are irreconcilable.

(6) Publish its findings and recommendations (including where appropriate a finding that the submitted evidence does not support the position of an agency).

(7) When appropriate, submit the referral and the response together with the Council's recommendation to the President for action.

(g) The Council shall take no longer than 60 days to complete the actions specified in paragraph (f)(2), (3), or (5) of this section.

(h) When the referral involves an action required by statute to be determined on the record after opportunity for agency hearing, the referral shall be conducted in a manner consistent with 5 U.S.C. 557(d) (Administrative Procedure Act).

[43 FR 55998, Nov. 29, 1978; 44 FR 873, Jan. 3, 1979]

PART 1505—NEPA AND AGENCY DECISIONMAKING

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 55999, Nov. 29, 1978, unless otherwise noted.

§1505.1 Agency decisionmaking procedures.

Agencies shall adopt procedures (§1507.3) to ensure that decisions are made in accordance with the policies and purposes of the Act. Such procedures shall include but not be limited to:

(a) Implementing procedures under section 102(2) to achieve the requirements of sections 101 and 102(1).

(b) Designating the major decision points for the agency's principal programs likely to have a significant effect on the human environment and assuring that the NEPA process corresponds with them.

(c) Requiring that relevant environmental documents, comments, and responses be part of the record in formal rulemaking or adjudicatory proceedings.

(d) Requiring that relevant environmental documents, comments, and responses accompany the proposal through existing agency review processes so that agency officials use the statement in making decisions.

(e) Requiring that the alternatives considered by the decisionmaker are encompassed by the range of alternatives discussed in the relevant environmental documents and that the decisionmaker consider the alternatives described in the environmental impact statement. If another decision document accompanies the relevant environmental documents to the decisionmaker, agencies are encouraged to make available to the public before the decision is made any part of that document that relates to the comparison of alternatives.

§1505.2 Record of decision in cases requiring environmental impact statements.

At the time of its decision (§1506.10) or, if appropriate, its recommendation to Congress, each agency shall prepare a concise public record of decision. The record, which may be integrated into any other record prepared by the agency, including that required by OMB Circular A–95 (Revised), part I, sections 6(c) and (d), and part II, section 5(b)(4), shall:

(a) State what the decision was.

(b) Identify all alternatives considered by the agency in reaching its decision, specifying the alternative or alternatives which were considered to be environmentally preferable. An agency may discuss preferences among alternatives based on relevant factors including economic and technical considerations and agency statutory missions. An agency shall identify and discuss all such factors including any essential considerations of national policy which were balanced by the agency in making its decision and state how those considerations entered into its decision.

(c) State whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation.

§1505.3 Implementing the decision.

Agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases. Mitigation (§1505.2(c)) and other conditions established in the environmental impact statement or during its review and committed as part of the decision shall be implemented by the lead agency or other appropriate consenting agency. The lead agency shall:

(a) Include appropriate conditions in grants, permits or other approvals.

(b) Condition funding of actions on mitigation.

(c) Upon request, inform cooperating or commenting agencies on progress in carrying out mitigation measures which they have proposed and which were adopted by the agency making the decision.

(d) Upon request, make available to the public the results of relevant monitoring.

PART 1506—OTHER REQUIREMENTS OF NEPA

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 56000, Nov. 29, 1978, unless otherwise noted.

§1506.1 Limitations on actions during NEPA process.

(a) Until an agency issues a record of decision as provided in §1505.2 (except as provided in paragraph (c) of this section), no action concerning the proposal shall be taken which would:

(1) Have an adverse environmental impact; or

(2) Limit the choice of reasonable alternatives.

(b) If any agency is considering an application from a non-federal entity, and is aware that the applicant is about to take an action within the agency's jurisdiction that would meet either of the criteria in paragraph (a) of this section, then the agency shall promptly notify the applicant that the agency will take appropriate action to insure that the objectives and procedures of NEPA are achieved.

(c) While work on a required program environmental impact statement is in progress and the action is not covered by an existing program statement, agencies shall not undertake in the interim any major federal action covered by the program which may significantly affect the quality of the human environment unless such action:

(1) Is justified independently of the program;

(2) Is itself accompanied by an adequate environmental impact statement; and

(3) Will not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives.

(d) This section does not preclude development by applicants of plans or designs or performance of other work necessary to support an application for federal, state or local permits or assistance. Nothing in this section shall preclude Rural Electrification Administration approval of minimal expenditures not affecting the environment (e.g. long leadtime equipment and purchase options) made by non-governmental entities seeking loan guarantees from the Administration.

§1506.2 Elimination of duplication with State and local procedures.

(a) Agencies authorized by law to cooperate with state agencies of statewide jurisdiction pursuant to section 102(2)(D) of the Act may do so.

(b) Agencies shall cooperate with state and local agencies to the fullest extent possible to reduce duplication between NEPA and state and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include:

(1) Joint planning processes.

(2) Joint environmental research and studies.

(3) Joint public hearings (except where otherwise provided by statute).

(4) Joint environmental assessments.

(c) Agencies shall cooperate with state and local agencies to the fullest extent possible to reduce duplication between NEPA and comparable State and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include joint environmental impact statements. In such cases one or more federal agencies and one or more state or local agencies shall be joint lead agencies. Where state laws or local ordinances have environmental impact statement requirements in addition to but not in conflict with those in NEPA, federal agencies shall cooperate in fulfilling these requirements as well as those of federal laws so that one document will comply with all applicable laws.

(d) To better integrate environmental impact statements into state or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved state or local plan and laws (whether or not federally sanctioned). Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law.

§1506.3 Adoption.

(a) An agency may adopt a federal draft or final environmental impact statement or portion thereof provided that the statement or portion thereof meets the standards for an adequate statement under these regulations.

(b) If the actions covered by the original environmental impact statement and the proposed action are substantially the same, the agency adopting another agency's statement is not required to recirculate it except as a final statement. Otherwise the adopting agency shall treat the statement as a draft and recirculate it (except as provided in paragraph (c) of this section).

(c) A cooperating agency may adopt without recirculating the environmental impact statement of a lead agency when, after an independent review of the statement, the cooperating agency concludes that its comments and suggestions have been satisfied.

(d) When an agency adopts a statement which is not final within the agency that prepared it, or when the action it assesses is the subject of a referral under part 1504, or when the statement's adequacy is the subject of a judicial action which is not final, the agency shall so specify.

§1506.4 Combining documents.

Any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork.

§1506.5 Agency responsibility.

(a) Information. If an agency requires an applicant to submit environmental information for possible use by the agency in preparing an environmental impact statement, then the agency should assist the applicant by outlining the types of information required. The agency shall independently evaluate the information submitted and shall be responsible for its accuracy. If the agency chooses to use the information submitted by the applicant in the environmental impact statement, either directly or by reference, then the names of the persons responsible for the independent evaluation shall be included in the list of preparers (§1502.17). It is the intent of this paragraph that acceptable work not be redone, but that it be verified by the agency.

(b) Environmental assessments. If an agency permits an applicant to prepare an environmental assessment, the agency, besides fulfilling the requirements of paragraph (a) of this section, shall make its own evaluation of the environmental issues and take responsibility for the scope and content of the environmental assessment.

(c) Environmental impact statements. Except as provided in §§1506.2 and 1506.3 any environmental impact statement prepared pursuant to the requirements of NEPA shall be prepared directly by or by a contractor selected by the lead agency or where appropriate under §1501.6(b), a cooperating agency. It is the intent of these regulations that the contractor be chosen solely by the lead agency, or by the lead agency in cooperation with cooperating agencies, or where appropriate by a cooperating agency to avoid any conflict of interest. Contractors shall execute a disclosure statement prepared by the lead agency, or where appropriate the cooperating agency, specifying that they have no financial or other interest in the outcome of the project. If the document is prepared by contract, the responsible federal official shall furnish guidance and participate in the preparation and shall independently evaluate the statement prior to its approval and take responsibility for its scope and contents. Nothing in this section is intended to prohibit any agency from requesting any person to submit information to it or to prohibit any person from submitting information to any agency.

§1506.6 Public involvement.

Agencies shall:

(a) Make diligent efforts to involve the public in preparing and implementing their NEPA procedures.

(b) Provide public notice of NEPA-related hearings, public meetings, and the availability of environmental documents so as to inform those persons and agencies who may be interested or affected.

(1) In all cases the agency shall mail notice to those who have requested it on an individual action.

(2) In the case of an action with effects of national concern notice shall include publication in the FEDERAL REGISTER and notice by mail to

national organizations reasonably expected to be interested in the matter and may include listing in the 102 Monitor. An agency engaged in rule-making may provide notice by mail to national organizations who have requested that notice regularly be provided. Agencies shall maintain a list of such organizations.

(3) In the case of an action with effects primarily of local concern the notice may include:

(i) Notice to state and areawide clearinghouses pursuant to OMB Circular A–95 (Revised).

(ii) Notice to Indian tribes when effects may occur on reservations.

(iii) Following the affected state's public notice procedures for comparable actions.

(iv) Publication in local newspapers (in papers of general circulation rather than legal papers).

(v) Notice through other local media.

(vi) Notice to potentially interested community organizations including small business associations.

(vii) Publication in newsletters that may be expected to reach potentially interested persons.

(viii) Direct mailing to owners and occupants of nearby or affected property.

(ix) Posting of notice on and off site in the area where the action is to be located.

(c) Hold or sponsor public hearings or public meetings whenever appropriate or in accordance with statutory requirements applicable to the agency. Criteria shall include whether there is:

(1) Substantial environmental controversy concerning the proposed action or substantial interest in holding the hearing.

(2) A request for a hearing by another agency with jurisdiction over the action supported by reasons why a hearing will be helpful. If a draft environmental impact statement is to be considered at a public hearing, the agency should make the statement available to the public at least 15 days in advance (unless the purpose of the hearing is to provide information for the draft environmental impact statement).

(d) Solicit appropriate information from the public.

(e) Explain in its procedures where interested persons can get information or status reports on environmental impact statements and other elements of the NEPA process.

(f) Make environmental impact statements, the comments received, and any underlying documents available to the public pursuant to the provisions of the Freedom of Information Act (5 U.S.C. 552), without regard to the exclusion for interagency memoranda where such memoranda transmit comments of Federal agencies on the environmental impact of the proposed action. Materials to be made available to the public shall be provided to the public without charge to the extent practicable, or at a fee which is not more than the actual costs of reproducing copies required to be sent to other federal agencies, including the Council.

§1506.7 Further guidance.

The Council may provide further guidance concerning NEPA and its procedures including:

(a) A handbook which the Council may supplement from time to time, which shall in plain language provide guidance and instructions concerning the application of NEPA and these regulations.

(b) Publication of the Council's Memoranda to Heads of Agencies.

(c) In conjunction with the Environmental Protection Agency and the publication of the 102 Monitor, notice of:

(1) Research activities;

(2) Meetings and conferences related to NEPA; and

(3) Successful and innovative procedures used by agencies to implement NEPA.

§1506.8 Proposals for legislation.

(a) The NEPA process for proposals for legislation (§1508.17) significantly affecting the quality of the human environment shall be integrated with the legislative process of the Congress. A legislative environmental impact statement is the detailed statement required by law to be included in a recommendation or report on a legislative proposal to Congress. A legislative environmental impact statement shall be considered part of the formal transmittal of a legislative proposal to Congress; however, it may be transmitted to Congress up to 30 days later in order to allow time for completion of an accurate statement which can serve as the basis for public and Congressional debate. The statement must be available in time for Congressional hearings and deliberations.

(b) Preparation of a legislative environmental impact statement shall conform to the requirements of these regulations except as follows:

(1) There need not be a scoping process.

(2) The legislative statement shall be prepared in the same manner as a draft statement, but shall be considered the "detailed statement" required by statute; *Provided*, That when any of the following conditions exist both the draft and final environmental impact statement on the legislative proposal shall be prepared and circulated as provided by §§1503.1 and 1506.10.

(i) A Congressional committee with jurisdiction over the proposal has a rule requiring both draft and final environmental impact statements.

(ii) The proposal results from a study process required by statute (such as those required by the Wild and Scenic Rivers Act (16 U.S.C. 1271 *et seq.*) and the Wilderness Act (16 U.S.C. 1131 *et seq.*)).

(iii) Legislative approval is sought for federal or federally assisted construction or other projects which the agency recommends be located at specific geographic locations. For proposals requiring an environmental impact statement for the acquisition of space by the General Services Administration, a draft statement shall accompany the Prospectus or the 11(b) Report of Building Project Surveys to the Congress, and a final statement shall be completed before site acquisition.

(iv) The agency decides to prepare draft and final statements.

(c) Comments on the legislative statement shall be given to the lead agency which shall forward them along with its own responses to the Congressional committees with jurisdiction.

§1506.9 Filing requirements.

Environmental impact statements together with comments and responses shall be filed with the Environmental Protection Agency, attention Office of Federal Activities (MC2252-A), 1200 Pennsylvania Ave., NW., Washington, DC 20460. Statements shall be filed with EPA no earlier than they are also transmitted to commenting agencies and made available to the public. EPA shall deliver one copy of each statement to the Council, which shall satisfy the requirement of availability to the President. EPA may issue guidelines to agencies to implement its responsibilities under this section and §1506.10.

§1506.10 Timing of agency action.

(a) The Environmental Protection Agency shall publish a notice in the FEDERAL REGISTER each week of the environmental impact statements filed during the preceding week. The minimum time periods set forth in this section shall be calculated from the date of publication of this notice.

(b) No decision on the proposed action shall be made or recorded under §1505.2 by a federal agency until the later of the following dates:

(1) Ninety (90) days after publication of the notice described above in paragraph (a) of this section for a draft environmental impact statement.

(2) Thirty (30) days after publication of the notice described above in paragraph (a) of this section for a final environmental impact statement.

An exception to the rules on timing may be made in the case of an agency decision which is subject to a formal internal appeal. Some agencies have a formally established appeal process which allows other agencies or the public to take appeals on a decision and make their views known, after publication of the final environmental impact statement. In such cases, where a real opportunity exists to alter the decision, the decision may be made and recorded at the same time the environmental impact statement is published. This means that the period for appeal of the decision and the 30-day period prescribed in paragraph (b)(2) of this section may run concurrently. In such cases the environmental impact statement shall explain the timing and the public's right of appeal. An agency engaged in rulemaking under the Administrative Procedure Act or other statute for the purpose of protecting the public health or safety, may waive the time period in paragraph (b)(2) of this section and publish a decision on the final rule simultaneously with publication of the notice of the availability of the final environmental impact statement as described in paragraph (a) of this section.

(c) If the final environmental impact statement is filed within ninety (90) days after a draft environmental impact statement is filed with the Environmental Protection Agency, the minimum thirty (30) day period and the minimum ninety (90) day period may run concurrently. However, subject to paragraph (d) of this section agencies shall allow not less than 45 days for comments on draft statements.

(d) The lead agency may extend prescribed periods. The Environmental Protection Agency may upon a showing by the lead agency of compelling reasons of national policy reduce the prescribed periods and may upon a showing by any other Federal agency of compelling reasons of national policy also extend prescribed periods, but only after consultation with the lead agency. (Also see §1507.3(d).) Failure to file timely comments shall not be a sufficient reason for extending a period. If the lead agency does not concur with the extension of time, EPA may not extend it for more than 30 days. When the Environmental Protection Agency reduces or extends any period of time it shall notify the Council.

[43 FR 56000, Nov. 29, 1978; 44 FR 874, Jan. 3, 1979]

§1506.11 Emergencies.

Where emergency circumstances make it necessary to take an action with significant environmental impact without observing the provisions of these regulations, the federal agency taking the action should consult with the Council about alternative arrangements. Agencies and the Council will limit such arrangements to actions necessary to control the immediate impacts of the emergency. Other actions remain subject to NEPA review.

§1506.12 Effective date.

The effective date of these regulations is July 30, 1979, except that for agencies that administer programs that qualify under section 102(2)(D) of the Act or under section 104(h) of the Housing and Community Development Act of 1974 an additional four months shall be allowed for the State or local agencies to adopt their implementing procedures.

(a) These regulations shall apply to the fullest extent practicable to ongoing activities and environmental documents begun before the effective date. These regulations do not apply to an environmental impact statement or supplement if the draft statement was filed before the effective date of these regulations. No completed environmental documents need be redone by reasons of these regulations. Until these regulations are applicable, the Council's guidelines published in the FEDERAL REGISTER of August 1, 1973, shall continue to be applicable. In cases where these regulations are applicable the guidelines are superseded. However, nothing shall prevent an agency from proceeding under these regulations at an earlier time.

(b) NEPA shall continue to be applicable to actions begun before January 1, 1970, to the fullest extent possible.

PART 1507—AGENCY COMPLIANCE

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 56002, Nov. 29, 1978, unless otherwise noted.

§1507.1 Compliance.

All agencies of the federal government shall comply with these regulations. It is the intent of these regulations to allow each agency flexibility in adapting its implementing procedures authorized by §1507.3 to the requirements of other applicable laws.

§1507.2 Agency capability to comply.

Each agency shall be capable (in terms of personnel and other resources) of complying with the requirements enumerated below. Such compliance may include use of other's resources, but the using agency shall itself have sufficient capability to evaluate what others do for it. Agencies shall:

(a) Fulfill the requirements of section 102(2)(A) of the Act to utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on the human environment. Agencies shall designate a person to be responsible for overall review of agency NEPA compliance.

(b) Identify methods and procedures required by section 102(2)(B) to insure that presently unquantified environmental amenities and values may be given appropriate consideration.

(c) Prepare adequate environmental impact statements pursuant to section 102(2)(C) and comment on statements in the areas where the agency has jurisdiction by law or special expertise or is authorized to develop and enforce environmental standards.

(d) Study, develop, and describe alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. This requirement of section 102(2)(E) extends to all such proposals, not just the more limited scope of section 102(2)(C)(iii) where the discussion of alternatives is confined to impact statements.

(e) Comply with the requirements of section 102(2)(H) that the agency initiate and utilize ecological information in the planning and development of resource-oriented projects.

(f) Fulfill the requirements of sections 102(2)(F), 102(2)(G), and 102(2)(I), of the Act and of Executive Order 11514, Protection and Enhancement of Environmental Quality, Sec. 2.

§1507.3 Agency procedures.

(a) Not later than eight months after publication of these regulations as finally adopted in the Federal Register, or five months after the establishment of an agency, whichever shall come later, each agency shall as necessary adopt procedures to supplement these regulations. When the agency is a department, major subunits are encouraged (with the consent of the department) to adopt their own procedures. Such procedures shall not paraphrase these regulations. They shall confine themselves to implementing procedures. Each agency shall consult with the Council while developing its procedures and before publishing them in the Federal Register for comment. Agencies with similar programs should consult with each other and the Council to coordinate their procedures, especially for programs requesting similar information from applicants. The procedures shall be adopted only after an opportunity for public review and after review by the Council for conformity with the Act and these regulations. The Council shall complete its review within 30 days. Once in effect they shall be filed with the Council and made readily available to the public. Agencies are encouraged to publish explanatory guidance for these regulations and their own procedures. Agencies shall continue to review their policies and procedures and in consultation with the Council to revise them as necessary to ensure full compliance with the purposes and provisions of the Act.

(b) Agency procedures shall comply with these regulations except where compliance would be inconsistent with statutory requirements and shall include:

(1) Those procedures required by §§1501.2(d), 1502.9(c)(3), 1505.1, 1506.6(e), and 1508.4.

(2) Specific criteria for and identification of those typical classes of action:

(i) Which normally do require environmental impact statements.

(ii) Which normally do not require either an environmental impact statement or an environmental assessment (categorical exclusions (§1508.4)).

(iii) Which normally require environmental assessments but not necessarily environmental impact statements.

(c) Agency procedures may include specific criteria for providing limited exceptions to the provisions of these regulations for classified proposals. They are proposed actions which are specifically authorized under criteria established by an Executive Order or statute to be kept secret in the interest of national defense or foreign policy and are in fact properly classified pursuant to such Executive Order or statute. Environmental assessments and environmental impact statements which address classified proposals may be safeguarded and restricted from public dissemination in accordance with agencies' own regulations applicable to classified information. These documents may be organized so that classified portions can be included as annexes, in order that the unclassified portions can be made available to the public.

(d) Agency procedures may provide for periods of time other than those presented in §1506.10 when necessary to comply with other specific statutory requirements.

(e) Agency procedures may provide that where there is a lengthy period between the agency's decision to prepare an environmental impact statement and the time of actual preparation, the notice of intent required by §1501.7 may be published at a reasonable time in advance of preparation of the draft statement.

PART 1508—TERMINOLOGY AND INDEX

Sec.

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 *et seq.*), sec. 309 of the Clean Air Act, as amended (42 U.S.C. 7609), and E.O. 11514 (Mar. 5, 1970, as amended by E.O. 11991, May 24, 1977).

SOURCE: 43 FR 56003, Nov. 29, 1978, unless otherwise noted.

§1508.1 Terminology.

The terminology of this part shall be uniform throughout the federal government.

§1508.2 Act.

"Act" means the National Environmental Policy Act, as amended (42 U.S.C. 4321, *et seq.*) which is also referred to as "NEPA."

§1508.3 Affecting.

"Affecting" means will or may have an effect on.

§1508.4 Categorical exclusion.

"Categorical exclusion" means a category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a federal agency in implementation of these regulations (§1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact statement is required. An agency may decide in its procedures or otherwise, to prepare environmental assessments for the reasons stated in §1508.9 even though it is not required to do so. Any procedures under this section shall provide for extraordinary circumstances in which a normally excluded action may have a significant environmental effect.

§1508.5 Cooperating agency.

"Cooperating agency" means any federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in §1501.6. A state or local agency of similar qualifications or, when the effects are on a reservation, an Indian tribe, may by agreement with the lead agency become a cooperating agency.

§1508.6 Council.

"Council" means the Council on Environmental Quality established by title II of the Act.

§1508.7 Cumulative impact.

"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

§1508.8 Effects.

"Effects" include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

§1508.9 Environmental assessment.

"Environmental assessment":

(a) Means a concise public document for which a federal agency is responsible that serves to:

(1) Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact.

(2) Aid an agency's compliance with the Act when no environmental impact statement is necessary.

(3) Facilitate preparation of a statement when one is necessary.

(b) Shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted.

§1508.10 Environmental document.

"Environmental document" includes the documents specified in §1508.9 (environmental assessment), §1508.11 (environmental impact statement), §1508.13 (finding of no significant impact), and §1508.22 (notice of intent).

§1508.11 Environmental impact statement.

"Environmental impact statement" means a detailed written statement as required by section 102(2)(C) of the Act.

§1508.12 Federal agency.

"Federal agency" means all agencies of the federal government. It does not mean the Congress, the Judiciary, or the President, including the performance of staff functions for the President in his Executive Office. It also includes for purposes of these regulations states and units of general local government and Indian tribes assuming NEPA responsibilities under section 104(h) of the Housing and Community Development Act of 1974.

§1508.13 Finding of no significant impact.

"Finding of no significant impact" means a document by a federal agency briefly presenting the reasons why an action, not otherwise excluded (§1508.4), will not have a significant effect on the human environment and for which an environmental impact statement there fore will not be prepared. It shall include the environmental assessment or a summary of it and shall note any other environmental documents related to it (§1501.7(a)(5)). If the assessment is included, the finding need not repeat any of the discussion in the assessment but may incorporate it by reference.

§1508.14 Human environment.

"Human environment" shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment. (See the definition of "effects" (§1508.8).) This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.

§1508.15 Jurisdiction by law.

"Jurisdiction by law" means agency authority to approve, veto, or finance all or part of the proposal.

§1508.16 Lead agency.

"Lead agency" means the agency or agencies preparing or having taken primary responsibility for preparing the environmental impact statement.

§1508.17 Legislation.

"Legislation" includes a bill or legislative proposal to Congress developed by or with the significant cooperation and support of a federal agency, but does not include requests for appropriations. The test for significant cooperation is whether the proposal is in fact predominantly that of the agency rather than another source. Drafting does not by itself constitute significant cooperation. Proposals for legislation include requests for ratification of treaties. Only the agency which has primary responsibility for the subject matter involved will prepare a legislative environmental impact statement.

§1508.18 Major federal action.

"Major federal action" includes actions with effects that may be major and which are potentially subject to federal control and responsibility. Major reinforces but does not have a meaning independent of significantly (§1508.27). Actions include the circumstance where the responsible officials fail to act and that failure to act is reviewable by courts or administrative tribunals under the Administrative Procedure Act or other applicable law as agency action.

(a) Actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised agency rules, regulations, plans, policies, or procedures; and legislative proposals (§§1506.8, 1508.17). Actions do not include funding assistance solely in the form of general revenue sharing funds, distributed under the State and Local Fiscal Assistance Act of 1972, 31 U.S.C. 1221 *et seq.*, with no federal agency control over the subsequent use of such funds. Actions do not include bringing judicial or administrative civil or criminal enforcement actions.

(b) Federal actions tend to fall within one of the following categories:

(1) Adoption of official policy, such as rules, regulations, and interpretations adopted pursuant to the Administrative Procedure Act, 5 U.S.C. 551 *et seq.*; treaties and international conventions or agreements; formal documents establishing an agency's policies which will result in or substantially alter agency programs.

(2) Adoption of formal plans, such as official documents prepared or approved by federal agencies which guide or prescribe alternative

uses of federal resources, upon which future agency actions will be based.

(3) Adoption of programs, such as a group of concerted actions to implement a specific policy or plan; systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive.

(4) Approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.

§1508.19 Matter.

"Matter" includes for purposes of Part 1504:

(a) With respect to the Environmental Protection Agency, any proposed legislation, project, action or regulation as those terms are used in section 309(a) of the Clean Air Act (42 U.S.C. 7609).

(b) With respect to all other agencies, any proposed major federal action to which section 102(2)(C) of NEPA applies.

§1508.20 Mitigation.

"Mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

§1508.21 NEPA process.

"NEPA process" means all measures necessary for compliance with the requirements of section 2 and title I of NEPA.

§1508.22 Notice of intent.

"Notice of intent" means a notice that an environmental impact statement will be prepared and considered. The notice shall briefly:

(a) Describe the proposed action and possible alternatives.

(b) Describe the agency's proposed scoping process including whether, when, and where any scoping meeting will be held.

(c) State the name and address of a person within the agency who can answer questions about the proposed action and the environmental impact statement.

§1508.23 Proposal.

"Proposal" exists at that stage in the development of an action when an agency subject to the Act has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated. Preparation of an environmental impact statement on a proposal should be timed (§1502.5) so that the final statement may be completed in time for the statement to be included in any recommendation or report on the proposal. A proposal may exist in fact as well as by agency declaration that one exists.

§1508.24 Referring agency.

"Referring agency" means the federal agency which has referred any matter to the Council after a determination that the matter is unsatisfactory from the standpoint of public health or welfare or environmental quality.

§1508.25 Scope.

"Scope" consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement. The scope of an individual statement may depend on its relationships to other statements (§§1502.20 and 1508.28). To determine the scope of environmental impact statements, agencies shall consider 3 types of actions, 3 types of alternatives, and 3 types of impacts. They include:

(a) Actions (other than unconnected single actions) which may be:

(1) Connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

(2) Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

(3) Similar actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequencies together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement.

(b) Alternatives, which include:

(1) No action alternative.

(2) Other reasonable courses of actions.

(3) Mitigation measures (not in the proposed action).

(c) Impacts, which may be: (1) direct; (2) indirect; (3) cumulative.

§1508.26 Special expertise.

"Special expertise" means statutory responsibility, agency mission, or related program experience.

§1508.27 Significantly.

"Significantly" as used in NEPA requires considerations of both context and intensity:

(a) *Context.* This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short and long-term effects are relevant.

(b) *Intensity.* This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.

(2) The degree to which the proposed action affects public health or safety.

(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

(8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

(10) Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment. [43 FR 56003, Nov. 29, 1978; 44 FR 874, Jan. 3, 1979]

§1508.28 Tiering.

"Tiering" refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. Tiering is appropriate when the sequence of statements or analyses is:

(a) From a program, plan, or policy environmental impact statement to a program, plan, orpolicy statement or analysis of lesser scope or to a site-specific statement or analysis.

(b) From an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe.

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

June 24, 2005

MEMORANDUM

FROM: JAMES L. CONNAUGHTON
CHAIRMAN

TO: HEADS OF FEDERAL AGENCIES

RE: GUIDANCE ON THE CONSIDERATION OF PAST ACTIONS IN CUMULATIVE EFFECTS ANALYSIS

I. Introduction

In this Memorandum, the Council on Environmental Quality (CEQ) provides guidance on the extent to which agencies of the Federal government are required to analyze the environmental effects of past actions when they describe the cumulative environmental effect of a proposed action in accordance with Section 102 of the National Environmental Policy Act (NEPA), 42 U.S.C. § 4332, and the CEQ Regulations for Implementing the Procedural Provisions of NEPA, 40 C.F.R. parts 1500-1508. CEQ's interpretation of NEPA is entitled to deference. *Andrus v. Sierra Club*, 442 U.S. 347, 358 (1979).

II. Guidance

The environmental analysis required under NEPA is forward-looking, in that it focuses on the potential impacts of the proposed action that an agency is considering. Thus, review of past actions is required to the extent that this review informs agency decisionmaking regarding the proposed action. This can occur in two ways:

First, the effects of past actions may warrant consideration in the analysis of the cumulative effects of a proposal for agency action. CEQ interprets NEPA and CEQ's NEPA regulations on cumulative effects as requiring analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for action and its alternatives may have a continuing, additive and significant relationship to those effects. In determining what information is necessary for a cumulative effects analysis, agencies should use scoping to focus on the extent to which information is "relevant to reasonably foreseeable significant adverse impacts," is "essential to a reasoned choice among alternatives," and can be obtained without exorbitant cost. 40 CFR 1502.22. Based on scoping, agencies have discretion to determine whether, and to what extent, information about the specific nature, design, or present effects of a past action is useful for the agency's analysis of the effects of a proposal for agency action and its reasonable alternatives.

Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions combined. Agencies retain substantial discretion as to the extent of such inquiry and the appropriate level of explanation. *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 376-77 (1989). Generally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.

Second, experience with and information about past direct and indirect effects of individual past actions may also be useful in illuminating or predicting the direct and indirect effects of a proposed action. However, these effects of past actions may have no cumulative relationship to the effects of the proposed action. Therefore, agencies should clearly distinguish analysis of direct and indirect effects based on information about past actions from a cumulative effects analysis of past actions.

III. Discussion

The CEQ regulations for the implementation of NEPA define cumulative effects consistent with the Supreme Court's reading of NEPA in *Kleppe v. Sierra Club*, 427 U.S. 390, 413-414 (1976). "Cumulative impact" is defined in CEQ's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions . . ." 40 CFR 1508.7. CEQ interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action and its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future actions.

Agencies should be guided in their cumulative effects analysis by the scoping process, in which agencies identify the scope and "significant" issues to be addressed in an environmental impact statement. 40 CFR 1500.1(b), 1500.4(g), 1501.7, 1508.25. In the context of scoping, agencies typically decide the extent to which "it is reasonable to anticipate a cumulatively significant impact on the environment." 40 CFR 1508.27(b)(7). Agencies should ensure that their NEPA process produces environmental information that is useful to decisionmakers and the public by reducing the "accumulation of extraneous background data" and by "emphasiz[ing] real environmental issues and alternatives." 40 CFR 1500.2(b). Accordingly, the NEPA process requires agencies to identify "the significant environmental issues deserving study and deemphasizing insignificant issues, narrowing the scope of the environmental impact statement" at an early stage of agency planning. 40 CFR 15001.1(d). The Supreme Court has also emphasized that agencies may properly limit the scope of their cumulative effects analysis based on practical considerations. *Kleppe*, 427 U.S at 414. The CEQ regulations provide for explicit documentation of such practical considerations when there is incomplete or unavailable information that is relevant to reasonably foreseeable significant adverse impacts. 40 CFR 1502.22. The extent and form of the information needed to analyze appropriately the cumulative effects of a proposed action and alternatives under NEPA varies widely and must be determined by the federal agency proposing the action on a case-by-case basis.

The analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from the alternative proposals for agency action. Agencies then look for present effects of past actions that are, in the judgment of the agency, relevant and useful because they have a significant cause-and-effect relationship with the direct and indirect effects of the proposal for agency action and its alternatives. CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonably foreseeable future actions) on the affected environment.

With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decisionmaking.

IV. Tools for NEPA Practitioners

a. Scoping:

It is not practical to analyze how the cumulative effects of an action interact with the universe; the analysis of environmental effects must focus on the aggregate effects of past, present and reasonably foreseeable future actions that are truly meaningful. Thus, analysts must narrow the focus of the cumulative effects analysis to effects of significance to the proposal for agency action and its alternatives, based on thorough scoping. A specific objective of scoping is to save time in the overall process by helping to ensure that draft statements adequately address the effects of the proposed action and alternatives that should be addressed. See Scoping Guidance (CEQ 1981) (http://ceq.eh.doe.gov/nepa/regs/guidance.html). Scoping provides the agency the opportunity to focus in on those cumulative effects that may be significant. The scope of the cumulative impact analysis is related to the magnitude of the environmental impacts of the proposed action. Proposed actions of limited scope typically do not require as comprehensive an assessment of cumulative impacts as proposed actions that have significant environmental impacts over a large area. Proposed actions that are typically finalized with a finding of no significant impact usually involve only a limited cumulative impact assessment to confirm that the effects of the proposed action do not reach a point of significant environmental impacts. Except in extraordinary circumstances, proposed actions that are categorically excluded from NEPA analysis do not involve cumulative impact analyses.

b. Incomplete and Unavailable Information:

The purpose of 40 CFR 1502.22 is to disclose the fact of incomplete or unavailable information, to acquire information if it is "relevant to reasonably foreseeable significant adverse impacts" and "essential to a reasoned choice among alternatives," and to advance decision-making even in the absence of all information regarding reasonably foreseeable effects. The focus of this provision is, first and foremost, on "significant adverse impacts." The agency must find that the incomplete information is relevant to a "reasonably foreseeable" and "significant" impact before the agency is required to comply with 40 CFR 1502.22. If the incomplete cumulative effects information meets that threshold, the agency must consider the "overall costs" of obtaining the information. 40 CFR 1502.22(a). The term "overall costs" encompasses financial costs and other costs such as costs in terms of time (delay), program and personnel commitments. The requirement to determine if the "overall costs" of obtaining information is exorbitant should not be interpreted as a requirement to weigh the cost of obtaining the information against the severity of the effects, or to perform a cost-benefit analysis. Rather, the agency must assess overall costs in light of agency environmental program needs.

c. Programmatic Evaluations

In geographic settings where several Federal actions are likely to have effects on the same environmental resources it may be advisable for the lead Federal agencies to cooperate to provide historical or other baseline information relating to the resources. This can be done either through a programmatic NEPA analysis or can be done separately, such as through a joint inventory or planning study. The results can then be incorporated by reference into NEPA documents prepared for specific Federal actions so long as the programmatic analysis or study is reasonably available to the interested public.

d. Environmental Management Systems:

Agencies are encouraged at their discretion to consider whether programmatic coordination of cumulative effects analysis can be assisted through implementation of environmental management systems (EMS). See Executive Order 13148, 65 Fed. Reg. 24,595 (April 21, 2000); Memorandum from the Chairman of CEQ and the Director of the Office of Management and Budget to heads of all Federal agencies (http://www.whitehouse.gov/ceq/memoranda01.html). Pursuant to Executive Order 13148, agencies that choose to use an EMS to improve their cumulative analysis may find that the EMS can be designed and implemented to more efficiently meet NEPA requirements, improve public participation in the NEPA process, and provide a framework for cumulative effects analysis and adaptive management. By managing information collection on an ongoing basis, an EMS can provide a more systematic approach to agencies' identification and management of environmental conditions and obligations. Agencies can use an EMS to confirm assumptions, track performance, and increase confidence in their assessment of cumulative environmental effects.

d. Direct and Indirect Effects:

In some cases, based on scoping, information about the effects of past actions that were similar to the proposed action may be useful in describing the possible effects of the proposed action. In these circumstances, agencies should consider using available information about the effects of individual past actions that help illuminate or predict the direct or indirect effects of the proposed action and its alternatives. Agencies should clearly distinguish their use of past experience in direct and indirect effects analysis from their cumulative effects analysis.

Considering Cumulative Effects

Under the National Environmental Policy Act

Council on Environmental Quality
Executive Office of the President

Considering Cumulative Effects Under the National Environmental Policy Act

Council on Environmental Quality

January 1997

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Considering Cumulative Effects Under the National Environmental Policy Act

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SCOPING FOR CUMULATIVE EFFECTS

PRINCIPLES

- Include past, present, and future actions.
- Include all federal, nonfederal, and private actions.
- Focus on each affected resource, ecosystem, and human community.
- Focus on truly meaningful effects.

Expanding environmental impact assessment to incorporate cumulative effects can only be accomplished by the enlightened use of the scoping process. The purpose of scoping for cumulative effects is to determine (1) whether the resources, ecosystems, and human communities of concern have already been affected by past or present activities and (2) whether other agencies or the public have plans that may affect the resources in the future. This is best accomplished as an iterative process, one that goes beyond formal scoping meetings and consultations to include creative interactions with all the stakeholders. Scoping should be used in both the planning and project development stage (i.e., whenever information on cumulative effects will contribute to a better decision).

Scoping information may come from agency consultations, public comments, the analyst's own knowledge and experience, planning activities, the proponent's statements of purpose and need, underlying studies in support of the project proposal, expert opinion, or other NEPA analyses. This information supports all the steps in cumulative effects analysis, including identifying data for establishing the environmental baseline (see Chapter 3) and identifying information related to impact significance (see Chapter 4). Most importantly, however, scoping for cumulative effects should include the following steps:

Step 1	Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.
Step 2	Establish the geographic scope for the analysis.
Step 3	Establish the time frame for the analysis.
Step 4	Identify other actions affecting the resources, ecosystems, and human communities of concern.

IDENTIFYING CUMULATIVE EFFECTS ISSUES

Identifying the major cumulative effects issues of a project involves defining the following:

- the direct and indirect effects of the proposed action,
- which resources, ecosystems, and human communities, are affected, and
- which effects on these resources are important from a cumulative effects perspective.

The proposed action may affect several resources either directly or indirectly. Resources can be elements of the physical environment, species, habitats, ecosystem parameters and functions, cultural resources, recreational opportunities, human community structure, traffic patterns, or other economic and social conditions. In a broad sense, all the impacts on affected resources are probably cumulative; however, the role of the analyst is to narrow the focus of the cumulative effects analysis to important issues of national, regional, or local significance. This narrowing can occur only after thorough scoping. The analyst should ask basic questions such as whether the proposed action will have effects similar to other actions in the area and whether the resources have been historically affected by cumulative actions (Table 2-1). Many significant cumulative effects issues are well known. Public interest groups, natural resource and land management agencies, and regulatory agencies regularly deal with cumulative effects. Newspapers and scientific journals frequently publish letters and comments dealing with these issues.

Not all potential cumulative effects issues identified during scoping need to be included in an EA or an EIS. Some may be irrelevant or inconsequential to decisions about the proposed action and alternatives. Cumulative effects analysis should "count what counts", not produce superficial analyses of a long laundry list of issues that have little relevance to the effects of the proposed action or the eventual decisions. Because cumulative effects can result from the activities of other agencies or persons, they may have already been analyzed by others and the importance of the issue determined. For instance, an agency proposing an action with minor effects on wetlands should not unilaterally decide that cumulative effects on wetlands is not an important issue. Cumulative effects analysis should consider the concerns of agencies managing and regulating wetlands, as well as the regional history of cumulative wetland losses and degradation, and the presence of other proposals that would produce future wetland losses or degradation.

BOUNDING CUMULATIVE EFFECTS ANALYSIS

Once the study goals of the cumulative effects analysis are established, the analyst must decide on the specific content of the study that will meet those requirements. Analyzing cumulative effects differs from the traditional approach to environmental impact assessment because it requires the analyst to expand the geographic boundaries and extend the time frame to encompass additional effects on the resources, ecosystems, and human communities of concern.

Identifying Geographic Boundaries

For a project-specific analysis, it is often sufficient to analyze effects within the immediate area of the proposed action. When analyzing the contribution of this proposed action to cumulative effects, however, the geographic boundaries of the analysis almost always should be expanded. These expanded boundaries can be thought of as differences in hierarchy or scale. Project-specific analyses are usually conducted on the scale of counties, forest management units, or installation boundaries, whereas cumulative effects analysis should be conducted on the scale of human communities, landscapes, watersheds, or airsheds. Choosing the appropriate scale to use is critical and will depend on the resource or system. Figure 2-1 illustrates the utility of using the ecologically relevant watershed boundary of the Anacostia River basin rather than the political boundaries of local governments to develop restoration plans.

A useful concept in determining appropriate geographic boundaries for a cumulative effects analysis is the **project impact zone**.

Table 2-1. Identifying potential cumulative effects issues related to a proposed action

1. What is the value of the affected resource or ecosystem? Is it:
   - protected by legislation or planning goals?
   - ecologically important?
   - culturally important?
   - economically important?
   - important to the well-being of a human community?

2. Is the proposed action one of several similar past, present, or future actions in the same geographic area? (Regions may be land management units, watersheds, regulatory regions, states, ecoregions, etc.) *Examples: timber sales in a national forest; hydropower development on a river; incinerators in a community.*

3. Do other activities (whether governmental or private) in the region have environmental effects similar to those of the proposed action? *Example: release of oxidizing pollutants to a river by a municipality, an industry, or individual septic systems.*

4. Will the proposed action (in combination with other planned activities) affect any natural resources; cultural resources; social or economic units; or ecosystems of regional, national, or global public concern? *Examples: release of chlorofluorocarbons to the atmosphere; conversion of wetland habitat to farmland located in a migratory waterfowl flyway.*

5. Have any recent or ongoing NEPA analyses of similar actions or nearby actions identified important adverse or beneficial cumulative effect issues? *Examples: National Forest Plan EIS; Federal Energy Regulatory Commission Basinwide EIS or EA.*

6. Has the impact been historically significant, such that the importance of the resource is defined by past loss, past gain, or investments to restore resources? *Example: mudflat and salt-marsh habitats in San Francisco Bay.*

7. Might the proposed action involve any of the following cumulative effects issues?
   - long range transport of air pollutants resulting in ecosystem acidification or eutrophication
   - air emissions resulting in degradation of regional air quality
   - release of greenhouse gases resulting in climate modification
   - loading large water bodies with discharges of sediment, thermal, and toxic pollutants
   - reduction or contamination of groundwater supplies
   - changes in hydrological regimes of major rivers and estuaries
   - long-term containment and disposal of hazardous wastes
   - mobilization of persistent or bioaccumulated substances through the food chain
   - decreases in the quantity and quality of soils
   - loss of natural habitats or historic character through residential, commercial, and industrial development
   - social, economic, or cultural effects on low-income or minority communities resulting from ongoing development
   - habitat fragmentation from infrastructure construction or changes in land use
   - habitat degradation from grazing, timber harvesting, and other consumptive uses
   - disruption of migrating fish and wildlife populations
   - loss of biological diversity

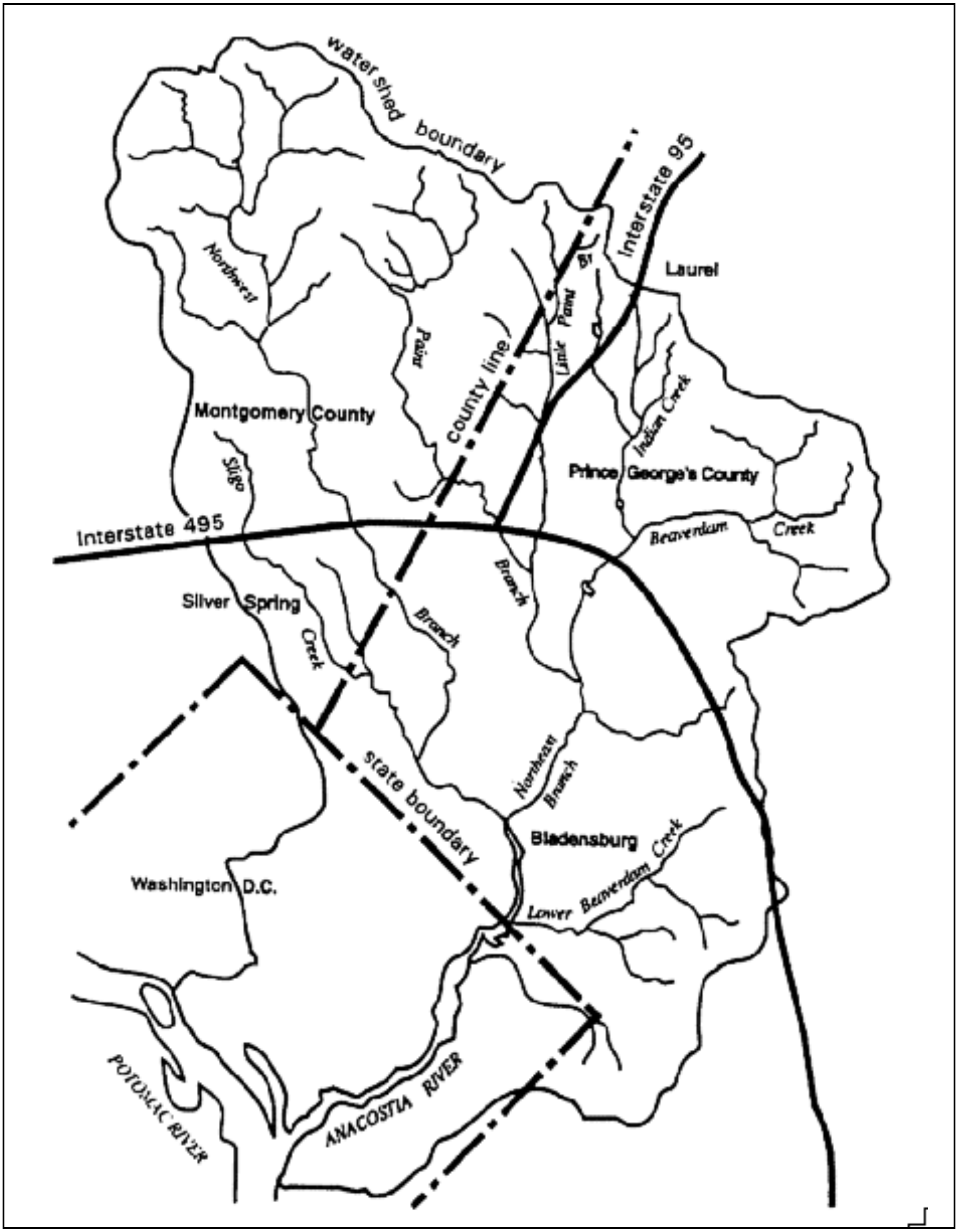

Figure 2-1. Juxtaposition of natural and political boundaries surrounding the Anacostia River

For a proposed action or reasonable alternative, the analysts should

- Determine the area that will be affected by that action. That area is the project impact zone.
- Make a list of the resources within that zone that could be affected by the proposed action.
- Determine the geographic areas occupied by those resources outside of the project impact zone. In most cases, the largest of these areas will be the appropriate area for the analysis of cumulative effects.
- Determine the affected institutional jurisdictions, both for the proposing agency and other agencies or groups.

Project impact zones for a proposed action are likely to vary for different resources and environmental media. For water, the project impact zone would be limited to the hydrologic system that would be affected by the proposed action. For air, the zone may be the physiographic basin in which the proposed action would be located. Land-based effects may occur within some set distance from the proposed action. In addition, the boundaries for an individual resource should be related to the resource's dependence on different environmental media. Table 2-2 provides some possible geographic boundaries for different resources. This list is *not* inclusive. The applicable geographic scope needs to be defined case by case.

Table 2-2. Geographic areas that could be used in a cumulative effects analysis

Resource	Possible Geographic Areas for Analysis
Air quality	Metropolitan area, airshed, or global atmosphere
Water quality	Stream, watershed, river basin, estuary, aquifer, or parts thereof
Vegetative resources	Watershed, forest, range, or ecosystem
Resident wildlife	Species habitat or ecosystem
Migratory wildlife	Breeding grounds, migration route, wintering areas, or total range of affected population units
Fishery resources	Stream, river basin, estuary, or parts thereof; spawning area and migration route
Historic resources	Neighborhood, rural community, city, state, tribal territory, known or possible historic district
Sociocultural resources	Neighborhood, community, distribution of low-income or minority population, or culturally valued landscape
Land use	Community, metropolitan area, county, state, or region
Coastal zone	Coastal region or watershed
Recreation	River, lake, geographic area, or land management unit
Socioeconomics	Community, metropolitan area, county, state, or country

One way to evaluate geographic boundaries is to consider the distance an effect can travel. For instance, air emissions can travel substantial distances and are an important part of regional air quality. Air quality regions are defined by the EPA, and these regions are an appropriate boundary for assessment of the cumulative effects of releases of pollutants to the atmosphere. For water resources, an appropriate regional boundary may be a river basin or parts thereof. Watershed boundaries are useful for cumulative effects analysis because (1) pollutants and material released in the watershed may travel downstream to be mingled with other pollutants and materials; (2) migratory fish may travel up and down the river system during their life cycle; and (3) resource agencies may have basin-wide management and planning goals. For land-based effects, an appropriate regional boundary may be a "forest or range," a watershed, an ecological region (ecoregion), or socioeconomic region (for evaluating effects on human communities). Which boundary is the most appropriate depends both on the accumulation characteristics of the effects being assessed and an evaluation of the management or regulatory interests of the agencies involved.

Identifying Time Frames

The time frame of the project-specific analysis should also be evaluated to determine its applicability to the cumulative effects analysis. This aspect of the cumulative effects analysis may at first seem the most troublesome to define. CEQ's regulations define cumulative effects as the "incremental effect of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR § 1508.7). In determining how far into the future to analyze cumulative effects, the analyst should first consider the time frame of the project-specific analysis. If the effects of the proposed action are projected to last five years, this time frame may be the most appropriate for the cumulative effects analysis. The analyst should attempt to identify actions that could reasonably be expected to occur within that period.

There may be instances when the time frame of the project-specific analysis will need to be expanded to encompass cumulative effects occurring further into the future (Figure 2-2). For instance, even though the effects of a proposed action may linger or decrease slowly through time, the time frame for the project-specific analysis usually does not extend beyond the time when project-specific effects drop below a level determined to be significant. These project-specific effects, however, may combine with the effects of other actions beyond the time frame of the proposed action and result in significant cumulative effects that must be considered.

IDENTIFYING PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

As described above, identifying past, present, and future actions is critical to establishing the appropriate geographic and time boundaries for the cumulative effects analysis. Identifying boundaries and actions should be iterative within the scoping process.

A schematic diagram showing the area in which the proposed action is located, the location of resources, and the location of other facilities (existing or planned), human communities, and disturbed areas can be useful for identifying actions to be included in the cumulative effects analysis (Figure 2-3). A geographic information system (GIS) or a manual map overlay system can be used to depict this information (see Appendix A for a description of map overlays and GIS). Such a diagram is is useful for determining project-specific impact zones and their overlap with areas affected by other nonproject actions.

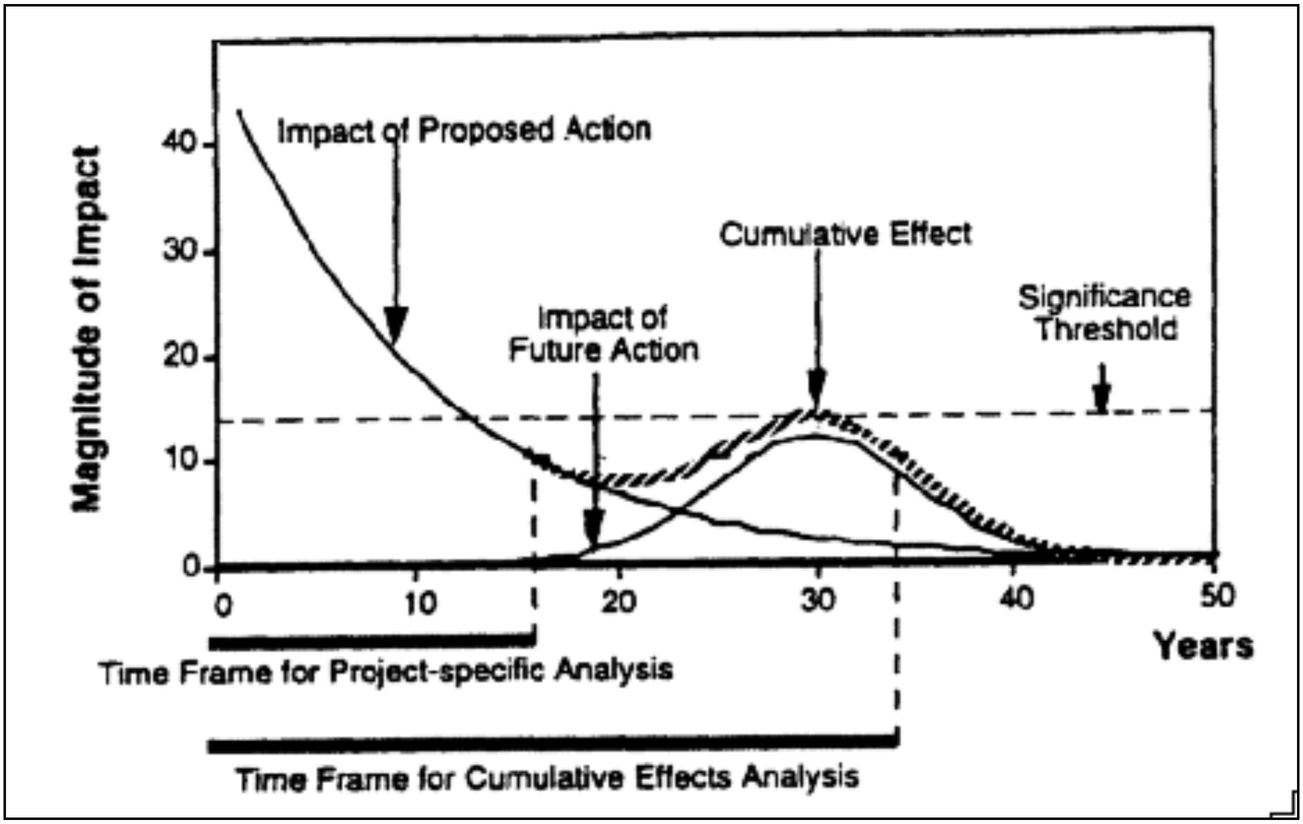

Figure 2-2. Time frames for project-specific and cumulative effects analyses

By examining the overlap of impact zones on the areas occupied by resources, it should be possible to refine the list of projects or activities (past, present, or future) to be included in the analysis. Proximity of actions may not be sufficient justification to include them in the analysis. In the example shown in Figure 2-3, the cumulative effects analysis for trout should consider the effects of the existing mine and the planned logging activity, because these activities would have either present or future effects on the trout spawning area below the proposed power plant facility. Although an agricultural area is nearby, it can be excluded from the analysis because its sediment loading effects occur downstream of the trout spawning area. Proximity of other actions to the proposed action is not the decisive factor for including these actions in an analysis; these actions must have some influence on the resources affected by the proposed action. In other words, these other actions should be included in analysis when their impact zones overlap areas occupied by resources affected by the proposed action.

Completing the geographic or schematic diagram depending on applying cause-and-effect models that link human actions and the resources or ecosystems. This too is an iterative process. Identifying other activities contributing to cumulative effects could result in the addition of new effect pathways to the cause-and-effect model. In the example, addition of an existing mine to the cumulative effects analysis could require adding a pathway for the effects of chemical pollution on trout. Chapters 4 and 5 and Appendix A discuss cause-and-effect modeling and network analysis.

The availability of data often determines how far back past effects are examined. Although certain types of data (e.g., forest cover) may be available for extensive periods in the past (i.e., several decades), other data (e.g., water quality data) may be available only for

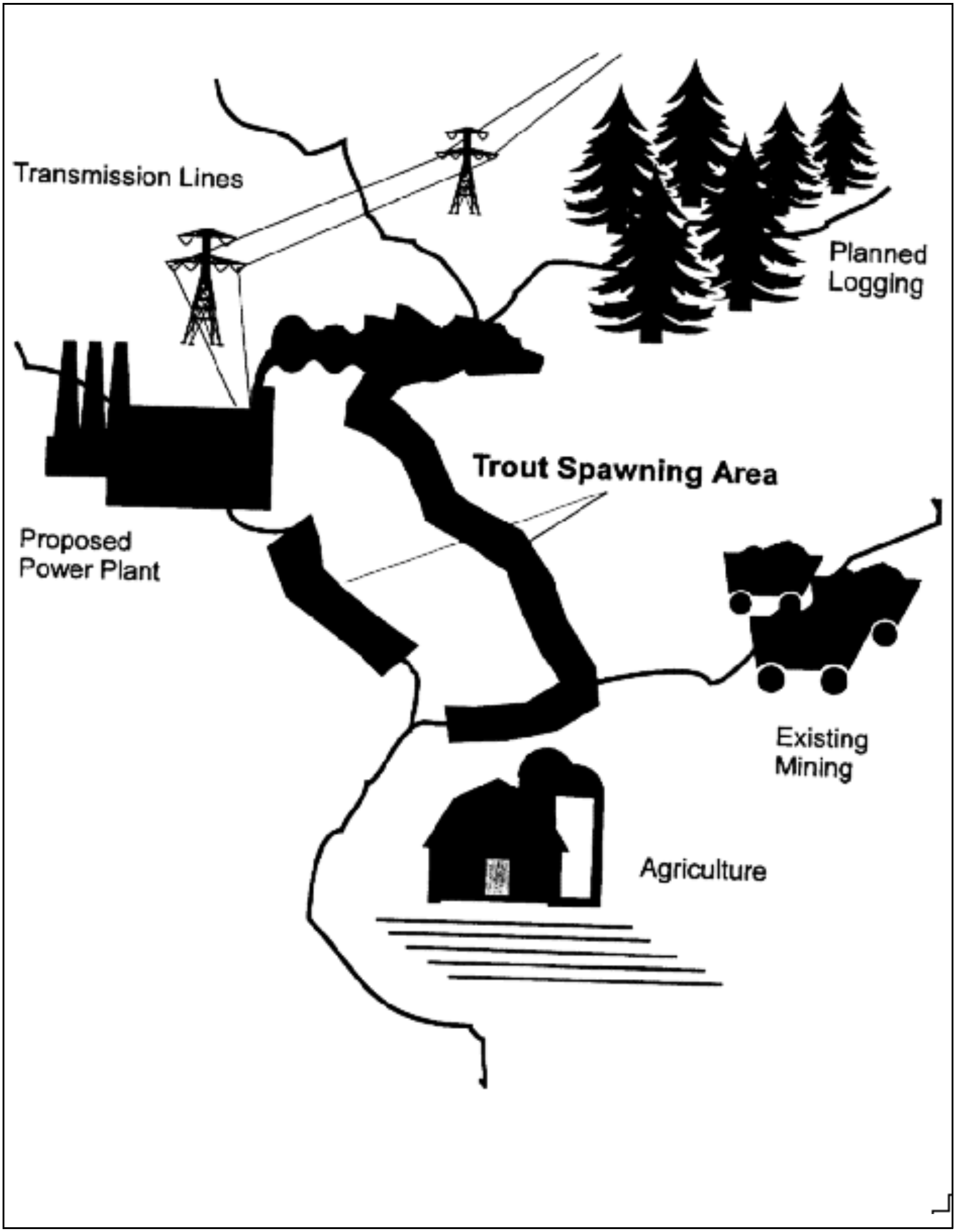

Figure 2-3. Impact zones of proposed and existing development relative to a trout population

much shorter periods. Because the data describing past conditions are usually scarce, the analysis of past effects is often qualitative.

Identifying similar actions presently underway is easier than identifying past or future actions, but it is by no means simple. Because most of the analytical effort in an environmental impact assessment deals with the proposed action, the actions of other agencies and private parties are usually less well known. Effective cumulative effects analysis requires close coordination among agencies to ensure that even all present actions, much less past and future actions, are considered.

The first step in identifying future actions is to investigate the plans of the proponent agency and other agencies in the area. Commonly, analysts only include those plans for actions which are funded or for which other NEPA analysis is being prepared. This approach does not meet the letter or intent of CEQ's regulations. It underestimates the number of future projects, because many viable actions may be in the early planning stage. On the other hand, some actions in the planning, budgeting, or execution phase may not go forward. To include all proposals ever considered as other actions would most likely overestimate the future effects of cumulative effects on the resources, ecosystems, and human communities; therefore, the analyst should develop guidelines as to what constitutes "reasonably foreseeable future actions" based on the planning process within each agency. Specifically, the analyst should use the best available information to develop scenarios that predict which future actions might reasonably be expected as a result of the proposal. Such scenarios are generally based on experience obtained from similar projects located elsewhere in the region. Including future actions in the study is much easier if an agency has already developed a planning document that identifies proposed future actions and has commutilated these plans to other federal agencies and governmental bodies in the affected region.

When identifying future actions to include in the cumulative effects analysis, reasonably foreseeable actions by private organizations or individuals are usually more difficult to identify than those of federal or other governmental entities. In many cases, local government planning agencies can provide useful information on the likely future development of the region, such as master plans. Local zoning requirements, water supply plans, economic development plans, and various permitting records will help in identifying reasonably foreseeable private actions (see Chapter 3 for other sources of information). In addition, some private landowners or organizations may be willing to share their plans for future development or land use. These plans can be considered in the analysis, but it is important to indicate in the NEPA analysis whether these plans were presented by the private party responsible for originating the action. Whenever speculative projections of future development are used, the analyst should provide an explicit description of the assumptions involved. If the analyst is uncertain whether to include future actions, it may be appropriate to bound the problem by developing several scenarios with different assumptions about future actions.

In general, future actions can be excluded from the analysis of cumulative effects if

- the action is outside the geographic boundaries or time frame established for the cumulative effects analysis;
- the action will not affect resources that are the subject of the cumulative effects analysis; or
- including of the action would be arbitrary.

At the same time, NEPA litigation [*Scientists' Institute for Public Information, Inc., v. Atomic Energy Commission* (481 F.2d 1079 D.C. Cir.1073)] has made it clear that "reasonable forecasting" is implicit in NEPA and that it is the responsibility of federal agencies to predict the environmental effects of proposed actions before they are fully known. CEQ's regulations provide for including these uncertainties in the environmental impact assessment where the foreseeable future action is not planned in sufficient detail to permit complete analysis. Specifically, CEQ's regulations state

> [w]hen 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, ... [that] 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... the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community (40 CFR § 1502.22).

Even when the decisionmaker does not select the environmentally preferable alternative, including the cumulative effects of future actions in the analysis serves the important NEPA function of informing the public and potentially influencing future decisions.

AGENCY COORDINATION

Because the actions of other agencies are part of cumulative effects analysis, greater emphasis should be placed on consulting with other agencies than is commonly practiced. Fortunately, when federal agencies adopt the ecosystem approach to management (espoused by the Interagency Ecosystem Management Task Force) such consultation probably will be enhanced (see box). During scoping, periodic coordination with other agencies may enhance the cumulative effects analysis process. As described above, a cumulative effects analysis might

- include an assessment of another agency's proposed action,
- include an assessment of the effects of another agency's completed actions,
- evaluate another agency's resource management practices and goals, or
- evaluate another agency's future plans.

Ecosystem Management

Vice President Gore's National Performance Review called for the agencies of the federal government to adopt "a proactive approach to ensuring a sustainable economy and a sustainable environment through ecosystem management." The Interagency Ecosystem Management Task Force (IEMTF 1995) was established to carry out this mandate. The ecosystem approach espoused by IEMTF and a wide range of government, industry, and private interest groups is a method for sustaining or restoring natural systems in the face of the cumulative effects of many human actions. In addition to using the best science, the ecosystem approach to management is based on a collaboratively developed vision of desired future conditions that integrates ecological, economic, and social factors. Achieving this shared vision requires developing partnerships with nonfederal stakeholders and improving communication between federal agencies and the public. Many ecosystem management initiatives are underway across the United States. The lessons learned from these experiences should be incorporated into the scoping process under NEPA to address cumulative effects more effectively. The IEMTF specifically recommends that agencies develop regional ecosystem plans to coordinate their review activities under NEPA. These ecosystem plans can provide a framework for evaluating the environmental status quo and the combined cumulative effects of individual projects.

The success of any of these activities is enhanced by coordination with the affected agency. At a minimum, the analyst should establish an ongoing process of periodic consultation and coordination with other agencies early in the scoping process whenever there are significant cumulative effects issues. Where appropriate, the lead agency should pursue cooperating agency status for affected agencies to facilitate reviewing drafts, supplying information, writing sections of the document, and using the document to support more than one agency's programs.

SCOPING SUMMARY

Scoping for cumulative effects analysis is a proactive and iterative process. It involves a thorough evaluation of the proposed action and its environmental context. During the scoping process, the analyst should

- consult with agencies and other interested persons concerning cumulative effects issues;
- evaluate the agency's planning as well as the proposed action and reasonable alternatives (including the no-action alternative) to identify potential cumulative effects;
- evaluate the importance of the cumulative effects issues associated with a proposed action to identify additional resources, ecosystems, and human communities that should be included in the EA or EIS;
- identify the geographic boundaries for analysis of the cumulative effects on each resource, ecosystem, and human community;
- identify a time frame for the analysis of the cumulative effects on each resource, ecosystem, and human community; and
- determine which other actions should be included in the analysis and agree among interested parties on the scope of the data to be gathered, the methods to be used, the way the process will be documented, and how the results will be reviewed.

At the end of the scoping process, there should be a list of cumulative effects issues to be assessed, a geographic boundary and time frame assigned for each resource analysis, and a list of other actions contributing to each cumulative effects issue. In addition, during scoping the analyst should obtain information and identify data needs related to the affected environment (Chapter 3) and environmental consequences (Chapter 4) of cumulative effects, including resource capabilities, thresholds, standards, guidelines, and planning goals.

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[FWS-R6-ES-2010-0018]
[MO 92210-0-0008-B2]

Endangered and Threatened Wildlife and Plants; 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of 12–month petition findings.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce three 12–month findings on petitions to list three entities of the greater sage-grouse (*Centrocercus urophasianus*) as threatened or endangered under the Endangered Species Act of 1973, as amended (Act). We find that listing the greater sage-grouse (rangewide) is warranted, but precluded by higher priority listing actions. We will develop a proposed rule to list the greater sage-grouse as our priorities allow.

We find that listing the western subspecies of the greater sage-grouse is not warranted, based on determining that the western subspecies is not a valid taxon and thus is not a listable entity under the Act. We note, however, that greater sage-grouse in the area covered by the putative western subspecies (except those in the Bi-State area (Mono Basin), which are covered by a separate finding) are encompassed by our finding that listing the species is warranted but precluded rangewide.

We find that listing the Bi-State population (previously referred to as the Mono Basin area population), which meets our criteria as a distinct population segment (DPS) of the greater sage-grouse, is warranted but precluded by higher priority listing actions. We will develop a proposed rule to list the Bi-State DPS of the greater sage-grouse as our priorities allow, possibly in conjunction with a proposed rule to list the greater sage-grouse rangewide.

DATES: The finding announced in the document was made on March 23, 2010.

ADDRESSES: This finding is available on the Internet at *http://www.regulations.gov* and *www.fws.gov*. Supporting documentation we used to prepare this finding is available for public inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, 5353 Yellowstone Road, Suite 308A, Cheyenne, Wyoming 82009; telephone (307) 772-2374; facsimile (307) 772-2358. Please submit any new information, materials, comments, or questions concerning this species to the Service at the above address.

FOR FURTHER INFORMATION CONTACT: Brian T. Kelly, Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Ecological Services Office (see **ADDRESSES**). If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at (800) 877-8339.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(B) of the Act (16 U.S.C. 1531 *et seq.*), requires that, for any petition containing substantial scientific or commercial information that the listing may be warranted, we make a finding within 12 months of the date of the receipt of the petition on whether the petitioned action is (a) not warranted, (b) warranted, or (c) warranted, but that immediate proposal of a regulation implementing the petitioned action is precluded by other pending proposals to determine whether species are threatened or endangered, and expeditious progress is being made to add or remove qualified species from the Lists of Endangered and Threatened Wildlife and Plants. Section 4(b)(3)(C) of the Act requires that we treat a petition for which the requested action is found to be warranted but precluded as though resubmitted on the date of such finding; that is, requiring a subsequent finding to be made within 12 months. We must publish these 12–month findings in the **Federal Register**.

Previous Federal Action

Greater Sage-Grouse

On July 2, 2002, we received a petition from Craig C. Dremann requesting that we list the greater sage-grouse (*Centrocercus urophasianus*) as endangered across its entire range. We received a second petition from the Institute for Wildlife Protection on March 24, 2003, requesting that the greater sage-grouse be listed rangewide. On December 29, 2003, we received a third petition from the American Lands Alliance and 20 additional conservation organizations (American Lands Alliance *et al.*) to list the greater sage-grouse as threatened or endangered rangewide. On April 21, 2004, we announced our 90–day petition finding in the **Federal Register** (69 FR 21484) that these petitions taken collectively, as well as information in our files, presented substantial information indicating that the petitioned actions may be warranted. On July 9, 2004, we published a notice to reopen the period for submitting comments on our 90–day finding, until July 30, 2004 (69 FR 41445). In accordance with section 4(b)(3)(A) of the Act, we completed a status review of the best available scientific and commercial information on the species. On January 12, 2005, we announced our not-warranted 12–month finding in the **Federal Register** (70 FR 2243).

On July 14, 2006, Western Watersheds Project filed a complaint in Federal district court alleging that the Service's 2005 12–month finding was incorrect and arbitrary and requested the finding be remanded to the Service. On December 4, 2007, the U.S. District Court of Idaho ruled that our 2005 finding was arbitrary and capricious, and remanded it to the Service for further consideration. On January 30, 2008, the court approved a stipulated agreement between the Department of Justice and the plaintiffs to issue a new finding in May 2009, contingent on the availability of a new monograph of information on the sage-grouse and its habitat (Monograph). On February 26, 2008, we published a notice to initiate a status review for the greater sage-grouse (73 FR 10218), and on April 29, 2008, we published a notice extending the request for submitting information to June 27, 2008 (73 FR 23172). Publication of the Monograph was delayed due to circumstances outside the control of the Service. An amended joint stipulation, adopted by the court on June 15, 2009, required the Service to submit the 12–month finding to the **Federal Register** by February 26, 2010; this due date was subsequently extended to March 5, 2010.

Western Subspecies of the Greater Sage-Grouse

The western subspecies of the greater sage-grouse (*Centrocercus urophasianus phaios*) was identified by the Service as a category 2 candidate species on September 18, 1985 (50 FR 37958). At the time, we defined Category 2 species as those species for which we possessed information indicating that a proposal to list as endangered or threatened was possibly appropriate, but for which conclusive data on biological vulnerability and threats were not available to support a proposed rule. On February 28, 1996, we discontinued the designation of category 2 species as candidates for listing under the Act (61 FR 7596), and consequently the western subspecies was no longer considered to be a candidate for listing.

We received a petition, dated January 24, 2002, from the Institute for Wildlife

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subspecies by current taxonomic standards, and Schroeder noted that the differences were not consistent with any of the described geographic or genetic delineations between putative subspecies. Schroeder (2008 p. 9) also noted regional behavior differences in strut rate, but stated it was not clear if this variation reflected population-level effects. Finally, the best available genetic information indicates there is no distinction between the putative western and eastern subspecies (Benedict *et al.* 2003, p. 309; Oyler-McCance and Quinn in press, p. 12).

Because the best scientific and commercial information do not support the taxonomic validity of the purported eastern or western subspecies, our analysis of the status of the greater sage-grouse (below) does not address considerations at the scale of subspecies. (See Findings section, below, for our finding on the petition to list the western subspecies of the greater sage-grouse.)

Life History Characteristics

Greater sage-grouse depend on a variety of shrub-steppe habitats throughout their life cycle, and are considered obligate users of several species of sagebrush (e.g., *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush), *A. t.* ssp. *vaseyana* (mountain big sagebrush), and *A. t. tridentata* (basin big sagebrush)) (Patterson 1952, p. 48; Braun *et al.* 1976, p. 168; Connelly *et al.* 2000a, pp. 970-972; Connelly *et al.* 2004, p. 4-1; Miller *et al.* in press, p. 1). Greater sage-grouse also use other sagebrush species such as *A. arbuscula* (low sagebrush), *A. nova* (black sagebrush), *A. frigida* (fringed sagebrush), and *A. cana* silver sagebrush (Schroeder *et al.* 1999, pp. 4-5; Connelly *et al.* 2004, p. 3-4). Thus, sage-grouse distribution is strongly correlated with the distribution of sagebrush habitats (Schroeder *et al.* 2004, p. 364). Sage-grouse exhibit strong site fidelity (loyalty to a particular area even when the area is no longer of value) to seasonal habitats, which includes breeding, nesting, brood rearing, and wintering areas (Connelly *et al.* 2004, p. 3-1). Adult sage-grouse rarely switch between these habitats once they have been selected, limiting their adaptability to changes.

During the spring breeding season, male sage-grouse gather together to perform courtship displays on areas called leks. Areas of bare soil, short-grass steppe, windswept ridges, exposed knolls, or other relatively open sites typically serve as leks (Patterson 1952, p. 83; Connelly *et al.* 2004, p. 3-7 and references therein). Leks are often surrounded by denser shrub-steppe cover, which is used for escape, thermal, and feeding cover. The proximity, configuration, and abundance of nesting habitat are key factors influencing lek location (Connelly *et al.*, 1981, and Connelly *et al.*, 2000 b, cited in Connelly *et al.*, in press a, p. 11). Leks can be formed opportunistically at any appropriate site within or adjacent to nesting habitat (Connelly *et al.* 2000a, p. 970), and, therefore, lek habitat availability is not considered to be a limiting factor for sage-grouse (Schroeder 1999, p. 4). Nest sites are selected independent of lek locations, but the reverse is not true (Bradbury *et al.* 1989, p. 22; Wakkinen *et al.* 1992, p. 382). Thus, leks are indicative of nesting habitat.

Leks range in size from less than 0.04 hectare (ha) (0.1 acre (ac)) to over 36 ha (90 ac) (Connelly *et al.* 2004, p. 4-3) and can host from several to hundreds of males (Johnsgard 2002, p. 112). Males defend individual territories within leks and perform elaborate displays with their specialized plumage and vocalizations to attract females for mating. Although males are capable of breeding the first spring after hatch, young males are rarely successful in breeding on leks due to the dominance of older males (Schroeder *et al.* 1999, p. 14). Numerous researchers have observed that a relatively small number of dominant males account for the majority of copulations on each lek (Schroeder *et al.* 1999, p. 8). However, Bush (2009, p. 106) found on average that 45.9 percent (range 14.3 to 54.5 percent) of genetically identified males in a population fathered offspring in a given year, which indicates that males and females likely engage in off-lek copulations. Males do not participate in incubation of eggs or rearing chicks.

Females have been documented to travel more than 20 km (12.5 mi) to their nest site after mating (Connelly *et al.* 2000a, p. 970), but distances between a nest site and the lek on which breeding occurred is variable (Connelly *et al.* 2004, pp. 4-5). Average distance between a female's nest and the lek on which she was first observed ranged from 3.4 km (2.1 mi) to 7.8 km (4.8 mi) in five studies examining 301 nest locations (Schroeder *et al.* 1999 p. 12).

Productive nesting areas are typically characterized by sagebrush with an understory of native grasses and forbs, with horizontal and vertical structural diversity that provides an insect prey base, herbaceous forage for pre-laying and nesting hens, and cover for the hen while she is incubating (Gregg 1991, p. 19; Schroeder *et al.* 1999, p. 4; Connelly *et al.* 2000a, p. 971; Connelly *et al.* 2004, pp. 4-17, 18; Connelly *et al.* in press b, p. 12). Sage-grouse also may use other shrub or bunchgrass species for nest sites (Klebenow 1969, p. 649; Connelly *et al.* 2000a, p. 970; Connelly *et al.* 2004, p. 4-4). Shrub canopy and grass cover provide concealment for sage-grouse nests and young, and are critical for reproductive success (Barnett and Crawford 1994, p. 116; Gregg *et al.* 1994, p. 164; DeLong *et al.*1995, p. 90; Connelly *et al.* 2004, p. 4-4). Published vegetation characteristics of successful nest sites included a sagebrush canopy cover of 15–25 percent, sagebrush heights of 30 to 80 cm (11.8 to 31.5 in.), and grass/forb cover of 18 cm (7.1 in.) (Connelly *et al.* 2000a, p. 977).

Sage-grouse clutch size ranges from 6 to 9 eggs with an average of 7 eggs (Connelly *et al.* in press a, pp. 14-15). The likelihood of a female nesting in a given year averages 82 percent in eastern areas of the range (Alberta, Montana, North Dakota, South Dakota, Colorado, Wyoming) and 78 percent in western areas of the range (California, Nevada, Idaho, Oregon, Washington, Utah) (Connelly *et al.* in press a, p. 15). Adult females have higher nest initiation rates than yearling females (Connelly *et al.* in press a, p. 15). Nest success (one or more eggs hatching from a nest), as reported in the scientific literature, varies widely (15–86 percent Schroeder *et al.* 1999, p. 11). Overall, the average nest success for sage-grouse in habitats where sagebrush has not been disturbed is 51 percent and for sage-grouse in disturbed habitats is 37 percent (Connelly *et al.*, in press a, p. 1). Re-nesting only occurs if the original nest is lost (Schroeder *et al.* 1999, p. 11). Sage-grouse re-nesting rates average 28.9 percent (based on 9 different studies) with a range from 5 to 41 percent (Connelly *et al.* 2004. p. 3-11). Other game bird species have much higher re-nesting rates, often exceeding 75 percent. The impact of re-nesting on annual productivity for most sage-grouse populations is unclear and thought to be limited (Crawford *et al.* 2004, p. 4). In north-central Washington State, re-nesting contributed to 38 percent of the annual productivity of that population (Schroeder 1997, p. 937). However, the author postulated that the re-nesting efforts in this population may be greater than anywhere else in the species' range because environmental conditions allow a longer period of time to successfully rear a clutch (Schroeder 1997, p. 939).

Little information is available on the level of productivity (number of chicks per hen that survive to fall) that is necessary to maintain a stable population (Connelly *et al.* 2000b, p.

970). However, Connelly *et al.* (2000b, p. 970, and references therein) suggest that 2.25 chicks per hen are necessary to maintain stable to increasing populations. Long-term productivity estimates of 1.40–2.96 chicks per hen across the species range have been reported (Connelly and Braun 1997, p. 20). Productivity declined slightly after 1985 to 1.21–2.19 chicks per hen (Connelly and Braun 1997, p. 20). Despite average clutch sizes of 7 eggs (Connelly *et al.* in press a, p. 15) due to low chick survival and limited renesting, there is little evidence that populations of sage-grouse produce large annual surpluses (Connelly *et al.* in press a, p. 24).

Hens rear their broods in the vicinity of the nest site for the first 2–3 weeks following hatching (within 0.2–5 km (0.1–3.1 mi)), based on two studies in Wyoming (Connelly *et al.* 2004, p. 4-8). Forbs and insects are essential nutritional components for chicks (Klebenow and Gray 1968, p. 81; Johnson and Boyce 1991, p. 90; Connelly *et al.* 2004, p. 4-9). Therefore, early brood-rearing habitat must provide adequate cover (sagebrush canopy cover of 10 to 25 percent; Connelly *et al.* 2000a, p. 977) adjacent to areas rich in forbs and insects to ensure chick survival during this period (Connelly *et al.* 2004, p. 4-9).

All sage-grouse gradually move from sagebrush uplands to more mesic areas (moist areas such as streambeds or wet meadows) during the late brood-rearing period (3 weeks post-hatch) in response to summer desiccation of herbaceous vegetation (Connelly *et al.* 2000a, p. 971). Summer use areas can include sagebrush habitats as well as riparian areas, wet meadows, and alfalfa fields (Schroeder *et al.* 1999, p. 4). These areas provide an abundance of forbs and insects for both hens and chicks (Schroeder *et al.* 1999, p. 4; Connelly *et al.* 2000a, p. 971). Sage-grouse will use free water although they do not require it since they obtain their water needs from the food they eat. However, natural water bodies and reservoirs can provide mesic areas for succulent forb and insect production, thereby attracting sage-grouse hens with broods (Connelly *et al.* 2004, p. 4-12). Broodless hens and cocks also will use more mesic areas in close proximity to sagebrush cover during the late summer, often arriving before hens with broods (Connelly *et al.* 2004, p. 4-10).

As vegetation continues to desiccate through the late summer and fall, sage-grouse shift their diet entirely to sagebrush (Schroeder *et al.* 1999, p. 5). Sage-grouse depend entirely on sagebrush throughout the winter for both food and cover. Sagebrush stand selection is influenced by snow depth (Patterson 1952, p. 184; Hupp and Braun 1989, p. 827), availability of sagebrush above the snow to provide cover (Connelly *et al.* 2004, pp. 4-13, and references therein) and, in some areas, topography (e.g., elevation, slope and aspect; Beck 1977, p. 22; Crawford *et al.* 2004, p. 5).

Many populations of sage-grouse migrate between seasonal ranges in response to habitat distribution (Connelly *et al.* 2004, p. 3-5). Migration can occur between winter and breeding and summer areas, between breeding, summer, and winter areas, or not at all. Migration distances of up to 161 km (100 mi) have been recorded (Patterson 1952, p.189); however, distances vary depending on the locations of seasonal habitats (Schroeder *et al.* 1999, p. 3). Migration distances for female sage-grouse generally are less than for males (Connelly *et al.* 2004, p. 3-4), but in one study in Colorado, females traveled farther than males (Beck 1977, p. 23). Almost no information is available regarding the distribution and characteristics of migration corridors for sage-grouse (Connelly *et al.* 2004, p. 4-19). Sage-grouse dispersal (permanent moves to other areas) is poorly understood (Connelly *et al.* 2004, p. 3-5) and appears to be sporadic (Dunn and Braun 1986, p. 89). Estimating an "average" home range for sage-grouse is difficult due to the large variation in sage-grouse movements both within and among populations. This variation is related to the spatial availability of habitats required for seasonal use, and annual recorded home ranges have varied from 4 to 615 square kilometers (km^2) (1.5 to 237.5 square miles (mi^2)) (Connelly *et al.*, in press a, p. 10).

Sage-grouse typically live between 3 and 6 years, but individuals up to 9 years of age have been recorded in the wild (Connelly *et al.* 2004, p. 3-12). Hens typically survive longer due to a disproportionate impact of predation on leks to males (Schroeder *et al.* 1999, p. 14). Juvenile survival (from hatch to first breeding season) is affected by food availability, habitat quality, harvest, and weather. Based on a review of many field studies, juvenile survival rates range from 7 to 60 percent (Connelly *et al.* 2004, p. 3-12). The variation in juvenile mortality rates may be associated with gender, weather, harvest rates, age of brood female (broods with adult females have higher survival), and with habitat quality (rates increase in poor habitats) (Schroeder *et al.* 1999, p. 14; Connelly *et al.*, in press a, p. 20). The average annual survival rate for male sage-grouse (all ages combined) documented in various studies ranged from 38 to 60 percent and 55 to 75 percent for females (Schroeder *et al.* 1999, p. 14). Higher female survival rates account for a female-biased sex ratio in adult birds (Schroeder 1999, p. 14; Johnsgard 2002, p. 621). The sex ratio of sage-grouse breeding populations varies widely with values between 1.2 and 3 females per male being reported (Connelly *et al.*, in press a, p. 23). Although seasonal patterns of mortality have not been thoroughly examined, over-winter mortality appears to be low (Connelly *et al.* 2000b, p. 229; Connelly *et al.* 2004, p. 9-4). While both males and females are capable of breeding the first spring after hatch, young males are rarely successful due to the dominance of older males on the lek (Schroeder *et al.* 1999, p. 14). Nesting rates of yearling females are 25 percent less than adult females (Schroeder *et al.* 1999, p. 13).

Habitat Description and Characteristics

Sage-grouse are dependent on large areas of contiguous sagebrush (Patterson 1952, p. 48; Connelly *et al.* 2004, p. 4-1; Connelly *et al.* in press a, p. 10; Wisdom *et al.* in press, p. 4), and large-scale characteristics within surrounding landscapes influence sage-grouse habitat selection (Knick and Hanser in press, p. 26). Sagebrush is the most widespread vegetation in the intermountain lowlands in the western United States (West and Young 2000, p. 259) and is considered one of the most imperiled ecosystems in North America (Knick *et al.* 2003, p. 612; Miller *et al.* in press, p. 4, and references therein). Scientists recognize 14 species and 13 subspecies of sagebrush (Connelly *et al.* 2004, p. 5-2; Miller *et al.* in press, p. 8), each with unique habitat requirements and responses to perturbations (West and Young 2000, p. 259). Sagebrush species and subspecies occurrence in an area is dictated by local soil type, soil moisture, and climatic conditions (West 1983, p. 333; West and Young 2000, p. 260; Miller *et al.* in press, pp. 8-11). The degree of dominance by sagebrush varies with local site conditions and disturbance history. Plant associations, typically defined by perennial grasses, further define distinctive sagebrush communities (Miller and Eddleman 2000, pp. 10-14; Connelly *et al.* 2004, p. 5-3), and are influenced by topography, elevation, precipitation, and soil type. These ecological conditions influence the response and resiliency of sagebrush and their associated understories to natural and human-caused changes.

Sagebrush is typically divided into two groups, big sagebrush and low sagebrush, based on their affinities for different soil types (West and Young 2000, p. 259). Big sagebrush species and subspecies, such as *A. tridentata* ssp. *wyomingensis*, are limited to coarse-textured and/or well-drained sediments. Low sagebrush, such as *A. nova,* typically occur where erosion has exposed clay or calcified soil horizons (West 1983, p. 334; West and Young 2000, p. 261). Reflecting these soil differences, big sagebrush will die if surfaces are saturated long enough to create anaerobic conditions for 2 to 3 days (West and Young 2000, p. 259). Some low sagebrush are more tolerant of occasionally supersaturated soils, and many low sage sites are partially flooded during spring snowmelt. None of the sagebrush taxa tolerate soils with high salinity (West 1983, p. 333; West and Young 2000, p. 257). Sagebrush that provide important annual and seasonal habitats for sage-grouse include three subspecies of big sagebrush (*A. t.* ssp. *wyomingensis, A. t.* ssp. *tridentata* and *A. t.* ssp. *vaseyana*), two low forms of sagebrush (*A. arbuscula* (little sagebrush) and *A. nova*), and *A. cana* ssp. *cana* (Miller *et al.* in press, p. 8).

All species of sagebrush produce large ephemeral leaves in the spring, which persist until reduced soil moisture occurs in the summer. Most species also produce smaller, over-wintering leaves in the late spring that last through summer and winter. Sagebrush have fibrous tap root systems, which allow the plants to draw surface soil moisture, and also to access water deep within the soil profile when surface water is limited (West and Young 2000, p. 259). Most sagebrush flower in the fall. However, during years of drought or other moisture stress, flowering may not occur. Although seed viability and germination are high, seed dispersal is limited. Sagebrush seeds, depending on the species, remain viable for 1 to 3 years. However, Wyoming big sagebrush seeds do not persist beyond the year of their production (West and Young 2000, p. 260).

Sagebrush is long-lived, with plants of some species surviving up to 150 years (West 1983, p. 340). They produce allelopathic chemicals that reduce seed germination, seedling growth, and root respiration of competing plant species and inhibit the activity of soil microbes and nitrogen fixation. Sagebrush has resistance to environmental extremes, with the exception of fire and occasionally defoliating insects (e.g., webworm (*Aroga* spp.); West 1983, p. 341). Most species of sagebrush are killed by fire (West 1983, p. 341; Miller and Eddleman 2000, p. 17; West and Young 2000, p. 259), and historic fire-return intervals were as long as 350 years, depending on sagebrush type and environmental conditions (Baker in press, p. 16). Natural sagebrush recolonization in burned areas depends on the presence of adjacent live plants for a seed source or on the seed bank, if present (Miller and Eddleman 2000, p. 17), and requires decades for full recovery.

Plants associated with the sagebrush understory vary, as does their productivity. Both plant composition and productivity are influenced by moisture availability, soil characteristics, climate, and topographic position (Miller *et al.*, in press, pp. 8-14). Forb abundance can be highly variable from year to year and is largely affected by the amount and timing of precipitation.

Very little sagebrush within its extant range is undisturbed or unaltered from its condition prior to EuroAmerican settlement in the late 1800s (Knick *et al.* 2003, p. 612, and references therein). Due to the disruption of primary patterns, processes, and components of sagebrush ecosystems since EuroAmerican settlement (Knick *et al.* 2003, p. 612; Miller *et al.* in press, p. 4), the large range of abiotic variation, the minimal short-lived seed banks, and the long generation time of sagebrush, restoration of disturbed areas is very difficult. Not all areas previously dominated by sagebrush can be restored because alteration of vegetation, nutrient cycles, topsoil, and living (cryptobiotic) soil crusts has exceeded recovery thresholds (Knick *et al.* 2003, p. 620). Additionally, processes to restore sagebrush ecology are relatively unknown (Knick *et al.* 2003, p. 620). Active restoration activities are often limited by financial and logistic resources and lack of political motivation (Knick *et al.* 2003, p. 620; Miller *et al.* in press, p. 5) and may require decades or centuries (Knick *et al.* 2003, p. 620, and references therein). Meaningful restoration for greater sage-grouse requires landscape, watershed, or eco-regional scale context rather than individual, unconnected efforts (Knick *et al.* 2003, p. 623, and references therein; Wisdom *et al.* in press, p. 27). Landscape restoration efforts require a broad range of partnerships (private, State, and Federal) due to landownership patterns (Knick *et al.* 2003, p. 623; see discussion of landownership below). Except for areas where active restoration is attempted following disturbance (e.g., mining, wildfire), management efforts in sagebrush ecosystems are usually focused on maintaining the remaining sagebrush (Miller *et al.* in press, p. 5; Wisdom *et al.* in press, pp. 26, 30).

Greater sage-grouse require large, interconnected expanses of sagebrush with healthy, native understories (Patterson 1952, p. 9; Knick *et al.* 2003, p. 623; Connelly *et al.* 2004, pp. 4-15; Connelly *et al.* in press a, p. 10; Pyke in press, p. 7; Wisdom *et al.* in press, p. 4). There is little information available regarding minimum sagebrush patch sizes required to support populations of sage-grouse. This is due in part to the migratory nature of some but not all sage-grouse populations, the lack of juxtaposition of seasonal habitats, and differences in local, regional, and range-wide ecological conditions that influence the distribution of sagebrush and associated understories. Where home ranges have been reported (Connelly *et al.* in press a, p. 10 and references therein), they are extremely variable (4 to 615 km² range (1.5 to 237.5 mi²)). Occupancy of a home range also is based on multiple variables associated with both local vegetation characteristics and landscape characteristics (Knick *et al.* 2003, p. 621). Pyke (in press, p. 18) estimated that greater than 4,000 ha (9,884 ac) was necessary for population sustainability. However, he did not indicate whether this value was for migratory or nonmigratory populations, nor if this included juxtaposition of all seasonal habitats. Large seasonal and annual movements emphasize the landscape nature of the greater sage-grouse (Knick *et al.* 2003, p. 624; Connelly *et al.* in press a, p. 10).

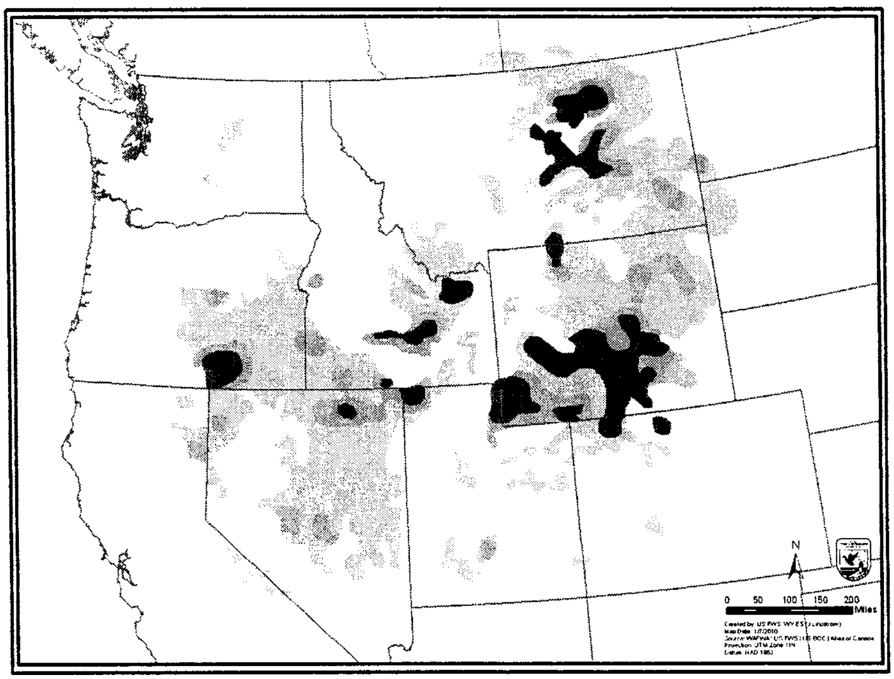
Range and Distribution of Sage-Grouse and Sagebrush

Prior to settlement of western North America by European immigrants in the 19th century, greater sage-grouse occurred in 13 States and 3 Canadian provinces—Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, North Dakota, Nebraska, Arizona, British Columbia, Alberta, and Saskatchewan (Schroeder *et al.* 1999, p. 2; Young *et al.* 2000, p. 445; Schroeder *et al.* 2004, p. 369). Sagebrush habitats that potentially supported sage-grouse occurred over approximately 1,200,483 km² (463,509 mi²) before 1800 (Schroeder *et al.* 2004, p. 366). Currently, greater sage-grouse occur in 11 States (Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, and North Dakota), and 2 Canadian provinces (Alberta and Saskatchewan), occupying approximately 56 percent of their historical range (Schroeder *et al.* 2004, p. 369). Approximately 2 percent of the total range of the greater sage-grouse occurs in Canada, with the remainder in the United States (Knick in press, p. 14).

Sage-grouse have been extirpated from Nebraska, British Columbia, and possibly Arizona (Schroeder *et al.* 1999, p. 2; Young *et al.* 2000 p. 445; Schroeder *et al.* 2004, p. 369). Current distribution of the greater sage-grouse is estimated at 668,412 km^2 (258,075 mi^2; Connelly *et al.* 2004, p. 6-9; Schroeder *et al.* 2004, p. 369). Changes in distribution are the result of sagebrush alteration and degradation (Schroeder *et al.* 2004, p. 363).

Sage-grouse distribution is associated with sagebrush (Schroeder *et al.* 2004; p. 364), although sagebrush is more widely distributed. However, sagebrush does not always provide suitable habitat due to fragmentation and degradation (Schroeder *et al.* 2004, pp. 369, 372). Very little of the extant sagebrush is undisturbed, with up to 50 to 60 percent having altered understories or having been lost to direct conversion (Knick *et al.* 2003, p. 612). There also are challenges in mapping altered and depleted understories, particularly in semi-arid regions, so maps depicting only sagebrush as a dominant cover type are deceptive in their reflection of habitat quality and, therefore, use by sage-grouse (Knick *et al.* 2003, p. 616). As such, variations in the quality of sagebrush habitats (from either abiotic or anthropogenic events) are reflected by sage-grouse distribution and densities (Figure 1).

Figure 1—Greater sage-grouse population densities based on average number of males per lek (from Stiver *et al.* 2006, p. 1-12). Darker areas indicate higher breeding population densities.



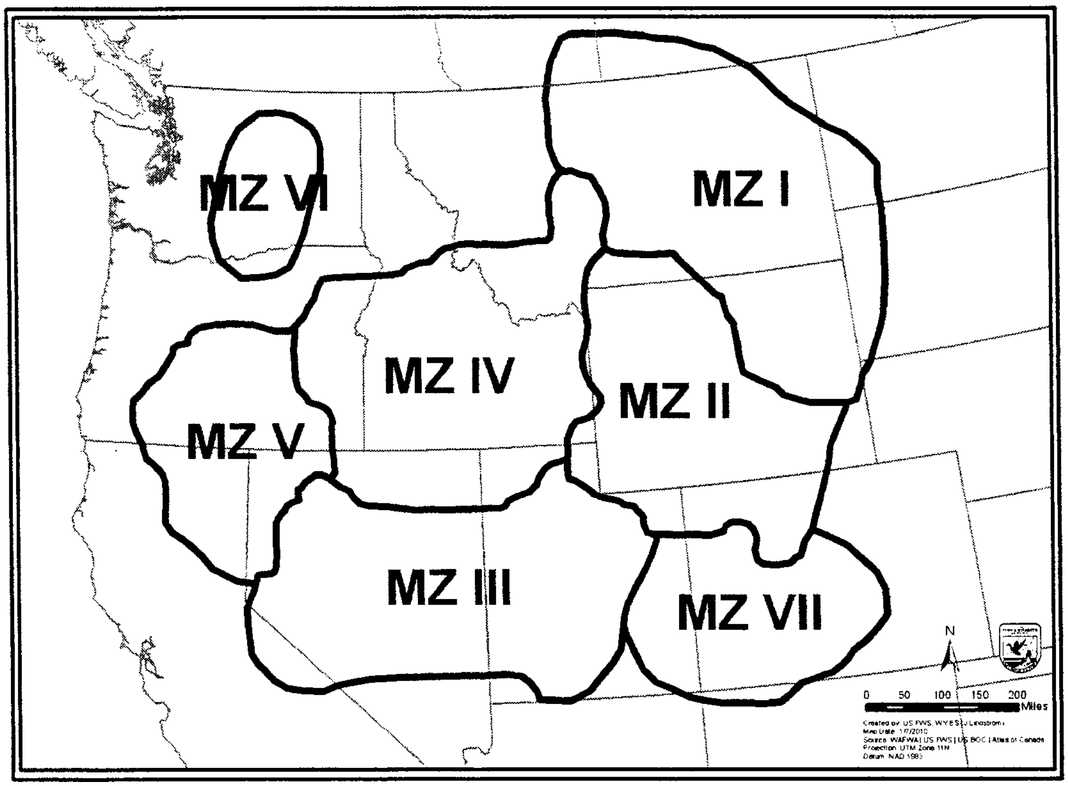
Sagebrush occurs in two natural vegetation types that are delineated by temperature and patterns of precipitation (Miller *et al.* in press, p. 7). Sagebrush steppe ranges across the northern portion of sage-grouse range, from British Columbia and the Columbia Basin, through the northern Great Basin, Snake River Plain, and Montana, and into the Wyoming Basin and northern Colorado. Great Basin sagebrush occurs south of sagebrush steppe, and extends from the Colorado Plateau westward into Nevada, Utah, and California (Miller *et al.* in press, p. 7). Other sagebrush types within greater sage-grouse range include mixed-desert shrubland in the Bighorn Basin of Wyoming, and grasslands in eastern Montana and Wyoming that also support *A. cana* and *A. filifolia* (sand sagebrush) (Miller *et al.* in press, p. 7).

Due to differences in the ecology of sagebrush across the range of the greater sage-grouse, the Western Association of Fish and Wildlife Agencies (WAFWA) delineated seven Management Zones (MZs I-VII) based primarily on floristic provinces (Figure 2; Table 1; Stiver *et al.* 2006, p. 1-6). The boundaries of these MZs were delineated based on their ecological and biological attributes rather than on arbitrary political boundaries (Stiver *et al.* 2006, p. 1-6). Therefore, vegetation found within a MZ is similar and sage-grouse and their habitats within these areas are likely to respond similarly to environmental factors and management actions. The WAFWA conservation strategy includes the Gunnison sage-grouse, and the boundary for MZ VII includes its range (Stiver *et al.* 2006, pp. 1-1, 1-8), which does not overlap with the range of the greater sage-grouse.

TABLE 1—THE MANAGEMENT ZONES OF THE GREATER SAGE-GROUSE AS DEFINED BY STIVER *et al.* (2006, PP. 1-7, 1-11).

MZ	STATES AND PROVINCES INCLUDED	FLORISTIC REGION
I	MT, WY, ND, SD, SK, AL	Great Plains
II	ID, WY, UT, CO	Wyoming Basin
III	UT, NV, CA	Southern Great Basin
IV	ID, UT, NV, OR	Snake River Plain
V	OR, CA, NV	Northern Great Basin
VI	WA	Columbia Basin
VII	CO, UT	Colorado Plateau

Figure 2—The Management Zones for sage-grouse as identified by Stiver *et al.* (2006, p. 1-11). (Delineation primarily based on floristic provinces and population boundaries.)



As stated above, due to the variability in habitat conditions, sage-grouse are not evenly distributed across the range (Figure 1). The MZs I, II, IV, and V encompass the core populations of greater sage-grouse and have the highest reported densities (Table 2, Figures 1, 2; Stiver *et al.* 2006, p. 1-12). The MZ III is composed of lower density populations in the Great Basin, while fewer numbers of more dispersed birds occur in MZ VI (Stiver *et al.* 2006, p. 1-7).

TABLE 2—RELATIVE ABUNDANCE OF GREATER SAGE-GROUSE LEKS, AND NUMBERS OF MALES ATTENDING LEKS BY MANAGEMENT ZONE, BASED ON THE MEAN NUMBER OF INDIVIDUAL LEKS AND MEAN MAXIMUM NUMBER OF MALES ATTENDING LEKS BY MZ DURING 2005–2007.

MZ	Relative Abundance of Leks	Relative Abundance of Males Attending Leks
I	0.17	0.15
II	0.48	0.50

TABLE 2—RELATIVE ABUNDANCE OF GREATER SAGE-GROUSE LEKS, AND NUMBERS OF MALES ATTENDING LEKS BY MANAGEMENT ZONE, BASED ON THE MEAN NUMBER OF INDIVIDUAL LEKS AND MEAN MAXIMUM NUMBER OF MALES ATTENDING LEKS BY MZ DURING 2005–2007.—Continued

MZ	Relative Abundance of Leks	Relative Abundance of Males Attending Leks
III	0.06	0.07
IV	0.19	0.18
V	0.09	0.10
VI	0.004	0.005
VII	0.003	0.003

Land Ownership of Habitats

Greater sage-grouse extant habitats have multiple surface ownerships, as reflected in Table 3. Most of the habitats occur on Federal surfaces, a reflection of land disposal practices during EuroAmerican settlement of the western United States (Knick in press, pp. 5-10). Lands dominated by sagebrush that were disposed to private ownership typically had deeper soils and greater available water capacity or access to water (valley bottoms), reflecting their capacity for agricultural development or increased grazing activities (Knick in press, p. 15). The lands remaining in Federal ownership were of poorer overall quality. The resulting low productivity on Federal surfaces affects their ability to recover from disturbance (Knick in press, p. 17).

Federal agencies manage almost two-thirds of the sagebrush habitats (Table 3). The Bureau of Land Management (BLM) manages just over half of sage-grouse habitats, while the U.S. Forest Service (USFS) is responsible for management of approximately 8 percent of sage-grouse habitat (Table 3). Other Federal agencies, including the Service, Bureau of Indian Affairs (BIA), Bureau of Reclamation (BOR), National Park Service (NPS), Department of Defense (DOD), and Department of Energy (DOE) also are responsible for sagebrush habitats, but at a much smaller scale (Table 3). State agencies manage approximately 5 percent of sage-grouse habitats.

TABLE 3—PERCENT SURFACE OWNERSHIP OF TOTAL SAGEBRUSH AREA (KM² (MI²)) WITHIN THE SAGE-GROUSE MANAGEMENT ZONES (FROM KNICK IN PRESS, P. 39). OTHER FEDERAL AGENCIES INCLUDE THE SERVICE, BOR, NPS, DOD, AND DOE. MZ VII INCLUDES BOTH GUNNISON AND GREATER SAGE-GROUSE.

Sage-grouse MZ	km^2	mi^2	Sagebrush Management and Ownership					
			BLM Percent	Private Percent	USFS Percent	State Percent	BIA Percent	Other Federal Percent
I Great Plains	50,264	19,407	17	66	2	7	4	3
II Wyoming Basin	108,771	41,996	49	35	4	7	4	1
III Southern Great Basin	92,173	35,588	73	13	10	3	1	0
IV Snake River Plain	134,187	51,810	53	29	11	6	1	0
V Northern Great Basin	65,536	25,303	62	21	10	1	1	6
VI Columbia Basin	12,105	4,674	6	64	2	12	13	3
VII Colorado Plateau	17,534	6,770	42	36	6	6	9	1
TOTALS	480,570	185,549	52	31	8	5	3	1

Population Size

Estimates of greater sage-grouse abundance were mostly anecdotal prior to the implementation of systematic surveys in the 1950s (Braun 1998, p. 139). Early reports suggested the birds were abundant throughout their range, with estimates of historical populations ranging from 1,600,000 to 16,000,000 birds (65 FR 51580, August 24, 2000). However, concerns about extinction were raised in early literature due to market hunting and habitat alteration (Hornaday 1916, pp. 181-185). Following a review of published literature and anecdotal reports, Connelly *et al.* (2004, ES-1-3) concluded that the abundance of sage-grouse has declined from presettlement (defined as 1800) numbers. Most of the historical population changes were the result of local extirpations, which has been inferred from a 44 percent reduction in sage-grouse distribution described by Schroeder *et al*. 2004 (Connelly *et al*. 2004, p. 6-9).

Population numbers are difficult to estimate due to the large range of the species, physical difficulty in accessing some areas of habitat, the cryptic coloration and behavior of hens (Garton *et al*. in press, p. 6), and survey protocols. Problems with inconsistent sampling protocols for lek surveys (e.g., number of times a lek is counted, number of leks surveyed in a year, observer bias, observer experience, time counted) were identified by Walsh *et al*. (2006, pp. 61-64) and Garton *et al*. (in press, p. 6), and many of those problems still persist (Stiver *et al*. 2006, p. 3-1). Additionally, estimating population sizes using lek data is difficult as the relationship of those data to actual population size (e.g., ratio of males to females, percent unseen birds) is usually unknown (WAFWA 2008, p. 3). However, the annual counting of males on leks remains the primary approach to monitor long-term trends of populations (WAFWA 2008, p. 3), and standardized techniques are beginning to be implemented throughout the species' range (Stiver *et al*. 2006, pp. 3-1 to 3-16). The use of harvest data for estimating population numbers also is of limited value since both harvest and the population size on which harvest is based are estimates. Given the limitations of these data, States usually rely on a combination of actual counts of birds on leks and harvest data to estimate population size. Estimates of populations by State, generated from a variety of data sources, are provided in Table 4.

TABLE 4—SAGE-GROUSE POPULATION ESTIMATES BASED ON DATA FROM STATE WILDLIFE AGENCIES.

Location	Data Year	Source	Estimated Population
CA/NV	2004	California/Nevada Sage-grouse Conservation Team (2004, p. 26)	88,000
CO	2008	2007 CO Conservation plan, based on adjusted male lek counts (count + 1.6 multiplier, sex ratio females:males) (Colorado Greater Sage-grouse Steering Committee 2008, p. 56)	22,646
ID	2007	Calculated based on assumption of 5% of population is harvested (Service, unpublished data)	98,700
MT	2007	Calculated based on assumption of 5% of population is harvested (Service, unpublished data)	62,320
ND	2007	2008 lek counts adjusted (assumes 75% of males counted at lek, & sex ratio of 2:1) (A. Robinson, NDGFD, pers. comm., 2008)	308
OR	2003	2003 Oregon Conservation Plan Estimate (Hagen 2005, p. 27)	40,000
SD	2007	South Dakota Game and Fish web page (last updated in 2007)	1,500
UT	2002	Utah Division of Wildlife Resources (2002, p. 13)	12,999
WA	2003	Washington Division of Fish and Wildlife (Stinson *et al.* 2004, p. 21)	1,059
WY	2007	Calculated based on assumption of 5% of population is harvested (Service, unpublished data)	207,560
Canada	2006	Government of Canada 2010	450

Braun (1998, p. 141) estimated that the minimum 1998 rangewide spring population numbered about 157,000 sage-grouse, derived from numbers of males counted on leks. The same year, State wildlife agencies within the range of the species estimated the population was at least 515,000 based on lek counts and harvest data (Warren 2008, pers. comm.). In 2000, we estimated the rangewide abundance of sage-grouse was between a minimum of 100,000 (taken from Braun 1998, p. 141) up to 500,000 birds (based on harvest data from Idaho, Montana, Oregon, and Wyoming, with the assumption that 10 percent of the population is typically harvested) (65 FR 51578, August 24, 2000). In 2003, based on increased lek survey efforts, Connelly *et al*. (2004, p. 13-5) concluded that rangewide population numbers were likely much greater than the 157,000 estimated by Braun (1998, p. 141), but they were unable to generate a rangewide population estimate. Garton *et al*., (in press, p. 2) estimated a rangewide minimum of 88,816 males counted on leks in 2007, the last year data were formally collated and reported. Estimates of historical populations range from 1,600,000 to 16,000,000 birds (65 FR 51580).

Population Trends

Although population numbers are difficult to estimate, the long-term data collected from counting males on leks provides insight to population trends. Periods of historical decline in sage-grouse abundance occurred from the late 1800s to the early-1900s (Hornaday 1916, pp. 179-221; Crawford 1982, pp. 3-6; Drut 1994, pp. 2-5; WDFW 1995; Braun 1998, p. 140; Schroeder *et al*. 1999, p. 1). Other noticeable declines in sage-grouse populations occurred in the 1920s and 1930s, and then again in the 1960s and 1970s (Connelly and Braun 1997, pp. 3-4; Braun 1998, p. 141). Declines in the 1920s and 1930s were attributed to hunting, and declines in the 1960s and 1970s were primarily as a result of loss of habitat quality and quantity (Connelly and Braun 1997, p. 2). State wildlife agencies were sufficiently concerned with the decline in the 1920s and 1930s that many closed their hunting seasons and others significantly reduced bag limits and season lengths as a precautionary measure (Patterson 1952, pp. 30-33; Autenrieth 1981, p. 10).

Using lek counts as an index for abundance, Connelly *et al*. (2004, p. 6-71) reported rangewide declines from 1965 through 2003. Declines averaged 2 percent per year from 1965 to 2003. The decline was more dramatic from 1965 through 1985, with an average annual change of 3.5 percent. The rate of decline rangewide slowed to 0.37 percent annually during 1986 to 2003 and some populations increased (Connelly *et al*. 2004, p. 6-71). Based on these analyses, Connelly *et al*. 2004 (p. 6-71) estimated that sage-grouse population numbers in the late 1960s and early 1970s were likely two to three times greater than current numbers (Connelly *et al*. 2004, p. 6-71). Using a statistical population reconstruction approach, Garton *et al*. (in press, p. 67) also demonstrated a pattern of higher numbers of sage-grouse in the late 1960s and early 1970s, which was supported by data from several other sources (Garton *et al*. in press, p. 68).

In 2008, WAFWA conducted new population trend analyses that incorporated an additional 4 years of data beyond the Connelly *et al*. 2004 analysis (WAFWA 2008, entire). Although the WAFWA analyses used different statistical techniques, lek counts also were used. WAFWA results were similar to Connelly *et al*. (2004) in that a long-term population decline was detected during 1965 to 2007 (average 3.1 percent annually; WAFWA 2008, p. 12). WAFWA attributed the decline to the reduction in number of active leks (WAFWA 2008, p. 51). Similar to Connelly *et al*. (2004), the WAFWA analyses determined that the rate of decline lessened during 1985 to 2007 (average annual change of 1.4 percent annually) (WAFWA 2008, p. 58). Garton *et al*. (in press, pp. 68-69) also had similar results. While the average annual rate of decline has lessened since 1985 (3.1 to 1.4 percent), population declines continue and populations are now at much lower levels than in the early 1980's. Therefore, these continuing negative trends at such low relative numbers are concerning regarding long-term population persistence. Similarly, short-term increases or stable trends, while on the surface seem encouraging, do not indicate that populations are recovering but may instead be a function of losing leks and not increases in numbers (WAFWA 2008, p.51). Population stability may also be compromised if cycles in sage-grouse populations (Schroeder *et al*. 1999, p. 15; Connelly *et al*. 2004, p.6-71) are lost, which current analyses suggest, minimizing the opportunities for population recovery if habitat were available (Garton 2009, pers. comm.).

Although the MZs were not formally adopted by WAFWA until 2006, the population trend analyses conducted by Connelly *et al*. (2004) included trend analyses based on the same floristic provinces used to define the zones. While the average annual rate of change was not presented, the results of those analyses indicated long-term declines in greater sage-grouse for MZs I, II, III, IV and VI. Population trends in MZs V and VII were increasing, but the trends were not statistically significant (Connelly *et al*. 2004, p. 6-71; Stiver *et al*. 2006, p. 1-7). WAFWA (2008) and Garton *et al*. (in press) population trend analyses did consider MZs. The WAFWA (2008, pp. 13-27) and Garton *et al*. (in press, pp. 22-62) reported that MZs I through VI had negative population trends from 1965 to 2007. All population trend analyses had similar results, with the exception of MZ VII (Table 5). However, this MZ has one of the highest proportions of inactive leks (Garton *et al*. in press, p. 65), which may imply that male numbers on the remaining leks are increasing as birds relocate. The analysis of this MZ also suffered from small sample sizes and therefore large confidence intervals (Garton *et al*. in press, p. 217), so the trend may not actually reflect the population status.

TABLE 5—LONG-TERM POPULATION TREND ESTIMATES FOR GREATER SAGE-GROUSE MANAGEMENT ZONES.

MZ	States and Provinces Included	Population Trend Estimates 1965-2003* (Connelly *et al*. 2004)	Population Trend Estimates Based on Annual Rates of Change (%) 1965-2007(WAFWA 2008)	Population Trend Estimates Based on Annual Rates of Change (%) 1965–2007 (Garton *et al*. in press)
I	MT, WY, ND, SD, SK, AL	Long-term decline	-2.9	-2.9
II	ID, WY, UT, CO	Long-term decline	-2.7	-3.5
III	UT, NV, CA	Long-term decline	-2.2	-10**
IV	ID, UT, NV, OR	Long-term decline	-3.8	-4**
V	OR, CA, NV	Change statistically undetectable	-3.3	-2**
VI	WA	Long-term decline	-5.1	-6.5
VII	CO, UT	Change statistically undetectable	No detectable trend	+34**

*Average annual rate of change was not reported.
**Due to sample inadequacies for the statistical analyses used, only data from 1995 to 2007 could be used.

Differences in the MZ trends observed between the three analyses are minimal, with the exception of MZs III, V, and VII. While the results of Connelly *et al*. (2004) and WAFWA (2008) were similar for MZ III, Garton *et al*. (in press) showed a larger rate of decline. This difference may be due to the shortened time period (12 versus 42 years) Garton *et al*. (in press) used for the analyses because some earlier data were not suitable for the statistical procedures used. This increased rate of decline was not observed for MZ IV where Garton *et al*.'s (in press) analyses also spanned only 12 years, suggesting that declines in MZ III may have recently accelerated. No explanation was offered by WAFWA (2008) about the difference between their analyses and Connelly *et al*. (2004) for MZ V. However, Garton *et al*. (in press) results are similar to WAFWA for the same area.

The difference in the annual rate of change between Connelly *et al*. (2004) and WAFWA (2008) as compared to Garton *et al*. (in press) for MZ VII is substantial (Table 5). Garton *et al*. (in press) did not offer an explanation of this difference, but Connelly *et al*.

(2004; as cited by (Stiver *et al*. 2006, p. 1-7)) indicated population trends were increasing in this MZ, although those increases were not statistically significant. However, Garton *et al*. (in press, pp. 62-63) reported that the number of leks in MZ VII declined by 39 percent during the same analysis period. The increase in annual rate of change may simply reflect increases on remaining leks as habitat became more limited.

In addition to calculating annual rates of change by MZ, Garton *et al* (in press) also reported the percent change in number of males per lek from 1965 to 2007, the percent change of active leks from 1965 to 2007, and minimum male population estimates in 2007 (Table 6). The percent change in number of males per lek and the percent change in active leks reflect population declines, and possibly habitat loss in all MZs.

TABLE 6—MINIMUM MALE GREATER SAGE-GROUSE POPULATION ESTIMATES IN 2007, PERCENT CHANGE IN NUMBER OF MALES PER LEK AND PERCENT CHANGE IN NUMBER OF ACTIVE LEKS BETWEEN 1965 AND 2007 BY MANAGEMENT ZONE (FROM GARTON *et al.* IN PRESS, PP. 22-64).

MZ	Min Population Est in 2007 (# of males)	Percent Change in # of Males per Lek (1965–2007)	Percent Change of Active Leks (1965–2007)
I	14,814	-17	-22
II	42,429	-30	-7
III	6,851	-24	-16 ***
IV	15,761	-54	-11***
V	6,925	-17**	-21**
VI	315	-76	-57
VII	241	-13	-39*

*1995 to 2007 — due to sample sizes, only data from this time period were used.
**1985 to 2007 — due to sample sizes, only data from this time period were used.
***1975 to 2007 — due to sample sizes, only data from this time period were used.

In summary, since neither presettlement nor current numbers of sage-grouse are accurately known, the actual rate and magnitude of decline since presettlement times is uncertain. However, three groups of researchers using different statistical methods (but the same lek count data) concluded that rangewide greater sage-grouse have experienced long-term population declines in the past 43 years, with that decline lessening in the past 22 years. Many of these declines are the result of loss of leks (WAFWA 2008, p. 51), indicating either a direct loss of habitat or habitat function (Connelly and Braun 1997, p. 2). A recent increase in the annual rate of change for MZ VII may simply be an anomaly of small population numbers, as other indicators suggest this area is suffering habitat losses. A delayed response of sage-grouse to changes in carrying capacity was identified by Garton *et al*. (in press, p.71).

Connectivity

Greater sage-grouse are a landscape-scale species, requiring large expanses of sagebrush to meet all seasonal habitat requirements. The loss of habitat from fragmentation and conversion decreases the connectivity between seasonal habitats potentially resulting in the loss of the population (Doherty *et al*. 2008, p. 194). Loss of connectivity also can increase population isolation (Knick and Hanser in press, p. 4, and references therein) and, therefore, the probability of loss of genetic diversity and extirpation from stochastic events.

Analyses of connectivity of greater sage-grouse across the sagebrush landscape were conducted by Knick and Hanser (in press, entire). Knick and Hanser (in press, p. 29) found that the average movement between population centers (leks) of sage-grouse rangewide was 16.6 km (10.3 mi), with a standard deviation of 7.3 km (4.5 mi). Leks within 18 km (11.2 mi) of each other had common features when compared to leks further than this distance (Knick and Hanser in press, p. 17). Therefore, they used a distance of 18 km (11.2 mi) between leks to assess connectivity (movement between populations), but cautioned that this distance may not accurately reflect genetic flow, or lack thereof, between populations (Knick and Hanser in press, p. 28). Genetic evidence suggests that exchange of individual birds has not been restricted, although there is a gradation of allelic frequencies across the species' range (Oyler-McCance and Quinn, in press, p. 14). This result suggests that widespread movements (e.g., across several States) are not occurring.

Population linkages primarily occurred within MZs, and connectivity between MZs was limited, with the exception of MZs I (Great Plains) and II (Wyoming Basin). Within MZs, the Wyoming Basin (MZ II) had the highest levels of connectivity, followed by MZ IV (Snake River Plain) and MZ I (Great Plains) (Knick and Hanser in press, p. 18). The MZ VI (Columbia Basin) and VII (Colorado Plateau) had the least internal connectivity, suggesting there was limited dispersal between leks and an existing relatively high degree of isolation (Knick and Hanser in press, p. 18). Areas along the edges of the sage-grouse range (e.g., Columbia Basin, Bi-State area) are currently isolated from other sage-grouse populations (Knick and Hanser in press, p. 28).

Connectivity between sage-grouse MZs and the populations within them declined across all three analysis periods examined: 1965–1974, 1980–1989, and 1998–2007. The decline in connectivity was due to the loss of leks and reduced population size (Knick and Hanser in press, p. 29). Historic leks with low connectivity also were lost (Knick and Hanser in press, p. 20), suggesting that current isolation of leks by distance (including habitat fragmentation) will likely result in their future loss (Knick and Hanser in press, p. 28). Small decreases in lek connectivity resulted in large increases in probability of lek abandonment (Knick and Hanser, in press, p. 29). Therefore, maintaining habitat connectivity and sage-grouse population numbers are essential for sage-grouse persistence.

Sagebrush distribution was the most important factor in maintaining connectivity (Knick and Hanser in press, p. 32). This result suggests that any activities that remove or fragment sagebrush habitats will contribute to loss of connectivity and population isolation. This conclusion is consistent with research from both Aldridge *et al.* (2008, p. 988) and Wisdom *et al.* (in press, p. 13), which independently identified the proximity of sagebrush patches and area in sagebrush cover as the best predictors for sage-grouse presence.

Summary of Information Pertaining to the Five Factors

Section 4 of the Act (16 U.S.C. 1533) and implementing regulations (50 CFR part 424) set forth procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. In making this finding, we summarize below information regarding the status and threats to the greater sage-grouse in relation to the five factors provided in section 4(a)(1) of the Act. Under section (4) of the Act, we may determine a species to be endangered or threatened on the basis of any of the following five factors: (A) Present or threatened destruction, modification, or curtailment of habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Our evaluation of threats is based on information provided in the petition, available in our files, and other sources considered to be the best scientific and commercial information available, including published and unpublished studies and reports.

Differences in ecological conditions within each MZ affect the susceptibility of these areas to the various threats facing sagebrush ecosystems and its potential for restoration. For example, *Centaurea diffusa* (diffuse knapweed), an exotic annual weed, is most competitive within shrub-grassland communities where antelope bitterbrush is dominant (MZ VI), and *Bromus tectorum* (cheatgrass) is more dominant in areas with minimal summer precipitation (MZs III and V) (Miller *et al.*, in press, pp. 20-21). Therefore, we stratify our analyses by these MZs because they represent zones within which ecological variation is less than what it would be across the range of the species. This approach allows us to better assess the impact and benefits of actions occurring across the species' range and in turn more accurately assess the status of the species.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Several factors are contributing to the destruction, modification, or curtailment of the greater sage-grouse's habitat or range. Several recent studies have demonstrated that sagebrush area is one of the best landscape predictors of greater sage-grouse persistence (Aldridge *et al.* 2008, p. 987; Doherty *et al.* 2008, p. 191; Wisdom *et al.*, in press, p. 17). Sagebrush habitats are becoming increasingly degraded and fragmented due to the impacts of multiple threats, including direct conversion, urbanization, infrastructure such as roads and powerlines built in support of several activities, wildfire and the change in wildfire frequency, incursion of invasive plants, grazing, and nonrenewable and renewable energy development. Many of these threat factors are exacerbated by the effects of climate change, which may influence long-term habitat trends.

Habitat Conversion for Agriculture

Sagebrush is estimated to have covered roughly 120 million ha (296 million ac; Schroeder *et al.* 2004, p. 365) in western North America, but large portions of that area have been cultivated for the production of agricultural crops (e.g., potatoes, wheat; Schroeder *et al.* 1999, p. 16; 2000, p. 11). Western rangelands were converted to agricultural lands on a large scale beginning with the series of Homestead Acts in the 1800s (Braun 1998, p. 142, Hays *et al.* 1998, p. 26; Knick in press, p. 4; Knick *et al.* in press, p. 11), especially where suitable deep soil terrain and water were available (Rogers 1964, p.13, Schroeder and Vander Haegen, 2009, in press, p. 3). Connelly *et al.* (2004, p. 5-55) estimated that 24.9 million ha (61.5 million ac) within the sage-grouse conservation area (SGCA) used for their assessment area (historic range of Gunnison and greater sage-grouse plus a 50-km (31-mi) buffer) for sage-grouse is now comprised of agricultural lands, although some areas within the species' range are not sagebrush habitat, and the SGCA is larger than the sage-grouse current distribution. An estimated 10 percent of sagebrush steppe that existed prior to EuroAmerican settlement has been converted to agriculture (Knick *et al.* in press, p. 13). The remaining 90 percent is largely unsuited for agriculture because irrigation is not considered to be feasible, topography and soils are limiting, or temperatures are too extreme for many crops (West 1996 cited in Knick *et al.* in press, p. 13).

Habitat conversion results in loss of habitat available for sage-grouse use. The actual effect of this loss depends on the amount of sagebrush lost, the type of seasonal habitat affected, and the arrangement of habitat lost (large blocks or small patches) (Knick *et al.* in press, p. 15). Direct impacts to sage-grouse depend on the timing of conversion (e.g., loss of nests, eggs). Indirect effects of agricultural activities adjoining sagebrush habitats include increased predation with a resulting reduced sage-grouse nest success (Connelly *et al.* 2004, p. 7-23), increased human presence, and habitat fragmentation.

To estimate the area possibly influenced by these indirect effects, Knick *et al.* (in press, p. 13) applied a "high effective buffer" out to 6.9 km (4.3 mi) from agricultural lands, based on foraging distances of synathropic (ecologically associated with humans) predators (e.g. red foxes (*Vulpes vulpes*) and ravens (*Corvus corax*)). Given the distribution of agricultural activities across the sagebrush range, nearly three quarters of all sagebrush within range of sage-grouse has been influenced by agricultural activities (falls within the high effective buffer) (Knick *et al.* in press, p. 13). This influence includes foraging distances for synathropic predators (Leu *et al.* 2008, p. 1120; Knick *et al.* in press, p. 13), and associated features such as irrigation ditches. Extensive conversion of sagebrush to agriculture within a landscape has decreased abundance of sage-grouse in many portions of their range (Knick and Hanser in press, p. 30, and references therein).

Soil associations have resulted in disproportionate levels of habitat conversion across different sagebrush communities. For example, *Artemisia tridentata* ssp. *vaseyana* is found at lower elevations, in soils that retain moisture 2 to 4 weeks longer than in well-drained, but dry and higher elevation soils typical of *A. t.* ssp. *wyomingensis* locations. Therefore, sagebrush communities dominated by basin big sagebrush (*A. t.* ssp. *tridentata)* have been converted to agriculture more extensively than have communities on poorer soil sites (Winward 2004, p. 29) (also see discussion below).

Large losses of sagebrush shrub-steppe habitats due to agricultural conversion have occurred in some areas within the range of the greater sage-grouse. This loss has been especially apparent in the Columbia Basin of the Northwest (MZ VI), the Snake River Plain of Idaho (MZ IV) (Schroeder *et al.* 2004, p. 370), and the Great Plains (MZ

I) (Knick *et al.* in press, p. 13). Hironaka *et al.* (1983, p. 27) estimated that 99 percent of basin big sagebrush habitat in the Snake River Plain has been converted to cropland. Between 1975 and 1992 alone, 29,762 ha (73,543 ac) of sagebrush habitat were converted to cropland on the Upper Snake River Plain, a 74-percent increase in cropland (Leonard *et al.* 2000, p. 268). The loss of this primarily winter sage-grouse habitat is significantly related to subsequent sage-grouse declines (Leonard *et al.* 2000, p. 268).

Prior to EuroAmerican settlement in the 19th century, Washington had an estimated 42 million ha (103.8 million ac) of shrub-steppe (Connelly *et al.* 2004, p. 7-22). Approximately 60 percent of the original shrub-steppe habitat in Washington has been converted to primarily agricultural uses (Dobler 1994, p. 2). Deep soils supporting shrub-steppe communities in Washington within sage-grouse range continue to be converted to agricultural uses (Vander Haegen *et al.* 2000, p. 1156), resulting in habitat loss. Agriculture is the dominant land cover within sagebrush areas of Washington (42 percent) and Idaho (19 percent) (Miller *et al.*, in press, p. 18). In north-central Oregon (MZ V), approximately 2.6 million ha (6.4 million ac) of habitat were converted for agricultural purposes, essentially eliminating sage-grouse from this area (Willis *et al.* 1993, p. 35). More broadly, across the interior Columbia Basin of southern Idaho, northern Utah, northern Nevada, eastern Oregon (MZ IV), and Washington, approximately 6 million ha (14.8 million ac) of shrub-steppe habitat has been converted to agricultural crops (Altman and Holmes 2000, p. 10).

Braun concluded that development of irrigation projects to support agricultural production in areas where soils were sufficient to support agriculture, in some cases conjointly with hydroelectric dam construction, has resulted in additional sage-grouse habitat loss (Braun 1998, p. 142). The reservoirs formed by these projects impacted native shrub-steppe habitat adjacent to the rivers in addition to supporting the irrigation and direct conversion of shrub-steppe lands to agriculture. The projects precipitated conversion of large expanses of upland shrub-steppe habitat in the Columbia Basin for irrigated agriculture (65 FR 51578). The creation of these reservoirs also inundated hundreds of kilometers of riparian habitats used by sage-grouse broods (Braun 1998, p. 144). However, other small and isolated reclamation projects (4,000 to 8,000 ha (10,000 to 20,000 ac)) were responsible for three-fold localized increases in sage-grouse populations (Patterson 1952, pp. 266-274) by providing water in a semiarid environment, which provided additional insect and forb food resources (e.g., Eden Reclamation Project in Wyoming). Benefits of providing water through agricultural activities may now be negated due to the threat of West Nile virus (WNv) (Walker *et al.* 2004, p. 4).

Five percent of the areas occupied by Great Basin sagebrush have been converted to agriculture, urban or industrial areas (MZs III and IV) (Miller *et al.* in press, p. 18). Five percent has also been converted in the wheatgrass-needlegrass-shrubsteppe (MZ II, primarily in north-central Wyoming) (Miller *et al.*, in press, p. 18). In sagebrush-steppe habitats, 14 percent of sagebrush habitats had been converted to agriculture, urban or industrial activities (MZs II, IV, V, and VI) (Miller *et al.*, in press, pp. 17-18). Nineteen percent of the Great Plains area (MZ I) has been converted to agriculture (Knick *et al.* in press, p. 13). Conversions for sagebrush habitat types by State are detailed in Table 7.

TABLE 7—CURRENT SAGEBRUSH-STEPPE HABITAT AND AGRICULTURAL LANDS WITHIN GREAT BASIN SAGEBRUSH (AS DERIVED FROM LANDFIRE 2006 VEGETATION COVERAGE) (FROM MILLER *et al.* IN PRESS, PP. 17-18).

State	Percent Sagebrush	Percent Agriculture
Washington	23.7	42.4
Montana	56.2*	7.5*
Wyoming	66.0*	3.4*
Idaho	55.0	18.6
Oregon	64.5	8.6
Nevada	58.7	1.3
Utah	37.6	9.7
California	49.8	8.0
Colorado	40.6*	11.8*
TOTAL	55.4	10.0

*Analyses did not include sagebrush lands in the eastern portions of Colorado, Montana, and Wyoming.

Aldridge *et al.* (2008, pp. 990-991) reported that sage-grouse extirpations were more likely to occur in areas where cultivated crops exceeded 25 percent. Their results supported the conclusions of others (e.g., Schroeder 1997, p. 934; Braun 1998, p. 142; Aldridge and Brigham 2003, p. 30) that extensive cultivation and fragmentation of native habitats have been associated with sage-grouse population declines. Wisdom *et al.* (in press, p. 4) identified environmental factors associated with the regional extirpation of sage-grouse. Areas still occupied by sage-grouse have three times less area in agriculture and a mean human density 26 times lower than extirpated areas (Wisdom *et al.*, in press, p. 13). While sage-grouse may forage on agricultural crops (see discussion below), they avoid landscapes dominated by agriculture (Aldridge *et al.* 2008, p. 991). Conversions to croplands in southern Idaho have resulted in isolation of sagebrush-dominated landscapes into less productive regions north and south of the Snake River Plain (Knick *et al.* 2003, p. 618). Therefore, formerly continuous populations in this area are now disconnected (Knick and Hanser in press, p. 52).

Sagebrush habitat continues to be converted for both dryland and irrigated crop production (Montana Farm Services Agency (FSA) in litt, 2009; Braun 1998, p. 142; 65 FR 51578, August 24, 2000). The increasing value of wheat and corn crops has driven new conversions in recent years. For example, the acres of sagebrush converted to tilled agriculture in Montana increased annually from 2005 to 2009, with approximately 10,259 ha (25,351 ac) converted, primarily in the eastern two-thirds of the State (MZ I) (Montana FSA in litt, 2009). In addition, in 2008, a single conversion in central Montana totaled between 3,345 and 10,000 ha (10,000 and 30,000 ac) (MZ I) (Hanebury 2008a, pers. comm.). Other large conversions occurred in the same part of Montana in 2008, although these were unquantified (Hanebury 2008b, pers. comm.). We were unable to gather any further information on crop conversions of sagebrush habitats as there are no systematic efforts to collect State or local data on conversion rates in the majority of the greater sage-grouse range (GAO 2007, p. 16).

In addition to crop conversion for traditional crops, recent interest in the development of crops for use as biofuels could potentially impact sage-grouse. For example, the 2008 Farm Bill authorized the Biomass Crop Assistance Program (BCAP), which provides financial incentives to agricultural producers that establish and produce eligible crops for conversion to bioenergy products (U.S. Department of Agriculture (USDA) 2009b, p. 1). Further loss of sagebrush habitats due to BCAP will negatively impact sage-grouse populations. However, currently we have no way of predicting the magnitude of BCAP impacts to sage-grouse (see discussion under Factor D, below).

Although conversion of shrub-steppe habitat to agricultural crops impacts sage-grouse through the loss of sagebrush on a broad scale, some studies report the use of agricultural crops (e.g., alfalfa) by sage-grouse. When alfalfa fields and other croplands are adjacent to extant sagebrush habitat, sage-grouse have been observed feeding in these fields, especially during brood-rearing (Patterson 1952, p. 203; Rogers 1964, p. 53; Wallestad 1971, p. 134; Connelly *et al.* 1988, p.120; Fischer *et al.* 1997, p. 89). Connelly *et al.* (1988, p. 120) reported seasonal movements of sage-grouse to agricultural crops as sagebrush habitats desiccated during the summer. However, use of irrigated crops may not be beneficial to greater sage-grouse if it increases exposure to pesticides (Knick *et al.* in press, p. 16) and WNv (Walker *et al.* 2004, p. 4).

Some conversion of cropland to sagebrush has occurred in former sage-grouse habitats through the USDA's voluntary Conservation Reserve Program (CRP) which pays landowners a rental fee to plant permanent vegetation on portions of their lands, taking them out of agricultural production. In Washington State (Columbia Basin, MZ VI), sage-grouse have declined precipitously in the Columbia Basin largely due to conversion of sagebrush habitats to cropland (Schroeder and Vander Haegen, in press, p. 4). Approximately 599,314 ha (1,480,937 ac) of converted farmland had been enrolled in the CRP, almost all of which was historically shrub-steppe (Schroeder and Vander Haegen in press, p. 5). Schroeder and Vander Haegen (in press, p. 20) found that CRP lands that have been out of production long enough to allow re-establishment of sagebrush and was juxtaposed to a relatively intact shrub-steppe landscape was most beneficial to sage-grouse. There appears to be some correlation with sage-grouse use of CRP and a slight increase in population size in north-central Washington (Schroeder and Vander Haegen in press, p. 21). Schroeder and Vander Haegen (in press, p. 21) concluded that the loss of CRP due to expiration of the program or incentives to produce biofuels would likely severely impact populations in the Columbia Basin.

Although estimates of the numbers of acres enrolled rangewide in CRP (and the number of acres soon to expire from CRP) are available, the extent of cropland conversion to habitats beneficial to sage-grouse (i.e., CRP lands planted with native grasses, forbs, and shrubs) is not known for any other area barring the Columbia Basin. Thus, outside this area, we cannot judge the overall impact of CRP land to sage-grouse persistence.

Direct habitat loss and conversion also occurs via numerous other landscape uses, including urbanization, livestock forage production, road building, and oil pads. These activities are described in greater detail below. Although we were unable to obtain an estimate of the total amount of sagebrush habitats that have been lost due to these activities, they have resulted in habitat fragmentation, as well as habitat loss.

Urbanization

Low densities of indigenous peoples have been present for more than 12,000 years in the historical range of sage-grouse. By 1900, less than 1 person per km^2 (1 person per 0.4 mi^2) resided in 51 percent of the 325 counties within the SGCA, and densities greater than 10 persons per km^2 (10 persons per 0.4 mi^2) occurred in 4 percent of the counties (Connelly *et al.* 2004, p. 7-24). By 2000, counties with less than 1 person per km^2 (1 person per 0.4 mi^2) occurred in 31 percent of the 325 counties and densities greater than 10 persons per km^2 (10 persons per 0.4 mi^2) occurred in 22 percent of the counties (Connelly *et al.* 2004, p. 7-25). Today, the Columbia Basin (MZ VI) has the highest density of humans while the Great Plains (MZ I) and Wyoming Basin (MZ II) have the lowest (Knick *et al.* in press, p. 19). Growth in the Great Plains (MZ I) continues to be slower than other areas. For example, population densities have increased since 1990 by 7 percent in the Great Plains (MZ I), by 19 percent in the Wyoming Basin (MZ II), and by 31 percent in the Colorado Plateau (MZ VII) (Knick *et al.* in press, p. 19).

The dominant urban areas in the sage-grouse range are located in the Bear River Valley of Utah, the portion of Bonneville Basin southeast of the Great Salt Lake, the Snake River Valley of southern Idaho, and the Columbia River Valley of Washington (Rand McNally Road Atlas 2003; Connelly *et al.* 2004, p. 7-25). Overall, approximately 1 percent of the amount of potential sagebrush (estimated historic range) is now covered by lands classified as urban (Miller *et al.*, in press, p. 18).

Knick *et al* (in press, p. 107) examined the influence of urbanization on greater sage-grouse MZs by adding a 6.9-km (4.3-mi) buffer (an estimate of the foraging distances of mammalian and corvid predators of sage-grouse) to the total area of urban land use. Based the estimates using this approach, the Columbia Basin (MZ VI) was influenced the most by urbanization with 48.4 percent of the sagebrush area affected. The Northern Great Basin (MZ V) was influenced least with 12.5 percent affected. Wyoming Basin (MZ II), which has the majority of sage-grouse in the range, was at 18.4 percent affected.

Since 1950, the western U.S. population growth rate has exceeded the national average (Leu and Hanser in press, p. 4). This growth has led to increases in urban, suburban, and rural development. Rural development has increased especially rapidly in recent decades. For example, the amount of uninhabited area in the Great Basin ecoregion has decreased from 90,000 km^2 (34,749 mi^2) in 1990 to less than 12,000 km^2 (4,633 mi^2) in 2004 (Knick *et al.* in press, p. 20). Urbanization has directly eliminated some sage-grouse habitat (Braun 1998, p. 145). Interrelated effects from urbanization include construction of associated infrastructure (e.g., roads, powerlines, and pipelines) and predation threats from the introduction of domestic pets and increases in predators subsidized by human activities. In particular, municipal solid waste landfills (landfills) and roads have been shown to contribute to increases in common raven (*Corvus corax*) populations (Knight *et al.* 1993 p. 470; Restani *et al.* 2001, p. 403; Webb *et al.* 2004, p. 523). Ravens are known to be an important predator on sage-grouse nests and have been considered a restraint on sage-grouse population growth in some locations (Batterson and Morse 1948, p. 14; Autenrieth 1981, p. 45; Coates 2007, p. 26). Landfills (and roads) are found in every State within the greater sage-grouse range and a number of these are located within or adjacent to sage-grouse habitat.

Recent changes in demographic and economic trends have resulted in greater than 60 percent of the Rocky Mountain West's counties experiencing rural sprawl where rural areas are outpacing urban areas in growth (Theobald 2003, p. 3). In some Colorado counties, up to 50 percent of sage-grouse habitat is under rural subdivision development, and an estimated 3 to 5 percent of all sage-grouse historical habitat in Colorado has already been converted into urban areas (Braun 1998, p. 145). We are unaware of similar estimates for other States within the range of the greater sage-grouse and, therefore, cannot determine the effects of this factor on a rangewide basis. Rural development has increasingly taken the form of low-density (approximately 6 to 25 homes per km^2 (6 to 25 homes per 0.4 mi^2)) home development or exurban growth (Hansen *et al.* 2005, p. 1894). Between 1990 and 2000, 120,000 km^2 (46,332 mi^2) of land were developed at exurban densities nationally (Theobald 2001, p. 553). However, this value includes development nationwide, and we are unable to report values specifically for sagebrush habitats. However, within the Great Basin (including California, Idaho, Nevada, and Utah), human populations have increased 69 percent and uninhabited areas declined by 86 percent between 1990 and 2004 (Leu and Hanser in press, p. 19). Similar to higher density urbanization, exurban development has the potential to negatively affect sage-grouse populations through fragmentation or other indirect habitat loss, increased infrastructure, and increased predation.

In modeling sage-grouse persistence, Aldridge *et al.* (2008, pp. 991-992) found that the density of humans in 1950 was the best predictor of sage-grouse extirpation among the human population metrics considered (including increasing human population growth). Sage-grouse extirpation was more likely in areas having a moderate human population density of at least 4 people per km^2 (4 people per 0.4 mi^2). Increasing human populations were not a good predictor of sage-grouse persistence, most likely because much of the growth occurred in areas that are already no longer suitable for sage-grouse. Aldridge *et al.* (2008, p. 990) also reported that, based on their models, sage-grouse require a minimum of 25 percent sagebrush for persistence in an area. A high probability of persistence required 65 percent sagebrush or more. This result is similar to the results by Wisdom *et al.* (in press, p. 18) who reported that human density was 26 times greater in extirpated sage-grouse areas than in currently occupied range. Therefore, human population growth that results in exurban development in sagebrush habitats will reduce the likelihood of sage-grouse persistence in the area. Given the current demographic and economic trends in the Rocky Mountain West, we believe that rates of urbanization will continue increasing, resulting in further habitat fragmentation and degradation and decreasing the probability of long-term sage-grouse persistence.

Infrastructure in Sagebrush Habitats

Habitat fragmentation is the separation or splitting apart of previously contiguous, functional habitat components of a species. Fragmentation can result from direct habitat losses that leave the remaining habitat in noncontiguous patches, or from alteration of habitat areas that render the altered patches unusable to a species (i.e., functional habitat loss). Functional habitat losses include disturbances that change a habitat's successional state or remove one or more habitat functions; physical barriers that preclude use of otherwise suitable areas; and activities that prevent animals from using suitable habitat patches due to behavioral avoidance.

Sagebrush communities exhibit a high degree of variation in their resistance and resilience to change, beyond natural variation. Resistance (the ability to withstand disturbing forces without changing) and resilience (the ability to recover once altered) generally increase with increasing moisture and decreasing temperatures, and also can be linked to soil characteristics (Connelly *et al.* 2004, p. 13-6). However, most extant sagebrush habitat has been altered since European immigrant settlement of the West (Baker *et al.* 1976, p. 168; Braun 1998, p. 140; Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 13-6), and sagebrush habitat continues to be fragmented and lost (Knick *et al.* 2003, p. 614) through the factors described below. The cumulative effects of habitat fragmentation have not been quantified over the range of sagebrush and most fragmentation cannot be attributed to specific land uses (Knick *et al.* 2003, p. 616). However, in large-scale analysis of the collective effect of anthropogenic features (or the "human footprint") in the western United States, Leu *et al.* (2008, p. 1130) found that 13 percent of the area was affected in some way by anthropogenic features (i.e., fragmentation). Areas with the lowest "human footprint" (i.e., no to slight development or use) experienced above-average human population growth between 1990 and 2000. There is significant evidence these areas will experience increasing habitat fragmentation in the future (Leu *et al.* 2008, p. 1133). Although the area covered by these estimates includes all western states, we believe the general points regarding effects of anthropogenic features apply to sage-grouse habitat.

Fragmentation of sagebrush habitats has been cited as a primary cause of the decline of sage-grouse populations because the species requires large expanses of contiguous sagebrush (Patterson 1952, pp. 192-193; Connelly and Braun 1997, p. 4; Braun 1998, p. 140; Johnson and Braun 1999, p. 78; Connelly *et al.* 2000a, p. 975; Miller and Eddleman 2000, p. 1; Schroeder and Baydack 2001, p. 29; Johnsgard 2002, p. 108; Aldridge and Brigham 2003, p. 25; Beck *et al.* 2003, p. 203; Pedersen *et al.* 2003, pp. 23-24; Connelly *et al.* 2004, p. 4-15; Schroeder *et al.* 2004, p. 368; Leu *et al.* in press, p. 19). The negative effects of habitat fragmentation have been well documented in numerous bird species, including some shrub-steppe obligates (Knick and Rotenberry 1995, pp. 1068-1069). However, prior to 2005, detailed data to assess how fragmentation influences specific greater sage-grouse life-history parameters such as productivity, density, and home range were not available. More recently, several studies have documented negative effects of fragmentation as a result of oil and gas development and its associated infrastructure (see discussion of Energy Development below) on lek persistence, lek attendance, winter habitat use, recruitment, yearling annual survival rate, and female nest site choice (Holloran 2005, p. 49; Aldridge and Boyce 2007, pp. 517-523; Walker *et al.* 2007a, pp. 2651-2652; Doherty *et al.* 2008, p. 194). Wisdom *et al.* (in press, p. 18) reported that a variety of human developments, including roads, energy development, and other factors that contribute to habitat fragmentation have contributed to or been associated with sage-grouse extirpation. Estimating the impact of habitat fragmentation on sage-grouse is complicated by time lags in response to habitat changes (Garton *et al.*, in press, p. 71), particularly since these long-lived birds will continue to return to altered breeding areas (leks, nesting areas, and early brood-rearing areas) due to strong site fidelity despite nesting or productivity failures (Wiens and Rotenberry 1985, p. 666).

Powerlines

Power grids were first constructed in the United States in the late 1800s. The public demand for electricity has grown as human population and industrial activities have expanded (Manville 2002, p. 5), resulting in more than 804,500 km (500,000 mi) of transmission lines (lines carrying greater than 115,000 volts (115 kilovolts (kV)) by 2002 within the United States (Manville 2002, p. 4). A similar estimate is not available for distribution lines (lines carrying less than 69,000volts (69kV)), and we are not aware of data for Canada. Within the SGCA, Knick *et al.* (*in press*, p. 21) showed that powerlines cover a minimum of 1,089km^2 (420.5 mi).

Due to the potential spread of invasive species and predators as a result of powerline construction the impact from the powerline is greater than the actual footprint. Knick *et al.* (in press, p. 111) estimated these impacts may influence up to 39 percent of all sagebrush in the SGCA. Powerlines can directly affect greater sage-grouse by posing a collision and electrocution hazard (Braun 1998, pp. 145-146; Connelly *et al.* 2000a, p. 974), and can have indirect effects by decreasing lek recruitment (Braun *et al.* 2002, p. 10), increasing predation (Connelly *et al.* 2004, p. 13-12), fragmenting habitat (Braun 1998, p. 146), and facilitating the invasion of exotic annual plants (Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 7-25). In 1939, three adult sage-grouse died as a result of colliding with a telegraph line in Utah (Borell 1939, p. 85). Both Braun (1998, p. 145) and Connelly *et al.* (2000a, p. 974) report that sage-grouse collisions with powerlines occur, although no specific instances were presented. There was also an unpublished observation reported by Aldridge and Brigham (2003, p. 31). In 2009, two sage-grouse died from electrocution after colliding with a powerline in the Mono Basin of California (Gardner 2009, pers. comm.). We were unable to find any other documentation of other collisions or electrocution of sage-grouse resulting from powerlines.

In areas where the vegetation is low and the terrain relatively flat, power poles provide an attractive hunting and roosting perch, as well as nesting stratum for many species of raptors and corvids (Steenhof *et al.* 1993, p. 27; Connelly *et al.* 2000a, p. 974; Manville 2002, p. 7; Vander Haegen *et al.* 2002, p. 503). Power poles increase a raptor's range of vision, allow for greater speed during attacks on prey, and serve as territorial markers (Steenhof *et al.* 1993, p. 275; Manville 2002, p. 7). Raptors may actively seek out power poles where natural perches are limited. For example, within 1 year of construction of a 596-km (372.5-mi) transmission line in southern Idaho and Oregon, raptors and common ravens began nesting on the supporting poles (Steenhof *et al.* 1993, p. 275). Within 10 years of construction, 133 pairs of raptors and ravens were nesting along this stretch (Steenhof *et al.* 1993, p. 275). Raven counts have increased by approximately 200 percent along the Falcon-Gondor transmission line corridor in Nevada within 5 years of construction (Atamian *et al.* 2007, p. 2). The increased abundance of raptors and corvids within occupied sage-grouse habitats can result in increased predation. Ellis (1985, p. 10) reported that golden eagle (*Aquila chryrsaetos*) predation on sage-grouse on leks increased from 26 to 73 percent of the total predation after completion of a transmission line within 200 meters (m) (220 yards (yd)) of an active sage-grouse lek in northeastern Utah. The lek was eventually abandoned, and Ellis (1985, p. 10) concluded that the presence of the powerline resulted in changes in sage-grouse dispersal patterns and caused fragmentation of the habitat.

Leks within 0.4 km (0.25 mi) of new powerlines constructed for coalbed methane development in the Powder River Basin of Wyoming had significantly lower growth rates, as measured by recruitment of new males onto the lek, compared to leks further from these lines, which were presumed to be the result of increased raptor predation (Braun *et al.* 2002, p. 10). Within the SGCA, Connelly *et al.* (2004, p. 7-26) estimated that the area potentially influenced by additional perches for corvids and raptors provided by powerlines, assuming a 5- to 6.9-km (3.1- to 4.3-mi) radius buffer around the perches based on the average foraging distance of these predators, was 672,644 to 837,390 km^2 (259,641 to 323,317 mi^2), or 32 to 40 percent of the SGCA. The actual impact on the area would depend on corvid and raptor densities within the area, the amount of cover to reduce predation risk at sage-grouse nests, and other factors (see discussion in Factor C, below).

The presence of a powerline may fragment sage-grouse habitats even if raptors are not present. Braun (1998, p. 146) found that use of otherwise suitable habitat by sage-grouse near powerlines increased as distance from the powerline increased for up to 600 m (660 yd) and, based on that unpublished data, reported that the presence of powerlines may limit sage-grouse use within 1 km (0.6 mi) in otherwise suitable habitat. Similar results were recorded for other grouse species. Pruett *et al.* (2009, p. 6) found that lesser and greater prairie-chickens (*Tympanuchus pallidicinctus* and *T. cupido*, respectively) avoided otherwise suitable habitat near powerlines. Additionally, both species also crossed powerlines less often than nearby roads, which suggests that powerlines are a particularly strong barrier to movement (Pruett *et al.* 2009, p. 6).

Sage-grouse also may avoid powerlines as a result of the electromagnetic fields (Wisdom *et al.* in press, p. 19). Electromagnetic fields have been demonstrated to alter the behavior, physiology, endocrine systems, and immune function in birds, with negative consequences on reproduction and development (Fernie and Reynolds 2005, p. 135). Birds are diverse in their sensitivities to electromagnetic field exposures, with domestic chickens being very sensitive. Many raptor species are less affected (Fernie and Reynolds 2005, p. 135).

Linear corridors through sagebrush habitats can facilitate the spread of invasive species, such as *Bromus tectorum* (Gelbard and Belnap 2003, pp. 424-426; Knick *et al.* 2003, p. 620; Connelly *et al.* 2004, p. 1-2). However, we were unable to find any information regarding the amount of invasive species incursion as a result of powerline construction.

Powerlines are common to nearly every type of anthropogenic habitat use, except perhaps some forms of agricultural development (e.g., livestock grazing) and fire. Although we were unable to find an estimate of all future proposed powerlines within currently occupied sage-grouse habitats, we anticipate that powerlines will continue to increase into the foreseeable future, particularly given the increasing development of energy resources and urban areas. For example, up to 8,579 km (5,311 mi) of new powerlines are predicted for the development of the Powder River Basin coal-bed methane field in northeastern Wyoming (BLM 2003) in addition to the approximately 9,656 km (6,000 mi) already constructed in that area. In November 2009, nine Federal agencies signed a Memorandum of Understanding to expedite the building of new transmission lines on Federal lands. If these lines cross sage-grouse habitats, sage-grouse will likely be negatively affected.

Communication Towers

Within sage-grouse habitats, 9,510 new communication towers have been constructed within recent years (Connelly *et al.* 2004, p. 13-7). While millions of birds are killed annually in the United States through collisions with communication towers and their associated structures (e.g., guy wires, lights) (Shire *et al.* 2000, p. 5; Manville 2002, p. 10), most documented mortalities are of migratory songbirds. We were unable to determine if any sage-grouse mortalities occur as a result of collision with communication towers or their supporting structures, as most towers are not monitored and those that are lie outside the range of the species (Kerlinger 2000, p. 2; Shire *et al.* 2000 p. 19). Cellular towers have the potential to cause sage-grouse mortality via collisions, to influence movements through avoidance of a tall structure (Wisdom *et al.* in press, p. 20), or to provide perches for corvids and raptors (Steenhof *et al.* 1993, p. 275; Connelly *et al.* 2004, p. 13-7).

In a comparison of sage-grouse locations in extirpated areas of their range (as determined by museum species and historical observations) and currently occupied habitats, the distance to cellular towers was nearly twice as far from grouse locations in currently occupied habitats than extirpated areas (Wisdom *et al.* in press, p. 13). The results may have been influenced by location as many cellular towers are close to intensive human development. However, such associations with other indicators of development and cellular towers were low (Wisdom *et al.* in press, p. 20). High levels of electromagnetic radiation within 500 m (547 yd) of all towers have been linked to decreased populations and reproductive performance of some bird and amphibian species (Wisdom *et al.* in press, p. 19, and references therein). We do not know if greater sage-grouse are negatively impacted by electromagnetic radiation, or if their avoidance of these structures is a response to increased predation risk.

Fences

Fences are used to delineate property boundaries and for livestock management (Braun 1998, p. 145; Connelly *et al.* 2000a, p. 974). The effects of fencing on sage-grouse include direct mortality through collisions, creation of predator (raptor) and corvid perch sites, the potential creation of predator corridors along fences (particularly if a road is maintained next to the fence), incursion of exotic species along the fencing corridor, and habitat fragmentation (Call and Maser 1985, p. 22; Braun 1998, p. 145; Connelly *et al.* 2000a, p. 974; Beck *et al.* 2003, p. 211; Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 1-2).

More than 1,000 km (625 mi) of fences were constructed annually in sagebrush habitats from 1996 through 2002, mostly in Montana, Nevada, Oregon, and Wyoming (Connelly *et al.* 2004, p. 7-34). Over 51,000 km (31,690 mi) of fences were constructed on BLM lands supporting sage-grouse populations between 1962 and 1997 (Connelly *et al.* 2000a, p. 974). Sage-grouse frequently fly low and fast across sagebrush flats, and fences can create a collision hazard (Call and Maser 1985, p. 22). Thirty-six carcasses of sage-grouse were found near Randolph, Utah, along a 3.2-km (2-mi) fence within 3 months of its construction (Call and Maser 1985, p. 22). Twenty-one incidents of mortality through fence collisions near Pinedale, Wyoming, were reported in 2003 to the BLM (Connelly *et al.* 2004, p. 13-12). A recent study in Wyoming confirmed 146 sage-grouse fence strike mortalities over a 31–month period along a 7.6-km (4.6-mi) stretch of 3-wire BLM range fence (Christiansen 2009).

Not all fences present the same mortality risk to sage-grouse. Mortality risk appears to be dependent on a combination of factors including design of fencing, landscape topography, and spatial relationship with seasonal habitats (Christiansen 2009, unpublished data). Although the effects of direct strike mortality on populations are not understood, fences are ubiquitous across the landscape. In many parts of the sage-grouse range (primarily Montana, Nevada, Oregon, Wyoming) fences exceed densities of more than 2 km/km^2 (1.2 mi/0.4 mi^2; Knick *et al.* in press, p. 32). Fence collisions continue to be identified as a source of mortality for sage-grouse, and we expect this source of mortality to continue into the foreseeable future (Braun 1998, p. 145; Connelly *et al.* 2000a, p. 974; Oyler-McCance *et al.* 2001, p. 330; Connelly *et al.* 2004, p. 7-3).

Fence posts create perching places for raptors and corvids, which may increase their ability to prey on sage-grouse (Braun 1998, p. 145; Oyler-McCance *et al.* 2001, p. 330; Connelly *et al.* 2004, p. 13-12). We anticipate that the effect on sage-grouse populations through the creation of new raptor perches and predator corridors into sagebrush habitats is similar to that of powerlines discussed previously (Braun 1998, p. 145; Connelly *et al.* 2004, p. 7-3). Fences and their associated roads also facilitate the spread of invasive plant species that replace sagebrush plants upon which sage-grouse depend (Braun 1998, p. 145; Connelly *et al.* 2000a, p. 973; Gelbard and Belnap 2003, p. 421; Connelly *et al.* 2004, p. 7-3). Greater sage-grouse avoidance of habitat adjacent to fences, presumably to minimize the risk of predation, effectively results in habitat fragmentation even if the actual habitat is not removed (Braun 1998, p. 145).

Roads

Interstate highways and major paved roads cover approximately 2,500 km^2 (965 mi^2) or 0.1 percent of the SGCA (Knick *et al.* in press, p. 21). Based on applying a 7-km (4.3-mi) buffer to estimate the potential impact of secondary effects from roads, interstates and highways are estimated to influence 851,044 km^2 (328,590 mi^2) or 41 percent of the SGCA. Additionally, secondary paved roads are heavily distributed throughout most of the SGCA, existing at densities of up to greater than 5 km/km^2 (3.1 mi/mi^2). Taken together, 95 percent of all sage-grouse habitats were within 2.5 km (1.5 mi) of a mapped road, and almost no area of sagebrush was greater the 6.9 km (4.3 mi) from a mapped road (Knick *et al.* in press, p. 21).

Impacts from roads may include direct habitat loss, direct mortality, barriers to migration corridors or seasonal habitats, facilitation of predators and spread of invasive vegetative species, and other indirect influences such as noise (Forman and Alexander 1998, pp. 207-231). Sage-grouse mortality resulting from collisions with vehicles does occur (Patterson 1952, p. 81), but mortalities are typically not monitored or recorded. Therefore, we are unable to determine the importance of this factor on sage-grouse populations. Data regarding how roads affect seasonal habitat availability for individual sage-grouse populations by creating barriers and the ability of greater sage-grouse to reach these areas were not available. Road development within Gunnison sage-grouse (*C. minimus*) habitats impeded movement of local populations between the resultant patches, with grouse road avoidance presumably being a behavioral means to limit exposure to predation (Oyler-McCance *et al.* 2001, p. 330).

Roads can provide corridors for predators to move into previously unoccupied areas. For some mammalian species, dispersal along roads has greatly increased their distribution (Forman and Alexander 1998, p. 212; Forman 2000, p. 33). Corvids also use linear features such as primary and secondary roads as travel routes, expanding their movements into previously unused regions (Knight and Kawashima 1993, p. 268; Connelly *et al.* 2004, p. 12-3). In an analysis of anthropogenic impacts, at least 58 percent of the SGCA had a high or medium estimated presence of corvids (Connelly *et al.* 2004, p. 12-6). Corvids are important sage-grouse nest predators and in a study in Nevada were positively identified via video recorder as responsible for more than 50 percent of nest predations in the study area (Coates 2007, pp. 26-30). Bui (2009, p. 31) documented ravens following roads in oil and gas fields during foraging. Additionally, highway rest areas provide a source of food and perches for corvids and raptors, and facilitate their movements into surrounding areas (Connelly *et al.* 2004, p. 7-25).

The presence of roads increases human access and resulting disturbance effects in remote areas (Forman and Alexander 1998, p. 221; Forman 2000, p. 35; Connelly *et al.* 2004, pp. 7-6 to 7-25). Increases in legal and illegal hunting activities resulting from the use of roads built into sagebrush habitats have been documented (Hornaday 1916, p. 183; Patterson 1952, p. vi). However, the actual current effect of these increased activities on sage-grouse populations has not been determined. Roads also may facilitate access for rangeland habitat treatments, such as disking or mowing (Connelly *et al.* 2004, p. 7-25), resulting in subsequent direct habitat losses. New roads are being constructed to support development activities within the greater sage-grouse extant range. In the Powder River Basin of Wyoming, up to 28,572 km (17,754 mi) of roads to support coalbed methane development are proposed (BLM 2003).

The expansion of road networks contributes to exotic plant invasions via introduced road fill, vehicle transport, and road maintenance activities (Forman and Alexander 1998, p. 210; Forman 2000, p. 32; Gelbard and Belnap 2003, p. 426; Knick *et al.* 2003, p. 619; Connelly *et al.* 2004, p. 7-25). Invasive species are not limited to roadsides, but also encroach into surrounding habitats (Forman and Alexander 1998, p. 210; Forman 2000, p. 33; Gelbard and Belnap 2003, p. 427). In their study of roads on the Colorado Plateau of southern Utah, Gelbard and Belnap (2003, p. 426) found that improving unpaved four-wheel drive roads to paved roads resulted in increased cover of exotic plant species within the interior of adjacent plant communities. This effect was associated with road construction and maintenance activities and vehicle traffic, and not with differences in site characteristics. The incursion of exotic plants into native sagebrush systems can negatively affect greater sage-grouse through habitat losses and conversions (see further discussion in Invasive Plants, below).

Additional indirect effects of roads may result from birds' behavioral avoidance of road areas because of noise, visual disturbance, pollutants, and predators moving along a road. The absence of vegetation in arid and semiarid regions that may buffer these impacts further exacerbates the problem (Suter 1978, p. 6). Male sage-grouse lek attendance was shown to decline within 3 km (1.9 mi) of a methane well or haul road with traffic volume exceeding one vehicle per day (Holloran 2005, p. 40). Male sage-grouse depend on acoustical signals to attract females to leks (Gibson and Bradbury 1985, p. 82; Gratson 1993, p. 692). If noise interferes with mating displays, and thereby female attendance, younger males will not be drawn to the lek and eventually leks will become inactive (Amstrup and Phillips 1977, p. 26; Braun 1986, pp. 229-230).

Dust from roads and exposed roadsides can damage vegetation through interference with photosynthetic activities. The actual amount of potential damage depends on winds, wind direction, the type of surrounding vegetation and topography (Forman and Alexander 1998, p. 217). Chemicals used for road maintenance, particularly in areas with snowy or icy precipitation, can affect the composition of roadside vegetation (Forman and Alexander 1998, p. 219). We were unable to find any data relating these potential effects directly to impacts on sage-grouse population parameters.

In a study on the Pinedale Anticline in Wyoming, sage-grouse hens that bred on leks within 3 km (1.9 mi) of roads associated with oil and gas development traveled twice as far to nest as did hens bred on leks greater than 3 km (1.9 mi) from roads. Nest initiation rates for hens bred on leks close to roads also were lower (65 versus 89 percent) affecting population recruitment (33 versus 44 percent) (Lyon 2000, p. 33; Lyon and Anderson 2003, pp. 489-490). Lyon and Anderson (2003, p. 490) suggested that roads may be the primary impact of oil and gas development to sage-grouse, due to their persistence and continued use even after drilling and production have ceased. Braun *et al.* (2002, p. 5) suggested that daily vehicular traffic along road networks for oil wells can impact sage-grouse breeding activities based on lek abandonment patterns.

In a study of 804 leks within 100 km (62.5 mi) of Interstate 80 in southern Wyoming and northeastern Utah, Connelly *et al.* (2004, p. 13-12) found that there were no leks within 2 km (1.25 mi) of the interstate and only 9 leks were found between 2 and 4 km (1.25 and 2.5 mi) along this same highway. The number of active leks increased with increasing distance from the interstate. Lek persistence and activity relative to distance from the interstate also were measured. The distance of a lek from the interstate was a significant predictor of lek activity, with leks further from the interstate more likely to be active. An analysis of long-term changes in populations between 1970 and 2003 showed that leks closest (within 7.5 km (4.7 mi)) to the interstate declined at a greater rate than those further away (Connelly *et al.* 2004, p. 13-13). Extirpated sage-grouse range was 60 percent closer to highways (Wisdom *et al.* in press, p. 18). What is not clear from these studies is what specific factor relative to roads (e.g., noise, changes in vegetation, etc.) sage-grouse are responding to. Connelly *et al.* (2004, p. 13-13) caution that they have not included other potential sources of indirect disturbance (e.g., powerlines) in their analyses.

Aldridge *et al.* (2008, p. 992) did not find road density to be an important factor affecting sage-grouse persistence or rangewide patterns in sage-grouse extirpation. However, the authors did not consider the intensity of human use of roads in their modeling efforts. They also indicated that their analyses may have been influenced by inaccuracies in spatial road data sets, particularly for secondary roads (Aldridge *et al.* 2008, p. 992). However, Wisdom *et al.* (in press, p. 18) found that extirpated range has a 25 percent higher density of roads than occupied range. Wisdom *et al.*'s (in press) rangewide analysis supports the findings of numerous local studies showing that roads can have both direct and indirect impacts on sage-grouse distribution and individual fitness (e.g., Lyon and Anderson 2003, Aldridge and Boyce 2007).

Railroads

Railroads presumably have the same potential impacts to sage-grouse as do roads because they create linear corridors within sagebrush habitats. Railways and the cattle they transport were primarily responsible for the initial spread of *Bromus tectorum* in the intermountain region (Connelly *et al.* 2004, p. 7-25). *B. tectorum*, an exotic species that is unsuitable as sage-grouse habitat, readily invaded the disturbed soils adjacent to railroads. Fires created by trains facilitated the spread of *B. tectorum* into adjacent areas. Knick *et al.* (in press, p. 109) found that railroads cover 487 km^2 (188 mi^2) or less than 0.1 percent of the SGCA, but they estimated railroads could influence 10 percent of the SGCA based adding a 3-km (1.9-mi) buffer to estimate potential impacts from the exotic plants they can spread. Avian collisions with trains occur, although no estimates of mortality rates are documented in the literature (Erickson *et al.* 2001, p. 8).

Summary: Habitat Conversion for Agriculture; Urbanization; Infrastructure

Large losses of sagebrush shrub-steppe habitats due to agricultural conversion have occurred range wide, but have been especially significant in the Columbia Basin of Washington (MZ VI), the Snake River Plain of Idaho (MZ IV), and the Great Plains (MZ I). Conversion of sage brush habitats to cropland continues to occur, although quantitative data is available only for Montana. We do not know the current rate of conversion, but most areas suitable for agricultural production were converted many years ago. The current rate of conversion is likely to increase in the future if incentives for crop production for use as biofuels continue to be offered. Urban and exurban development also have direct and indirect negative effects on sage-grouse, including direct and indirect habitat losses, disturbance, and introduction of new predators and invasive plant species. Given current trends in the Rocky Mountain west, we expect urban and exurban development to continue. Infrastructure such as powerlines, roads, communication towers, and fences continue to fragment sage-grouse habitat. Past and current trends lead us to believe this source of fragmentation will increase into the future. Fragmentation of sagebrush habitats through a variety of mechanisms including those listed above has been cited as a primary cause of the decline of sage-grouse populations (Patterson 1952, pp. 192-193; Connelly and Braun 1997, p. 4; Braun 1998, p. 140; Johnson and Braun 1999, p. 78; Connelly *et al.* 2000a, p. 975; Miller and Eddleman 2000, p. 1; Schroeder and Baydack 2001, p. 29; Johnsgard 2002, p. 108; Aldridge and Brigham 2003, p. 25; Beck *et al.* 2003, p. 203; Pedersen *et al.* 2003, pp. 23-24; Connelly *et al.* 2004, p. 4-15; Schroeder *et al.* 2004, p. 368; Leu *et al.* in press, p. 19). The negative effects of habitat fragmentation on sage-grouse are diverse and include reduced lek persistence, lek attendance, winter habitat use, recruitment, yearling annual survival, and female nest site choice (Holloran 2005, p. 49; Aldridge and Boyce 2007, pp. 517-523; Walker *et al.* 2007a, pp. 2651-2652; Doherty *et al.* 2008, p. 194). Since fragmentation is associated with most anthropogenic activities, the effects are ubiquitous across the species range (Knick *et al.* in press, p. 24). We agree with the assessment that habitat fragmentation is a primary cause of sage-grouse decline and in some areas has already led to population extirpation. We also conclude that habitat fragmentation will continue into the foreseeable future and will continue to threaten the persistence of greater sage-grouse.

Fire

Many of the native vegetative species of the sagebrush-steppe ecosystem are killed by wildfires, and recovery requires many years. As a result of this loss of habitat, fire has been identified as a primary factor associated with greater sage-grouse population declines (Hulet 1983, *in* Connelly *et al.* 2000a, p. 973; Crowley and Connelly 1996, *in* Connelly *et al.* 2000c, p. 94; Connelly and Braun 1997, p. 232; Connelly *et al.* 2000a, p. 973; Connelly *et al.* 2000c, p. 93; Miller and Eddlemen 2000, p. 24; Johnson *et al.*, in press, p. 12; Knick and Hanser, in press, pp. 29-30). In nesting and wintering sites, fire causes direct loss of habitat due to reduced cover and forage (Call and Maser 1985, p. 17). For example, prescribed fires in mountain big sagebrush at Hart Mountain National Antelope Refuge caused a short-term increase in certain forbs, but reduced sagebrush cover, making habitat less suitable for nesting (Rowland and Wisdom 2002, p. 28). Similarly, Nelle *et al.* (2000, p. 586) and Beck *et al.* (2009, p. 400) reported nesting habitat loss from fire, creating a long-term negative impact that will require 25 to 150 years of sagebrush regrowth before sufficient canopy cover becomes available for nesting birds.

In southeastern Idaho, sage-grouse populations were generally declining across the entire study area, but declines were more severe in post-fire years (Connelly *et al.* 2000c, p. 93). Further, Fischer *et al.* (1997, p. 89) concluded that habitat fragmentation caused by fire may influence distribution or migratory patterns in sage-grouse. Hulet (1983, in Connelly *et al.* 2000a, p. 973) documented the loss of leks from fire.

Fire within 54 km (33.6 mi) of a lek is one of two primary factors in predicting lek extirpation (Knick and Hanser in press, p. 26). Small increases in the amount of burned habitat surrounding a lek had a large influence on the probability of lek abandonment (Knick and Hanser, in press, pp. 29-30). Additionally, fire had a negative effect on lek trends in the Snake River Plain (MZ IV) and Southern Great Basin (MZ III) (Johnson *et al.* in press, p.12). Several recent studies have demonstrated that sagebrush area is one of the best landscape predictors of greater sage-grouse persistence (Aldridge *et al.* 2008, p. 987; Doherty *et al.* 2008, p. 191; Wisdom *et al.*, in press, p. 17). While there may be limited instances where burned habitat is beneficial, these gains are lost if sagebrush habitat is not readily available (Woodward 2006, p. 65).

Herbaceous understory vegetation plays a critical role throughout the breeding season as a source of forage and cover for sage-grouse females and chicks. The response of herbaceous understory vegetation to fire varies with differences in species composition, pre-burn site condition, fire intensity, and pre- and post-fire patterns of precipitation. In general, when not considering the synergistic effects of invasive species, any short-term flush of understory grasses and forbs is lost after only a few years and little difference is apparent between burned and unburned sites (Cook *et al.* 1994, p. 298; Fischer *et al.* 1996, p. 196; Crawford 1999, p. 7; Wrobleski 1999, p. 31; Nelle *et al.* 2000, p. 588; Paysen *et al.* 2000, p. 154; Wambolt *et al.* 2001, p. 250). Independent of the response of perennial grasses and forbs to fire, the most important and widespread sagebrush species for greater sage-grouse (i.e., big sagebrush) are killed by fire and require decades to recover. Prior to recovery, these sites are of limited to no use to sage-grouse (Fischer *et al.* 1996, p. 196; Connelly *et al.* 2000c, p. 90; Nelle *et al.* 2000, p. 588; Beck *et al.* 2009, p. 400). Therefore, fire results in direct, long-term habitat loss.

In addition to altering plant community structure, fires can influence invertebrate food sources

(Schroeder *et al*. 1999, p. 5). Ants (Hymenoptera), grasshoppers (Orthoptera), and beetles (Coleoptera) are an essential component of juvenile greater sage-grouse diets, especially in the first 3 weeks of life (Johnson and Boyce 1991, p. 90). Crawford and Davis (2002, p. 56) reported that the abundance of arthropods did not decline following wildfire. Pyle (1992, p. 14) reported no apparent effect of prescribed burning to beetles. However, Fischer *et al*. (1996, p. 197) found that the abundance of insects was significantly lower 2–3 years post-burn. Additionally, grasshopper abundance declined 60 percent in burned plots versus unburned plots 1 year post-burn, but this difference disappeared the second year (Bock and Bock 1991, p. 165). Conversely, Nelle *et al*. (2000, p. 589) reported the abundance of beetles and ants was significantly greater in 1–year-old burns, but returned to pre-burn levels by years 3 to 5. The effect of fire on insect populations likely varies due to a host of environmental factors. Because few studies have been conducted and the results of those available vary, the specific magnitude and duration of the effects of fire on insect communities is still uncertain, as is the effect any changes may have on greater sage-grouse populations.

The few studies that have suggested fire may be beneficial for greater sage-grouse were primarily conducted in mesic areas used for brood-rearing (Klebenow 1970, p. 399; Pyle and Crawford 1996, p. 323; Gates 1983, *in* Connelly *et al*. 2000c, p. 90; Sime 1991, *in* Connelly *et al*. 2000a, p. 972). In this habitat, small fires may maintain a suitable habitat mosaic by reducing shrub encroachment and encouraging understory growth. However, without available nearby sagebrush cover, the utility of these sites is questionable. For example, Slater (2003, p. 63) reported that sage-grouse using burned areas were rarely found more than 60 m (200 ft) from the edge of the burn and may preferentially use the burned and unburned edge habitat. However, Byrne (2002, p. 27) reported avoidance of burned habitat by nesting, brood-rearing, and broodless females. Both Connelly *et al*. (2000c, p. 90) and Fischer *et al*. (1996, p. 196) found that prescribed burns did not improve brood-rearing habitat in Wyoming big sagebrush, as forbs did not increase and insect populations declined. Hence, fires in these locations may negatively affect brood-rearing habitat rather than improve it (Connelly and Braun 1997, p. 11).

The nature of historical fire patterns in sagebrush communities, particularly in *Artemisia tridentata* var. *wyomingensis*, is not well understood and a high degree of variability likely occurred (Miller and Eddleman 2000, p. 16; Zouhar *et al*. 2008, p. 154; Baker in press, p. 16). However, as inferred by several lines of reasoning, fire in sagebrush systems was historically infrequent (Baker in press, pp. 15-16). This conclusion is evidenced by the fact that most sagebrush species have not developed evolutionary adaptations such as re-sprouting and heat-stimulated seed germination found in other shrub-dominated systems, like chaparral, exposed to relatively frequent fire events. Baker (in press, p. 17) suggests natural fire regimes and landscapes were typically shaped by a few infrequent large fire events that occurred at intervals approaching the historical fire rotation (50 to 350 years – see discussion below). The researcher concludes that the historical sagebrush systems likely consisted of extensive sagebrush habitat dotted by small areas of grassland and that this condition was maintained by long interludes of numerous small fires, accounting for little burned area, punctuated by large fire events that consumed large expanses. In general, fire extensively reduces sagebrush within burned areas, and big sagebrush varieties, the most widespread species of sagebrush, can take up to 150 years to reestablish an area (Braun 1998, p. 147; Cooper *et al*. 2007, p. 13; Lesica *et al*. 2007, p. 264; Baker, in press, pp. 15-16).

Fire rotation, or the average amount of time it takes to burn once through a particular landscape, is difficult to quantify in large sagebrush expanses. Because sagebrush is killed by fire, it does not record evidence of prior burns (i.e., fire scars) as do forested systems. As a result, a clear picture of the complex spatial and temporal pattern of historical fire regimes in most sagebrush communities is not available. Widely variable estimates of historical fire rotation have been described in the literature. Depending on the species of sagebrush and other site-specific characteristics, fire return intervals from 10 to well over 300 years have been reported (McArthur 1994, p. 347; Peters and Bunting 1994, p. 33; Miller and Rose 1999, p. 556; Kilpatrick 2000, p. 1; Frost 1998, *in* Connelly *et al*. 2004, p. 7-4; Zouhar *et al*. 2008, p. 154; Baker in press, pp. 15-16). In general, mean fire return intervals in low-lying, xeric, big sagebrush communities range from over 100 to 350 years, and return intervals decrease from 50 to over 200 years in more mesic areas, at higher elevations, during wetter climatic periods, and in locations associated with grasslands (Baker 2006, p. 181; Mensing *et al*. 2006, p. 75; Baker, in press, pp. 15-16; Miller *et al*., in press, p. 35).

The invasion of exotic annual grasses, such as *Bromus tectorum* and *Taeniatherum asperum* (medusahead), has been shown to increase fire frequency within the sagebrush ecosystem (Zouhar *et al*. 2008, p. 41; Miller *et al*. in press, p. 39). *B. tectorum* readily invades sagebrush communities, especially disturbed sites, and changes historical fire patterns by providing an abundant and easily ignitable fuel source that facilitates fire spread. While sagebrush is killed by fire and is slow to reestablish, *B. tectorum* recovers within 1 to 2 years of a fire event (Young and Evans 1978, p. 285). This annual recovery leads to a readily burnable fuel source and ultimately a reoccurring fire cycle that prevents sagebrush reestablishment (Eiswerth *et al*. 2009, p. 1324). In the Snake River Plain (MZ IV), for example, Whisenant (1990, p. 4) suggests fire rotation due to *B. tectorum* establishment is now as low as 3–5 years. It is difficult and usually ineffective to restore an area to sagebrush after annual grasses become established (Paysen *et al*. 2000, p. 154; Connelly *et al*. 2004, pp. 7-44 to 7-50; Pyke, in press, p. 25). Habitat loss from fire and the subsequent invasion by nonnative annual grasses have negatively affected sage-grouse populations in some locations (Connelly *et al*. 2000c, p. 93).

Evidence exists of a significant relationship between an increase in fire occurrence caused by *Bromus tectorum* invasion in the Snake River Plain and Northern Great Basin since the 1960s (Miller *et al*., in press, p. 39) and in northern Nevada and eastern Oregon since 1980 (MZs IV and V). The extensive distribution and highly invasive nature of *B. tectorum* poses substantial increased risk of fire and permanent loss of sagebrush habitat, as areas disturbed by fire are highly susceptible to further invasion and ultimately habitat conversion to an altered community state. For example, Link *et al*. (2006, p. 116) show that risk of fire increases from approximately 46 to 100 percent when ground cover of *B. tectorum* increases from 12 to 45 percent or more. In the Great Basin Ecoregion (defined as east-central California, most of Nevada, and western Utah, MZs IV and V), approximately 58 percent of sagebrush habitats are at moderate to high risk of *B. tectorum* invasion during the next 30 years (Suring *et al*. 2005, p. 138). The BLM estimated that approximately 11.9 million ha (29 million ac) of public lands in the western distribution of the greater sage-grouse (Washington, Oregon, Idaho, Nevada, Utah) were infested with weeds as of 2000 (BLM 2007a, p. 3-28). The most dominant invasive plants consist of grasses in the *Bromus* genus, which represent nearly 70 percent of the total infested area (BLM 2007a, p. 3-28).

Conifer woodlands have expanded into sagebrush ecosystems over the last century (Miller *et al.* in press, p. 34). Woodlands can encroach into sagebrush communities when the interval between fires becomes long enough for seedlings to establish and trees to mature and dominate a site (Miller *et al.* in press, p. 36). However, historical fire rotation appears to have been sufficiently long to allow woodland invasion, and yet extensive stands of mature sagebrush were evident during settlement times (Vale 1975, p. 33; Baker, in press, pp. 15-16). This suggests that causes other than active fire suppression must largely explain recent tree invasions into sagebrush habitats (Baker in press, p. 21, 24). Baker (in press, p. 24) and Miller *et al.* (in press, p. 37) offer a suite of causes, acting in concert with fire exclusion that may better explain the dramatic expansion of conifer woodlands over the last century. These causes include alterations due to domestic livestock grazing (such as reduced competition from native grasses and forbs and facilitation of tree regeneration by increased shrub cover and enhanced seed dispersal), climatic fluctuations favorable to tree regeneration, enhanced tree growth due to increased water use efficiency associated with carbon dioxide fertilization, and recovery from past disturbance (both natural and anthropogenic). Regardless of the cause of conifer woodland encroachment, the rate of expansion is increasing and is resulting in the loss and fragmentation of sagebrush habitats (see discussion in Pinyon-juniper section below).

Between 1980 and 2007, the number of fires and total area burned increased in all MZs across the greater sage-grouse's range except the Snake River Plain (MZ IV) (Miller *et al.*, in press, p. 39). Additionally, average fire size increased in the Southern Great Basin (MZ III) during this same period. However, predicting the amount of habitat that will burn during an "average fire" year is difficult due to the highly variable nature of fire seasons. For example, the approximate area burned on or adjacent to BLM-managed lands varied from 140,000 ha (346,000 ac) in 1998 to a 6-fold increase in 1999 (814,200 ha; 2 million ac) returning back down to approximately the 1998 level in 2002 (157,700 ha; 384,743 ac) before rising again 10-fold in 2006 (1.4 million ha; 3.5 million ac) (Miller *et al.*, in press, pp. 39-40).

From 1980 to 2007, wildfires have burned approximately 8.7 million ha (21.5 million ac) of sagebrush, or approximately 18 percent of the estimated 47.5 million ha (117.4 million ac) of sagebrush habitat occurring within the delineated MZs (Baker, in press, p. 43). Additionally, the trend in total acreage burned since 1980 has primarily increased (Miller *et al.*, in press, p. 39). Although fire alters sagebrush habitats throughout the greater sage-grouse's range, fire disproportionately affects the Great Basin (Baker *et al.* in press, p. 20) (i.e., Utah, Nevada, Idaho, and eastern Oregon; MZ III, IV, and V) and will likely influence the persistence of greater sage-grouse populations in the area. In these three MZs combined, nearly 27 percent of sagebrush habitat has burned since 1980 (Baker, in press, p. 43). A primary reason for this disproportionate influence in this region is due to the presence of burned sites and their subsequent susceptibility to invasion by exotic annual grasses.

According to one review, range fires destroyed 30 to 40 percent of sage-grouse habitat in southern Idaho (MZ IV) in a 5–year period (1997–2001) (Signe Sather-Blair, BLM, *in* Healy 2001). This amount included about 202,000 ha (500,000 ac), which burned between 1999 and 2001, significantly altering the largest remaining contiguous patch of sagebrush in the State (Signe Sather-Blair, BLM, *in* Healy 2001). Between 2003 and 2007, Idaho lost an additional 267,000 ha (660,000 ac) of sage-grouse habitat, or approximately 7 percent of the total estimated remaining habitat in the State. Over nine fire seasons in Nevada (1999–2007), about 1 million ha (2.5 million ac) of sagebrush were burned, representing approximately 12 percent of the State's extant sagebrush habitat (Espinosa and Phenix 2008, p. 3). Most of these fires occurred in northeast Nevada (MZ IV) within quality habitat that has traditionally supported high densities of sage-grouse, which also is highly susceptible to *Bromus tectorum* invasion.

Baker (in press, p. 20) calculated recent fire rotation by MZ and compared these to estimates of historical fire rotations. Based on this analysis, the researcher suggests that increased fire rotations since 1980 are presumably outside the historic range of variability and far shorter in floristic regions where Wyoming big sagebrush is common (Baker in press, p. 20). This analysis included MZs III, IV, V, and VI, all of which have extensive *Bromus tectorum* invasions.

In addition to wildfire, land managers are using prescribed fire as well as mechanical and chemical treatments to obtain desired management objectives for a variety of wildlife species and domestic ungulates in sagebrush habitats throughout the range of the greater sage-grouse. While the efficacy of treatments in sagebrush habitats to enhance sage-grouse populations is questionable (Peterson 1970, p. 154; Swensen *et al.* 1987, p. 128; Connelly *et al.* 2000c, p. 94; Nelle *et al.* 2000, p. 590; WAFWA 2009, p. 12; Connelly *et al.* in press c, p. 8), as with wildland fire, an immediate and potentially long-term result is the loss of habitat (Beck *et al.* 2009, p. 400).

Knick *et al.* (in press, p. 33) report that more than 370,000 ha (914,000 ac) of public lands were treated with prescribed fire to address management objectives for many different species between 1997 and 2006, mostly in Oregon and Idaho, and an additional 124,200 ha (306,900 ac) were treated with mechanical means over this same time period, primarily in Utah and Nevada. However, these acreages represent all habitat types and thus overestimate negative impacts to greater sage-grouse. Quantifying the amount of sagebrush-specific habitat treatments is difficult due to the fact that centralized reporting is not typically categorized by habitat. However, agencies under the Department of the Interior (DOI) report species of special interest, including greater sage-grouse, which may occur in proximity to a prescribed treatment. Between 2003 and 2008, approximately 133,500 ha (330,000 ac) of greater sage-grouse habitat have been burned by land managers within the DOI or approximately 22,000 ha (55,000 ac) annually. This acreage does not reflect lands burned by agencies under the USDA (e.g., USFS). Although much of the land under USFS jurisdiction lies outside greater sage-grouse range, this agency manages approximately 8 percent of sagebrush habitats. Ultimately, the amount of sagebrush habitat treated by land managers appears to represent a relatively minor loss when compared to loss incurred by wildfire. However, in light of the significant habitat loss due to wildfire, and the preponderance of evidence that suggests these treatments are not beneficial to sage-grouse, the rationale for using such treatments to improve sage-grouse habitat deserves further scrutiny.

Sagebrush recovery rates are highly variable, and precise estimates are often hampered by limited data from older burns. Factors contributing to the rate of shrub recovery include the amount of and distance from unburned habitat, abundance and viability of seed in soil seed bank (depending on species, sagebrush seeds are typically viable for one to three seasons), rate of seed dispersal, and pre- and post-fire weather, which influences seedling germination and establishment (Young and Evans 1989, p. 204; Maier *et al*. 2001, p. 701; Ziegenhagen and Miller 2009, p. 201). Based on a review of existing literature, Baker (in press, pp. 14-15) reports that full recovery to pre-burn conditions in *Artemisia tridentata* ssp. *vaseyana* communities ranges between 25 and 100 years and in *A. t.* ssp. *wyomingensis* communities between 50 and 120 years. However, the researcher cautions that data pertaining to the latter community is sparse. What is known is that by 25 years post-fire, *A. t.* ssp. *wyomingensis* typically has less than 5 percent pre-fire canopy cover (Baker in press, p. 15).

A variety of techniques have been employed to restore sagebrush communities following a fire event (Cadwell *et al*. 1996, p. 143; Quinney *et al*. 1996, p. 157; Livingston 1998, p. 41). The extent and efficacy of restoration efforts is variable and complicated by limitations in capacity (personnel, equipment, funding, seed availability, and limited seeding window), incomplete knowledge of appropriate methods, invasive plant species, and abiotic factors, such as weather, that are largely outside the control of land managers (Hemstrom *et al*. 2002, pp. 1250-1251; Pyke, in press, p. 29). While post-fire rehabilitation efforts have benefited from additional resources in recent years, resulting in an increase of treated acres from 28,100 ha (69,436 ac) in 1997 to 1.6 million ha (3.9 million ac) in 2002 (Connelly *et al*. 2004, p. 7-35), acreage treated annually remains far outpaced by acreage disturbed. For example, of the more than 1 million ha (2.5 million ac) of sage-grouse habitat burned during the 2006 and 2007 fire seasons on BLM-managed lands, about 40 percent or 384,000 ha (950,000 ac) had some form of active post-fire restoration such as reseeding. More specifically, Eiswerth *et al*. (2009, p. 1321) report that over the past 20 years within the BLM's Winnemucca District in Nevada, approximately 12 percent of burned areas have been actively reseeded.

The main purpose of the Burned Area Emergency Stabilization and Rehabilitation program (BLM 2007b, pp. 1-2), designed to rehabilitate areas following fire, is to stabilize soils and maintain site productivity rather than to regain site suitability for wildlife (Pyke, in press, p. 24). Consequently, in areas that experience active post-fire restoration efforts, an emphasis is often placed on introduced grasses that establish quickly. Only recently has a modest increase in the use of native species for burned area rehabilitation been reported (Richards *et al*. 1998, p. 630; Pyke, in press, p. 24). Further complicating our understanding of the effectiveness of these treatments is that most managers do not keep track of monitoring data in a routine or systematic fashion (GAO 2003, p. 5). Assuming complete success of restoration efforts on targeted areas, however unlikely, the return of a shrub-dominated community will still require several decades, and landscape restoration may require centuries or longer (Knick 1999, p. 55; Hemstrom *et al*. 2002, p. 1252). Even longer periods may be required for greater sage-grouse to use recovered or restored landscapes (Knick *et al*., in press, p. 65).

The loss of habitat due to wildland fire is anticipated to increase due to the intensifying synergistic interactions among fire, people, invasive species, and climate change (Miller *et al*., in press, p. 50). The recent past- and present-day fire regimes across the greater sage-grouse distribution have changed with a demonstrated increase in the more arid Wyoming big sagebrush communities and a decrease across many mountain big sagebrush communities. Both scenarios of altered fire regimes have caused significant losses to greater sage-grouse habitat through facilitating conifer expansion at high-elevation interfaces and exotic weed encroachment at lower elevations (Miller *et al*., in press, p. 47). In the face of climate change, both of these scenarios are anticipated to worsen (Baker, in press, p. 24; Miller *et al*., in press, p. 48). Predicted changes in temperature, precipitation, and carbon dioxide are all anticipated to influence vegetation dynamics and alter fire patterns resulting in the increasing loss and conversion of sagebrush habitats (Neilson *et al*. 2005, p. 157). Further, many climate scientists suggest that in addition to the predicted change in climate toward a warmer and generally wetter Great Basin, variability of interannual and interdecadal wet-dry cycles will increase and likely act in concert with fire, disease, and invasive species to further stress the sagebrush ecosystem (Neilson *et al*. 2005, p. 152). The anticipated increase in suitable conditions for wildland fire will likely further interact with people and infrastructure. Human-caused fires have reportedly increased and been shown to be correlated with road presence (Miller *et al*., in press. p. 40). Given the popularity of off-highway vehicles (OHV) and the ready access to lands in the Great Basin, the increasing trend in both fire ignitions by people and loss of habitat will likely continue.

While multiple factors can influence sagebrush persistence, fire is the primary cause of recent large-scale losses of habitat within the Great Basin, and this stressor is anticipated to intensify. In addition to loss of habitat and its influence on greater sage-grouse population persistence, fragmentation and isolation of populations presents a higher probability of extirpation in disjunct areas (Knick and Hanser, in press, p. 20; Wisdom *et al*., in press, p. 22). Knick and Hanser (in press, p. 31) suggest extinction is currently more probable than colonization for many great sage-grouse populations because of their low abundance and isolation coupled with fire and human influence. As areas become isolated through disturbances such as fire, populations are exposed to additional stressors and persistence may be hampered by the limited ability of individuals to disperse into areas that are otherwise not self-sustaining. Thus, while direct loss of habitat due to fire has been shown to be a significant factor associated with population persistence, the indirect effect posed by loss of connectivity among populations may greatly expand the influence of this threat beyond the physical fire perimeter.

Summary: Fire

Fire is one of the primary factors linked to population declines of greater sage-grouse because of long-term loss of sagebrush and conversion to monocultures of exotic grasses (Connelly and Braun 1997, p. 7; Johnson *et al*., in press, p. 12; Knick and Hanser, in press, pp. 29-30). Loss of sagebrush habitat to wildfire has been increasing in western areas of the greater sage-grouse range for the past three decades. The change in fire frequency has been strongly influenced by the presence of exotic annual grasses and significantly deviates from extrapolated historical regimes. Restoration of these communities is challenging, requires many years, and may, in fact, never be achieved in the presence of invasive grass species. Greater sage-grouse are slow to recolonize burned areas even if structural features of the shrub community may have recovered (Knick *et al*., in press, p. 46). While it is not currently possible to predict the extent or location of future fire events, the best scientific and commercial information available indicates that fire frequency is likely to increase in the foreseeable future due to increases in cover of *Bromus tectorum* and the projected effects of climate change (see Invasive plants (annual grasses and other noxious weeds), below, and also Climate Change, below).

An analysis of previously extirpated sage-grouse habitats has shown that the extent and abundance of sagebrush habitats, proximity to burned habitat, and degree of connectivity among sage-grouse groups strongly affects persistence (Aldridge *et al.* 2008, p. 987; Knick and Hanser, in press, pp. 29-30; Wisdom *et al.*, in press, p. 17). The loss of habitat caused by fire and the functional barrier burned habitat can pose to movement and dispersal compounds the influence this stressor can have on populations and population dynamics. Barring alterations to the current fire pattern, as well as the difficulties associated with restoration, the concerns presented by this threat will continue and likely strongly influence persistence of the greater sage-grouse, especially in the western half of its range within the foreseeable future.

Invasive Plants (Annual Grasses and Other Noxious Weeds)

For the purposes of our analysis in this section, we consider invasive plants (invasives) to be any nonnative plant that negatively impacts sage-grouse habitat, including annual grasses and other noxious weeds. However, in the literature that we reviewed, the terms noxious weeds and invasives were not consistently defined or applied. Consequently, both terms are used in our discussion to reflect the original use in the sources we cite. In the source material, it was often unclear whether discussions about noxious weeds included invasive annual grasses (e.g., *Bromus tectorum*), referred solely to invasive forbs and invasive perennial grasses, or only referenced species that are listed on State and Federal noxious weed lists (many of which do not consider *B. tectorum* a noxious weed). Nonetheless, all of these can be categorized as nonnative plants that have a negative impact on sage-grouse habitat and thus meet our definition of invasive plants.

Invasives alter plant community structure and composition, productivity, nutrient cycling, and hydrology (Vitousek 1990, p. 7) and may cause declines in native plant populations through competitive exclusion and niche displacement, among other mechanisms (Mooney and Cleland 2001, p. 5446). Invasive plants reduce and, in cases where monocultures occur, eliminate vegetation that sage-grouse use for food and cover. Invasives do not provide quality sage-grouse habitat. Sage-grouse depend on a variety of native forbs and the insects associated with them for chick survival, and sagebrush, which is used exclusively throughout the winter for food and cover. Invasives impact the entire range of sage-grouse, although not all given species are distributed across the entire range. Leu *et al.* (2008, pp. 1119-1139) modeled the risk of invasion by exotic plant species for the entire range of sage-grouse. Areas at high risk for invasion were distributed throughout the range, but were especially concentrated in eastern Washington (MZ VI), southern Idaho (MZ IV), central Utah (MZ III), and northeast Montana (MZ I).

Along with replacing or removing vegetation essential to sage-grouse, invasives fragment existing sage-grouse habitat. They can create long-term changes in ecosystem processes, such as fire-cycles (see discussion under Fire above) and other disturbance regimes that persist even after an invasive plant is removed (Zouhar *et al.* 2008, p. 33). A variety of nonnative annuals and perennials are invasive to sagebrush ecosystems (Connelly *et al.* 2004, pp. 7-107 and 7-108; Zouhar *et al.* 2008, p 144). *Bromus tectorum* is considered most invasive in *Artemisia tridentata* ssp. *wyomingensis* communities, while *Taeniatherum asperum* fills a similar niche in more mesic communities with heavier clay soils (Connelly *et al.* 2004, p. 5-9). Some other problematic rangeland weeds include *Euphorbia esula* (leafy spurge), *Centaurea solstitialis* (yellow starthistle), *Centaurea maculosa* (spotted knapweed), *Centaurea diffusa* (diffuse knapweed), and a number of other *Centaurea* species (DiTomaso 2000, p. 255; Davies and Svejcar 2008, pp. 623-629).

Nonnative annual grasses (e.g., *Bromus tectorum* and *Taeniatherum asperum*) have caused extensive sagebrush habitat loss in the Intermountain West and Great Basin (Connelly *et al.* 2004, pp. 1-2 and 4-16). They impact sagebrush ecosystems by shortening fire intervals to as low as 3 to 5 years, perpetuating their own persistence and intensifying the role of fire (Whisenant 1990, p. 4). Connelly *et al.* (2004, p. 7-5) suggested that fire intervals are shortened to less than 10 years. Although nonnative annual grasses occur throughout the sage-grouse's range, they are more problematic in western States (MZs III, IV, V, and VI) than Rocky Mountain States (MZs I and II) (Connelly *et al.* 2004, p. 5-9).

Quantifying the total amount of sage-grouse habitat impacted by invasives is problematic due to differing sampling methodologies, incomplete sampling, inconsistencies in species sampled, and varying interpretations of what constitutes an infestation (Miller *et al.*, in press, p. 19). Widely variable estimates of the total acreage of weed infestations have been reported. BLM (1996, p. 6) estimated invasives (which may or may not have included *Bromus tectorum* in their estimate) covered at least 3.2 million ha (8 million ac) of BLM lands as of 1994, and predicted 7.7 million ha (19 million ac) would be infested by 2000. However, a qualitative 1991 BLM survey covering 40 million ha (98.8 million ac) of all BLM-managed land in Washington, Oregon, Idaho, Nevada, and Utah (MZs III, IV, V, and VI) reported that introduced annual grasses were a dominant or significant presence on 7 million ha (17.2 million ac) of sagebrush ecosystems (Connelly *et al.* 2004, p. 5-10). An additional 25.1 million ha (62 million ac) had less than 10 percent *B. tectorum* in the understory, but were considered to be at risk of *B. tectorum* invasion (Zouhar 2003, p. 3, in reference to the same survey). More recently, BLM reported that as of 2000, noxious weeds and annual grasses occupied 11.9 million ha (29.4 million ac) of BLM lands in Washington, Oregon, Idaho, Nevada, and Utah (BLM 2007a, p. 3-28). However, when considering all States within the current range of sage-grouse, this number increases to 14.8 million ha (36.5 million ac). Although estimates of the total area infested by *B. tectorum* vary widely, it is clear that *B. tectorum* is a significant presence in western rangelands.

The Landscape Fire and Resource Management Planning Tools Project (LANDFIRE) has a rangewide dataset documenting annual grass distribution. Based on 1999–2002 imagery, at least 885,990 ha (2.2 million ac) of annual grasses occur within the current range of sage-grouse (LANDFIRE 2007). Satellite data only map annual grass monocultures, and not areas where they occur in lower densities or even dominate the sagebrush understory (which is mapped as sagebrush). Therefore, the LANDFIRE dataset is a gross underestimate of the total acres of infestation. However, this dataset provides a rangewide comparison of annual grass monocultures and identifies the large extent of these monocultures in both the western and eastern part of the sage-grouse's range.

Approximately 80 percent of land in the Great Basin Ecoregion (MZs III, IV, and V) is susceptible to displacement by *Bromus tectorum* (including over 58 percent of sagebrush that is moderately or highly susceptible) within 30 years (Connelly *et al.* 2004, p. 7-17, Suring *et al.* 2005, p. 138). Due to the disproportionate abundance of *B. tectorum* in the Great Basin, suggesting an increased susceptibility to *B. tectorum* invasion than other parts of the sage-grouse's range, Connelly *et al.* (2004, p. 7-8) cautioned that a formal analysis of the risk of *B. tectorum* invasion in other areas was needed before such inferences are made. Also, while nonnative annual grasses are usually associated with lower elevations and drier climates (Connelly *et al.* 2004, p. 5-5), the ecological range of *B. tectorum* continues to expand at low and high elevations (Ramakrishnan *et al.* 2006, pp. 61-62), both southward and eastward (Miller *et al.*, in press, p. 21). Local infestations of *B. tectorum* and other annual grasses occur in Montana, Wyoming, and Colorado (MZs I and II) (Miller *et al.*, in press, p. 21), and there is evidence that *B. tectorum* is impacting fire intervals in Wyoming. For example, 40,469 ha (100,000 ac) of sagebrush that burned in a wildfire southeast of Worland, Wyoming (MZ II), became infested with *B. tectorum*, accelerating the fire interval in this area (Wyoming Big Horn Basin Sage-grouse Local Working Group 2007, pp. 39-40).

Noxious weeds spread about 931 ha (2,300 ac) per day on BLM land and 1,862 ha (4,600 ac) per day on all public land in the West (BLM 1996, p. 1), or increase about 8 to 20 percent annually (*Federal Interagency Committee for the Management of Noxious and Exotic Weeds* 1997, p. v). Invasions are often associated with ground disturbances caused by wildfire, grazing, infrastructure, and other anthropogenic activity (Rice and Mack 1990, p. 84; Gelbard and Belnap 2003, p. 420; Zouhar *et al.* 2008, p. 23), but disturbance is not required for invasives to spread (Young and Allen 1997, p. 531; Roundy *et al.* 2007, p. 614). Invasions also may occur sequentially, where initial invaders (e.g., *Bromus tectorum*) are replaced by new exotics (Crawford *et al.* 2004, p 9; Miller *et al.*, in press, p. 20).

Based on data collected in the western half of the range, Bradley *et al.* (2009, pp. 1511-1521; Bradley 2009, pp. 196-208) predicted favorable conditions for *Bromus tectorum* across much of the sage-grouse's range under current and future (2100) climate conditions. A strong indicator for future *B. tectorum* locations is the proximity to current locations (Bradley and Mustard 2006, p. 1146) as well as summer, annual, and spring precipitation, and winter temperature (Bradley 2009, p. 196). Bradley *et al.* (2009, p. 1517) predicted that in the future some areas will become unfavorable for *B. tectorum* while others will become favorable. Specifically, Bradley *et al.* (2009, p. 1515) predicted that climatically suitable *B. tectorum* habitat will shift northwards, leading to expanded risk in Idaho, Montana, and Wyoming, but reduced risk in southern Nevada and Utah. Despite the potential for future retreat in Nevada and Utah, there will still be climatically suitable *B. tectorum* habitat in these States, well within the range of sage-grouse (see Figure 4b in Bradley *et al.* 2009, p. 1517). Bradley *et al.* (2009, p. 1511) noted that changes in climatic suitability may create restoration opportunities in areas that are currently dominated by invasives. We anticipate that *B. tectorum* will eventually disappear from areas that become climatically unsuitable for this species, but this transition is unlikely to occur suddenly. Also, Bradley *et al.* (2009, p. 1519) cautioned that areas that become unfavorable to *B. tectorum* may become favorable to other invasives, such as *B. rubens* (red brome) in the southern Great Basin, which is more tolerant of higher temperatures. Therefore, areas that become unsuitable for *B. tectorum* will not necessarily be returned to pre-invaded habitat conditions without significant effort. Bradley *et al.* (2009, p. 1519) suggested that modeling and experimental work is needed to assess whether native species could occupy these sites if invasives are reduced or eliminated by climate change.

LANDFIRE also has a rangewide dataset documenting other exotic grasses and forbs, including perennial grasses and annual, perennial, and biennial forbs. Like annual grasses, other invasive plants are grossly underestimated in the LANDFIRE dataset because the dataset only includes monocultures of these species. Based on 1999–2002 imagery, at least 1.3 million ha (3.3 million ac) of other exotic plants occur within the current range of sage-grouse (LANDFIRE 2007). Aside from LANDFIRE, the only other information documenting the specific distribution of invasives within the sage-grouse's range is at a presence–absence scale at the county level. DiTomaso (2000, p. 257) estimated that western rangelands are infested with 2,900,000 ha (7,166,027 ac) of *C. maculosa*, 1,300,000 ha (3,212,357 ac) of *C. diffusa*, 8,000,000 ha (19,768,352 ac) of *C. solstitialis*, and 1,100,000 ha (2,718,148 ac) of *Euphorbia esula,* but this estimate did not describe the distribution of invasives across the landscape. These estimates, combined with estimates of acres infested by *Bromus tectorum,* and the fact that LANDFIRE detected more acres of other noxious weeds than annual grasses, illustrate the severity of the invasives problem.

Invasives that are not annual grasses impact the entire range of sage-grouse, although not all given species are distributed across the entire range. Leu *et al.* (2008, pp. 1119-1139) modeled the risk of invasion by exotic plant species (which also would include annual grasses), for the entire range of sage-grouse. Areas at high risk for invasion were distributed throughout the range, but were especially concentrated in eastern Washington (MZ VI), southern Idaho (MZ IV), central Utah (MZ III), and northeastern Montana (MZ I). Like *Bromus tectorum*, the distribution of other invasives will likely shift with climate change. Bradley *et al.* (2009, p. 1518) predicts that the range of *C. maculosa* will expand in some areas, mainly in parts of Oregon, Idaho, western Wyoming, and Colorado, and will contract in other areas (e.g., eastern Montana). She also predicts that the range of *C. solstitialis* will expand eastward (Bradley *et al.* 2009, p. 1514) and that the invasion risk of *Euphorbia esula* will likely decrease in several States, including parts of Colorado, Oregon, and Idaho (Bradley *et al.* 2009, pp. 1516-1518).

Many efforts are ongoing to restore or rehabilitate sage-grouse habitat affected by invasive species. Common rehabilitation techniques include first reducing the density of invasives using herbicides, defoliation via grazing, pathogenic bacteria and other forms of biocontrol, or prescribed fire (Tu *et al.* 2001; Larson *et al.* 2008, p. 250; Pyke, in press, pp. 25-26). Sites are then typically reseeded with grass and forb mixes, and sometimes planted with sagebrush plugs. Despite ongoing efforts to transform lands dominated by invasive annual grasses into quality sage-grouse habitat, restoration and rehabilitation techniques are considered to be mostly unproven and experimental (Pyke, in press, pp. 25-28, and see discussion on fire above).

Several components of the restoration process are being investigated with varying success (Pyke, in press, p. 25). Some techniques show promise, such as use of the herbicide Imazapic to control *Bromus tectorum*. However, further analyses of the benefit of this method still need to be conducted (Pyke, in press, p. 27). Also, it will take time for sagebrush to establish and mature in areas currently dominated by annual grasses. Rehabilitation and restoration efforts also are hindered by cost and the ability to procure the equipment and seed needed for projects (Pyke, in press, pp. 29-30). Furthermore, while restoration projects for other species may depend on a single site or landowner, restoration of sage-grouse habitat requires partnerships across multiple ownerships in order to restore and maintain a connective network of intact vegetation (Pyke, in press, pp. 33-34).

Treatment success also depends on factors which are not controllable, such as precipitation received at the treatment site (Pyke, in press, p. 30). For example, only 3.3 to 33.6 percent of recent vegetation treatments conducted by the BLM in annual grassland monocultures were reported as successful (Carlson 2008b, pers. comm.). Areas with established annual grasses that receive less than 22.9 cm (9 in.) of annual precipitation are less likely to benefit from restoration (Connelly *et al.* 2004, p. 7-17, Carlson 2008b, pers. comm.). Consequently, BLM focuses most (98 percent) of their restoration efforts in areas receiving more than 22.9 cm (9 in.) of annual precipitation where there is greater chance of success. Of the BLM treatments in annual grasslands, only 10 percent of acres treated in areas receiving less than 22.9 cm (9 in.) of annual precipitation were considered to be effectively treated. In areas receiving between 22.9 cm (9 in.) and 30.5 cm (12 in.) of annual precipitation, 33.6 percent of the acres were treated effectively, and 3.3 percent of the acres were treated effectively in areas receiving greater than 30.5 cm (12 in.) of annual precipitation (Carlson 2008b, pers. comm.). Since the BLM treatments in annual grassland monocultures included both the reestablishment of native shrub and grass species and greenstripping efforts to reduce the frequency of fires in annual grassland monocultures, it is unclear how many of these successfully treated acres are attributed to restoration versus prevention.

A variety of regulatory mechanisms and nonregulatory measures to control invasive plants exist. However, the extent to which these mechanisms effectively ameliorate the current rate of invasive expansion is unclear. If noxious weeds are spreading at a rate of 931 ha (2,300 ac) per day on BLM lands (BLM 1996, p. 1), this amounts to 339,815 ha (839,500 ac) per year, which includes both suitable and nonsuitable habitat for sage-grouse. It is unclear whether this estimate is limited to noxious weeds or if it includes other invasives (e.g., *Bromus tectorum*). Still, we can compare this estimate to the area of all invasives (excluding conifers) treated by the BLM between October 2005 and September 2007, which totaled 259,897 ha (642,216 ac), i.e., approximately 86,632 ha (214,072 ac) treated annually.

The number of acres treated annually (86,632 ha; 214,072 ac) is not keeping pace with the rate of spread (339,815 ha; 839,500 ac) especially when considering the inability to treat the problem. We acknowledge that the rate of spread on BLM lands also includes areas that are not sage-grouse habitat. However, the rate of spread may not have included *B. tectorum* and only part of the invasive treatments completed by BLM (23.6 percent of treatments in annual grassland monocultures and 7.5 percent of treatments in sagebrush with annual grassland understories) were considered to be effective by the BLM (Carlson 2008b, pers. comm.). Also, treatments are typically considered to be successful based on whether native vegetation was reestablished, maintained, or enhanced, and not based on a positive population response of sage-grouse to the treatment. Therefore, the effectiveness of treatments for sage-grouse is likely much less than reported for vegetation.

The National Invasive Species Council (2008, p. 8) acknowledges that there has been a significant increase in activity and awareness, but that much remains to be done to prevent and mitigate the problems caused by invasive species. As an example, the State of Montana has made much progress through partnerships in reducing noxious weeds in the State from 3.2 million ha (8 million ac) in 2000 to 3.1 million ha (7.6 million ac) in 2008 (Montana Weed Control Association 2008). However, the Montana Noxious Weed Summit Advisory Council Weed Management Task Force (2008, p. III) estimates that to slow weed spread and reduce current infestations by 5 percent annually, they require 2.6 times the current level of funding from a variety of private, local, State, and Federal sources (or $55.8 million versus $21.2 million). In addition to funding, other factors that potentially limit ability to control invasives include the amount of available native seed sources, the time it takes to restore sagebrush to an area once it is removed from a site, and the existence of treatments that are known to be effective in the long-term. Monitoring is limited in many cases and, where it occurs, monitoring typically does not document the population response of sage-grouse to these treatments.

Invasives are a serious rangewide threat, and one of the highest risk factors for sage-grouse based on the plants' ability to out-compete sagebrush, the inability to effectively control them once they become established, and the synergistic interaction between them and other risk factors on the landscape (e.g., wildfire, infrastructure construction). Invasives reduce and eliminate vegetation that is essential for sage-grouse to use as food and cover. Their presence on the landscape has removed and fragmented sage-grouse habitat. Because invasives are widespread, have the ability to spread rapidly, occur near areas susceptible to invasion, and are difficult to control, we anticipate that invasives will continue to replace and reduce the quality of sage-grouse habitat across the range in the foreseeable future. There have been many studies addressing effective invasive control methods, as well as conservation actions to control invasives, with varied success. While some efforts appear successful at smaller scales, prevention (e.g., early detection and fire prevention) appears to be the only known effective tool to preclude or minimize large-scale habitat loss from invasive species in the future.

Pinyon-Juniper Encroachment

Pinyon-juniper woodlands are a native habitat type dominated by pinyon pine (*Pinus edulis*) and various juniper species (*Juniperus* spp.) that can encroach upon, infill, and eventually replace sagebrush habitat. These two woodland types are often referred to collectively as pinyon-juniper; however, some portions of the sage-grouse's range are only impacted by juniper encroachment. Commons *et al.* (1999, p. 238) found that the number of male Gunnison sage-grouse (*C. minimus*) on leks in southwestern Colorado doubled after pinyon-juniper removal and mechanical treatment of mountain sagebrush and deciduous brush. Hence, we infer that some greater sage-grouse populations have been negatively affected by pinyon-juniper encroachment and that some populations will decline in the future due to projected increases in the pinyon-juniper type, especially in areas where pinyon-juniper encroachment is a large-scale threat (parts of MZs III, IV, and V). Doherty *et al.* (2008, p. 187) reported a strong avoidance of conifers by female greater sage-grouse in the winter, further supporting our previous inference. Also, Freese's (2009, pp. 84-85, 89-90) 2–year telemetry study in central Oregon found that sage-grouse used areas with less than 5 percent juniper cover more often in the breeding and summer seasons than similar habitat that had greater than 5 percent juniper cover. Therefore, pinyon-juniper encroachment into occupied sage-grouse habitat reduces, and likely eventually eliminates, sage-grouse occupancy in these areas.

Pinyon-juniper woodlands are often associated with sagebrush communities and currently occupy at least 18 million ha (44.6 million ac) of the Intermountain West within the sage-grouse's range (Crawford *et al.* 2004, p. 8; Miller *et al.* 2008, p. 1). Pinyon-juniper extent has increased 10-fold in the Intermountain West since European settlement causing the loss of many bunchgrass and sagebrush-bunchgrass communities (Miller and Tausch 2001, pp. 15-16). This expansion has been attributed to the reduced role of fire, the introduction of livestock grazing, increases in global carbon dioxide concentrations, climate change, and natural recovery from past disturbance (Miller and Rose 1999, pp. 555-556; Miller and Tausch 2001, p. 15; Baker, in press, p. 24; see also discussion under Fire above).

Connelly *et al.* (2004, pp. 7-8 to 7-14) estimated that approximately 60 percent of sagebrush in the Great Basin was at low risk of displacement by pinyon-juniper in 30 years, 6 percent at moderate risk, and 35 percent at high risk. Mountain big sagebrush appears to be most at risk of pinyon-juniper displacement (Connelly *et al.* 2004, pp. 7-13). When juniper increases in mountain big sagebrush communities, shrub cover declines and the season of available succulent forbs is shortened due to soil moisture depletion (Crawford *et al.* 2004, p. 8). As with *Bromus tectorum*, the Great Basin appears more susceptible to pinyon-juniper invasion than other areas of the sage-grouse's range; however, Connelly *et al.* (2004, pp. 7-8) cautioned that a formal analysis of the risks posed in other locations was needed before such inferences could be made.

Annual encroachment rates that were reported in five studies ranged from 0.3 to 31 trees per hectare (0.7 to 77 trees per acre) (Sankey and Germino 2008, p. 413). For the three studies that measured the percent increase in juniper cover per year, cover increased between 0.4 and 4.5 percent annually (Sankey and Germino 2008, p. 413). Sankey and Germino (2008, p. 413) compared juniper encroachment rates from previous research to their study. Their estimate that juniper cover increased 0.7 to 1.5 percent annually was based on a 22 to 30 percent increase in cover between 1985 and 2005 at their southeastern Idaho study site (Sankey and Germino 2008, pp. 412-413).

Pinyon-juniper expansion into sagebrush habitats, with subsequent replacement of sagebrush communities, has been well documented (Miller *et al.* 2000, p. 575; Connelly *et al.* 2004, p. 7-5; Crawford *et al.* 2004, p. 2; Miller *et al.* 2008, p. 1). However, few studies have documented woodland dynamics at the landscape level across different ecological provinces, creating some uncertainty regarding the total amount of expansion that has occurred in sagebrush communities (Miller *et al.* 2008, p. 1). Regardless, we know that up to 90 percent of existing woodlands in the sagebrush-steppe and Great Basin sagebrush vegetation types were previously dominated by sagebrush vegetation prior to the late 1800s (Miller *et al.*, in press, pp. 23-24). Based on past trends and the current distribution of pinyon-juniper relative to sagebrush habitat, we anticipate that expansion will continue at varying rates across the landscape and cause further loss of sagebrush habitat within the western part of the sage-grouse's range, especially in parts of MZs III, IV, and V.

While pinyon-juniper expansion appears less problematic in the eastern portion of the range (MZs I, II and VII) and silver sagebrush areas (primarily MZ I), woodland encroachment is a threat mentioned in Wyoming, Montana, and Colorado State sage-grouse conservation plans, indicating that this is of some concern in these States as well (Stiver *et al.* 2006, p. 2-23). Colorado's State plan mapped areas threatened by pinyon-juniper encroachment in northwestern Colorado, and specifically attributed some sage-grouse habitat loss in Colorado to pinyon-juniper expansion (Colorado Greater Sage-grouse Steering Committee 2008, pp. 179, 182). Furthermore, LANDFIRE (2007) data illustrates extensive coverage of pinyon-juniper woodlands in parts of northwestern Colorado within the range of sage-grouse. These data also show limited pinyon-juniper coverage in Montana and Wyoming; however, LANDFIRE data could be a major underestimate of juniper because it is difficult to classify pinyon-juniper woodlands with satellite imagery when the trees occur at low densities (Hagen 2005, p. 142).

Recently, many conservation actions have addressed this threat using a variety of techniques (e.g., mechanical, herbicide, cutting, burning) to remove conifers in sage-grouse habitat. The effectiveness of these treatments varies with the technique used and proximity of the site to invasive plant infestations, among other factors. We are not aware of any study documenting a direct correlation between these treatments and increased greater sage-grouse productivity; however, we infer some level of positive response based on Commons *et al.*'s (1999) Gunnison sage-grouse study and the documented avoidance, or reduced use, by sage-grouse of areas where pinyon-juniper has encroached upon sagebrush communities (Doherty *et al.* 2008, p. 187; Freese 2009, pp. 84-85, 89-90). However, since the effectiveness of treatments for sage-grouse is usually based on a short-term, anecdotal evaluation of whether pinyon-juniper was successfully removed from a site, it is unclear whether pinyon-juniper removal has a positive long-term population-level impact for sage-grouse. In most cases it is still too early to measure a population response to these treatments (Oregon Department of Fish and Wildlife (ODFW) 2008, p. 3). Consequently, we do not know if these efforts are effectively ameliorating the threat of pinyon-juniper expansion at the site-level.

Furthermore, while many acres have been treated since 2004, treatments are not likely keeping pace with the current rate of pinyon-juniper encroachment, at least in parts of the range. For example, while Oregon has treated approximately 8,094 ha (20,000 ac) of juniper to restore native sagebrush habitat between 2003 and early 2008 (about 1,619 ha or 4,000 ac per year; ODFW 2008, p. 3), LANDFIRE data show at least 106,882 ha (264,110 ac) of juniper occur within 4.8 km (3 mi) of Oregon leks. This distance (4.8 km; 3 mi) reflects the upper estimate of a typical pinyon seed dispersal event, although seeds may be dispersed shorter distances and up to at least 10 km (6.2 mi) (Chambers *et al.* 1999, p. 12). At this rate, it would take approximately 60 years to remove the threat of juniper encroachment within 3 miles of sage-grouse leks in Oregon, assuming expansion does not continue.

Again, LANDFIRE data provides a gross underestimate of pinyon-juniper since it misses single, large trees. This underestimate suggests that it will take longer than 60 years to fully address the threat of juniper encroachment in Oregon, if conservation actions continue to occur at the current rate. Furthermore, not all treatments are effective. Of the 38,780 ha (95,826 ac) treated by BLM in Fiscal Year (FY) 2006 and FY 2007, only 21,598 ha (53,369 ac), or 55.7 percent were considered to be effective by the BLM (Carlson 2008b, pers. comm.). Again, the measure of effectiveness typically refers to whether vegetation was treated successfully, and not whether sage-grouse use an area that has been treated.

Summary: Invasive Plants and Pinyon-Juniper Encroachment

Invasives plants negatively impact sage-grouse primarily by reducing or eliminating native vegetation that sage-grouse require for food and cover, resulting in habitat loss and fragmentation. A variety of nonnative annuals and perennials (e.g., Bromus tectorum, Euphorbia esula) and native conifers (e.g., pinyon pine, juniper species) are invasive to sagebrush ecosystems. Nonnative invasives, including annual grasses and other noxious weeds, continue to expand their range, facilitated by ground disturbances such as wildfire, grazing, and infrastructure. Pinyon and juniper and some other native conifers are expanding and infilling their current range mainly due to decreased fire return intervals, livestock grazing, and increases in global carbon dioxide concentrations associated with climate change, among other factors.

Collectively, invasives plants impact the entire range of sage-grouse, although they are most problematic in the Intermountain West and Great Basin (MZs III, IV, V, and VI). A large portion of the Great Basin is at risk of *B. tectorum* invasion or pinyon-juniper encroachment within the next 30 years. Approximately 80 percent of land in the Great Basin Ecoregion (MZs III, IV, and V) is susceptible to displacement by *B. tectorum* within 30 years (Connelly *et al.* 2004, p. 7-17, Suring *et al.* 2005, p. 138). Connelly *et al.* (2004, pp. 7-8 to 7-14) estimated that approximately 35 percent of sagebrush in the Great Basin was at high risk of displacement by pinyon-juniper in 30 years. *Bromus tectorum* is widespread at lower elevations and pinyon-juniper woodlands tend to expand into higher elevation sagebrush habitats, creating an elevational squeeze from both low and high elevations. Climate change will likely alter the range of individual invasive species, increasing fragmentation and habitat loss of sagebrush communities. Despite the potential shifting of individual species, invasive plants will persist and continue to spread rangewide in the foreseeable future.

A variety of restoration and rehabilitation techniques are used to treat invasive plants, but they can be costly and are mostly unproven and experimental. The success of treatments, particularly for annual grassland restoration, depends on uncontrollable factors (e.g., precipitation). While some efforts appear successful at smaller scales, prevention appears to be the only known effective tool to preclude large-scale habitat loss from invasive annuals and perennials in the future. Pinyon-juniper treatments, particularly when done in the early stages of encroachment when sagebrush and forb understory is still intact, have the potential to provide an immediate benefit to sage-grouse. However, studies have not yet documented a correlation between pinyon-juniper treatments and increased greater sage-grouse productivity.

Grazing

Native herbivores, such as pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), bison (*Bison bison*), and other ungulates were present in low numbers on the sagebrush-steppe region prior to European settlement of western States (Osborne 1953, p. 267; Miller *et al.* 1994, p. 111), and sage-grouse co-evolved with these animals. However, mass extinction of the majority of large herbivores occurred 10,000 to 12,000 years ago (Knick *et al.* 2003, p. 616; Knick *et al.*, in press, p. 40). From that period up until European settlement, many areas of sagebrush-steppe still did not support herds of large ungulates and grazing pressure was likely sporadic and localized (Miller *et al.* 1994, p. 113; Plew and Sundell 2000, p. 132; Grayson 2006, p. 921). Additionally, plants of the sagebrush-steppe lack traits that reflect a history of large ungulate grazing pressure (Mack and Thompson 1982, pp. 757). Therefore, native vegetation communities within the sagebrush ecosystem evolved in the absence of significant grazing presence (Mack and Thompson 1982, p. 768). With European settlement of western States (1860 to the early 1900s), unregulated numbers of cattle, sheep, and horses rapidly increased, peaking at the turn of the century (Oliphant 1968, p. vii; Young *et al.* 1976, pp. 194-195, Carpenter 1981, p. 106; Donahue 1999, p. 15) with an estimated 19.6 million cattle and 25 million sheep in the West (BLM 2009a, p. 1).

Excessive grazing by domestic livestock during the late 1800s and early 1900s, along with severe drought, significantly impacted sagebrush ecosystems (Knick *et al.* 2003, p. 616). Long-term effects from this overgrazing, including changes in plant communities and soils, persist today (Knick *et al.* 2003, p.116). Currently, livestock grazing is the most widespread type of land use across the sagebrush biome (Connelly *et al.* 2004, p. 7-29); almost all sagebrush areas are managed for livestock grazing (Knick *et al.* 2003, p. 616; Knick *et al.*, in press, p. 27).

Although little direct experimental evidence links grazing practices to population levels of greater sage-grouse (Braun 1987, p. 137; Connelly and Braun 1997, p. 231), the impacts of livestock grazing on sage-grouse habitat and on some aspects of the life cycle of the species have been studied. Sage-grouse need significant grass and shrub cover for protection from predators, particularly during nesting season, and females will preferentially choose nesting sites based on these qualities (Hagen *et al.* 2007, p. 46). The reduction of grass heights due to livestock grazing in sage-grouse nesting and brood-rearing areas has been shown to negatively affect nesting success when cover is reduced below the 18 cm (7 in.) needed for predator avoidance (Gregg *et al.* 1994, p. 165). Based on measurements of cattle foraging rates on bunchgrasses both between and under sagebrush canopies, the probability of foraging on under-canopy bunchgrasses depends on sagebrush morphology, and consequently, the effects of grazing on nesting habitats might be site specific (France *et al.* 2008, pp. 392-393).

Several authors have noted that grazing by livestock could reduce the suitability of breeding and brood-rearing habitat, negatively affecting sage-grouse populations (Braun 1987, p. 137; Dobkin 1995, p. 18; Connelly and Braun 1997, p. 231; Beck and Mitchell 2000, pp. 998-1000). Exclosure studies have demonstrated that domestic livestock grazing reduces water infiltration rates and cover of herbaceous plants and litter, as well as compacting soils and increasing soil erosion (Braun 1998, p. 147; Dobkin *et al.* 1998, p. 213). These impacts result in a change in the proportion of shrub, grass, and forb components in the affected area, and an increased invasion of exotic plant species that do not provide suitable habitat for sage-grouse (Mack and Thompson 1982, p. 761; Miller and Eddleman 2000, p. 19; Knick *et al.*, in press, p. 41).

Livestock also may compete directly with sage-grouse for rangeland resources. Cattle are grazers, feeding mostly on grasses, but they will make seasonal use of forbs and shrub species like sagebrush (Vallentine 1990, p. 226). Domestic sheep are intermediate feeders making high use of forbs, but also using a large volume of grass and shrub species like sagebrush (Vallentine 1990, pp. 240-241). Sheep consume rangeland forbs in occupied sage-grouse habitat (Pederson *et al.* 2003, p. 43) and, in general, forb consumption may reduce food availability for sage-grouse. This impact is particularly important for pre-laying hens, as forbs provide essential calcium, phosphorus, and protein (Barnett and Crawford 1994, p. 117). A hen's nutritional condition affects nest initiation rate, clutch size, and subsequent reproductive success (Barnett and Crawford 1994, p.117; Coggins 1998, p. 30).

Other effects of direct competition between livestock and sage-grouse depend on condition of the habitat and the grazing practices. Thus, the effects vary across the range of the greater sage-grouse. For example, Aldridge and Brigham (2003, p. 30) suggest that poor livestock management in mesic sites, which are considered limited habitats for sage-grouse in Alberta (Aldridge and Brigham 2002, p. 441), results in a reduction of forbs and grasses available to sage-grouse chicks, thereby affecting chick survival.

Other consequences of grazing include several related to livestock trampling of grouse and habitat. Although the effect of trampling at a population level is unknown, outright nest destruction has been documented and the presence of livestock can cause sage-grouse to abandon their nests (Rasmussen and Griner 1938, p. 863; Patterson 1952, p. 111; Call and Maser 1985, p. 17; Holloran and Anderson 2003, p. 309; Coates 2007, p.28). Coates (2007, p. 28) documented nest abandonment following partial nest depredation by a cow. In general all recorded encounters between livestock and grouse nests resulted in hens flushing from nests, which could expose the eggs to predation; there is strong evidence that visual predators like ravens use hen movements to locate sage-grouse nests (Coates 2007, p.33). Livestock also may trample sagebrush seedlings, thereby removing a source of future sage-grouse food and cover (Connelly *et al.* 2004, p. 7-31). Trampling of soil by livestock can reduce or eliminate biological soil crusts making these areas susceptible to *Bromus tectorum* invasion (Mack 1981 as cited in Miller and Eddleman 2000, p. 21; Young and Allen 1997, p. 531).

Some livestock grazing effects may have positive consequences for sage-grouse. Evans (1986, p. 67) found that sage-grouse used grazed meadows significantly more during late summer than ungrazed meadows because grazing had stimulated the regrowth of forbs. Klebenow (1981, p. 121) noted that sage-grouse sought out and used openings in meadows created by cattle grazing in northern Nevada. Also, both sheep and goats have been used to control invasive weeds (Mosley 1996 as cited in Connelly *et al.* 2004, p. 7-49; Merritt *et al.* 2001, p. 4; Olsen and Wallander 2001, p. 30) and woody plant encroachment (Riggs and Urness 1989, p. 358) in sage-grouse habitat.

Sagebrush plant communities are not adapted to domestic grazing disturbance. Grazing changed the functioning of systems into less resilient, and in some cases, altered communities (Knick *et al.*, in press, p. 39). The ability to restore or rehabilitate areas depends on the condition of the area relative to its site potential (Knick *et al.*, in press, p. 39). For example, if an area has a balanced mix of shrubs and native understory vegetation, a change in grazing management can restore the habitat to its potential vigor (Pyke, in press, p. 11). Wambolt and Payne (1986, p. 318) found that rest from grazing had a better perennial grass response than other treatments. Active restoration would be required where native understory vegetation is much reduced (Pyke, in press, p. 15). But, if an area has soil loss and/or invasive species, returning the site to the native historical plant community may be impossible (Daubenmire 1970, p. 82; Knick *et al.*, in press, p. 39; Pyke, in press, p. 17). Aldridge *et al.* (2008, p. 990) did not find any relationship between sage-grouse persistence and livestock densities. However, the authors noted that livestock numbers do not necessarily correlate with range condition. They concluded that the intensity, duration, and distribution of livestock grazing are more influential on rangeland condition than the livestock density values used in their modeling efforts (Aldridge *et al.* 2008, p. 990).

Extensive rangeland treatment has been conducted by federal agencies and private landowners to improve conditions for livestock in the sagebrush-steppe region (Connelly *et al.* 2004, p. 7- 28; Knick *et al.*, in press, p. 28). By the 1970s, over 2 million ha (5 million ac) of sagebrush are estimated to have been mechanically treated, sprayed with herbicide, or burned in an effort to remove sagebrush and increase herbaceous forage and grasses (Crawford *et al.* 2004, p. 12). The BLM treated over 1,800,000 ha (4,447,897 ac) from 1940 to 1994, with 62 percent of the treatment occurring during the 1960s (Miller and Eddleman 2000, p. 20). Braun (1998, p. 146) concluded that, since European settlement of western North America, all sagebrush habitats used by greater sage-grouse have been treated in some way to reduce shrub cover. The use of chemicals to control sagebrush was initiated in the 1940s and intensified in the 1960s and early 1970s (Braun 1987, p. 138). Crawford *et al.* (2004, p. 12) hypothesized that reductions in sage-grouse habitat quality (and possibly sage-grouse numbers) in the 1970s may have been associated with extensive rangeland treatments to increase forage for domestic livestock.

Greater sage-grouse response to herbicide treatments depends on the extent to which forbs and sagebrush are killed. Chemical control of sagebrush has resulted in declines of sage-grouse breeding populations through the loss of live sagebrush cover (Connelly *et al.* 2000a, p. 972). Herbicide treatment also can result in sage-grouse emigration from affected areas (Connelly *et al.* 2000a, p. 973), and has been documented to have a negative effect on nesting, brood carrying capacity (Klebenow 1970, p. 399), and winter shrub cover essential for food and thermal cover (Pyrah 1972 and Higby 1969 as cited in Connelly *et al.* 2000a, p. 973). Conversely, small treatments interspersed with nontreated sagebrush habitats did not affect sage-grouse use, presumably due to minimal effects on food or cover (Braun 1998, p. 147). Also, application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the coverage of herbaceous plant foods (Autenrieth 1981, p. 65).

Mechanical treatments are designed to either remove the aboveground portion of the sagebrush plant (mowing, roller chopping, and roto-beating), or to uproot the plant from the soil (grubbing, bulldozing, anchor chaining, cabling, railing, raking, and plowing; Connelly *et al.* 2004, p. l7-47). These treatments were begun in the 1930s and continued at relatively low levels to the late 1990s (Braun 1998, p. 147). Mechanical treatments, if carefully designed and executed, can be beneficial to sage-grouse by improving herbaceous cover, forb production, and sagebrush resprouting (Braun 1998, p. 147). However, adverse effects also have been documented (Connelly *et al.* 2000a, p. 973). For example, in Montana, the number of breeding males declined by 73 percent after 16 percent of the 202-km^2 (78- mi^2) study area was plowed (Swenson *et al.* 1987, p. 128). Mechanical treatments in blocks greater than 100 ha (247 ac), or of any size seeded with exotic grasses, degrade sage-grouse habitat by altering the structure and composition of the vegetative community (Braun 1998, p. 147).

The current extent to which mechanical, chemical, and prescribed fire methods are used to remove or control sagebrush is not known, particularly with regard to private lands. However, BLM has stated that with rare exceptions, they no longer are involved in actions that convert sagebrush to other habitat types, and that mechanical or chemical treatments in sagebrush habitat on BLM lands currently focus on improving the diversity of the native plant community, reducing conifer encroachment, or reducing the risk of a large wildfire (see discussion of Fire above; BLM 2004, p. 15).

Historically, the elimination of sagebrush followed with rangeland seedings was encouraged to improve forage for livestock grazing operations (Blaisdell 1949, p. 519). Large expanses of sagebrush removed via chemical and mechanical methods have been reseeded with nonnative grasses, such as crested wheatgrass (*Agropyron cristatum*), to increase forage production on public lands (Pechanec *et al.* 1965 as cited in Connelly *et al.* 2004, p.7-28). These treatments reduced or eliminated many native grasses and forbs present prior to the seedings (Hull 1974, p. 217). Sage-grouse are affected indirectly through the loss of native forbs that serve as food and loss of native grasses that provide concealment or hiding cover (Connelly *et al.* 2004, p. 4-4).

Water developments for the benefit of livestock and wild ungulates on public lands are common (Connelly *et al.* 2004, p. 7-35). Development of springs and other water sources to support livestock in upland shrub-steppe habitats can artificially concentrate domestic and wild ungulates in important sage-grouse habitats, thereby exacerbating grazing impacts in those areas such as heavy grazing and vegetation trampling (Braun 1998, p. 147; Knick *et al.*, in press, p. 42). Diverting the water sources has the secondary effect of changing the habitat present at the water source before diversion. This impact could result in the loss of either riparian or wet meadow habitat important to sage-grouse as sources of forbs or insects. Water developments for livestock and wild ungulates also could be used as mosquito breeding habitat, and thus have the potential to facilitate the spread of West Nile virus (see discussion under Factor C: Disease and Predation).

Another indirect negative impact to sage-grouse from livestock grazing occurs due to the placement of thousands of miles of fences for livestock management purposes (see discussion above under Infrastructure). Fences cause direct mortality through collision and indirect mortality through the creation of predator perch sites, the potential creation of predator corridors along fences (particularly if a road is maintained next to the fence), incursion of exotic species along the fencing corridor, and habitat fragmentation (Call and Maser 1985, p. 22; Braun 1998, p. 145; Connelly *et al.* 2000a, p. 974; Beck *et al.* 2003, p. 211; Knick *et al.* 2003, p. 612; Connelly *et al.* 2004, p. 1-2).

The impacts of livestock operations on sage-grouse depend upon stocking levels, season of use, and utilization levels. Cattle and sheep Animal Unit Months (AUMs) (the amount of forage required to feed one cow with calf, one horse, five sheep, or five goats for 1 month) on all Federal land have declined since the early 1900s (Laycock *et al.* 1996, p. 3). By the 1940s, AUMs on all Federal lands (not just areas occupied by sage-grouse) were estimated to be 14.6 million, increasing to 16.5 million in the 1950s, and gradually declining to 10.2 million by the 1990s (Miller and Eddleman 2000, p. 19). Although AUMs have decreased over time, we cannot assume that the net impact of grazing has decreased because the productivity of those lands has decreased (Knick *et al.*, in press, p. 42). As of 2007, the number of permitted AUMs for BLM lands in States where sage-grouse occur totaled 7,118,989 (Beever and Aldridge, in press, p. 19-20). We estimate that those permitted AUMs occur in approximately 18,783 BLM grazing allotments in sage-grouse habitat (Stoner 2008). Since 2005, 644 (3.4 percent) of those allotments have decreased the permitted AUMs (Service 2008a). However, BLM tracks the number of AUMs permitted rather than the number of AUMs actually used. The number permitted typically is higher than what is used, thus we do not know how the decrease on paper corresponds to the actual number of AUMs for the last four years.

Wild Horse and Burro Grazing

Free-roaming horses and burros have been a component of sagebrush and other arid communities since they were brought to North America at the end of the 16th century (Wagner 1983, p. 116; Beever 2003, p. 887). About 31,000 wild horses occur in 10 western States (including 2 states outside the range of the greater sage-grouse), with herd sizes being largest in Nevada, Wyoming, and Oregon, which are the States with the most extensive sagebrush cover (Connelly *et al.* 2004, p. 7-37). Of about 5,000 burros occur in five western States approximately 700 occur within the SGCA (Connelly *et al.* 2004, p.7-37). Beever and Aldridge (2009, in press, p. 7) estimate that about 12 percent (78, 389 km^2, 30,266 mi^2) of sage-grouse habitat is managed for free-roaming horses and burros. However, the extent to which the equids use land outside of designated management areas is difficult to quantify but may be considerable.

We are unaware of any studies that directly address the impact of wild horses or burros on sagebrush and sage-grouse. However, some authors have suggested that wild horses could negatively impact important meadow and spring brood-rearing habitats used by sage-grouse (Crawford *et al.* 2004, p. 11; Connelly *et al.* 2004, p. 7-37). Horses are generalists, but seasonally their diets can be almost wholly comprised of grasses (Wagner 1983, pp. 119-120). A comparison of areas with and without horse grazing showed 1.9 to 2.9 times more grass cover and higher grass density in areas without horse grazing (Beever *et al.* 2008 as cited Beever and Aldridge in press, p. 11). Additionally, sites with horse grazing had less shrub cover and more fragmented shrub canopies (Beever and Aldridge in press, p. 12). As noted above, sage-grouse need significant grass and shrub cover for protection from predators particularly during nesting season, and females will preferentially choose nesting sites based on these qualities (Hagen *et al.* 2007, p. 46). Sites with grazing also generally showed less plant diversity, altered soil characteristics, and 1.6 to 2.6 times greater abundance of nonnative *Bromus tectorum* (Beever *et al.* 2008 as cited in Beever and Aldridge 2009, in press, p. 13). These impacts combined indicate that horse grazing has the potential to result in an overall decrease in the quality and quantity of sage-grouse habitat in areas where such grazing occurs.

Currently, free-roaming equids consume an estimated 315,000 to 433,000 AUMs as compared to over 7 million AUMs for domestic livestock within the range of greater sage-grouse (Beever and Aldridge, in press, p. 21). Cattle typically outnumber horses by a large degree in areas where both occur; however, locally ratios of 2:1 (horse:cow) have been reported (Wagner 1983, p.126). The local effects of ungulate grazing depend on a host of abiotic and biotic factors (e.g., elevation, season, soil composition, plant productivity, and composition). Additional significant biological and behavioral differences influence the impact of horses as compared to cattle grazing on habitat (Beever 2003, pp. 888-890). For example, due to physiological differences, a horse must forage longer and consumes 20 to 65 percent more forage than would a cow of equivalent body mass (Wagner 1983, p. 121; Menard *et al.* 2002, p.127). Unlike cattle and other ungulates, horses can crop vegetation close to the ground, potentially limiting or delaying recovery of plants (Menard *et al*. 2002, p.127). In addition, horses seasonally move to higher elevations, spend less time at water, and range farther from water sources than cattle (Beever and Aldridge in press, pp. 20, 21). Given these differences, along with the confounding factor of past range use, it is difficult to assess the overall magnitude of the impact of horses on the landscape in general, or on sage-grouse habitat in particular. In areas grazed by both horses and cattle, whether the impacts are synergistic or additive is currently unknown (Beever and Aldridge, in press, p. 21).

Wild Ungulate Herbivory

Native herbivores, such as elk (*Cervus elaphus*), mule deer, and pronghorn antelope coexist with sage-grouse in sagebrush ecosystems (Miller *et al*. 1994, p. 111). These ungulates are present in sagebrush ecosystems during various seasons based on dietary needs and forage availability (Kufeld 1973, p. 106-107; Kufeld *et al*. 1973 as cited in Wallmo and Regelin 1981, p. 387-396; Allen *et al*. 1984, p. 1). Elk primarily consume grasses but are highly versatile in consumption of forbs and shrubs when grasses are not available (Kufeld 1973, pp. 106-107; Vallentine 1990, p. 235). In the winter, heavy snow forces elk to lower-elevation sagebrush areas where they forage heavily on sagebrush (Wambolt and Sherwood 1999, p. 225). Mule deer utilize forbs, shrubs, and grasses throughout the year dependent upon availability and preference (Kufeld *et al*. 1973 as cited in Wallmo and Regelin 1981, pp. 389-396). Pronghorn antelope, most commonly associated with grasslands and sagebrush, consume a wide variety of available shrubs and forbs and consume new spring grass growth (Allen *et al*. 1984, p. 1; Vallentine 1990, p. 236).

We are unaware of studies evaluating the effects of native ungulate herbivory on sage-grouse and sage-grouse habitat. However, concentrated native ungulate herbivory may impact vegetation in sage-grouse habitat on a localized scale. Native ungulate winter browsing can have substantial, localized impacts on sagebrush vigor, resulting in decreased shrub cover or sagebrush mortality (Wambolt 1996, p. 502; Wambolt and Hoffman 2004, p. 195). Additionally, despite decreased habitat availability, elk and mule deer populations are currently higher than pre-European estimates (Wasley 2004, p. 3; Young and Sparks 1985, pp. 67-68). As a result, some States started small-scale supplemental feeding programs for deer and elk. In those localized areas, vegetation is heavily utilized from the concentration of animals (Doman and Rasmussen 1944, p. 319; Smith 2001, pp. 179-181). Unlike domestic ungulates, wild ungulates are not confined to the same area, at the same time each year. Therefore, the impacts from wild ungulates are spread more diffusely across the landscape, resulting in minimal long-term impacts to the vegetation community.

Summary: Grazing

Livestock management and domestic grazing can seriously degrade sage-grouse habitat. Grazing can adversely impact nesting and brood-rearing habitat by decreasing vegetation concealment from predators. Grazing also has been shown to compact soils, decrease herbaceous abundance, increase erosion, and increase the probability of invasion of exotic plant species. Once plant communities have an invasive annual grass understory dominance, successful restoration or rehabilitation techniques are largely unproven and experimental (Pyke, in press, p. 25). Massive systems of fencing constructed to manage domestic livestock cause direct mortality to sage-grouse in addition to degrading and fragmenting habitats. Livestock management also can involve water developments that can degrade important brood-rearing habitat and or facilitate the spread of WNv. Additionally, some research suggests there may be direct competition between sage-grouse and livestock for plant resources. However, although there are obvious negative impacts, some research suggests that under very specific conditions grazing can benefit sage-grouse.

Similar to domestic grazing, wild horses and burros have the potential to negatively affect sage-grouse habitats in areas where they occur by decreasing grass cover, fragmenting shrub canopies, altering soil characteristics, decreasing plant diversity, and increasing the abundance of invasive *Bromus tectorum*.

Native ungulates have coexisted with sage-grouse in sagebrush ecosystems. Elk and mule deer browse sagebrush during the winter and can cause mortality to small patches of sagebrush from heavy winter use. Pronghorn antelope, largely overlapping with sage-grouse habitat year around, consume grasses and forbs during the summer and browse on sagebrush in the winter. We are not aware of research analyzing impacts from these native ungulates on sage-grouse or sage-grouse habitat.

Currently there is little direct evidence linking grazing practices to population levels of greater sage-grouse. However, testing for impacts of grazing at landscape scales important to sage-grouse is confounded by the fact that almost all sage-grouse habitat has at one time been grazed and thus no non-grazed, baseline areas currently exist with which to compare (Knick *et al*. in press, p. 43). Although we cannot examine grazing at large spatial scales, we do know that grazing can have negative impacts to sagebrush and consequently to sage-grouse at local scales. However, how these impacts operate at large spatial scales and thus on population levels is currently unknown. Given the widespread nature of grazing, the potential for population-level impacts cannot be ignored.

Energy Development

Greater sage-grouse populations are negatively affected by energy development activities (primarily oil, gas, and coal-bed methane), especially those that degrade important sagebrush habitat, even when mitigative measures are implemented (Braun 1998, p. 144; Lyon 2000, pp. 25-28; Holloran 2005, pp. 56-57; Naugle *et al*. 2006, pp. 8-9; Walker *et al*. 2007a, p. 2651; Doherty *et al*. 2008, p. 192; Harju *et al*. in press, p. 22). Impacts can result from direct habitat loss, fragmentation of important habitats by roads, pipelines, and powerlines (Kaiser 2006, p. 3; Holloran *et al*. 2007, p. 16), noise (Holloran 2005, p. 56), and direct human disturbance (Lyon and Anderson 2003, p. 489). The negative effects of energy development often add to the impacts from other human development and activities and result in sage-grouse population declines (Harju *et al*. in press, p. 22; Naugle *et al*., in press, p. 1). For example, 12 years of coal-bed methane gas development in the Powder River Basin of Wyoming has coincided with 79 percent decline in the sage-grouse population (Emmerich 2009, pers. comm.). Population declines associated with energy development result from the abandonment of leks (Braun *et al*. 2002, p. 5; Walker *et al*. 2007a, p. 2649; Clark *et al*. 2008, pp. 14, 16), decreased attendance at the leks that persist (Holloran 2005, pp. 38-39, 50; Kaiser 2006, p. 23; Walker *et al*. 2007a, p. 2648; Harju *et al*. in press, p. 22), lower nest initiation (Lyon 2000, p. 109; Lyon and Anderson 2003, p. 5), poor nest success and chick survival (Aldridge and Boyce 2007, p. 517), decreased yearling survival (Holloran *et al*., in press, p. 6), and avoidance of energy infrastructure in important wintering habitat (Doherty *et al*. 2008, pp. 192-193).

Nonrenewable Energy Sources

Nonrenewable fossil fuel energy development (e.g., petroleum products, coal) has been occurring in sage-grouse habitats since the late 1800s (Connelly *et al*. 2004, p. 7-28). Interest in developing oil and gas resources in North America has been cyclic based on demand and market conditions (Braun *et al*. 2002, p. 2). Between 2004 and 2008, the exploration and development of fossil fuels in sagebrush habitats increased rapidly as prices and demand were spurred by geopolitical uncertainties and legislative mandates (National Petroleum Council 2007, pp. 5-7). Legislative mandates that were used to effect an increase in energy development include those of the Energy Policy and Conservation Act (EPCA) of 1975 (42 United States Code (U.S.C.) 6201 *et seq*.) to secure energy supplies and increase the availability of fossil fuels. Reauthorization and amendments to the EPCA have occurred through subsequent legislation including the Energy Policy Act of 2000 (Public Law (P.L.) 106-469) that mandates the inventory of Federal nonrenewable resources (42 U.S.C. 6217). The 2005 Energy Policy Act requires identification and resolution of impediments to timely granting of Federal leases and post-leasing development (42 U.S.C. 15851). In addition, the 2005 Energy Policy Act mandated the designation of corridors on Federal lands for energy transport (42 U.S.C. 15926), ordered the identification of renewable energy sources (e.g., wind, geothermal), and provided incentives for development of renewable energy sources (42 U.S.C. 15851).

Global recession starting in 2008 resulted in decreased energy demand and subsequently slowed rate of energy development (Energy Information Administration (EIA) 2009b, p. 2). However, the production of fossil fuels is predicted to regain and surpass the early 2008 levels starting in 2010 (EIA 2009b, p. 109). Forecasts to the year 2030 predict fossil fuels to continue to provide for the United States' energy needs while not necessarily in conventional forms or from present extraction techniques (EIA 2009b, pp. 2-4, 109). Recent concerns about curbing greenhouse gas emissions associated with fossil fuel use are being addressed through government policy, legislation, and advanced technologies and are likely to effect a transition in fuel form (EIA 2009b, pp. 2-3, 78).

The decline in use of conventional fossil fuels for power generation in the future is expected to be supplemented with biomass, unconventional oil and gas, and renewable sources—all of which are existing or potentially available in current sage-grouse habitats (U.S. Department of Energy (DOE) 2006, p. 3; National Petroleum Council 2007, p. 6; BLM 2005a, p. 2-4; National Renewable Energy Laboratory (NREL) 2008a, entire; Idaho National Engineering and Environmental Laboratory 2003, entire; EIA 2009b, pp. 2-4). For example, oil shale and tar sands are unconventional fossil fuel liquids predicted for increased development in the sage-grouse range. Shale sources providing 2 million barrels per day in 2007 are expected to contribute 5.6–6.1 million barrels by 2030 (EIA 2009b, p. 30). Extraction of this resource involves removal of habitat and disturbance similar to oil and gas development (see discussion below). National reserves of oil shale lie primarily in the Uinta–Piceance area of Colorado and Utah (MZs II, III, and VII), and the Green River and Washakie areas of southwestern Wyoming (MZ II). These 1.4 million ha (3.5 million ac) of Federal lands contain an estimated 1.23 trillion barrels of oil—more than 50 times the United States' proven conventional oil reserves (BLM 2008a, p. 2).

Available EPCA inventories detail energy resources in 11 geological basins (DOI *et al*. 2008, entire) in the greater sage-grouse conservation assessment area identified in the 2006 Conservation Strategy (Stiver *et al*. 2006, p. 1-11). Extensive oil and gas reserves are identified in the Williston Basin of western North Dakota, northwestern South Dakota, and eastern Montana; Montana Thrust Belt in west-central Montana; Powder River Basin of northeastern Wyoming and southeastern Montana; Wyoming Thrust Belt of extreme southwestern Wyoming, northern Utah, and southeastern Idaho; Southwest Wyoming Basin including portions of southwestern and central Wyoming, northeastern Utah, and northwestern Colorado; Uinta–Piceance Basin of west-central Colorado and east-central Utah; Eastern Great Basin in eastern Nevada, western Utah, and southern Idaho; and Paradox Basin in south-central and southeastern Utah. Although all these geological basins have some component of sage habitats, the Southwestern Wyoming Basin as defined by EPCA (DOI *et al*. 2008, p. 3-11) is highest in sagebrush-dominated landscapes (Knick *et al*. 2003, pp. 613, 615) and is located in MZ II as described in Stiver *et al*. 2006 (pp. 1-11).

Oil and gas development has occurred in the past, with historical well locations concentrated in MZs I, II, III, and VII of Wyoming, eastern Montana, western Colorado, and eastern Utah (IHS Incorporated 2006). Currently, oil, conventional gas, or coal-bed methane development occur across the eastern component of the SGCA. Four geological basins are most affected by a concentration of development—Powder River (MZ I), Williston (MZ I), Southwestern Wyoming (MZ II), and the Uinta–Piceance (MZs II, III, VII) coinciding with the highest proportion of high-density areas of sage-grouse, the greatest number of leks, and the highest male sage-grouse attendance at leks compared with any other area in the eastern part of the range (Doherty *et al*. in press, p. 11). The Powder River Basin in northeastern Wyoming and southeastern Montana is home to an important regional population of the larger Wyoming Basin populations, which represents 25 percent of the sage-grouse in the species' range (Connelly *et al*. 2004, p. A4-37). The Powder River Basin serves as a link to peripheral populations in eastern Wyoming and western South Dakota and between the Wyoming Basin and central Montana. The Pinedale Anticline Project is in the Greater Green River area of the Southwest Wyoming Basin where the subpopulation in southwestern Wyoming and northwestern Colorado has been a stronghold for sage-grouse with some of the highest estimated densities of males per square kilometer anywhere in the remaining range of the species (Connelly *et al*. 2004, pp. 6-62, A5-23). The southwestern Wyoming-northwestern Colorado subpopulation has historically supported more than 800 leks (Connelly *et al*. 2004, p. 6-62). The preservation of large contiguous blocks or interconnected patches of habitats that exist in southwestern Wyoming is considered a conservation priority for sage-grouse (Knick and Hanser in press, p. 31).

Extensive development and operations are occurring in sage-grouse habitats where the number of producing wells has tripled in the past 30 years (Naugle *et al*., in press, p. 17). More than 8 percent of the distribution of sagebrush habitats is directly or indirectly affected by oil and gas development and associated pipelines (Knick *et al*. in press, p. 48). Forty-four percent of the 16-million-ha (39-million-ac) Federal mineral estate in MZs I and II is leased and authorized for exploration and development (Naugle *et al*. in press, pp. 17-18). Wyoming contains the highest percentage of the Federal mineral estate with 10.6 million ha (26.2 million ac); 52 percent of it is authorized for development (Naugle *et* *al.*, in press, pp. 17-18). Other Federal mineral estates in the eastern portion of the sage-grouse conservation assessment area that are authorized for development include at least 27 percent of Montana's 3.7 million ha (9.1 million ac), 50 percent of 915,000 ha (2.3 million ac) in Colorado, 25 percent of 405,000 ha (1.0 million ac) in Utah, and 14 percent of North and South Dakota's combined 365,000 ha (902,000 ac) (Naugle *et al.* in press, p. 38).

The Great Plains MZ (MZ I) contains all or portions of the 20.9-million-ha (51.7-million-ac) Powder River and Williston geological basins identified as significant oil and gas resources. The resource areas include 7.2 million ha (18.2 million ac) of sagebrush habitats. Oil and gas infrastructure and planned development occupies less than 1 percent of the land area in MZ I; however, the ecological effect is greater than 20 percent of the sagebrush habitat, based on applying a buffer zone to estimate the potential the distance of sage-grouse response to infrastructure (Lyon and Anderson 2003, p. 489; Knick *et al.*, in press, p. 133). Energy development is concentrated in the Powder River geologic basin in northeastern Wyoming and southeastern Montana. Coal-bed natural gas extraction is the most recent development in the Powder River Basin, which also is the largest actively producing coal basin in the United States (Wyoming Mining Association 2008, p. 2).

In 2002, the BLM in Wyoming proposed development of 39,367 coal-bed methane wells and 3,200 conventional oil or gas wells in the Powder River Basin in addition to an existing 12,024 coal-bed methane wells drilled or permitted (BLM 2002, pp. 2-3). Wells would be developed over a 10–year period with production lasting until 2019 (BLM 2002, p. 3). The BLM estimated 82,073 ha (202,808 ac) of surface disturbance from all activities such as well pads, pipelines, roads, compressor stations, and water handling facilities over a 3.2-million-ha (8-million-ac) project area (BLM 2002, p. 2). Roads and water handling facilities were expected to be long-term disturbances encompassing approximately 38,501 ha (95,140 ac) (BLM 2002, p. 3). Reclamation of well sites was expected to be complete by 2022 (BLM 2002, p. 3). It is not clear if this 2022 date takes into consideration the length of time necessary to achieve suitable habitat conditions for sage-grouse or if restoration of sage-grouse habitat is possible.

Between 1997 and 2007, approximately 35,000 producing wells were in place on Federal, State, and private holdings in the Powder River Basin area (Naugle *et al.*, in press, p. 7). In 2008, the BLM in Montana completed a supplement to the 2003 Environmental Impact Statement (EIS) and Record of Decision (ROD) to allow for 5,800–16,500 new coal bed methane wells in the Montana portion of the Powder River Basin over the pursuant 20 years (BLM 2008b, pp. 4.2, 4.4-4.5). The BLM estimated a direct impact of 0.8–1.3 ha (2–3.4 ac) per well site (BLM 2008b, p. 4.11). In addition to the well footprint, each additional group of 2–10 wells has been shown to increase the number of new roads, power lines, and other infrastructure (Naugle *et al.* in press, p. 7). Ranching, tillage agriculture, and energy development are the primary land uses in the Powder River Basin. The presence of human features and road densities are high in areas where all three activities coincide to the level that every 0.8 ha (0.5 mi) could be bounded by a road and bisected by a power line (Naugle *et al.* in press, p. 9).

The Powder River Basin serves as a link to peripheral sage-grouse populations in eastern Wyoming and western South Dakota and between the Wyoming basin and central Montana. This connectivity is expected to be lost in the near future because of the intensity of development in the region. Sage-grouse populations have declined in the Powder River Basin by 79 percent since the development of coal-bed methane resources (Emmerich 2009, pers. comm.). In the Powder River Basin between 2001 and 2005, sage-grouse lek-count indices declined by 82 percent inside gas fields compared to 12 percent outside development (Walker *et al.* 2007a, p. 2648). By 2004–2005, fewer leks remained active (38 percent) inside gas fields compared to leks outside fields (84 percent) (Walker *et al.* 2007a, p. 2648). Sage-grouse are less likely to use suitable wintering habitat with abundant sagebrush when coal-bed methane development is present (Doherty *et al.* 2008, p. 192). At current maximum permitted well density (12 wells per 359 ha (888 ac)), planned full-field development will impact the remaining wintering habitat in the basin (Doherty *et al.* 2008, pp. 192, 194) and lead to extirpation.

Energy development in the Powder River Basin is predicted to continue to actively reduce sage-grouse populations and sagebrush habitats over the next 20 years based on the length of development and production projects described in existing project and management plans. The BLM concluded that sage-grouse habitats would not be restored to pre-disturbance conditions for an extended time (BLM 2003, p. 4-268). Sagebrush restoration after development is difficult to achieve, and successful restoration is not assured as described above (Habitat Description and Characteristics).

The 9.6-million-ha (23.9-million-ac) Williston Basin underlies the northeastern corner of the current sage-grouse range in Montana, North and South Dakota. It is another energy resource area experiencing concentrated oil and gas development in MZ I. Oil production has occurred in the Williston Basin for at least 80 years with oil production peaking in the 1980s (Advanced Resources International 2006, p. 3-3). Advances in technology including directional drilling and coal-bed methane technology have boosted development of oil and gas in the basin (Advanced Resources International 2006, p. 3.2; Zander 2008, p. 1). Large, developed fields are concentrated in the Bowdoin Dome area of north-central Montana and the 193-km (120-mi) long Cedar Creek Anticline area of southeastern Montana, southwestern North Dakota, and northwestern South Dakota. Extensive energy development in the Cedar Creek Anticline area could be isolating the very small North Dakota population from sage-grouse populations in central Montana and the northern Powder River Basin.

One hundred and thirty-six wells were put into production in 2008–2009 in major oil and gas fields of the Williston Basin north of the Missouri River in the range of the Northern Montana sage-grouse population (Montana Department of Natural Resources 2009, entire) including the Bowdoin Dome area. The Bowdoin Dome area is populated by more than 1,500 gas wells with associated infrastructure, and an additional 1,200 new or replacement wells were approved in the remaining occupied active sage-grouse habitat (BLM 2008c, pp. 1, 3-127 to 3-129). Active drilling operations are expected to occur over 10–15 years, and gas production is expected to extend the project life 30–50 additional years (BLM 2008c, p. 1). The BLM's project description does not take into consideration the time period necessary to restore native sagebrush communities to suitability for sage-grouse. Energy extraction, ranching, and tillage agriculture coincide in this area of the State described by Leu and Hanser (in press, p. 44) as experiencing high-intensity human activity that is consistent with lek loss and population decline (Wisdom *et al.*, in press, p. 23). Energy development in Montana has contributed to post-settlement sage-grouse range contraction and possibly the geographic separation of the existing subpopulations in northern Montana and Canada. Foreseeable development is expected to further reduce the remaining sage-grouse habitat within developed oil and gas fields, and contribute to future range and population reductions (Copeland *et al.* 2009, p. 5).

Southwestern and central Wyoming and northwestern Colorado in MZ II has been considered a stronghold for sage-grouse with some of the highest estimated densities of males anywhere in the remaining range of the species (Connelly *et al.* 2004, pp. 6-62, A5-23). Wisdom *et al.* (in press, p. 23) identified this high-density sagebrush area as one of the highest priorities for conservation consideration as it comprises one of two remaining areas of contiguous range essential for the long-term persistence of the species. The Southwestern Wyoming geological basin also is experiencing significant growth in energy development which, based on the conclusions of recent investigations on the effects of oil and gas development, is expected over time to reduce sage-grouse habitat, increase fragmentation, and decrease and isolate sage-grouse populations leading to extirpations.

Oil, gas, and coal-bed methane development is occurring across MZ II, and development is concentrated in some areas. Intensive development and production is occurring in the Greater Green River area in southwestern Wyoming and northern Colorado and northeastern Utah. The BLM published a ROD in 2000 for the Pinedale Anticline Project Area in southwestern Wyoming (BLM 2000, entire). The project description included up to 900 drill pads, including dry holes, over a 10- to 15–year development period (BLM 2008d, p. 4-4). By the end of 2005, approximately 457 wells on 322 well pads were under production (BLM 2008d, p. 6). In 2008, the BLM amended the project to accommodate an accelerated rate of development exceeding that in the 2002 project description (BLM 2008d, p. 4). Approximately 250 new well pads are proposed in addition to pipelines and other facilities (BLM 2008d, p. 36). Total initial direct disturbance acres for the entire Pinedale project are approximately 10,400 ha (25,800 ac) with more than 7,200 ha (18,000 ac) in sagebrush land cover type (BLM 2008d, p. 4-52).

The Jonah Gas Infill Project also is underway in the Pinedale Anticline area of the Southwest Wyoming Basin that expands on the Jonah Project started in 2000. In 2006, the BLM issued a ROD and EIS to extend the existing project to an additional 3,100 wells and up to 6,556 ha (16,200 ac) of new surface disturbance (BLM 2006, p. 2-4). In addition, at least 64 well pads would be situated per 259 ha (640 ac), and up to 761 km (473 mi) of pipeline and roads, 56 ha (140 ac) of additional disturbance for ancillary facilities (p. 2-5) also would occur. The project life of 76 years includes 13 years of development and 63 years of production (BLM 2006, p. 2-15). The project description requires reclamation of disturbed sites and establishment of stabilizing vegetation by 1 year post-reclamation (BLM 2006, p. 2-24) and standard lease stipulations to protect sage-grouse. This project is located in high-density sage-grouse habitat, but it is not clear from the project description if suitable sage-grouse habitat is the reclamation goal. Therefore, sagebrush habitats, and the associated sage-grouse are likely to be lost.

Knick *et al.* (in press, pp. 49, 128) reviewed BLM documents for the Greater Green River Basin area, which includes the Pinedale and Jonah projects, and reported that 6,185 wells have been drilled, and there are agency plans for more than 9,300 wells and associated infrastructure. Existing and planned energy development influences over 20 percent of the sagebrush area in the Wyoming Basin (MZ II) (Knick *et al.*, in press, p. 133). Drilling, gas production, and traffic on main haul roads have all been shown to affect lek attendance and lek persistence when it coincides with breeding habitat within 3.2 km (2 mi) (Holloran 2005, p. 40; Walker *et al.* 2007a, p. 2651). Using 2006 well point data and, therefore, a conservative estimate as oil exploration and development experienced significant growth between 2006 and 2008, we calculated that 21 to 35 percent of active breeding habitat for subpopulations in the Southwest Wyoming geological basin may be negatively impacted by the proximity of energy development (Service 2008b).

In the Greater Green River Basin area, yearling male sage-grouse reared near gas field infrastructure had lower survival rates and were less likely to establish breeding territories than males with less exposure to energy development; yearling female sage-grouse avoided nesting within 950 m (0.6 mi) of natural gas infrastructure (Holloran *et al.*, in press, p. 6). The fidelity of sage-grouse to natal sites may result in birds staying in areas with development but they do not breed (Lyon and Anderson 2003, p. 49; Walker *et al.* 2007a, p. 2651; Holloran *et al.*, in press, p. 6). The effect of energy development on sage-grouse population numbers may then take 4 to 5 years to appear (Walker *et al.* 2007a, p. 2651). Copeland *et al.* (2009, p. 5) depicted an extensive development scenario for southwest Wyoming, northern Colorado, and northeastern Utah based on known reserves and existing project plans that indicates an intersection between future oil and gas development and high-density sage-grouse core areas that could result in 6.3 to 24.1 percent decrease in sage-grouse numbers over the next 20 years in MZ II (Copeland 2010, pers. comm.).

The Greater Green River area of southwest Wyoming and the Uintah–Piceance basin (discussed below) also are, in addition to oil and gas, important reserves of oil shale and tar sands that are expected to supply more of the nation's resource needs in the future (EIA 2009b, p. 30). The Uintah–Piceance geologic basin includes the Colorado Plateau (MZ VII) and overlaps into the southern edge of the Wyoming Basin (MZ II). Sage-grouse in this part of the range are reduced to four small, isolated populations, a likely consequence of urban and agricultural development (Knick *et al.*, in press, pp. 106-107; Leu and Hanser, in press, p. 15). All four populations are threatened by environmental, demographic, and genetic stochasticity due to their small population sizes as well as housing and energy development, predation, disease, and conifer invasion (Garton *et al.*, in press, p. 7; Petch 2009, pers. comm.; Maxfield 2009, pers. comm.) although population data are limited for most of this area (Garton *et al.*, in press, p. 63).

Based on applying a 3 km (1.9 mi) buffer to construction areas, Knick *et al.* (in press, p. 133) estimate existing energy development affects over 30 percent of sagebrush habitats in this area. In the past 4 years, the number of oil and gas wells increased in sage-grouse habitats of northwestern Colorado and northeastern Utah by 325 and 870 wells, respectively (Service 2008c). More than 1,370 wells were completed in Uintah (location of the two Utah populations) and Duchesne Counties of northeast Utah between July 2008 and August 2009 (Utah Oil and Gas Program 2009, entire), and approximately 7,700 wells are active in the counties (Utah DNRC 2009, entire). We expect that the development of energy resources will continue based on available reserves and recent development history (Copeland *et al.* 2009, p. 5), and development will further stress the persistence of these small populations at the southern edge of the sage-grouse range.

Using GIS analysis, we calculated that 70 percent of the sage-grouse breeding habitat is potentially impacted by oil and gas development in the Powder River Basin (Service 2008b). The 70 percent figure was derived from well point data supplied by the BLM, buffered by 3.2 km (2 mi), and intersecting these areas with known lek locations buffered to 6.4 km (4 mi). The 70 percent figure is conservative because the most comprehensive well point data set available was 2 years old and did not reflect the rapid development that occurred in 2008. Breeding habitat is defined as a 6.4-km (4-mi) radius around known lek points and includes the range of the average distances between nests and nearest lek (Autenrieth 1981, p. 18; Wakkinen *et al.* 1992, p. 2).

The effects of oil and gas development, as described in detail later in this section, are likely to continue for decades even with the current protective or mitigative measures in place. Based on a review of project EISs, Connelly *et al.* (2004, p. 7-41) concluded that the economic life of a coal-bed methane well averages 12–18 years and 20–100 years for deep oil and gas wells. A recent review of energy projects in development, primarily gas and coal-bed methane, supports these timeframes (BLM 2008b, p. 4-2; 2008c, p. 2; 2009b, p. 2). In addition, many energy projects are tiered to the 20–year land use plans developed by individual BLM field offices or districts to guide development and other activities.

The BLM is the primary Federal agency managing the United States' energy resources and has the legal authority to regulate and condition oil and gas leases and permits. Although the restrictive stipulations that BLM applies to permits and leases are variable, a 0.4-km (0.25-mi) radius around sage-grouse leks is generally restricted to no surface occupancy (NSO) during the breeding season, and noise and development activities are often limited during the breeding season within a 0.8- to 3.2-km (0.5 to 2-mi) radius of sage-grouse leks. As stated above, the BLM's NSO buffer stipulation is ineffective in protecting sage-grouse (Walker *et al.* 2007a, p. 2651), and it is not applied or applicable to all development sites (see discussion under Factor D). We estimated the sage-grouse breeding habitat impacted within 0.4 km (0.25 mi) of a producing well or drilling site with an approved BLM permit using 2006 well-site locations (the most comprehensive data available to us). Figures derived from the 2006 data are conservative because the rapid pace of development in 2007 and 2008 is not reflected. Within 16.2 million ha (38 million ac) of sage-grouse breeding habitat in MZs I and II (where 65 percent of all sage-grouse reside), approximately 1.7 million ha (4.2 million ac) or 10 percent are within 0.4 km (0.25 mi) of a producing well, drilling operation or site (Service 2008d). Walker *et al.* (2007a, p. 2651) reported negative impacts on lek attendance of coal-bed methane development within 0.8 km (0.5 mi) and 3.2 km (2 mi) of a lek, and Holloran (2005, pp. 57-60) observed that the influence of producing well sites and mail haul roads on lek attendance extended to at least 3 km (2 mi). Expanding our analysis area from 0.4 km (0.25 mi) to include breeding habitat within 3 km (2 mi) of producing well or drilling sites with an approved BLM permit, we determined that 40 percent of the sage-grouse breeding habitat in MZs I and II is potentially affected by oil or gas development (Service 2008b).

In some cases, localized areas are experiencing higher levels of effects. Seventy percent of the sage-grouse breeding habitat is within 3 km (2 mi) of development in the Powder River Basin of northeastern Wyoming and southeastern Montana (Service 2008b), where Walker *et al.* (2007, p. 2651) concluded that full-field development would reduce the probability of lek persistence from 87 to 5 percent. Our analyses show that subpopulations of sage-grouse in MZ II have up to 35 percent of breeding habitat within 3.2 km (2 mi) of development, and where data are available for populations in the Uintah–Piceance Basin of Colorado and Utah, 100 percent of the breeding habitat is affected by oil and gas development (Service 2008b). Additionally these calculations do not take into account the added effects of loss of habitat or habitat effectiveness resulting from the increasing level of renewable energy development or other anthropogenic factors occurring in concert with oil and gas development, such as agricultural tillage, urban expansion, or predation, fire, and invasives (see discussions under those headings).

Energy development impacts sage-grouse and sagebrush habitats through direct habitat loss from well pad, access construction, seismic surveys, roads, powerlines, and pipeline corridors; indirectly from noise, gaseous emissions, changes in water availability and quality, and human presence; and the interaction and intensity of effects could cumulatively or individually lead to fragmentation (Suter 1978, pp. 6-13; Aldridge 1998, p. 12; Braun 1998, pp. 144-148; Aldridge and Brigham 2003, p. 31; Knick *et al.* 2003, pp. 612, 619; Lyon and Anderson 2003, pp. 489-490; Connelly *et al.* 2004, pp. 7-40 to 7-41; Holloran 2005, pp. 56-57; Holloran 2007, pp. 18-19; Aldridge and Boyce 2007, pp. 521-522; Walker *et al.* 2007a, pp. 2652-2653; Zou *et al.* 2006, pp. 1039-1040; Doherty *et al.* 2008, p. 193; Leu and Hanser, in press, p. 28).

The development of oil and gas resources requires surveys for economically recoverable reserves, construction of well pads and access roads, subsequent drilling and extraction, and transport of oil and gas, typically through pipelines. Ancillary facilities can include compressor stations, pumping stations, electrical generators, and powerlines (Connelly *et al.* 2004, p. 7-39; BLM 2007c, p. 2-110). Surveys for recoverable resources occur primarily through seismic activities, using vibroesis buggies (thumpers) or shothole explosives. Well pads vary in size from 0.10 ha (0.25 ac) for coal-bed natural gas wells in areas of level topography to greater than 7 ha (17.3 ac) for deep gas wells and multiwell pads (Connelly *et al.* 2004, p. 7-39; BLM 2007c, p. 2-123). Pads for compressor stations require 5–7 ha (12.4–17.3 ac) (Connelly *et al.* 2004, p. 7-39).

Well densities and spacing are typically designed to maximize recovery of the resource and are administered by State oil and gas agencies and the BLM, the Federal agency charged with administering the nation's Federal mineral estate (Connelly *et al.* 2004 pp. 7-39 to 7-40). Well density on BLM-administered lands is incorporated in land use plans and often based on the spacing decision of individual State oil and gas boards. Each geologic basin has a standard spacing, but exemptions are granted. Density of wells for current major developments in the sage-grouse range vary from 1 well per 2 ha (5ac) to 1 well per 64 ha (158 ac) (Knick *et al.*, in press, pp. 128). Greater sage-grouse respond to the density and distribution of infrastructure on the landscape. Holloran (2005, pp. 38-39, 50) reported that male sage-grouse attendance at leks decreased over 23 percent in gas fields where well density was 5 or more within 3 km (1.9 mi). Sage-grouse are less likely to occupy areas with wells at a 32 ha (80 ac) spacing than a 400 ha (988 ac) spacing (Doherty *et al.* 2008, p. 193).

Direct habitat loss from the human footprint contributes to decreased population numbers and distribution of the greater sage-grouse (Knick *et al.* 2003, p. 1; Connelly *et al.* 2004, p. 7-40; Aldridge *et al.* 2008, p. 983; Copeland *et al.* 2009, p. 6; Knick *et al.*, in press, p. 60; Leu and Hanser, in press, p. 5).

The footprint of energy development contributes to direct habitat loss from construction of well pads, roads, pipelines, powerlines, and through the crushing of vegetation during seismic surveys. The amount of direct habitat loss within an area is ultimately determined by well densities and the associated loss from ancillary facilities.

The ecological footprint is the extended effect of the infrastructure or activity beyond its physical footprint and determined by a physical or behavioral response of the sage-grouse. The physical footprint of oil and gas infrastructure including pipelines is estimated to be 5 million ha (1.2 million ac) and less than 1 percent of the SGCA (Knick *et al.*, in press, p. 133). However, the estimated ecological footprint is more than 13.8 million ha (34.2 million ac) or 6.7 percent of the SGCA (Knick *et al.*, in press, p. 133) based on applying a buffer zone to estimate potential avoidance, increased mortality risk, and lowered fecundity in the vicinity of development (Lyon and Anderson 2003, p. 459; Walker *et al.* 2007a, p. 2651; Holloran *et al.* in press, p. 6). Based on their method, Knick *et al.* (in press, p. 133) estimated more than 8 percent of sagebrush habitats within the SGCA are affected by energy development. The MZs with concentrations of oil and gas development have a higher estimated percentage of sagebrush habitats affected: 20 percent of the Great Plains (MZ I), 20 percent of the Wyoming Basin (MZ II), and 29 percent of the Colorado Plateau (MZ VII) (Knick *et al*, in press, p. 133). Copeland *et al.* (2009, p. 6) predict a scenario with a minimum of 2.3 million additional ha (5.7 million ac) directly impacted by oil and gas development by the year 2030. The corresponding ecological footprint is likely much larger. The projected increase in oil and gas energy development within the sage-grouse range could reduce the population by 7 to 19 percent from today's numbers (Copeland *et al.* 2009, p. 6). This projection does not reflect the effects of the increased development of renewable energy sources.

Roads associated with oil and gas development were suggested to be the primary impact to greater sage-grouse due to their persistence and continued use even after drilling and production ceased (Lyon and Anderson 2003, p. 489). Declines in male lek attendance were reported within 3 km (1.9 mi) of a well or haul road with a traffic volume exceeding one vehicle per day (Holloran 2005, p. 40; Walker *et al.* 2008a, p. 2651). Sage-grouse also may be at increased risk for collision with vehicles simply due to the increased traffic associated with oil and gas activities (Aldridge 1998, p. 14; BLM 2003, p. 4-222).

Habitat fragmentation resulting from oil and gas development infrastructure, including access roads, may have effects on sage-grouse greater than the associated direct habitat losses. The Powder River Basin infrastructure footprint is relatively small (typically 6-8 ha per 2.6 km^2 (15-20 ac per section)). Considering the mostly contiguous nature of the project area, the density of facilities could affect sage-grouse habitats on over 2.4 million ha (5.9 million ac). Energy development and associated infrastructure works cumulatively with other human activity or development to decrease available habitat and increase fragmentation. Walker *et al.* (2007, p. 2652) determined that leks had the lowest probability of persisting (40–50 percent) in a landscape with less than 30 percent sagebrush within 6.4 km (4 mi) of the lek. These probabilities were even less in landscapes where energy development also was a factor.

Noise can drive away wildlife, cause physiological stress, and interfere with auditory cues and intraspecific communication. Aldridge and Brigham (2003, p. 32) reported that, in the absence of stipulations to minimize the effects of noise, mechanical activities at well sites may disrupt sage-grouse breeding and nesting activities. Hens bred on leks within 3 km (1.9 mi) of oil and gas development in the upper Green River Basin of Wyoming selected nest sites with higher total shrub canopy cover and average live sagebrush height than hens nesting away from disturbance (Lyon 2000, p. 109). The author hypothesized that exposure to road noise associated with oil and gas drilling may have been one cause for the difference in habitat selection. However, noise could not be separated from the potential effects of increased predation resulting from the presence of a new road. In the Pinedale Anticline area of southwest Wyoming, lek attendance declined most noticeably downwind from a drilling rig indicating that noise likely affected male presence (Holloran 2005, p. 49).

Above-ground noise is typically not regulated to mitigate effects to sage-grouse or other wildlife (Connelly *et al.* 2004, p. 7-40). Ground shock from seismic activities may affect sage-grouse if it occurs during the lekking or nesting seasons (Moore and Mills 1977, p. 137). We are unaware of any research on the impact of ground shock to sage-grouse.

Water quality and quantity may be affected by oil and gas development. In many large field developments, the contamination threat is minimized by storing water produced by the gas dehydration process in tanks. Water also may be depleted from natural sources for drilling or dust suppression purposes. Concentrating wildlife and domestic livestock may increase habitat degradation at remaining water sources. Negative effects of changes in water quality, availability, and distribution are a reduction in habitat quality (e.g., trampling of vegetation, changes in water filtration rates), and habitat degradation (e.g., poor vegetation growth), which could result in brood habitat loss. However, we have no data to suggest that this, by itself, is a limiting factor to sage-grouse.

Water produced by coal-bed methane drilling may benefit sage-grouse through expansion of existing riparian areas and creation of new areas (BLM 2003, p. 4-223). These habitats could provide additional brood rearing and summering habitats for sage-grouse. However, the increased surface-water on the landscape may negatively impact sage-grouse populations by providing an environment for disease vectors (Walker and Naugle in press, p. 13). Based on the 2002 discovery of WNv in the Powder River Basin, and the resulting mortalities of sage-grouse (Naugle *et al.* 2004, p. 705), there is concern that produced water could have a negative impact if it creates suitable breeding reservoirs for the mosquito vector of this disease (see also discussion in Factor C, Disease and Predation). Produced water also could result in direct habitat loss through prolonged flooding of sagebrush areas, or if the discharged water is of poor quality because of high salt or other mineral content, either of which could result in the loss of sagebrush or grasses and forbs necessary for foraging broods (BLM 2003, p. 4-223).

Air quality could be affected where combustion engine emissions, fugitive dust from road use and wind erosion, natural gas-flaring, fugitive emissions from production site equipment, and other activities (BLM 2008d, p. 4-74) occur in sage-grouse habitats. Presumably, as with surface mining, these emissions are quickly dispersed in the windy, open conditions of sagebrush habitats (Moore and Mills 1977, p. 109), minimizing the potential effects on sage-grouse. However, high-density development could produce airborne pollutants that reach or exceed quality standards in localized areas for short periods of time (BLM 2008d, pp. 4-82 to 4-88). Walker (2008, entire) characterized emissions from well flaring in the Pinedale Anticline area of Sublette County, Wyoming. The investigator suggested a comprehensive study be conducted by regulatory agencies of the potential health effects of alkali elements in combusted well-plume material (Walker 2008, entire). No information is available regarding the effects to sage-grouse of gaseous emissions produced by oil and gas development.

Increased human presence resulting from oil and gas development can impact sage-grouse either through avoidance of suitable habitat, disruption of breeding activities, or increased hunting and poaching pressure (Braun *et al*. 2002, pp. 4-5; Aldridge and Brigham 2003, pp. 30-31; Aldridge and Boyce 2007, p. 518; Doherty *et al*. 2008, p. 194). Sage-grouse also may be at increased risk for collision with vehicles simply due to the increased traffic associated with oil and gas activities (BLM 2003, p. 4-216).

Negative effects of direct habitat disturbance can be offset by successful reclamation. Reclamation of areas disturbed by oil and gas development can be concurrent with field development or conducted after the shut-in or abandonment of the well or field. Sage-grouse may repopulate the area as disturbed areas are reclaimed. However, there is no evidence that populations will attain their previous size, and reestablishment may take 20 to 30 years (Braun 1998, p. 144). For most developments, return to pre-disturbance population levels is not expected due to a net loss and fragmentation of habitat (Braun *et al*. 2002, p. 150). After 20 years, sage-grouse have not recovered to pre-development numbers in Alberta, even though well pads in these areas have been reclaimed (Braun *et al*. 2002, pp. 4-5). In some reclaimed areas, sage-grouse have not returned (Aldridge and Brigham 2003, p. 31).

Mining

Mining began in the range of the sage-grouse before 1900 (State of Wyoming, 1898; U.S. Census 1913, p. 187) and continues today. Currently, surface and subsurface mining activities for numerous resources are conducted in all 11 States across the sage-grouse range. We do not have comprehensive information on the number or surface extent of mines across the range, but the development of mineral resources is occurring in sage-grouse habitats and is important to the economies of a few of the States. Nevada (MZs III, IV, and V) is ranked second in the United States in terms of value of overall nonfuel mineral production in 2006 (USGS 2006, p. 10). Wyoming (MZs I and II) is the largest coal producer in the United States, and the top ten producing mines in the country are located in Wyoming's Powder River Basin (MZ I) (Wyoming Mining Association 2008, p. 2). A preliminary estimate of at least 9.9 km² (3.8 mi²) of occupied sage-grouse habitat will be directly impacted by new or expanded mining operations, currently in the planning phase, for coal in Montana (MZ I) and Utah (MZ III), for phosphate in Idaho (MZ IV), and uranium in Nevada (MZ IV) and Wyoming (MZs I and II) (Service 2008b).

Uranium mining and milling has occurred in Wyoming, Utah, and Colorado, and Nevada within the greater sage-grouse conservation area; however, recent production has been very limited with only one operation in production in Wyoming (EIA 2009c, entire). Tax credits indicated in the 2005 Energy Policy Act and concerns for green-house gas emissions associated with fossil-fuel electricity generation are expected to increase nuclear power generation (EIA 2009b, p. 73) and stimulate the demand for uranium. Electricity supplied by nuclear plants is expected to increase 2–55 percent by 2030; the increase is dependent on variables such as construction costs and regulatory mandates (EIA 2009b, p. 52), which are difficult to predict. In 2009, industry announced the intent to pursue development (Peninsula Minerals 2009, entire), and the Nuclear Regulatory Commission announced the review of numerous new uranium facilities in Wyoming (74 FR 41174, Uaugust 14, 2009; 74 FR 45656, September 3, 2009). Areas in central Wyoming and Wyoming's Powder River Basin are considered major reserves of uranium coinciding with areas of high sage-grouse population densities (Finch 1996, pp. 19-20; Wyoming State Governor's Sage-grouse Implementation Team 2008, entire).

Bentonite mining has been conducted on over 85 km² (33 mi²) in the Bighorn Basin of north-central Wyoming (EDAW, Inc. and BLM 2008, p. 1). Bentonite is a primary component of oil and gas drilling muds. The loss of sagebrush associated with bentonite mining has been intensive on a localized level and has contributed to altering 12 percent of the sagebrush habitats in the 2,173 km² (839 mi²) Bighorn Basin (EDAW Inc., and BLM 2008, p. 2). Restoration efforts at mine sites have been mostly unsuccessful (EDAW, Inc. and BLM 2008, p. 1). The BLM foresees up to 89 additional km² (34 mi²) to be disturbed by bentonite mining in the area through 2024, in addition to possible oil and gas and energy transmission disturbances (EDAW, Inc. and BLM 2008, p. 2; BLM 2009c, p. 5).

Between 2006 and 2007, surface coal production decreased 9 percent in Colorado while increasing by 1.6 and 4.4 percent in Wyoming (MZ I) and Montana (MZ I), respectively (EIA 2008a, entire). The number of Wyoming coal mines increased from 19 in 2005 to 23 in 2008 (Wyoming Mining Association 2005, p. 5). All of Wyoming's 23 coal mines are in sagebrush and in the SGCA. Sixteen of these mines are located in the Powder River Basin (MZ I) where oil and gas development is extensive (Wyoming Mining Association 2008, p. 2).

Coal mining in Montana is focused in the Powder River Basin just north of the Wyoming border, in sagebrush habitat. In Wyoming and Montana, an estimated 558 km² (215 mi²) of sagebrush habitats have been disturbed by coal mines and associated facilities; disturbance increased approximately 170 km² (66 mi²) between 2005 and 2007 (Service 2005, p. 75; Service 2008c; Wyoming Mining Association 2008, p. 7). Wyoming estimates that 275 km² ha (106 mi²) of mine-disturbed land has been reclaimed (Wyoming Mining Association 2008, p. 7), but we have no knowledge of the effectiveness of these reclamation projects in providing functional sage-grouse habitat.

While western coal production has grown steadily since 1970, growth is predicted to increase through 2030, but at a much slower rate than in the past (EIA 2009b, p. 83). Coal production is projected to increase with the development of technology to reduce sulfur emissions and most of the future output of coal is expected from low-sulfur coal mines in Wyoming, Montana, and North Dakota (EIA 2009b, p. 83). We do not have information to quantify the footprint of future coal production; however, additional losses and deterioration of sage-grouse habitats are expected where mining activity occurs (described later in this section). The use of coal may be reduced if limitations on green-house gas emissions are enacted in the future. A transition would require development of lower emission sources, such as wind, solar, or nuclear, that may have their own impacts on sage-grouse environments.

Surface and subsurface mining for mineral resources (coal, uranium, copper, phosphate, aggregate, and others) results in direct loss of habitat if occurring in sagebrush habitats. The direct impact from surface mining is usually greater than it is from subsurface activity. Habitat loss from both types of mining can be exacerbated by the storage of overburden (soil removed to reach subsurface resource) in otherwise undisturbed habitat. If the construction of mining infrastructure is necessary, additional direct loss of habitat could result from structures, staging areas, roads, railroad tracks, and powerlines. Sage-grouse and nests could be directly affected by trampling or vehicle collision. Sage-grouse also will likely be impacted indirectly from an increase in human presence, land use practices, ground shock, noise, dust, reduced air quality, degradation of water quality and quantity, and changes in vegetation and topography (Moore and Mills 1977, entire; Brown and Clayton 2004, p. 2).

An increase in human presence increases collision risk with vehicles and potentially exposes sage-grouse and other wildlife to pathogens introduced from septic systems and waste disposal (Moore and Mills 1977, pp. 114-116, 135). Water contamination also could occur from leaching of waste rock and overburden and nutrients from blasting chemicals and fertilizer (Moore and Mills 1977, pp. 115, 133). Altering of water regimes could lead to decreased surface water and eventual habitat degradation from wildlife or livestock concentrating at remaining sources. Sage-grouse do not require water other than what they obtain from plant resources (Schroeder *et al*. 1999, p. 6); therefore, local water quality deterioration or dewatering is not expected to have population-level impacts. Degradation of riparian areas could result in a loss of brood habitat.

Mining and associated activities creates an opportunity for invasion of exotic and noxious weed species that alter suitability for sage-grouse (Moore and Mills 1977, pp. 125, 129). Reclamation is required by State and Federal laws, but laws generally allow for a change in post-mining land use. Restoration of sagebrush is difficult to achieve and disturbed sites may never return to suitability for sage-grouse (refer to Habitat Description and Characteristics section).

Heavy equipment operations and use of unpaved roads produces dust that can interfere with plant photosynthesis and insect populations. Most large surface mines are required to control dust. Gaseous emissions generated from heavy equipment operation are quickly dispersed in open, windy areas typical of sagebrush (Moore and Mills 1977, p.109). Blasting, to remove overburden or the target mineral, produces noise and ground shock. The full effect of ground shock on wildlife is unknown. Repeated use of explosives during lekking activity could potentially result in lek or nest abandonment (Moore and Mills 1977, p. 137). Noise from mining activity could mask vocalizations resulting in reduced female attendance and yearling recruitment as seen in sharp-tailed grouse (*Pedioecetes phasianellus*) (Amstrup and Phillips 1977, pp. 23, 25-27). In this study, the authors found that the mining noise in the study area was continuous across days and seasons and did not diminish as it traveled from its source. The mechanism of how noise affects sage-grouse is not known, but it is known that sage-grouse depend on acoustical signals to attract females to leks (Gibson and Bradbury 1985, pp. 81-82; Gratson 1993, pp. 693-694). Noise associated with oil and gas development may have played a factor in habitat selection and a decrease in lek attendance by sage-grouse (Holloran 2005, pp. 49, 56).

A few scientific studies specifically examine the effects of coal mining on greater sage-grouse. In a study in North Park, Colorado, overall sage-grouse population numbers were not reduced, but there was a reduction in the number of males attending leks within 2 km (0.8 mi) of three coal mines, and existing leks failed to recruit yearling males (Braun 1986, pp. 229-230; Remington and Braun 1991, pp. 131-132). New leks formed farther from mining disturbance (Remington and Braun 1991, p. 131). Additionally, some leks that were abandoned adjacent to mine areas were reestablished when mining activities ceased, suggesting disturbance rather than habitat loss was the limiting factor (Remington and Braun 1991, p.132). Hen survival did not decline in a population of sage-grouse near large surface coal mines in northeast Wyoming, and nest success appeared not to be affected by adjacent mining activity (Brown and Clayton 2004, p. 1). However, the authors concluded that continued mining would result in fragmentation and eventually impact sage-grouse persistence if adequate reclamation was not employed (Brown and Clayton 2004, p.16).

Surface coal mining and associated activities have negative short-term impacts on sage-grouse numbers and habitats near mines (Braun 1998, p. 143). Sage-grouse will reestablish on mined areas once mining has ceased, but there is no evidence that population levels will reach their previous size, and any population reestablishment could take 20 to 30 years based on observations of disturbance in oil and gas fields (Braun 1998, p. 144). Local sage-grouse populations could decline if several leks are affected by coal mining, but the loss of one or two leks in a regional area was likely not limiting to local populations in the Caballo Rojo Mine in northeastern Wyoming based on the presence of viable habitat elsewhere in the region (Hayden-Wing Associates 1983, p. 81).

As described above, mining directly removes habitat, may interfere with auditory clues important to mate selection, and results in a decrease of males and inhibits yearling recruitment at leks in proximity to mining activity. Sage-grouse habitat reestablishment and recovery of population numbers in an area post-disturbance is uncertain. Similar avoidance of disturbance has been noted in recent investigations of oil and gas development in Wyoming and discussed in detail in the Nonrenewable Energy section. The studies recounted here were conducted on a local scale that provides limited insight into impacts at a larger landscape perspective. In Wyoming specifically, the cumulative impacts of surface coal mine disturbance, concurrent increases in oil and gas development, increased development of renewable energy resources (discussed in the following section), and transmission infrastructure development could have significant impacts on sage-grouse in the Powder River Basin. The Powder River Basin is home to an important regional population of the larger Wyoming Basin populations covering most of Wyoming, northwestern Colorado, and northeastern Utah (Connelly *et al*. 2004, pp. 6-62 to 6-63).

Renewable Energy Sources

The demand for electricity from renewable energy sources is increasing. Electricity production from renewable sources increased from 6.4 quadrillion British thermal units (Btu) in 2005 to 6.9 quadrillion Btu in 2006. Production was down slightly in 2007, but energy production by renewables reached 7.3 quadrillion Btu by the end of 2008 (EIA 2009d, entire). Wind, geothermal, solar and biomass are renewable energy sources developable in sage-grouse habitats. Large-scale hydropower generation occurs in the sage-grouse range in parts of Washington State. Conventional hydropower electrical generation has actually decreased over the past 10 years (EIA 2009d, entire). In general, growth of the renewable energy industry is predictable based on legislated mandates to achieve target levels of renewable-produced electricity in many States within the sage-grouse range.

Wind

Areas of commercially viable wind generation have been identified by the NREL (2008b, entire) and BLM (2005, p.

2.4) in all 11 States in the greater sage-grouse range.

MZs III through VII each have approximately 1 to 14 percent of sagebrush habitats that are commercially developable for wind energy (Service 2008e, entire). Wind harvesting potentials are more concentrated and geographically extensive in sage-grouse MZs I and II that include parts of Montana, Wyoming, North Dakota, and South Dakota; areas of highest commercial potential include 59 percent of the available sagebrush habitats in these four States. Over 30 percent of the sagebrush lands in the sage-grouse range have high potential for wind power (Table 8).

TABLE 8—AREA OF SAGEBRUSH HABITAT WITH WIND ENERGY DEVELOPMENT POTENTIAL, BY MANAGEMENT ZONE. (DATA FROM SERVICE 2008E)

SAGE-GROUSE MZ	Area of Sagebrush with Developable Wind Potential		
	km²	mi²	Percent of MZ
I	137,733	53,179	76.02
II	46,835	18,083	42.16
III	3,028	1,169	3.23
IV	12,952	5,001	9.05
V	5,532	2,136	8.27
VI	2,660	1,027	14.44
VII	199	77	1.10
TOTAL	208,939	80,672	33.02

Commercial viability is based on wind intensity and consistency, available markets and access to transmission facilities. Consequently, current development is focused in areas with existing power transmission infrastructure associated with urban development, preexisting conventional energy resource development (e.g., coal and natural gas) and power generation. Growth of wind power development is expected to continue even in the current economic climate (EIA 2009b, p. 3), spurred by statutory mandates or financial incentives to use renewable energy sources in all 11 States in the range (Association of Fish and Wildlife Agencies (AFWA) and Service 2007, pp. 7, 8, 14, 28, 30, 36, 39, 43, 46, 49, 52; State of Oregon 2008, entire).

Wind generating facilities have increased in size and number, outpacing development of other renewable sources in the sage-grouse range. The BLM, the major land manager in the sage-grouse range, developed programmatic guidance to facilitate the use of BLM land for wind development (BLM 2005a, entire). The BLM wind policy permits granting private right-of-ways and leasing of public land for 3–year monitoring and testing facilities and long-term (30 to 35 years) commercial generating facilities (American Wind Energy Association (AWEA) 2008, p. 4-24). Active leases for wind energy development on BLM lands increased from 9.7 km² (3.7 mi²) in 2002 to 5,113 km² (1,973 mi²) in 2008, and an additional 5,381 km² (2,077 mi²) of lease requests were pending approval in the sage-grouse range (Knick *et al.*, in press, p. 136).

A recent increase in wind energy development is most notable within the range of the south-central Wyoming subpopulation of greater sage-grouse in MZ II where 1,387 km² (535 mi²) have active wind leases and an additional 2,828 km² (1,092 mi²) are pending (Knick *et al.*, in press, p. 136). The south-central Wyoming subpopulation has a loose association with adjacent populations where there is accelerated oil, gas, and coal development in the State – the Powder River Basin (MZ I) to the northeast and Pinedale-Jonah Gas Fields in the southwest Wyoming Basin (MZ II) (Connelly *et al.* 2004, p. 6-62). As stated previously, the Powder River Basin is home to an important regional population of the larger Wyoming Basin populations (Connelly *et al.* 2004, p. 6-62). The subpopulation in southwest Wyoming and northwest Colorado is a stronghold for sage-grouse with some of the highest estimated densities of males anywhere in the remaining range of the species (Connelly *et al.* 2004, pp. 6-62, A5-23). The south-central Wyoming wind potential corridor is not only a geographical bridge between two important population areas but is home to a large population of sage-grouse (Connelly *et al.* 2004, p. A5-22) and core areas identified preliminarily as high density breeding areas for sage-grouse by the Wyoming State Governor's Executive Order (State of Wyoming 2008, entire). Although regulatory mechanisms are being developed for Wyoming's core areas (see regulatory mechanisms section below), they are still largely subject to the impacts of both conventional and renewable energy development. Twenty-one percent of Wyoming core areas have high wind development potential, and 51 percent are subject to either wind or authorized development of oil and gas leases (Doherty *et al.*, in press, p. 31).

In addition to Wyoming, southeastern Oregon is a focus area for potential commercial-scale wind development. Currently, south-central and southeastern Oregon have large areas of relatively unfragmented sage-dominated landscapes which are important for maintaining long-term connectivity between the sage-grouse populations (Knick and Hanser, in press, pp. 1-2.). Historically, central Oregon's population provided connectivity with the Columbia Basin area through narrow habitat corridors (Connelly *et al.* 2004, p. 6-13). These connections have now been lost, resulting in the isolation of the northern extant population in Washington. The Northern Great Basin ranks lowest of the MZs in the intensity of the human footprint and consequent effects (Leu and Hanser, in press, p. 25; Wisdom *et al.*, in press, p. 16), and this could be contributing to the substantial connectivity that still exists between the Northern Great Basin, Snake River Plain, and the Southern Great Basin

Region populations (Knick and Hanser, in press, p. 1). The BLM is the major land manager in this part of the southeastern Oregon, with jurisdiction over 49,000 km² (18,900 mi²) (BLM 2009d, entire) that include much of the scantily vegetated ridge tops prone to high and sustained wind. At this time, most of the development activity is in the initial phase of meteorological site investigation and involves little infrastructure (AWEA 2009, entire; BLM 2009e). Many of these monitoring sites could be developed, considering the projected demand for renewable energy, contributing to fragmentation of this relatively intact sagebrush landscape.

Most published reports of the effects of wind development on birds focus on the risks of collision with towers or turbine blades. No published research is specific to the effects of wind farms on the greater sage-grouse. However, the avoidance of human-made structures such as powerlines and roads by sage-grouse and other prairie grouse is documented (Holloran 2005, p. 1; Pruett *et al*, in press, p. 6). Renewable energy facilities, including wind power, typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly *et al.* 2004, pp. 7-40 to 7-41) will generally be similar to those already discussed for nonrenewable energy development.

Wind farm development begins with site monitoring and collection of meteorological data to accurately characterize the wind regime. Turbines are installed after the meteorological data indicate the appropriate siting and spacing. Roads are necessary to access the turbine sites for installation and maintenance. Each turbine unit has an estimated footprint of 0.4 to 1.2 ha (1 to 3 ac) (BLM 2005a, pp. 3.1-3.4). One or more substations may be constructed depending on the size of the farm. Substation footprints are 2 ha (5 ac) or less in size (BLM 2005a, p. 3.7).

The average footprint of a turbine unit is relatively small from a landscape perspective. Turbines require careful placement within a field to avoid loss of output from interference with neighboring turbines. Spacing improves efficiency but expands the overall footprint of the field. Sage-grouse populations are impacted by the direct loss of habitat, primarily from construction of access roads as well as indirect loss of habitat due to avoidance. Sage-grouse could be killed by flying into turbine rotors or towers (Erickson *et al.* 2001, entire) although reported collision mortalities have been few. One sage-grouse was found dead within 45 m (148 ft) of a turbine on the Foote Creek Rim wind facility in south-central Wyoming, presumably from flying into a turbine (Young *et al.* 2003, Appendix C, p. 61). This is the only known sage-grouse mortality at this facility during three years of monitoring. Sage-grouse hens with broods have been observed under turbines at Foote Creek Rim (Young 2004, pers. comm.). We have no recent reports of sage-grouse mortality due to collision with a wind turbine; however, many facilities may not be monitored. No deaths of gallinaceous birds were reported in a comprehensive review of avian collisions and wind farms in the United States; the authors hypothesized that the average tower height and flight height of grouse, and diurnal migration habitats of some birds minimized the risk of collision (Johnson *et al.* 2000, pp. ii-iii; Erickson *et al.* 2001, pp. 8, 11, 14, 15).

Noise is produced by wind turbine mechanical operation (gear boxes, cooling fans) and airfoil interaction with the atmosphere. No published studies have focused specifically on the effects of wind power noise and greater sage-grouse. In studies conducted in oil and gas fields, noise may have played a factor in habitat selection and decrease in lek attendance (Holloran 2005, pp. 49, 56). However, comparison between wind turbine and oil and gas operations is difficult based on the character of sound. Adjusting for manufacturer type and atmospheric conditions, the audible operating sound of a single wind turbine has been calculated as the same level as conversational speech at 1 m (3 ft) at a distance of 600 m (2,000 ft) from the turbine. This level is typical of background levels of a rural environment (BLM 2005a, p. 5-24). However, commercial wind farms do not have a single turbine, and multiple turbines over a large area would likely have a much larger noise print. Low-frequency vibrations created by rotating blades produce annoyance responses in humans (van den Berg 2003, p. 1), but the specific effect on birds is not documented.

Moving blades of turbines cast moving shadows that cause a flickering effect producing a phenomenon called "shadow flicker" (AWEA 2008, p. 5-33). Hypothetically, shadow flicker could mimic predator shadows and elicit an avoidance response in birds during daylight hours, but this potential effect has not been investigated.

Since 2005, states have required an increasing amount of energy to come from renewable sources. For example, Colorado law requires incremental increases of renewable generation from 3 percent in 2007 to 20 percent by 2020 (AFWA and Service 2007, p. 8). Financial incentives, including grants and tax breaks, encourage private development of renewable sources. Although development of renewables is encouraged at a State level, siting authority for wind varies from State to State (AFWA and Service 2007, pp. 7, 8, 14, 28, 30, 36, 39, 43, 46, 49, 52; State of Oregon 2008, entire). For example, the State of Idaho provides tax incentives and loan programs for renewable energy development, but wind power is currently unregulated at any level of government (AFWA and Service 2007, p. 14). The North Dakota Public Service Commission regulates siting of wind power facilities over 100 megawatts using the Service's interim voluntary guidelines (Service 2003, entire).

Wyoming does not have a requirement for increased reliance on renewable energy sources and no specific wind siting authority. However, large construction projects in the State are subject to approval by an Industrial Siting Council (ISC) of the State Department of Environmental Quality, with the WGFD providing recommendations for mitigating impacts to wildlife associated with development considered by the ISC. The ISC's review and approval of projects is subject to the Wyoming Governor's executive order (State of Wyoming 2008, entire) that is intended to prevent harmful effects to sage-grouse from development or new land uses in designated core areas. Wind developers in Wyoming understand that most proposed wind developments regardless of locale must be approved by the ISC and that development proposed in core areas is unlikely to be permitted by the ISC due to the Governor's Executive Order (see discussion in Factor D below).

The BLM manages more land areas of high wind resource potential than any other land management agency. In 2005, the BLM completed the Wind Energy Final Programmatic EIS that provides an overarching guidance for wind project development on BLM-administered lands (BLM 2005a, entire). Best management practices (BMPs) are prescribed to minimize impacts of all phases of construction and operation of a wind production facility. The BMPs guide future project planning and do not guarantee protections specific to sage-grouse. We do not have information on how or where the EIS guidance has been applied since 2005 and cannot evaluate its effectiveness. The footprint of wind energy developments is reported to be small (BLM 2005a, p. 5-2). The BLM indicates that approximately 600 km^2 (232 mi^2) of BLM-administered lands are likely to be developed in nine States within the sage-grouse's range before 2025 (BLM 2005a, pp. ES-8, 5-2). It is estimated that only 5 to 10 percent of a development will have a long-term disturbance that remains on the landscape for at least as long as the generating facility is viable (i.e., roads, foundations, substation, fencing) (BLM 2005a, p. 5-2). However, this estimate does not account for sage-grouse avoidance of developed areas and could be an underestimation of indirect effects. Based on what we know of oil and gas development (previously described), the impact of structures, noise and human activity can reach far beyond the point of origin and contribute cumulatively to other human-made and natural disturbances that fragment and decrease the quality of sage-grouse habitats. The BLM's determination of the quantity of lands potentially impacted by wind energy development could be extremely conservative considering the interest in reducing green-house emissions and the institution of State renewable energy mandates and incentives that have occurred since 2005.

Wind development is guided by policy at BLM national and State levels that generally offers only guidance to avoid impacts to sage-grouse and habitats. A 2008 BLM Instruction Memo IM 2009-43 (BLM 2008e, p. 2) emphasizes the use of the Service's 2003 interim guidelines as voluntary and to be used only on a general basis in siting, design, and monitoring decisions. The BLM's Oregon State Office Instruction Memorandum OR-2008-014 (BLM 2007d, entire) is explicit in the placement of meteorological test towers to avoid active leks, seasonal concentrations, and collision; IM OR-2009-038 (BLM 2009f, entire) reduces the ODFW's recommended buffer distance for wind farms and applies only guidelines for avoidance of sage-grouse leks and seasonal habitats.

Wind energy resources are found throughout the range of the greater sage-grouse, and growth of wind power development is expected to continue. The DOE predicts that wind may provide a significant portion of the nation's energy needs by the year 2030, and substantial growth of wind developments will be required (DOE 2008, p. 1). In mid-2009, wind energy production facilities in the sage-grouse range in operation or under construction had a capacity of 11.93 gigawatts (AWEA 2009, entire) (Table 9). To achieve predicted levels of 49 to greater than 90 gigawatts capacity (DOE 2008, p. 10), the generation capacity will need to increase by 400 to 800 percent by 2030. Existing commercial wind turbines range from 1-2 megawatt generating capacity (AWEA 2009, entire). The forecasted increase in production would require approximately 37,000 to 78,000 or more turbines based on the existing technology and equipment in use. Assuming a generation capacity of 5 megawatts per km^2 (0.4 mi^2) density, Copeland *et al.* (2009, p. 1) estimated an additional 50,000 km^2 (19,305 mi^2) of land in the sage-grouse range would be required to meet the predicted level of wind-generated electricity by 2030.

TABLE 9— WIND ENERGY DEVELOPMENT IN THE GREATER SAGE-GROUSE RANGE, 2009–2030.

STATE	MZ	Existing Capacity 2009* (gigawatts)	Forecasted Capacity in 2030 (gigawatts)**
North Dakota	I	1.2	1 to 5
South Dakota	I	0.31	5 to 10
Montana	I	0.17	5 to 10
Wyoming	I, II	1.3	10 plus
Utah	II, III, IV, VII	0.4	1 to 5
Idaho	IV	0.15	1 to 5
Nevada	III, IV, V	0	5 to 10
California	III, V	2.8	10 plus
Oregon	IV, V	2.2	5 to 10
Washington	VI	2.2	5 to 10
Colorado	II, VII	1.2	1 to 5
Total		11.93	49 to 90 plus

*Includes completed and under construction, Source: American Wind Energy Assn. (2009, entire).
** Source: DOE (2008, p. 10).
(1000 megawatt = 1 gigawatt)

States such as Nevada and Montana that have not been tapped for extensive wind power development are likely to experience significant new energy development within the next 20 years (Table 9). In Wyoming, where wind development is advancing and predicted to increase by 10 fold or more (Table 9), the effects of both conventional and nonconventional renewable sources may claim a substantial toll on sage-grouse habitats and geographic areas that were in the past considered refugia for the species. As with oil and gas development, the average footprint of a turbine unit is relatively small from a landscape perspective, but the effects of large-scale developments have the potential to reduce the size of sagebrush habitats directly, degrade habitats with invasive species, provide pathways for synanthropic predators (i.e., predators that live near and benefit from an association with humans), and cumulatively contribute to habitat fragmentation.

Other Renewable Energy Sources

Hydropower development can cause direct habitat losses and possibly an increase in human recreational activity. Reservoirs created concurrently with power generation structures inundated large areas of riparian habitats used by sage-grouse broods (Braun 1998, p. 144). Reservoirs and the availability of irrigation water precipitated conversion of large expanses of upland shrub-steppe habitat in the Columbia Basin adjacent to the rivers (65 FR 51578, August 24, 2000). We were unable to find any information regarding the amount of sage-grouse habitat affected by hydropower projects in other areas of the species' range beyond the Columbia Basin. No new large-scale facilities have been constructed and hydropower electricity generation has decreased steadily over the past 10 years (EIA 2009d, entire). We do not anticipate that future dam construction will result in large losses of sagebrush habitats.

Solar-powered electricity generation is increasing. Between 2005 and the end of 2008, solar electricity generation increased from the equivalent of 66 trillion Btu to 83 trillion Btu (EIA 2009d, entire). Solar-generating systems have been used on a small scale to power individual buildings, small complexes, remote facilities, and signs. Solar energy infrastructure is often ancillary to other development, and large-scale solar-generating systems have not contributed to any calculable direct habitat loss for sage-grouse, but this may change as more systems come on line for commercial electricity generation. Solar energy systems require, depending on local conditions, 1.6 ha (4 ac) to produce 1 megawatt of electricity. For example, the 162-ha (400-ac) Nevada Solar One, the third largest solar electricity producer in the world, has a maximum potential of 75 megawatts from a 121-ha (300-ac) solar field (nevadasolarone.com 2008, entire).

No commercial solar plants are operating in sage-grouse habitats at this time. Southern and eastern Nevada, the Pinedale area of Wyoming, and east-central Utah are the areas of the sage-grouse range with good potential for commercial solar development (EIA 2009e, entire). There are a total of 196 ha (484 ac) of active solar leases on BLM property in northern California (MZ IV) and central Wyoming (MZ II) (BLM 2009g, map) in sagebrush habitats within the current sage-grouse range and these leases will likely be developed. The BLM is developing a programmatic EIS for leasing and development of solar energy on BLM lands. The EIS planning period has been extended to analyze the effects of concentrating large-scale development in selected geographic areas including sage-grouse habitats in east-central Nevada and southern Utah (BLM 2009h, entire) because of the considerable administrative and public interest in developing public lands for solar-generated electricity (BLM 2009i, entire). At this time, we do not have enough information available to evaluate the scale of future impacts of solar power generation in sage-grouse habitats. We will continue to evaluate and monitor the impacts of solar power development in sage-grouse habitats as more information becomes available. We are not aware of any investigations reporting the impacts of solar generating facilities on sage-grouse or other gallinaceous birds. Commercial solar generation could produce direct habitat loss (i.e., solar fields completely eliminate habitat), fragmentation, roads, powerlines, increased human presence, and disturbance during facility construction with similar effects to sage-grouse as reported with oil and gas development.

Geothermal energy production has remained steady since 2005 (EIA 2009d, entire). Geothermal facilities are within the sage-grouse range in California (3 plants, MZ III), Nevada (5 plants, MZs III and V), Utah (2 plants, MZ III), and Idaho (1 plant, MZ IV). Since 2005, two additional plants were constructed is in current sage-grouse range – one in Idaho and one in Utah (Geothermal Energy Association 2008, pp. 2-7). One existing geothermal plant in southern Utah is in the vicinity of sage-grouse habitat in an area where wind power is being considered for development (First Wind-Milford 2009, entire), which will result in cumulative impacts. Geothermal potential occurs across the sage-grouse range in States with existing development and southeast Oregon, west-central Wyoming, and north-central Colorado (EIA 2009e, entire).

Geothermal energy production is similar to oil and gas development such that it requires surface exploration, exploratory drilling, field development, and plant construction and operation. Wells are drilled to access the thermal source and could take from 3 weeks to 2 months of continuous drilling (Suter 1978, p. 3), which may cause disturbance to sage-grouse. The ultimate number of wells, and therefore potential loss of habitat, depends on the thermal output of the well and expected production of the plant (Suter 1978, p. 3). Pipelines are needed to carry steam or superheated liquids to the generating plant which is similar in size to a coal- or gas-fired plant, resulting in further habitat and indirect disturbance. Direct habitat loss occurs from well pads, structures, roads, pipelines and transmission lines, and impacts would be similar to those described previously for oil and gas development.

The development of geothermal energy requires intensive human activity during field development and operation. Geothermal plants could be in remote areas necessitating housing construction, transportation, and utility infrastructure for employees and their families (Suter 1978, p. 12). Geothermal development could cause toxic gas release; the type and effect of these gases depends on the geological formation in which drilling occurs (Suter 1978, pp. 7-9). The amount of water necessary for drilling and condenser cooling may be high. Local water depletions may be a concern if such depletions result in the loss of brood-rearing habitat.

The BLM has the authority to lease geothermal resources in 11 western States. A programmatic EIS for geothermal leasing and operations was completed in 2008 (BLM and USFS 2008a, entire). Best management practices for minimizing the effects of geothermal development and operations on sage-grouse are guidance only and are general in nature (BLM and USFS 2008a, pp. 4.82-4.83). The EIS' reasonably foreseeable development scenario predicts that Nevada will experience the greatest increase in geothermal growth–doubling the production of electricity from geothermal sources by 2025 (BLM and USFS 2008, p. 2-35). Currently, approximately 1,800 km^2 (694 mi^2) of active geothermal leases exist on public lands primarily in the Southern (MZ IV) and Northern Great Basin (MZ III) and 1,138 km^2 (439 mi^2) of leases are pending (Knick *et al.*, in press, p. 138).

Energy production from biomass sources has increased every year since 2005 (EIA 2009d, entire). Wood has been a primary biomass source, but corn ethanol and biofuels produced from cultivated crops are on the increase (EIA 2008b, entire). Currently, wood products and corn production do not occur in the range of the sage-grouse in significant quantities (Curtis 2008, p. 7). The National Renewable Energy Laboratory cites potentials for agricultural biomass resources in northern Montana (MZ I), southern Idaho (MZ IV), eastern Washington (MZ VI), eastern Oregon MZ IV), northwest Nevada (MZ V), and southeast Wyoming (MZ II) (NREL 2005, entire). Conversion from native sod to agriculture for the purpose of biomass production could result in a loss of sage-grouse habitat on private lands. The 2007 Energy Independence and Security Act mandated incremental production and use through the year 2022 of advanced biofuel, cellulosic biofuel, and biomass-based diesel (P.L. 110-140, section 203) and could provide an incentive to convert native sod or expired CRP lands to biomass crops. The effects on sage-grouse will depend on amount and location of sagebrush habitats developed. The effects of agriculture are discussed in habitat conversion section above.

Transmission Corridors

Section 368(a) of the Energy Policy Act of 2005 (42 U.S.C. 15926) directs Federal land management agencies to designate corridors on Federal land in 11 western States for oil, gas and hydrogen pipelines and electricity transmission and distribution facilities (energy transport corridors). The agencies completed a programmatic EIS (DOE *et al.* 2008, entire) to address the environmental impacts of corridors on Federal lands. The proposed action calls for designating more than 9,600 km (6,000 mi) with an average width of 1 km (0.6 mi) of energy corridors across the western United States (DOE *et al.* 2008, p. S-17). The designated corridors on Federal lands will tie in to corridors on private lands and lands in other governmental jurisdictions. Some of the areas proposed for designation are currently used for transmission. Federal lands newly incorporated into transportation or utility rights-of-way are mostly BLM lands in California (185 km, 115 mi), Colorado (97 km, 60 mi), Idaho (303 km, 188 mi), Montana (254 km, 158 mi), Nevada (810 km, 503 mi), Oregon (418 km, 260 mi), Washington (no additional land), Utah (356 km, 221 mi), and Wyoming (198 km, 123 mi) (DOE *et al.* 2008, p. S-18).

It is uncertain how much of the proposed corridors are in sagebrush habitat within the distribution area of sage-grouse, but based on the proposed location, habitat in Wyoming (MZ II), Idaho (MZ IV), Utah (MZ III), Nevada (MZ III) and Oregon (MZs III and IV) would be most affected. The purpose of the corridor designation is to serve a role in expediting applications to construct or modify oil, gas, and hydrogen pipelines and electricity transmission and distribution. These designated areas will likely facilitate the development of novel renewable and nonrenewable electricity generating facilities on public and private lands. Sage-grouse could be impacted through a direct loss of habitat, human activity (especially during construction periods), increased predation, habitat deterioration through the introduction of nonnative plant species, and additional fragmentation of habitat.

Summary: Energy Development

Energy development is a significant risk to the greater sage-grouse in the eastern portion of its range (Montana, Wyoming, Colorado, and northeastern Utah – MZs I, II, VII and the northeastern part of MZ III), with the primary concern being the direct effects of energy development on the long-term viability of greater sage-grouse by eliminating habitat, leks, and whole populations and fragmenting some of the last remaining large expanses of habitat necessary for the species' persistence. The intensity of energy development is cyclic and based on many factors including energy demand, market prices, and geopolitical uncertainties. However, continued exploration and development of traditional and nonconventional fossil fuel sources in the eastern portion of the greater sage-grouse range is predicted to continue to increase over the next 20 years (EIA 2009b, p. 109). Greater sage-grouse populations are predicted to decline 7 to 19 percent over the next 20 years due to the effects of oil and gas development in the eastern part of the range (Copeland *et al.* 2009, p. 4); this decline is in addition to the 45 to 80 percent decline that is estimated to have already occurred range wide (Copeland *et al.* 2009, p. 4).

Development of commercially viable renewable energy—wind, solar, geothermal, biomass—is increasing across the range with focus in some areas already experiencing traditional energy development (EIA 2009b, pp. 3-4; AWEA 2009a, entire). In Wyoming, where wind development is advancing and predicted to increase by 10-fold (DOE 2008, p. 10), the effects of both conventional and nonconventional and renewable sources may claim a substantial toll on sage-grouse habitats and geographic areas that were in the past considered refugia for the species. Renewable energy resources are likely to be developed in areas previously untouched by traditional energy development. Wind energy resources are being investigated in south-central and southeastern Oregon where large areas of relatively unfragmented sage-dominated landscapes are important for maintaining long-term connectivity within the sage-grouse populations (Knick and Hanser in press, pp. 1-2.).

Greater sage-grouse populations are negatively affected by energy development activities, even when mitigative measures are implemented (Holloran 2005, pp. 57-60; Walker *et al.* 2007a, p. 2651). Energy development, particularly high density development, will continue to threaten sage-grouse populations, specifically in the MZs I and II, which contain the greatest numbers of birds throughout their range.

Development of commercially viable renewable energy–wind, solar, geothermal, biomass–is rapidly increasing rangewide with a focus in some areas already experiencing significant traditional energy development (e.g., MZs I and II). The effects of renewable energy development are likely similar to those of nonrenewable energy as similar types of infrastructure are required. Based on our review of the literature, we anticipate the impacts of these developments will negatively affect the ability of greater sage-grouse to persist in those areas in the foreseeable future.

Climate Change

The Intergovernmental Panel on Climate Change (IPCC) has concluded that warming of the climate is unequivocal, and that continued greenhouse gas emissions at or above current rates will cause further warming (IPCC 2007, p. 30). Eleven of the 12 years from 1995 through 2006 rank among the 12 warmest years in the instrumental record of global surface temperature since 1850 (ISAB 2007). Climate-change scenarios estimate that the mean air temperature could increase by over 3°C (5.4°F) by 2100 (IPCC 2007, p. 46). The IPCC also projects that there will very likely be regional increases in the frequency of hot extremes, heat waves, and heavy precipitation (IPCC 2007, p. 46), as well as increases in atmospheric carbon dioxide (IPCC 2007, p. 36).

We recognize that there are scientific differences of opinion on many aspects of climate change, including the role of natural variability in climate. In our analysis, we rely primarily on synthesis documents (e.g., IPCC 2007; Global Climate Change Impacts in the United States 2009) that present the consensus view of a very large number of experts on climate change from around the world. We have found that these synthesis reports, as well as the scientific papers used in those reports or resulting from those reports, represent the best available scientific information we can use to inform our decision and have relied upon them and provided citation within our analysis. In addition, where possible we have used projections specific to the region of interest, the western United States and southern Canada, which includes the range of the greater sage-grouse. We also use projections of the effects of climate change to sagebrush where appropriate, while acknowledging that the uncertainty of climate change effects increases as one applies those potential effects to a habitat variable like sagebrush, and then increases again when the impacts to the habitat variable are applied to the species.

Projected climate change and its associated consequences have the potential to affect greater sage-grouse and may increase its risk of extinction, as the impacts of climate change interact with other stressors such as disease, and habitat degradation and loss that are already affecting the species (Walker and Naugle, in press, entire; Global Climate Change Impacts in the United States 2009, p. 81; Miller *et al.* in press, pp. 46-50). In the Pacific Northwest, regionally averaged temperatures have risen 0.8 degrees Celsius (1.5 degrees Fahrenheit) over the last century (as much as 2 degrees Celsius (4 degrees Fahrenheit) in some areas), and are projected to increase by another 1.5 to 5.5 degrees Celsius (3 to 10 degrees Fahrenheit) over the next 100 years (Mote *et al.* 2003, p. 54; Global Climate Change Impacts in the United States 2009, p. 135). Arid regions such as the Great Basin where greater sage-grouse occurs are likely to become hotter and drier; fire frequency is expected to accelerate, and fires may become larger and more severe (Brown *et al.* 2004, pp. 382-383; Neilson *et al.* 2005, p. 150; Chambers and Pellant 2008, p. 31; Global Climate Change Impacts in the United States 2009, p. 83).

Climate changes such as shifts in timing and amount of precipitation, and changes in seasonal high and low temperatures, as well as average temperatures, may alter distributions of individual species and ecosystems significantly (Bachelet *et al.* 2001, p174). Under projected future temperature conditions, the cover of sagebrush within the distribution of sage-grouse is anticipated to be reduced (Neilson *et al.* 2005, p. 154; Miller *et al.* in press, p. 45). Warmer temperatures and greater concentrations of atmospheric carbon dioxide create conditions favorable to *Bromus tectorum*, as described above, thus continuing the positive feedback cycle between the invasive annual grass and fire frequency that poses a significant threat to greater sage-grouse (Chambers and Pellant 2008, p. 32; Global Climate Change Impacts in the United States 2009, p. 83). Fewer frost-free days also may favor frost-sensitive woodland vegetation of Sonoran and Chihuahuan deserts, which may expand, potentially encroaching on the sagebrush biome in the southern Great Basin where sage-grouse populations currently exist (Miller *et al.* in press, p. 44). Such encroachment of woody vegetation degrades sage-grouse habitat (see Factor A, Invasive plants).

Temperature and precipitation both directly influence potential for West Nile virus (WNv) transmission (Walker and Naugle in press, p. 12). In sage-grouse, WNv outbreaks appear to be most severe in years with higher summer temperatures (Walker and Naugle in press, p. 13) and under drought conditions (Epstein and Defilippo, p. 105). This relationship is due to the breeding cycle of the WNv vector, *Culex tarsalis* being highly dependent on warm water temperature for mosquito activity and virus amplification (Walker and Naugle in press, p. 12; see discussion under Disease and Predation below). Therefore, the higher summer temperatures and more frequent or severe drought or both, that are likely under current climate change projections, make more severe WNv outbreaks likely in low-elevation sage-grouse habitats where WNv is already endemic, and also make WNv outbreaks possible in higher elevation sage-grouse habitats that to date have been WNv-free due to relatively cold conditions.

Emissions of carbon dioxide, considered to be the most important anthropogenic greenhouse gas, increased by approximately 80 percent between 1970 and 2004 due to human activities (IPCC 2007, p. 36). Future carbon dioxide emissions from energy use are projected to increase by 40 to 110 percent over the next few decades, between 2000 and 2030 (IPCC 2007, p. 44). An increase in the atmospheric concentration of carbon dioxide has important implications for greater sage-grouse, beyond those associated with warming temperatures, because higher concentrations of carbon dioxide are favorable for the growth and productivity of *Bromus tectorum* (Smith *et al.* 1987, p. 142; Smith *et al.* 2000, p. 81). Although most plants respond positively to increased carbon dioxide levels, many invasive nonnative plants respond with greater growth rates than native plants, including *B. tectorum* (Smith *et al.* 1987, p. 142; Smith *et al.* 2000, p. 81; Global Climate Change Impacts in the United States 2009, p. 83). Laboratory research results illustrated that *B. tectorum* grown at carbon dioxide levels representative of current climatic conditions matured more quickly, produced more seed and greater biomass, and produced significantly more heat per unit biomass when burned than *B. tectorum* grown at "pre-industrial" carbon dioxide levels (Blank *et al.* 2006, pp. 231, 234). These responses to increasing carbon dioxide may have increased the flammability in *B. tectorum* communities during the past century (Ziska *et al.* 2005, as cited in Zouhar *et al.* 2008, p. 30; Blank *et al.* 2006, p. 234).

Field studies likewise demonstrate that *Bromus* species demonstrate significantly higher plant density, biomass, and seed rain (dispersed seeds) at elevated carbon dioxide levels relative to native annuals (Smith *et al.* 2000, pp. 79-81). The researchers conclude that "the results from this study confirm experimentally in an intact ecosystem that elevated carbon dioxide may enhance the invasive success of *Bromus* spp. in arid ecosystems," and suggest that this enhanced success will then expose these areas to accelerated fire cycles (Smith *et al.* 2000, p. 81). Chambers and Pellant (2008, p. 32) also suggest that higher carbon dioxide levels are likely increasing *B. tectorum* fuel loads due to increased productivity, with a resulting increase in fire frequency and extent. Based on the best available information, we expect the current and predicted atmospheric carbon dioxide levels to increase the threat posed to greater sage-grouse by *B. tectorum* and from more frequent, expansive, both in sage-grouse habitat degradation (functional fragmentation) and severe wildfires (Smith *et al.* 1987, p. 143; Smith *et al.* 2000, p. 81; Brown *et al.* 2004, p. 384; Neilson *et al.* 2005, pp. 150, 156; Chambers and Pellant 2008, pp. 31-32). Therefore, beyond the potential changes associated with temperature and precipitation, increases in carbon dioxide concentrations represent a threat to the sagebrush biome and an indirect threat to sage-grouse through habitat degradation and loss (Miller *et al.* in press, p. 45), with the combined effects of higher temperatures and carbon dioxide concentrations leading to a loss of 12 percent of the current area of sagebrush per degree Celsius of temperature increase, or from 34 to 80 percent of sagebrush distribution depending on the emissions scenario used (Nielson *et al.* 2005, p. 6, 10; Miller *et al.* in press, p. 45).

Bradley (2009, pp. 196-208) and Bradley *et al.* (2009, pp. 1-11) predict that nonnative invasive species in the sagebrush-steppe ecosystem may either expand or contract under climate change, depending on the current and projected future range of a particular invasive plant species. They developed a bioclimatic model for *B. tectorum* based on maps of invaded range derived from remote sensing. The best predictors of *B. tectorum* occurrence were summer, annual, and spring precipitation, followed by winter temperature (Bradley *et al.*, 2009, p. 5). Depending primarily on future precipitation conditions, the model predicts *B. tectorum* is likely to shift northwards, leading to expanded risk of *B. tectorum* invasion in Idaho, Montana, and Wyoming, but reduced risk of invasion in southern Nevada and Utah, which currently have large areas dominated by this nonnative grass (Bradley *et al.*, 2009, p. 5). Therefore, the threat posed to greater sage-grouse by the greater frequency and geographic extent of wildfires and other associated negative impacts from the presence of *B. tectorum* is expected to continue into the foreseeable future. Bradley (2009, pp. 205) stated that the bioclimatic model she used is an initial step in assessing the potential geographic extent of *B. tectorum*, because climate conditions only affect invasion on the broadest regional scale. Other factors relating to land use, soils, competition, or topography may affect suitability of a given location. Bradley (2009, entire) concludes that the potential for climate to shift away from suitability for *B. tectorum* in the future may offer an opportunity for restoration of the sagebrush biome in this area. We anticipate that areas that become unsuitable for *B. tectorum*, may transition to other vegetation over time. However, it is not known if transition back to sagebrush as a dominant landcover or to other native or nonnative vegetation is more likely.

In a study that modeled potential impacts to big sagebrush (*A. tridentata* ssp.) due to climate change, Shafer *et al.* (2001, pp. 200-215) used response surfaces to describe the relationship between bioclimatic variables and the distribution of tree and shrub taxa in western North America. Species distributions were simulated using scenarios generated by three general circulation models – HADCM2, CGCM1, and CSIRO. Each scenario produced similar results, simulating future bioclimatic conditions that would reduce the size of the overall range of sagebrush and change where sagebrush may occur. These simulated changes were the result of increases in the mean temperature of the coldest month which the authors speculated may interact with soil moisture levels to produce the simulated impact. Each model predicted that climate suitability for big sagebrush would shift north into Canada. Areas in the current range would become less suitable climatically, and would potentially cause significant contraction. The authors also point out that increases in fire frequency under the simulated climate projections would leave big sagebrush more vulnerable to fire impacts.

Shafer *et al.* (2001, pp. 213) explicitly state that their approach should not be used to predict the future range of a species, and that the underlying assumptions of the models they used are “unsatisfying” because they presume a direct causal relationship between the distribution of a species and particular environmental variables. Shafer *et al.* (2001, pp. 207, 213) identify cautions similar to Bradley *et al.* (in press, pp. 205) regarding their models. A variety of factors are not included in climate space models, including: the effect of elevated CO_2 on the species’ water-use efficiency, what really is the physiological effect of exceeding the assumed (modeled) bioclimatic limit on the species, the life stage at which the limit affects the species (seedling versus adult), the life span of the species, and the movement of other organisms into the species range (Shafer *et al.*, 2001, pp. 207). These variables would likely help determine how climate change would affect species distributions. Shafer *et al.* (2001, pp. 213) concludes that while more empirical studies are needed on what determines a species and multi-species distributions, those data are often lacking; in their absence climatic space models can play an important role in characterizing the types of changes that may occur so that the potential impacts on natural systems can be assessed.

Schrag *et al.* (submitted MS, 2009, pp. 1-42) developed a bioclimatic envelope model for big sagebrush and silver sagebrush in the States of Montana, Wyoming, and North and South Dakotas. This analysis suggests that large displacement and reduction of sagebrush habitats will occur under climate change as early as 2030 for both species of sagebrush examined. At the time of this finding, the Schrag *et al.* analysis has not been peer reviewed, and we have significant reservations about using analyses of this level of complexity in making management decisions, without it having gone through a review process where experts in the fields of climate change, bioclimatic modeling, and sagebrush ecology can all assess the validity of the reported results. Other models projecting the affect of climate change on sagebrush habitat discussed more below, identify uncertainty associated with projecting climatic habitat conditions into the future given the unknown influence of other factors that such models do not incorporate (e.g., local physiographic conditions, life stage of the plant, generation time of the plant and its reaction to changing CO_2 levels).

In some cases, effects of climate change can be demonstrated (e.g., McLaughlin *et al.* 2002) and where it can be, we rely on that empirical evidence, such as increased stream temperatures (see Rio Grande cutthroat trout, 73 FR 27900), or loss of sea ice (see polar bear, 73 FR 28212), and treat it as a threat that can be analyzed. However, we have no such data relating to greater sage-grouse. Application of continental scale climate change models to regional landscapes, and even more local or “step-down” models projecting habitat potential based on climatic factors, while informative, contain a high level of uncertainty due to a variety of factors including: regional weather patterns, local physiographic conditions, life stages of individual species, generation time of species, and species reactions to changing CO_2 levels. The models summarized above are limited by these types of factors; therefore, their usefulness in assessing the threat of climate change on greater sage-grouse also is limited.

Summary: Climate Change

The direct, long-term impact from climate change to greater sage-grouse is yet to be determined. However, as described above, the invasion of *Bromus tectorum* and the associated changes in fire regime currently pose one of the significant threats to greater sage-grouse and the sagebrush-steppe ecosystem. Under current climate-change projections, we anticipate that future climatic conditions will favor further invasion by *B. tectorum,* as well as woody invasive species that affect habitat suitability, and that fire frequency will continue to increase, and the extent and severity of fires may increase as well. Climate warming is also likely to increase the severity of WNv outbreaks and to expand the area susceptible to outbreaks into areas that are now too cold for the WNv vector. Therefore, the consequences of climate change, if current projections are realized, are likely to exacerbate the existing primary threats to greater sage-grouse of frequent wildfire and invasive nonnative plants, particularly *B. tectorum* as well as the threat posed by disease. As the IPCC projects that the changes to the global climate system in the 21st century will likely be greater than those observed in the 20th century (IPCC 2007, p. 45), we anticipate that these effects will continue and likely increase into the foreseeable future. As there is some degree of uncertainty regarding the potential effects of climate change on greater sage-grouse specifically, climate change in and of itself was not considered a significant factor in our determination whether greater sage-grouse is warranted for listing. However, we expect the severity and scope of two of the significant threats to greater sage-grouse, frequent wildfire and *B. tectorum* colonization and establishment; as well as epidemic WNv, to magnify within the foreseeable future due the effects of climate change already underway (i.e., increased temperature and carbon dioxide). Thus, currently we consider climate change as playing a potentially important indirect role in intensifying some of the current significant threats to the species.

Analysis of Habitat Fragmentation in the Context of Factor A

Greater sage-grouse are a landscape-scale species requiring large, contiguous areas of sagebrush for long-term persistence. Large-scale characteristics within surrounding landscapes influence habitat selection, and adult sage-grouse exhibit a high fidelity to all seasonal habitats, resulting in little adaptability to changes. Fragmentation of sagebrush habitats has been cited as a primary cause of the decline of sage-grouse populations (Patterson 1952, pp. 192-193; Connelly and Braun 1997, p. 4; Braun 1998, p. 140; Johnson and Braun 1999, p. 78; Connelly *et al.* 2000a, p. 975; Miller and Eddleman 2000, p. 1; Schroeder and Baydack 2001, p. 29; Johnsgard 2002, p. 108; Aldridge and Brigham 2003, p. 25; Beck *et al.* 2003, p. 203; Pedersen *et al.* 2003, pp. 23-24; Connelly *et al.* 2004, p. 4-15; Schroeder *et al.* 2004, p. 368; Leu *et al.* in press, p. 19). Documented negative effects of fragmentation include reduced lek persistence, lek attendance, population recruitment, yearling and adult annual survival, female nest site selection, nest initiation, and loss of leks and winter habitat (Holloran 2005, p. 49; Aldridge and Boyce 2007, pp. 517-523; Walker *et al.* 2007a, pp. 2651-2652; Doherty *et al.* 2008, p. 194). Functional habitat loss also contributes to habitat fragmentation as greater sage-grouse avoid areas due to human activities, including noise, even though sagebrush remains intact. In an analysis of population connectivity, Knick and Hanser (in press, p. 31) demonstrated that in some areas of the sage-grouse range, populations are already isolated and at risk for extirpation due to genetic, demographic, and environmental stochasticity. Habitat loss and fragmentation contribute to this population isolation and increased risk of extirpation.

We examined several factors that result in habitat loss and fragmentation. Historically, large losses of sagebrush habitats occurred due to conversion for agricultural croplands. This conversion is continuing today, and may increase due to the promotion of biofuel production and new technologies to provide irrigation to arid lands. Indirect effects of agricultural activities, such as linear corridors created by irrigation ditches, also contribute to habitat fragmentation by allowing the incursion of nonnative plants. Direct habitat loss and fragmentation also has occurred as the result of expanding human populations in the western United States, and the resulting urban development in sagebrush habitats.

Fire is one of the primary factors linked to population declines of greater sage-grouse because of long-term loss of sagebrush and conversion to nonnative grasses. Loss of sagebrush habitat to wildfire has been increasing in the western portion of the greater sage-grouse range due to an increase in fire frequency and size. This change is the result of incursion of nonnative annual grasses, primarily *Bromus tectorum*, into sagebrush ecosystems. The positive feedback loop between *B. tectorum* and fires facilitates future fires and precludes the opportunity for sagebrush, which is killed by fire, to become re-established. *B. tectorum* and other invasive plants also alter habitat suitability for sage-grouse by reducing or eliminating native forbs and grasses essential for food and cover. Annual grasses and noxious perennials continue to expand their range, facilitated by ground disturbances, including wildfire, grazing, agriculture, and infrastructure associated with energy development and urbanization. Concern with habitat loss and fragmentation due to fire and invasive plants has mostly been focused in the western portion of the species' range. However, climate change may alter the range of invasive plants, potentially expanding this threat into other areas of the species' range. The establishment of these plants will then contribute to increased fire frequency in those areas, further compounding habitat loss and fragmentation. Functional habitat loss is occurring from the expansion of native conifers, mainly due to decreased fire return intervals, livestock grazing, increases in global carbon dioxide concentrations, and climate change.

Sage-grouse populations are significantly reduced, including local extirpation, by nonrenewable energy development activities, even when mitigative measures are implemented (Walker *et al.* 2007a, p. 2651). The persistent and increasing demand for energy resources is resulting in their continued development within sage-grouse range, and will only act to increase habitat fragmentation. Habitat fragmentation due to energy development results not only from the actual footprint of energy development and its appurtenant facilities (e.g., powerlines, roads), but also from functional habitat loss (e.g., noise, presence of overhead structures).

Livestock management and domestic livestock and wild horse grazing have the potential to seriously degrade sage-grouse habitat at local scales through loss of nesting cover, decreasing native vegetation, and successional stage and, therefore, vegetative resiliency, and increasing the probability of incursion of invasive plants. Fencing constructed to manage domestic livestock causes direct mortality, degradation, and fragmentation of habitats, and increased predator populations. There is little direct evidence linking grazing practices to population levels of greater sage-grouse. However, testing for impacts of grazing at landscape scales important to sage-grouse is confounded by the fact that almost all sage-grouse habitat has at one time been grazed, and thus no non-grazed areas currently exist with which to compare. While some rangeland treatments to remove sagebrush for livestock forage production can temporarily increase sage-grouse foraging areas, the predominant effect is habitat loss and fragmentation, although those losses cannot be quantified or spatially analyzed due to lack of data collection.

Restoration of sagebrush habitat is challenging, and restoring habitat function may not be possible because alteration of vegetation, nutrient cycles, topsoil, and cryptobiotic crusts have exceeded recovery thresholds. Even if possible, restoration will require decades and will be cost-prohibitive. To provide habitat for sage-grouse, restoration must include all seasonal habitats and occur on a large scale (4,047 ha (10,000 ac) or more) to provide all necessary habitat components. Restoration may never be achieved in the presence of invasive grass species.

The WAFWA identified a goal of "no net loss" of birds and habitat in their Greater Sage-grouse Comprehensive Conservation Strategy (Stiver *et al.* 2006, p. 1-7). Knick and Hanser (in press, p. 32) have concluded that this strategy may no longer be possible due to natural and anthropogenic threats that are degrading the remaining sagebrush habitats. They recommend focusing conservation on areas critical to range-wide persistence of this species (Knick and Hanser in press, p. 31). Wisdom *et al.* (in press, pp. 24-25) and

Knick and Hanser (in press, p. 17) identified two strongholds of contiguous sagebrush habitat essential for the long-term persistence of greater sage-grouse (the southwest Wyoming Basin and the Great Basin area straddling the States of Oregon, Nevada, and Idaho). Other areas within the greater sage-grouse range had a high uncertainty for continued population persistence (Wisdom *et al.*, in press, p. 25) due to fragmentation from anthropogenic impacts. However, our analyses of fragmentation in the two stronghold areas showed that habitats in these areas are becoming fragmented due to wildfire, invasive species, and energy development. Therefore, we are concerned that the level of fragmentation in these areas may already be limiting sage-grouse populations and further reducing connectivity between populations. These threats have intensified over the last two decades, and we anticipate that they will continue to accelerate due to the positive feedback loop between fire and invasives and the persistent and increasing demand for energy resources.

Population Trends in Relation to Habitat Loss and Fragmentation

In order to assess the effects of habitat loss and fragmentation on greater sage-grouse populations and persistence, we examined a variety of data to understand how population trends reflected the changing habitat condition. Patterns of sage-grouse extirpation were identified by Aldridge *et al.* 2008 (entire) Johnson *et al.* (in press, entire), Wisdom *et al.* (in press, entire), Knick and Hanser (in press, entire), and others, and discussed in detail above. Examples include fragmentation of populations and their isolation as a result of habitat loss from fire (Knick and Hanser in press, p. 20; Wisdom *et al.* in press, p. 22), an increase in the probability of extirpation as a result of fire (Knick and Hanser in press, p. 31) and agricultural activities and human densities (Aldridge *et al.* 2008, p. 990; Wisdom *et al.* in press, p. 4), and sage-grouse population declines as a result of energy development (Doherty *et al.* 2008, p. 193; Johnson *et al.* in press, p. 13; Leu and Hanser, in press, p. 28). Therefore, where these habitat factors, and others identified above, are occurring, we anticipate that sage-grouse population trends will continue to decline.

Lek count data are the only data available to estimate sage-grouse population trends, and are the data WAFWA collects (WAFWA 2008, p. 3). The use of lek count data as an index of trends involves various types of uncertainty (such as measurement error, count methods, statistical and other types of assumptions; e.g. see Connelly *et al.*, 2004, pp. 6-18 to 6-20; and WAFWA 2008, pp. 7-8). Nevertheless, these data have been collected for 50 years in most locations and therefore do have utility in examining long-term trends (Gerrodette 1987, p. 1370; Connelly *et al.* 2004, p. A3-3; Stiver *et al.* 2009, p. 3-5; WAFWA 2008, p. 3), and in evaluating differences in trends across the species' range. Therefore, we are considering the results of researchers whose work relies on lek data (e.g., Garton *et al.* (in press), Wisdom *et al.* (in press), Connelly *et al.* (2004, p. 6-18 to 6-59; WAFWA 2008, entire) to help inform our overall analyses.

Population trends (average number of males per lek) in MZs I and II, the areas with the highest concentration of nonrenewable energy development, decreased by 17 and 30 percent from 1965 to 2007, respectively (Garton *et al.* in press, pp. 28, 35). Individual population trends within each MZ varied. However, in areas of intensive energy development, trends were negative as habitat continued to be fragmented. For example, in the Powder River Basin of Wyoming, sage-grouse populations have declined by 79 percent in the 12 years since coal-bed methane development was initiated there (Emmerich 2009, pers. comm.). In MZs affected by *Bromus tectorum* and fire, (primarily MZs IV (Snake River Plain) and V (Northern Great Basin)), population trends from 1995 to 2007 also were negative (Table 6). These results are consistent with the analyses conducted by Wisdom *et al.* (in press, p. 24) that demonstrate that fragmentation as a result of disturbance results in reduced population numbers and population isolation.

In some populations within the species' range, population trends (number of males counted on leks) since the early 1990s appear to be stable, and in some cases increasing (Garton *et al.* in press, Figs.2-8, pp.188-219). However, simply looking at total number of males counted does not accurately reflect habitat conditions, as leks, and by inference the associated breeding habitats, could have been lost. Additionally, as discussed above, sage-grouse will continue to attend leks even after habitat suitability is diminished simply due to site fidelity (Walker *et al.* 2007a, p. 2651). Therefore, the counts of males on these leks may artificially minimize the declines seen in trend analyses, as little productivity results from them. Because the analyses were truncated in 2007 to be comparable to other analyses of population trends (i.e. Connelly *et al.* 2004 and WAFWA 2008, see discussion under population size above), delays in population response to habitat loss and fragmentation events within the past 2 to 3 years may not have been captured. Also, some significant events that have resulted in habitat loss occurred after the 2007 lekking season. For example, the Murphy complex fire in Idaho and Nevada burned 264,260 ha (653,000 ac), resulting in the loss of 75 of 102 leks, and the associated nesting habitats in the area. Population-level effects of this fire would not be reflected by any of the three population trend analyses (Connelly *et al.*, 2004; WAFWA 2008; Garton *et al.* in press) simply because it occurred after the time period analyzed.

Projections of Future Populations

As described above, our analysis of habitat trends, and those provided in the published literature show that population extirpation and declines have, and are likely to continue to track habitat loss or environmental changes (e.g., Walker *et al.*, 2005, Aldridge *et al.* 2008; Knick and Hanser in press; Wisdom *et al.* in press). Estimation of how these trends may affect future population numbers and habitat carrying capacity was conducted by Garton *et al.* (in press, entire). We realize population viability analyses are based on assumptions that may or may not be realistic given the species analyzed. Additionally, lek counts are not the best data for use in these kinds of analyses as variability in lek attendance, observer bias, and the unknown relationship between males counted to actual population sizes limit unbiased estimation of future population numbers (see also discussion under population sizes above, and in Garton *et al.*, in press, pp. 8, 66). At the request of the Colorado Division of Wildlife, three individuals (Conroy 2009, entire; Noon 2009, entire; Runge 2009, entire) reviewed Garton *et al.* outside the established peer review process and noted similar limitations of these data. We received these reviews and have reviewed them in the context of all other data we received in preparation of this finding. Their primary concern was about the applicability of analyzing and presenting future population projections in the manner done by Garton *et al.* in press, based on the limitations of the data, the assumptions required, and uncertainty in the estimates of the model parameters (see also discussion above).

Garton *et al.*, (in press, pp. 6-8, 64-67) acknowledged these concerns, as several of the reviewers pointed out, and their analyses underwent peer review via the normal scientific process prior to acceptance for publication. Population viability analyses can provide useful information in examining the potential future status of a species as long as the assumptions of the model, and violations thereof, are clearly identified and considered in the interpretation of the results. Therefore, we present the analyses conducted by Garton *et al*. (in press, entire) here in relation to our conclusion of how existing and continued habitat fragmentation may impact the greater sage-grouse within the foreseeable future. The projections reported by Garton *et al*. (in press, entire; see discussion below) are generally consistent with what we expect given the causes of sage-grouse declines and extirpation documented in the literature (see above) and where those threats occur in the species range, despite the concerns of the authors and others about the limitations of lek data and prospective analysis. We are unaware of any other prospective rangewide population viability analyses for this species.

Garton *et al*. (in press, entire) projected population and habitat carrying capacity trends (the modeled estimate where population growth rate is 0) at 30 (2037) and 100 (2107) years into the future. Growth rates were analogous to rates from 1987 to 2007, and quasi-extinction thresholds (artificial thresholds below which the long-term persistence and viability of a species is questionable due to stochastic variables, such as small populations or genetic inbreeding) corresponded to minimum counts of 20 and 200 males at leks (Garton *et al*. in press, p. 19). The thresholds were established to correspond to populations of 50 and 500 breeding birds, numbers generally accepted for adequate effective population sizes to avoid negative genetic effects from inbreeding (Garton *et al*. in press, p. 19). Therefore, population projections that fell below 50 breeding adults (males and females) were identified as being at short-term risk of extinction, and those that fell below 500 breeding adults (males and females) were identified as being at long-term risk for extinction. However, recent work by Bush (2009, p. 106) suggests that a higher proportion of male sage-grouse are breeding than previously identified. Therefore, Garton *et al*. (in press, p. 20) state that their resulting projections are likely underestimates of actual impacts as more birds are necessary than they assumed for population productivity. Additionally, Traill *et al*. (2010, p. 32) argue that a minimum effective population size must be 5,000 individuals to maintain evolutionary minimal viable populations of wildlife (retention of sufficient genetic material to avoid effect of inbreeding depression or deleterious mutations). We examined the projected population trends for 30 years to minimize the risk of error associated with the 100 year projections simply due to using lek data.

One assumption made by Garton *et al*. (in press, p. 19) is that future population growth would be analogous to what occurred from 1987 to 2007. We anticipate adverse habitat impacts (see discussion of foreseeable future below) and synergism between these impacts (e.g. fire and invasive species expansion) to increase habitat loss; therefore, Garton *et al*.'s (in press) likely over-estimate the resulting future habitat carrying capacity and population numbers.

In all MZs, the analyses by Garton *et al*. (in press) predict that populations will continue to decline. In MZ I, Garton *et al*. (in press, p. 29) project a population decline of 59 percent between 2007 and 2037 if current population and habitat trends continue (Table 10). In the Powder River Basin area, where significant gas development is occurring, population trends were projected an almost 90 percent decline by 2037 (Garton *et al*. in press, p. 26). This projection is consistent with Walker *et al*. (2007, p. 2651) estimate that lek persistence would decline to 5 percent in the Powder River Basin with full field development over a similar time frame. Also, Johnson (in press, p. 13) found that lek counts were reduced from 1997 to 2007 in areas of oil and gas development, and our GIS analyses found that a minimum of 70 percent of breeding habitats is affected by energy development activities in this area (Service 2008b; see discussion under Energy Development). Declines in the Powder River Basin within the past 12 years of development have reached 79 percent (Emmerich 2009, pers. comm.). Populations in MZ I that do not experience the same levels of energy development are not projected to decline as significantly, with the exception of the Yellowstone watershed population (Table 10). This population is projected to be extirpated within 30 years (Garton *et al*. in press, p. 46). This area is highly fragmented by agricultural and energy development, factors identified by Aldridge *et al*. (2008, p. 991) and Wisdom *et al*. (in press, p. 23) with sage-grouse extirpation. Wisdom *et al*. (in *press*, p. 23) also predicted extirpation in this area due to the continuing loss of sagebrush. Loss of the Yellowstone watershed population will result in a gap in the species' range, isolating sage-grouse north of the Missouri River from the rest of the species.

TABLE 10—PROJECTED CHANGES IN CARRYING CAPACITIES OF MANAGEMENT ZONES AND POPULATIONS FROM 2007 TO 2037. CARRYING CAPACITIES ARE REFLECTED AS THE AVERAGE NUMBER OF MALES PER LEK, AND WERE CALCULATED BY DIVIDING POPULATION PROJECTIONS FOR 2037 BY THE POPULATION ESTIMATE IN 2007. DATA FROM GARTON *et al.* (IN PRESS, PP. 22-63, 95-97).

Management Zone	Population	Change in Carrying Capacity from 2007 to 2037 (%)
I (Great Plains)		-59
	Yellowstone watershed	-100
	Powder River	-90
	Northern Montana	-11
	Dakotas	-62
II (Wyoming Basin)		-66

TABLE 10—PROJECTED CHANGES IN CARRYING CAPACITIES OF MANAGEMENT ZONES AND POPULATIONS FROM 2007 TO 2037. CARRYING CAPACITIES ARE REFLECTED AS THE AVERAGE NUMBER OF MALES PER LEK, AND WERE CALCULATED BY DIVIDING POPULATION PROJECTIONS FOR 2037 BY THE POPULATION ESTIMATE IN 2007. DATA FROM GARTON *et al.* (IN PRESS, PP. 22-63, 95-97).—Continued

Management Zone	Population	Change in Carrying Capacity from 2007 to 2037 (%)
	Eagle – S. Routt	extirpated
	Jackson Hole	—
	Middle Park	—
	Wyoming Basin	-64
III (Southern Great Basin)		-55
	Bi-State NV/CA	-7
	S. Mono Lake	—
	NE Interior UT	+211
	San Pete County UT	—
	S. central UT	-36
	Summit-Morgan UT	-14
	Toole-Juab UT	-27
	Southern Great Basin	-61
IV (Snake River Plain)		-55
	Baker, OR	No change
	Bannack, MT	-9
	Red Rocks, MT	-18
	Wisdom, MT	—
	E. central ID	—
	Snake, Salmon, Beaverhead, ID	-18
	Northern Great Basin	-73
V (Northern Great Basin)		-74
	Central OR	-67
	Klamath, OR	—
	NW Interior NV	—
	Western Great Basin	-59
VI (Columbia Basin)		-46
	Moses Coulee	-74
	Yakima	—

TABLE 10—PROJECTED CHANGES IN CARRYING CAPACITIES OF MANAGEMENT ZONES AND POPULATIONS FROM 2007 TO 2037. CARRYING CAPACITIES ARE REFLECTED AS THE AVERAGE NUMBER OF MALES PER LEK, AND WERE CALCULATED BY DIVIDING POPULATION PROJECTIONS FOR 2037 BY THE POPULATION ESTIMATE IN 2007. DATA FROM GARTON *et al.* (IN PRESS, PP. 22-63, 95-97).—Continued

Management Zone	Population	Change in Carrying Capacity from 2007 to 2037 (%)
VII (Colorado Plateau)*		—

— Data insufficient to model
* Although the model projects population increases, habitat is limited in the area, likely limiting actual population growth.

Garton *et al.* (in press, p. 36) projected populations will decline in MZ II by 66 percent between 2007 and 2037 if current population trends and habitat activities continue (Table 10). The Wyoming Basin area, where significant oil, gas and renewable energy development is occurring, is projected to decline by 64 percent (Garton *et al.* in press, p. 34). Population persistence for the Eagle–South Routt population, an area also experiencing significant energy development activities, could not be estimated due to data sampling concerns. However, the population is unlikely to persist for 20 years (Braun, as cited in Garton *et al.* in press, p 30), where 100 percent of the breeding habitat is affected by energy development (Service 2008b). Johnson (in press, p. 13) found that declines in lek attendance was strongly, negatively associated with the presence of wells in these areas once the total number of wells in this MZ exceeded 250. Wells in both of these populations currently exceed that threshold. Therefore, the results of Garton *et al.*'s (in press) analyses are not unexpected.

Garton *et al.* (in press, p. 46) projected populations in MZ III will decline by 53 percent between 2007 and 2037 if current population trends and habitat activities continue (Table 10). Most populations in this area are already isolated by topographic features and experience high native conifer incursions. *Bromus tectorum* also is of significant concern in the Southern Great Basin population. Large losses of sagebrush in this MZ have resulted from *B. tectorum* incursion and the resulting altered fire cycle (Johnson in press, p. 23). Fire within 54 km (33.5 mi) of a lek was identified by Knick and Hanser (in press, p. 29) as one of the most important factors negatively affecting sage-grouse persistence on the landscape. Assuming the current rate of habitat loss continues in this MZ, carrying capacity is projected to decline by 45 percent by 2037 (Garton *et al.* in press, p. 46).

In MZ IV, Garton *et al.* (in press, p. 53) populations are projected to decline by 55 percent between 2007 and 2037 if current population trends and habitat activities continue (Table 10). The Northern Great Basin population is projected to have the greatest drop in carrying capacity, and is the area currently most affected by reduced fire cycles as a result of *Bromus tectorum* incursions. As discussed above, fire within 54 km (33.5 mi) of a lek was identified by as one of the most important factors negatively affecting sage-grouse persistence on the landscape (Knick and Hanser in press, p. 29). The associated incursion of *B. tectorum* has resulted in large losses of habitat in this MZ (Johnson in press, p. 23). Carrying capacities in other populations in this MZ are not projected to decline as much, but these populations do not have significant fire and *B. tectorum* incursions.

In MZ V, Garton *et al.* (in press, p. 58) projected populations will decline by 74 percent between 2007 and 2037 if current population trends and habitat activities continue (Table 10). Nearly all populations within this MZ are affected by reduced fire frequencies and *Bromus tectorum* incursions (see discussion above). In MZ VI, Garton *et al.* (in press, p. 62) projected populations will decline by 46 percent between 2007 and 2037 if current population trends and habitat activities continue (Table 10). The two populations in this MZ are already isolated from the rest of the range, and actively managed by the State of Washington to maintain birds (e.g., translocations, active habitat enhancement). In addition to impacts from agricultural activities and human development (Johnson in press, p. 27), these populations are affected by the loss of CRP lands and military activities, neither of which were quantified by Garton *et al.* (in press, entire). Therefore, the projections provided in the population viability analysis are likely underestimated.

Carrying capacity projections could not be estimated for MZ VII due to insufficient data. Energy development activities occur within most populations in this area, and Johnson (in press, p. 13) reported that lek attendance was lower around producing wells in this MZ. We believe that based on habitat impacts, if birds are retained in this area, the populations will be reduced in size and further isolated.

The projections from Garton *et al.* (in press, entire), which are consistent with results reported by Wisdom *et al.* (in press, entire), our own analyses, and others examining the effects of habitat loss and degradation on population trends, reflect that by 2037 sage-grouse populations and connectivity between them will be further reduced across the species range. This is consistent with other literature that has documented patterns of decline and extirpation as a result of the ongoing habitat losses and fragmentation (for example, see Johnson in press, Knick *et al.* in press and Wisdom *et al.* in press). We are cautious in using a single projection for determining future population status based on the limitation of lek data and the lack of any other comparable rangewide population viability analyses. However, Garton *et al.*'s (in press, entire) results are consistent with the habitat loss and fragmentation analyses conducted by the Service and many other authors, as noted in the individual MZ discussions above.

The population and carrying capacity projections by Garton *et al.* (in press, pp. 22-64) are generally consistent with what we would expect given the causes of sage-grouse declines and extirpation documented in the literature (see above) and where those threats occur in the species range. Therefore, despite the concerns of the authors and other about the limitations of lek data and prospective analysis, the results presented by Garton *et al.* (in press, entire) are consistent with our analyses of habitat impacts based on the review of the best available scientific information.

Foreseeable Future of Habitat Threats

We examined the persistence of each of these habitat threats on the landscape to help inform a determination of foreseeable future. Habitat conversion and fragmentation resulting from agricultural activities and urbanization will continue indefinitely. Human populations are increasing in the western United States and we have no data indicating this trend will be reversed. Increased fire frequency as facilitated by the expanding distribution of invasive plant species will continue indefinitely unless an effective means for controlling the invasives is found. In the last approximately 100 years, no broad scale *Bromus tectorum* eradication method has been developed. Therefore, given the history of invasive plants on the landscape, our continued inability to control such species, and the expansive infestation of invasive plants across the species' range currently, we anticipate they and associated fires will be on the landscape for the next 100 years or longer.

Continued exploration and development of traditional and nonconventional fossil fuel sources in the eastern portion of the greater sage-grouse range will continue to increase over the next 20 years (EIA 2009b, p. 109). Based on existing National Environmental Policy Act (NEPA) documents for major oil and gas developments, production within existing developments will continue for a minimum of 20 years, with subsequent restoration (if possible) requiring from 30 to 50 additional years. Renewable energy development is estimated to reach maximum development by 2030. However, since most renewable energy facilities are permanent landscape features, unlike oil, gas and coal, direct and functional habitat loss from the development footprint will be permanent. Based on this information, we estimate the foreseeable future of energy development at a minimum of 50 years, and perhaps much longer for nonrenewable sources.

Grazing (both domestic and wild horse and burro) is unlikely to be removed from sagebrush ecosystems. Therefore, it is difficult to estimate a foreseeable future for livestock grazing. However, as of 2007, there were 7,118,989 permitted AUMs in sage-grouse habitat. Although there have been recent reductions in the number of AUMs (3.4 percent since 2005), we have no information suggesting that livestock grazing will be significantly reduced, or removed, from sage-grouse habitats. Therefore, while we cannot provide an exact estimate of the foreseeable future for grazing, we expect it to be a persistent use of the sage-grouse landscape for several decades.

Summary of Factor A

As identified above in our Factor A analysis, habitat conversion for agriculture, urbanization, infrastructure (e.g., roads, powerlines, fences); fire, invasive plants, pinyon-juniper woodland encroachment, grazing, energy development, and climate change are all contributing, individually and collectively, to the present and threatened destruction, modification, and curtailment of the habitat and range of the greater sage-grouse. The impacts are compounded by the fragmented nature of this habitat loss, as fragmentation results in functional loss of habitat for greater sage-grouse even when otherwise suitable habitat is still present.

Fragmentation of sagebrush habitats is a key cause, if not the primary cause, of the decline of sage-grouse populations. Fragmentation can make otherwise suitable habitat either too small or isolated to be of use to greater sage-grouse (i.e., functional habitat destruction), or the abundance of sage-grouse that can be supported in an area is diminished. Fire, invasive plants, energy development, various types of infrastructure, and agricultural conversion have resulted in habitat fragmentation and additional fragmentation is expected to continue for the foreseeable future in some areas.

In our evaluation of Factor A, we found that although many of the habitat impacts we analyzed (e.g, fire, urbanization, invasive species) are present throughout the range, they are not at a level that is causing a threat to greater sage-grouse everywhere within its range. Some threats are of high intensity in some areas but are low or nonexistent in other areas. Fire and invasive plants, and the interaction between them, is more pervasive in the western part of the range than in the eastern. Oil and gas development is having a high impact on habitat in many areas in the eastern part of the range, but a low impact further to the west. The impact of pinyon-juniper encroachment generally is greater in western areas of the range, but is of less concern in more eastern areas such as Wyoming and Montana. Agricultural development is high in the Columbia Basin, Snake River Plain, and eastern Montana, but low elsewhere. Infrastructure of various types is present throughout the most of range of the greater sage-grouse, as is livestock grazing, but the degree of impact varies depending on grazing management practices and local ecological conditions. The degree of urbanization and exurban development varies across the range, with some areas having relatively low impact to habitat.

While sage-grouse habitat has been lost or altered in many portions of the species' range, habitat still remains to support the species in many areas of its range (Connelly *et al*. in press c, p. 23), such as higher elevation sagebrush, and areas with a low human footprint (activities sustaining human development) such as the Northern and Southern Great Basin (Leu and Hanser in press, p. 14), indicating that the threat of destruction, modification or curtailment of the greater sage-grouse is moderate in these areas. In addition, two strongholds of contiguous sagebrush habitat (the southwest Wyoming Basin and the Great Basin area straddling the States of Oregon, Nevada, and Idaho) contain the highest densities of males in the range of the species (Wisdom *et al*. in press, pp. 24-25; Knick and Hanser in press, p. 17). We believe that the ability of these strongholds to maintain high densities to date in the presence of several threats indicates that there are sufficient habitats currently to support the greater sage-grouse in these areas, but not throughout its entire range unless these threats are ameliorated.

As stated above, the impacts to habitat are not uniform across the range; some areas have experienced less habitat loss than others, and some areas are at relatively lower risk than others for future habitat destruction or modification. Nevertheless, the impacts are substantial in many areas and will continue or even increase in the future across much of the range of the species. With continued habitat destruction and modification, resulting in fragmentation and diminished connectivity, greater sage-grouse populations will likely decline in size and become more isolated, making them more vulnerable to further reduction over time and increasing the risk of extinction.

We have evaluated the best scientific and commercial information available regarding the present or threatened destruction, modification, or curtailment of the greater sage-grouse's habitat or range. Based on the current and ongoing habitat issues identified here, their synergistic effects, and their likely continuation in the future, we conclude that this threat is significant such that it provides a basis for determining that the species warrants listing under the Act as a threatened or endangered species.

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Commercial Hunting

The greater sage-grouse was heavily exploited by commercial hunting in the late 1800s and early 1900s (Patterson 1952, pp. 30-32; Autenrieth 1981, pp. 3-11). Hornaday (1916, pp. 179-221) and others alerted the public to the risk of