Cumulative Impacts

Special status and Forest Service sensitive species are generally mobile with suitable habitat extending beyond the boundaries of the study area. The 20 projected new well locations would occur within piñon-juniper (10 wells), ponderosa pine (7 wells), and grassland (3 wells) habitat. This development may slightly affect bald eagle, MSO, peregrine falcon and Rio Grande cutthroat trout habitat through the construction and generally increased human activity.

Other foreseeable, surface-disturbing activities in the region include decommissioning of roads within the Cuba and Coyote Ranger Districts, the projects listed in Table OG-15, and other unknown construction projects on non-Federal land. In particular, projects 2, 3, 4, 6, 7, and 8 in Table OG-15 would have the greatest short-term impact on threatened, endangered, and sensitive species that rely on forested habitat due to plans for thinning trees and prescribed fire. These projects should improve habitat over the long term.

However, the loss of habitat as a result of activities in the study area would cause minimal impacts to threatened, endangered, and sensitive species locally, due to compliance with State and Federal laws requiring surveys, protection of threatened and endangered species, and site-specific NEPA analysis with mitigation measures prior to surface-disturbing activities.

Heritage Resources

The cultural history of the Santa Fe National Forest was recently summarized by Schieck et al. (1996), and the following discussion borrows heavily from this synopsis. Specifically, the study area most closely coincides with their discussion of the Rio Gallina subregion of the Jemez Mountains subdivision within the Santa Fe National Forest. Comparisons are based primarily on data from this area. Time-sequent phase designations and archeological characteristics generally follow nominal descriptions from this part of New Mexico, although there also are some differences in site characteristics typical of the Santa Fe National Forest.

Affected Environment

The current knowledge base regarding heritage resources in the study area derives from surveys totaling 80,868 acres. Almost 65 percent of the total survey acreage has focused on the Rio Gallina watershed. Site densities vary from a low of 0.0195 sites per 100 acres (Arroyo Balcon) to a high of 4.272 sites per 100 acres (Canada Larga).

Within the project area, there are 1,885 known prehistoric and/or historic archeological sites ranging in age from ca. 5,000 B.C. until historic times. Most of the sites contain components dating to the Coalition Period (A.D. 1100-1300) and most are situated in the Rio Gallina watershed. The analyses that follow are based on archeological site data obtained from the New Mexico Heritage Resources Information System (NMCRIS) at the Archaeological Records Management System (ARMS) in Santa Fe. Archeological site attributes (e.g., age, size, features) were linked to the specific watersheds that comprise the study area to facilitate analyses of variations in the numbers of sites in each watershed.

Note that a distinction is drawn between “sites” and “components.” A “site” is a single manifestation of human occupations at a specific locality, while “component” refers to the one or more definable time-sequent occupations that may have occurred at that locality. It is not

uncommon for sites to have been occupied on multiple occasions over long periods of time, so that a single site may contain evidence of multiple occupations (i.e., components). For some analyses, sites are used and for other analyses components are used. Alternative phase sequences are presented in Table OG-41.

The overall frequencies of sites and components by time period in each of the watersheds making up the study area are presented in Table OG-42. (See "Water Resources" section for watershed locations.) Because the Rio Chama and Rio Puerco de Chama watersheds barely fall within the boundaries of the study area, the Rio Chama watershed information has been combined with that of the Rio Nutrias watershed and the site data in the Rio Puerco de Chama watershed has been combined with the Arroyo Chijuilla watershed for the purpose of the present analysis.

Table OG-41. Alternate culture history periodization schemes

Pecos	Age	Santa Fe NF Scheick et al. 1996	Gallina Region
PaleoIndian	9000-5000 B.C.	PaleoIndian	PaleoIndian
Archaic	5000-3000 B.C.	Early Archaic	Archaic
	3000-1800 B.C.	Early-Middle Archaic	Archaic
Archaic	1800 B.C. - A.D. 1	Middle-Late Archaic	Archaic
Basketmaker II	A.D. 1-500	Late Archaic	Los Pinos (A.D. 1-400)
Basketmaker III	A.D. 500-700	Developmental	Sambrito (A.D. 400-700)
Pueblo I	A.D. 700-900	Developmental	Rosa (A.D. 700-850)
Pueblo II	A.D. 900-1100	Developmental	Piedra (A.D. 850-950)
Pueblo III	A.D. 1100-1300	Coalition	Arboles (A.D. 950--1050
			Gallina (A.D. 1050-1275)
Pueblo IV	A.D. 1300-1600	Classic	Classic (A.D. 1300-1450)
Pueblo V	A.D. 1600-1700	Protohistoric (A.D. 1450-1598)	Protohistoric
	A.D. 1598-1821	Spanish Colonial	Spanish Colonial
	A.D. 1821-1846	Mexican	Mexican
	A.D. 1846-1912	Territorial	Territorial
	A.D. 1912-1945	Statehood	Statehood
	A.D. 1945-present	Atomic	Atomic

Our current understanding of the prehistory and history of the study area is based on archeological surveys of over 300,000 acres in the surrounding region. In the study area, archeological surveys have focused primarily on Rio Gallina (10,164 acres), Arroyo Chijuilla (4,299 acres), and Rio Nutrias (2,426 acres) watersheds. Surveys in the remaining watersheds total about 2,419 acres. Based on these surveys, the Santa Fe National Forest oil-gas study area contains 1,885 known sites. The density of these known sites in the study area is shown on Figure OG-34, which is determined by the location and extent of surveys. It cannot be used to predict the density or distribution of all sites.

Table OG-42. Frequencies of components by time period and watershed

Period	Arroyo Balcon	Arroyo Chijuilla	Cañada Larga	Rio Gallina	Rio Guadalupe	Rio Nutrias	Tapacito Creek	Totals
PaleoIndian	0	0	0	0	0	0	0	0
Archaic	0	7	0	25	0	1	0	33
Developmental	0	4	26	381	0	128	0	539
Coalition	0	10	42	957	0	247	2	1,258
Classic	0	7	5	345	0	20	11	388
Protohistoric	0	6	7	354	0	21	11	399
Spanish Colonial	0	0	1	10	0	1	0	12
Mexican	1	3	3	13	0	1	0	21
Territorial	1	5	3	24	1	2	0	36
Statehood	1	8	2	39	2	7	1	60
Atomic	1	7	1	29	1	7	0	46
Unknown	0	22	3	76	5	0	0	106
Total Known Components	**4**	**79**	**93**	**2,253**	**9**	**435**	**25**	**2,898**
Total Sites	**1**	**64**	**57**	**1,429**	**3**	**317**	**14**	**1,885**

In general, the prehistory of the study area is divided into seven major periods. The earliest evidence of human occupations in the region is termed PaleoIndian. This is followed by the Archaic Period during which the beginnings of agriculture emerge in the archeological record. Subsequent prehistoric developments are divided into the Developmental (A.D. 500-1100), Coalition (A.D. 1100-1300), Classic (A.D. 1300-1450), and Protohistoric (A.D. 1450-1598) Periods. The final period, the Historic (A.D. 1598-present) Period, encompasses the remainder of cultural manifestations in the study area. Each of these periods is discussed in more detail below.

It is important to emphasize that the project area contains significant heritage resources linked to the Gallina Culture. This manifestation differs from more western Puebloan occupations in terms of architecture, artifacts, settlement patterns, and occupational durations. For this reason, the following synopsis will occasionally digress to these more regionalized prehistoric manifestations.

Summary of Prehistoric Occupations

PaleoIndian Period (pre-9000 B.C. to 5000 B.C.)

The archetypal view of the PaleoIndian Period is that it was characterized by relatively small bands of hunters relying on large, now extinct, Pleistocene megafauna. There is controversy concerning when these peoples first arrived in North America, with progressively earlier dates from sites of this period appearing almost every year. The earliest evidence in New Mexico conforms to the date range indicated above, although earlier sites will likely be found.

PaleoIndian sites are ephemeral, reflecting periodic movement of camps to areas where animals might be found. At the same time, there is some evidence of reliance on plant resources.

PaleoIndian sites consist of chipped and ground stone tools, including large bifacial projectile points. These points were attached to wooden shafts to form spears or large darts, thrown with an atlatl, or spear thrower. Variations in the ways these points were manufactured, specifically reliance on fluting and lateral thinning, have allowed archeologists to separate the PaleoIndian Period into three time-sequent complexes. Non-fluted Clovis points typify the earliest complex. Later, fluted points signal the appearance of the Folsom complex. Finally, points typified by extreme lateral thinning are indicative of the Plano complex. Rarely are bone and wooden tools preserved.

PaleoIndian sites are scarce over much of the study area due, perhaps, to the rugged terrain inimical to large animals (Scheick et al. 1996). According to Scheick et al. (1996), the few possible sites from this period consist of chipped stone scatters and rockshelter sites, both associated with remains from later occupations. They conclude, however, that evidence of PaleoIndian sites in the region is equivocal. Paleoenvironmental reconstructions using plant pollen suggest that drought conditions prevailed over much of the Rio Gallina region between 8000 and 6500 B.C. There are 11 possible PaleoIndian components among sites in the Santa Fe National Forest, representing about one-third of 1 percent of all known components. This proportion is similar to forest-wide proportions of PaleoIndian sites reported in Schieck et al. 1996. Most consist of simple artifact scatters without visible evidence of features (e.g., structures). Virtually all of the PaleoIndian sites in the broader region date to the later portion of this period and, consistent with what Scheick et al. (1996) observed elsewhere, are usually associated with remains from later occupations.

There are no unequivocal PaleoIndian sites known in the Santa Fe National Forest oil-gas study area.

Archaic Period (ca. 5000 B.C. to A.D. 500)

The Archaic Period is signaled by the extinction of earlier Pleistocene fauna, due to the combined effects of the drought noted earlier as well as hunting by PaleoIndian peoples. Although hunting continued to be important throughout the Archaic Period, there was greater reliance on gathering of wild plant resources. Consonant with this subsistence shift is the appearance of new classes of artifacts, notably ground stone implements used to process plant foods for consumption. As well, projectile points decrease in size consistent with hunting of smaller animals.

As in the PaleoIndian Period, Archaic hunting and gathering groups seem to have remained small in size, probably consisting of no more than a few co-residential, extended families. Archaic sites are more visible than PaleoIndian sites, but, with some exceptions, remain relatively ephemeral. This is again consistent with high mobility when groups continually move to take advantage of geographic and seasonal variations in the availability of plant and animal resources.

General trends in the number of Archaic sites across the Santa Fe National Forest suggest progressively greater use of the area during this period (Scheick et al. 1996). Surveys indicate Archaic site densities range between one Archaic site per 2,992 hectares to one Archaic site per 735 hectares. Of the sites for which information is available, most consist of simple artifact scatters without visible evidence of features (e.g., structures).

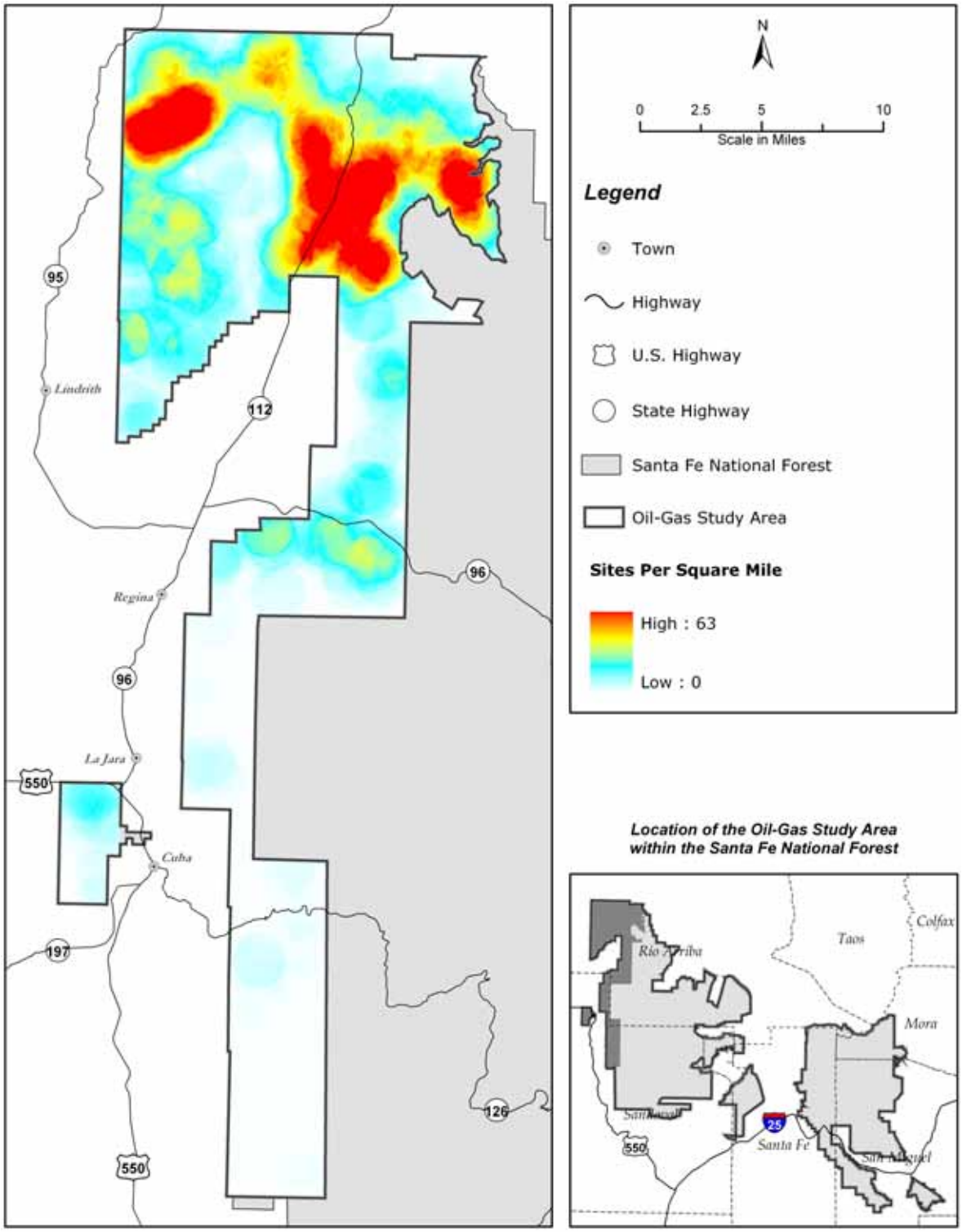

Figure OG-34. Density of recorded archeological sites within the study area

It should be emphasized that Archaic sites in the study area contain projectile points nominally assigned to both the Oshara Tradition and the Cochise Culture (Scheick et al. 1996). For purposes of this discussion, phase sequences identified with the Oshara Tradition will be used.

Not surprisingly, there are relatively few early Archaic Jay Phase (ca. 5500 to 4800 B.C.) or Bajada Phase (ca. 4800 to 3200 B.C.) sites. There appears to be a progressive increase in site numbers through the middle-late Archaic, including the San Jose (ca. 3000 to 1800 B.C.), Armijo (ca. 1800 to 800 B.C.) and En Medio (800 B.C. to A.D. 400) phases. This implies progressively greater use of the study area throughout the Archaic Period, perhaps in response to population growth.

The earliest evidence of domesticated crops, notably maize, appears at sites nominally associated with En Medio Phase deposits. Direct dates on corn remains suggest that cultigens began to appear in the study area between 710 B.C. and A.D. 830 (Scheick et al. 1996). This presages the much greater reliance on domesticated crops that characterizes the later prehistory of the study area. At the same time, reliance on domesticates implies the need to maintain fields, as well as store any surpluses that might be generated. Not surprisingly, the appearance of maize in the archeological record is accompanied by the almost simultaneous appearance of more permanent structures and storage facilities. At the same time, there is some suggestion that maize did not appear in all parts of the Rio Gallina region at the same time. Specifically, maize seems to appear earlier in the eastern part of the basin, but is largely absent in western parts of the basin. However, this may reflect an absence of surveys in the western region rather than any fundamental underlying variability in subsistence patterns across the study area.

Archaic sites in the study area average 4,987 square meters in size. Sites are situated at an average elevation of 7,465 feet, with modes at 7,200, 7,840, and 8,960 feet. There is no apparent interaction between site size and elevation among sites within the study area.

The ratio of structural to nonstructural Archaic sites is 1.85, so that there are almost twice as many sites with structural remnants (e.g., hearths) as those without such remnants. Nonstructural sites average 2,325 square meters in the Arroyo Chijuilla watershed and 2,791 square meters in the Rio Gallina watershed. In contrast, structural sites in the Rio Gallina are almost twice as large as those in the Arroyo Chijuilla watershed (8,092 vs. 4,094 square meters). Structural and nonstructural sites are found at the same elevations across the study area.

There are 33 sites containing Archaic components in the oil-gas leasing portion of the Santa Fe National Forest. These comprise about 1.2 percent of all known components in the forest. This proportion is almost 50 percent lower than forest-wide proportions of Archaic sites reported in Schieck et al. (1996). Of these, 25 are found in the Rio Gallina watershed, 7 are in the Arroyo Chijuilla watershed, and 1 is found in the Rio Nutrias watershed. Numerous lithic scatters in the study area may be related to Archaic occupations, but lack diagnostic artifacts and assemblages that would permit the cultural and temporal association of the sites to be determined.

Developmental Period (A.D. 500-1100)

The end of the Archaic Period signals the appearance of “Puebloan/Developmental” occupations across the larger region of which the study area is a part. In the study area proper, prehistoric occupations identified as “Gallina” are most closely related to archeological events centered

northward in the Gobernador portion of the San Juan basin. Here, time-sequent phases are designated as Los Pinos, Sambrito, Rosa, Piedra, Arboles, and Gallina.

The Gallina phases on the Santa Fe National Forest represent unique regionally localized Puebloan adaptations along the eastern periphery of the Pueblo heartland. There is a seeming absence of occupations dating between the Los Pinos (A.D. 1-400) and Arboles (A.D. 950-1050) Phases, suggesting that the Santa Fe National Forest was not occupied to a significant degree between A.D. 1 and 1050. This occupational hiatus implies that the Santa Fe National Forest was not the locus of a smooth Archaic-Puebloan transition so evident elsewhere.

Rather, many occupations in the study area contain Gallina components (A.D. 1050-1275) typified by the co-occurrence of below-ground and above-ground structures, including pit structures, storage structures, towers, cliff dwellings, and jacal structures. In contrast, Puebloan occupations located to the west in Chaco Canyon and to the north at Mesa Verde were, during this interval, characterized primarily by above-ground masonry architecture.

Further, Gallina phase sites exhibit some characteristics (i.e., pottery styles) reminiscent of Chaco Canyon. This has been interpreted as evidence in-migration from regions west and south of the study area. Sites are most often found on mesa tops and along ridges in what have been interpreted as “defensive” locations.

The Developmental Period, including the Gallina phase, saw the advent of settled villages dependent on the cultivation of domesticated crops (Scheick et al. 1996). However, the overall number of Developmental Period sites in the broader region in which the study area is situated is relatively small (Scheick et al. 1996). This forest-wide pattern is mirrored in the study area; Developmental Period sites are relatively uncommon.

There is no information for 278 sites as to the types of surface manifestations that are present. Of the remaining sites for which information is available, most (108) consist of single residential units and associated refuse deposits. In declining order of importance are multiple residential units: pit houses, roomblocks (56), artifact scatters lacking any structures (23), and residential complexes/communities (17) containing multiple structures and larger refuse deposits.

The ratio of structural to nonstructural Developmental Period sites is 5.76, so that there are almost six as many sites with structural remnants (e.g., hearths, rooms) as those without such remnants. Structural and nonstructural sites are found at the same elevations across the study area.

Developmental sites in the study area average 5,195 square meters in size. Sites are situated at an average elevation of 7,543 feet. Nonstructural sites average 4,688 square meters, while structural sites average 5,285 square meters. There is no apparent interaction between site size and elevation among sites within the study area. At the same time, there is considerable variability in site size by type depending on which watershed is examined.

Nonstructural sites average 2,275 square meters in the Arroyo Chijuilla watershed, 6,580 square meters in the Cañada Larga watershed, 4,733 square meters in the Rio Gallina watershed, and 2,757 square meters in the Rio Nutrias watershed. In contrast, structural sites in the Arroyo Chijuilla watershed average 4,038 square meters, 9,593 square meters in the Cañada Larga watershed, 5,457 square meters in the Rio Gallina watershed, and 4,388 square meters in the Rio Nutrias watershed. Structural and nonstructural sites are found at the same average elevation across the study area.

In the oil-gas study area of the Santa Fe National Forest, there are 539 sites containing evidence of Developmental components. These comprise about 19 percent of all known components in the

forest. This proportion is significantly higher than forest-wide proportions of Developmental sites reported in Schieck et al. (1996), doubtless reflecting the disproportionate importance of the Rio Gallina watershed in the current study. Of these Developmental sites, 381 are found in the Rio Gallina watershed, 128 are in the Rio Nutrias watershed, 26 are in the Cañada Larga watershed, and 4 are in the Arroyo Chijuilla watershed.

Coalition Period (A.D. 1100-1300)

The Coalition Period in the study area varies markedly from patterns observed in the surrounding region. During this period, populations in Chaco Canyon to the south and Mesa Verde to the north experienced substantial declines accompanied by the wholesale abandonment of sites. In contrast, during this same period, the study area exhibited perhaps the largest increase in settlement density, due, perhaps, to in-migration from the Chaco and Gobernador areas (Scheick et al. 1996). It is this postulated in-migration, accompanied by a spike in the numbers of sites and changes in the character of artifact assemblages and settlement patterns, which has led archeologists to designate the ca. A.D. 1050-1275 as the "Gallina Phase." Yet, by the end of the Coalition Period, many sites in the study area dating to this period were abandoned.

Settlement patterns are consistent with a very intensive, but short-lived, occupation of the study area lasting about 2 centuries. Sites are found on mesa tops, slopes, low hills, and valley bottoms (Scheick et al. 1996). Based on the appearance of ceramics with characteristics similar to those found to the west and the appearance of stockaded villages, some have speculated that the study area became a temporary haven for people formerly residing in the Gobernador and Navajo Reservoir regions to the west (Scheick et al. 1996). The impetus for this in-migration has been attributed to the onset of drought conditions that would have adversely affected agriculture at lower elevations or a process of gradual outward expansion of technologically advanced peoples into environmental zones previously deemed marginal for agricultural pursuits (Scheick et al. 1996).

Whatever the processes leading to the sudden increase in settlements, subsequent developments during the Coalition Period suggest a pronounced degree of geographic and social insularity among the region's inhabitants. Ceramic types became notably homogeneous and, with an absence of intrusive trade wares, there was an apparent collapse of—or non-participation in—large trade networks by the region's inhabitants during the Coalition Period (Scheick et al. 1996). Agriculture, while important, did not supplant hunting and gathering (Scheick et al. 1996). Hunting and gathering appears to have had greater relative importance among Coalition/Gallina Phase sites in the study area compared to other contemporary areas of the Southwest.

Sites of this period remain poorly understood, despite almost a century of research. Pit houses, stone residential structures termed "unit houses," ramadas, and storage facilities are common among sites dating to the Coalition Period (Mackey and Green 1979). For the larger region in which the study area is situated, settlements consist of isolated field houses/pit houses (31.8 percent), pit houses (19 percent), pit house/surface house villages (17.4 percent), hunting-gathering sites, and agricultural terraces. Semi-subterranean circular pit houses—whether isolated or in larger villages—vary between 5.5 and 7.3 meters in diameter, with a small proportion approaching 14 meters in diameter (Scheick et al. 1996). Above-ground structures consisted of masonry rooms resembling more typical roomblocks (Scheick et al. 1996). Surface storage rooms ("unit houses") vary between 1.4 and 4.8 square meters (Scheick et al. 1996).

In addition, stone towers interpreted as defensive structures are also known (Ellis 1988; Mackey and Green 1979). The tower structures, which average about two or more meters in height, are constructed of thick, double-coursed stone (Mackey and Green 1979). Floor area within these structures is significantly smaller than "residential structures," leading Mackey and Green to conclude that they were intended primarily for defensive purposes with secondary use as storage facilities (Mackey and Green 1979; Scheick et al. 1996). Subsistence activities during this period seem to have focused primarily on dry-land farming employing terraces or grid borders (Mackey and Green 1979), in conjunction with reliance on wild plant and animal resources available in the region.

Most Coalition Phase sites in the project area were abandoned by ca. A.D. 1250-1275. Causes are attributed to the combined effects of drought and prolonged inadequate harvests at elevations marginal for agriculture (Dean 1996, Scheick et al. 1996). Elsewhere, Cañada Larga-Rio Gallina Phase occupations coincide with this period of climatic deterioration (Mackey and Green 1979). Others, including Santa Fe National Forest archeologists, have argued that there is evidence of intraregional conflict between the occupants of different parts of the project area, the causes of which may be linked to dwindling resources resulting from deteriorating climatic conditions.

There is no information for 945 Coalition Period sites as to the types of surface manifestations that are present. Of the remaining sites for which information is available, most (109) consist of single residential units and associated refuse deposits. In declining order of importance are multiple residential units (e.g., pit houses, roomblocks; 56), artifact scatters lacking any structures (34), and features in association with artifact scatters (27). Residential complexes/communities containing multiple structures and larger refuse deposits are typical of a small number of sites (19).

The ratio of structural to nonstructural Coalition sites is 8.14, so that there are more than eight times as many sites with structural remnants (e.g., hearths, pit houses, masonry rooms) as those without such remnants. Nonstructural sites average 3,756 square meters, while structural sites average 3,191 square meters. At the same time, there is considerable variability in site size by type depending on which watershed is examined.

Coalition sites in the study area average 3,251 square meters in size. Sites are situated at an average elevation of 7,651 feet. While there appears to be no interaction between site size and elevation among sites within the study area, the location of many sites—notably habitation sites—in relatively inaccessible areas implies that defensible locations were often preferred (Bremer 2005).

Nonstructural sites average 6,979 square meters in the Arroyo Chijuilla watershed; 4,266 square meters in the Cañada Larga watershed; 3,784 square meters in the Rio Gallina watershed; and 1,756 square meters in the Rio Nutrias watershed. In contrast, structural sites in the Arroyo Chijuilla watershed average 2,913 square meters; 7,037 square meters in the Cañada Larga watershed; 3,176 square meters in the Rio Gallina watershed; 2,835 square meters in the Rio Nutrias watershed; and 1,350 square meters in the Tapacito Creek watershed. Structural and nonstructural sites are found at the same average elevation across the study area.

There are 1,258 sites containing Coalition Period components in the oil-gas study area of Santa Fe National Forest. These comprise about 45 percent of all known components in the study area. Again, this proportion is significantly higher than forest-wide proportions of Coalition sites reported in Schieck et al. (1996), underscoring the importance of the Rio Gallina watershed in the current study. Of these, 957 are found in the Rio Gallina watershed, 247 are in the Rio Nutrias

watershed, 42 are in the Cañada Larga watershed, 10 are in the Arroyo Chijuilla watershed, and 2 are in the Tapacito Creek watershed.

Classic Period (A.D. 1300-1450)

The Classic Period saw a significant depopulation of the wider region in which the study area is situated (Scheick et al. 1996). Some have speculated that some of the region's residents may have relocated to Jemez Canyon (Scheick et al. 1996). This occupational hiatus—which remains poorly understood—appears to have continued until Spanish contact. In the study area specifically, Classic Period sites are relatively infrequent.

There is no information for 392 sites as to the types of surface manifestations that are present. Of the remaining 9 sites for which information is available, most (5) consist of single residential units and associated refuse deposits.

The ratio of structural to nonstructural Classic sites is 6.9, so that there are almost seven sites with structural remnants (e.g., hearths, pit houses, masonry rooms) as those without such remnants. Nonstructural sites average 2,849 square meters, while structural sites average 2,051 square meters. At the same time, there is considerable variability in site size by type depending on which watershed is examined.

Classic Period sites in the study area average 2,154 square meters in size. Sites are situated at an average elevation of 7,798 feet. While there appears to be no interaction between site size and elevation among sites within the study area, the location of many sites—notably habitation sites—in relatively inaccessible areas implies that defensible locations were often preferred (Bremer 2005).

Nonstructural sites average 3,000 square meters in the Arroyo Chijuilla watershed; 1,875 square meters in the Cañada Larga watershed; 2,887 square meters in the Rio Gallina watershed; and 3,000 square meters in the Rio Nutrias watershed. In contrast, structural sites in the Arroyo Chijuilla watershed average 1,380 square meters; 2,250 square meters in the Cañada Larga watershed; 2,073 square meters in the Rio Gallina watershed; 838 square meters in the Rio Nutrias watershed; and 4,032 square meters in the Tapacito Creek watershed. Structural and nonstructural sites are found at the same average elevation across the study area.

There are 388 sites with Classic Period components in the oil-gas study area of the Santa Fe National Forest. These comprise 13.9 percent of all known components in the forest. This proportion is 50 percent lower than forest-wide proportions of Classic sites as reported in Schieck et al. (1996). Of the Classic sites, 345 are found in the Rio Gallina watershed, 20 are in the Rio Nutrias watershed, 5 are in the Cañada Larga watershed, 7 are in the Arroyo Chijuilla watershed, and 11 are in the Tapacito Creek watershed.

Protohistoric Period (A.D. 1450-1598)

The Protohistoric Period encompasses a relatively short interval between initial Spanish contact in A.D. 1540 and the establishment of the first permanent Spanish settlement near San Juan Pueblo in A.D. 1598.

Protohistoric sites in the study area average 2,295 square meters in size. Sites are situated at an average elevation of 7,800 feet. There is no apparent interaction between site size and elevation among sites within the study area.

The ratio of structural to nonstructural Protohistoric sites is 7.0, so that there are almost seven sites with structural remnants (e.g., hearths, pit houses, masonry rooms) as those without such remnants. Nonstructural sites average 2,849 square meters, while structural sites average 2,214 square meters. At the same time, there is considerable variability in site size by type depending on which watershed is examined.

Nonstructural sites average 3,000 square meters in the Arroyo Chijuilla watershed; 1,875 square meters in the Cañada Larga watershed; 2,887 square meters in the Rio Gallina watershed; and 3,000 square meters in the Rio Nutrias watershed. In contrast, structural sites in the Arroyo Chijuilla watershed average 1,380 square meters; 1,763 square meters in the Cañada Larga watershed; 2,265 square meters in the Rio Gallina watershed; 838 square meters in the Rio Nutrias watershed; and 4,033 square meters in the Tapacito Creek watershed. Nonstructural sites are found at an average elevation of 7,710 feet, while structural sites are found at an average elevation of 7,814 feet across the study area.

There are 399 sites exhibiting Protohistoric Period components in the oil-gas study area of the Santa Fe National Forest. Of the sites containing Protohistoric Period components, most (388) seemingly contain late Anasazi components. Although the study area was almost certainly visited by Native Americans during this time, there is minimal archeological evidence of their passing.

Protohistoric Period components comprise about 14.3 percent of all known components in the forest. This proportion is significantly greater than forest-wide proportions reported in Schieck et al. (1996). Of the Protohistoric sites, 354 are found in the Rio Gallina watershed, 21 are in the Rio Nutrias watershed, 7 are in the Cañada Larga watershed, 6 are in the Arroyo Chijuilla watershed, and 11 are in the Tapacito Creek watershed.

Summary of Historic Period Occupations

Spanish Colonial Period (A.D. 1598-1821)

Spanish Colonial Period refers to the 223-year period between the establishment of the first Spanish settlement near San Juan Pueblo in 1598 to Mexican independence in 1821. Early Spanish Colonial Period settlements included the mission at Jemez (1601). Most of the study area was not settled by Spaniards during the 1600s due to persistent warfare.

The Spanish Colonial Period had dramatic effects on indigenous peoples, introducing domesticated crops (e.g. wheat, barley, sheep), diseases to which they had no resistance, and Catholicism. Missions were in the early seventeenth century (Julyan 1996; Williams 1986) at San Ildefonso (1617), Jemez (1622), and Santa Clara (1622-1629).

Spanish expansion and colonization of new areas in Rio Arriba was arrested with the outbreak of the Pueblo Revolt of 1680 (Scheick et al. 1996). Withdrawing to El Paso, there was no Spanish presence in all of New Mexico—including the study area—for almost 16 years until the region was reconquered by Vargas in 1696.

In the years following the Reconquest, there was a succession of land grants awarded to Spaniard settlers in the study area. These include, in chronological order (Williams 1986; Scheick et al. 1996), Plaza Colorado (1739), Plaza Blanca (1739), Black Mesa (1743), Abiquiu (1754), Piedre Lumbre (1766), Polvadera (1766), Ojo Caliente (1793), and Canon de San Diego (1798). The village of Cuba, in the southern portion of the study area, was settled no later than 1776, while efforts to settle near La Ventana (ca. 1778) proved unsuccessful due to persistent raiding (Julyan 1996).

The tenuous nature of these settlements is underscored by the history of the Ojo Caliente and Abiquiu land grants, as well as the settlement at Cuba (Julyan 1996). Ojo Caliente initially was settled by Spanish colonists in the 1680s (Pearce 1965), only to be abandoned in 1748 due to warfare with neighboring Utes, Apaches, and Navajos. After a decades-long hiatus, it was resettled in the 1790s. Similarly, Abiquiu was initially settled in the 1740s, but abandoned in 1747 due to warfare, only to be resettled in 1754. Finally, Cuba was established no later than 1776, but was also abandoned shortly thereafter due to warfare with neighboring tribes (Julyan 1996).

Occupations dating to this period are relatively uncommon in the study area. Of these, most date to the later eighteenth century following a series of treaties with various Indian groups who once occupied the study area. The resulting decline in warfare between Indians and Spaniards allowed, for the first time, Spanish settlements to be extended into the study area in significant numbers. Current data also suggest that, throughout the later 1700s, populations in the study area continued to expand, oftentimes residing in small ranchos outside larger land grants (Scheick et al. 1996).

The primary economic activity at these ranchos was stock herding. Of the nine sites for which information is available, most (five) consist of single residential sites and associated refuse deposits. Spanish Colonial sites in the study area average 2,295 square meters in size. Sites are situated at an average elevation of 7,800 feet. There is no apparent interaction between site size and elevation among sites within the study area.

The ratio of structural to nonstructural Spanish Colonial Period sites is 7.0, so that there are almost seven sites with structural remnants (e.g., hearths, pit houses, masonry rooms) as those without such remnants. Nonstructural sites average 2,849 square meters, while structural sites average 2,214 square meters. At the same time, there is considerable variability in site size by type depending on which watershed is examined.

Nonstructural sites average 3,000 square meters in the Arroyo Chijuilla watershed; 1,875 square meters in the Cañada Larga watershed; 2,888 square meters in the Rio Gallina watershed; and 3,000 square meters in the Rio Nutrias watershed. In contrast, structural sites in the Arroyo Chijuilla watershed average 1,380 square meters; 1,763 square meters in the Cañada Larga watershed; 2,265 square meters in the Rio Gallina watershed; 838 square meters in the Rio Nutrias watershed; and 4,033 square meters in the Tapacito Creek watershed. Nonstructural sites are found at an average elevation of 7,710 feet, while structural sites are found at an average elevation of 7,814 feet across the study area.

Of the sites containing Spanish Colonial components, most (seven) are affiliated with Euro-Anglo occupations. These are followed in decreasing order by Hispanic (two) and Navajo (three) occupations. Again, it is likely that Navajo sites are underrepresented in the study area during this period.

There are 12 sites containing Spanish Colonial Period components in the oil-gas study area of the Santa Fe National Forest. These comprise 0.4 percent of all known components in the forest. This is comparable to forest-wide proportions reported in Schieck et al. (1996). Of the Spanish Colonial sites, 10 are found in the Rio Gallina watershed, 1 is in the Rio Nutrias watershed, and 1 is in the Cañada Larga watershed.

Mexican Period (A.D. 1821-1846)

The Mexican Period encompasses a 25-year period ending with the American occupation of New Mexico territory. It is during this time that the Santa Fe Trail was established, opening New Mexico to goods and people from the United States (Scheick et al. 1996).

Although the study area was still far removed from the government in Mexico City, Mexican settlements continued to expand. During this rather abbreviated period of Mexican administration, land grants continued to be awarded in the general region. These included most notably (Williams 1986) the Tierra Amarilla (1832) and Baca Location #1 (1835). The Baca grant, focus of a large sheep-raising operation, originally was awarded in 1821, settled in 1826, but abandoned in 1835 due to Indian raids (Scheick et al. 1996). This again underscores the limited ability of central government to protect its citizens during this period. Also during this period, the settlement of Gallina (1818) was founded. It is likely that there were also unnamed ranchos, whose history is largely unknown, scattered between these larger settlements.

Mexican Period sites in the study area average 15,150 square meters in size. Sites are situated at an average elevation of 8,011 feet. There is no apparent interaction between site size and elevation among sites within the study area, although the very small sample of sites renders this conclusion tentative. All of the Mexican Period sites are structural. Sample sizes of sites are too small to allow meaningful comparisons of interwatershed variations in site size.

Of the sites containing Mexican Period components, most (14) exhibit Euro-Anglo occupations. These are followed in decreasing order by sites exhibiting Hispanic (four) and Navajo (three) components.

Given this short duration, it is not surprising that there are relatively few sites dating to this period in the study area. In the oil-gas study area, there are 21 sites containing Mexican Period components. These represent about 0.8 percent of all known components in the forest. Of these, 13 are found in the Rio Gallina watershed, 3 each in the Arroyo Chijuilla and Cañada Larga watersheds, and 1 each in the Rio Nutrias and Arroyo Balcon watersheds.

Territorial Period (A.D. 1846-1912)

The Territorial Period refers to the period between the 1846 arrival of Euro-Anglos in New Mexico until New Mexico became a state in 1912. The study area continued to remain at the fringe of settlement most of this period, although settlement did increase (Scheick et al. 1996).

Documentary and archeological studies suggest that many of these settlements remained seasonal in nature (e.g., livestock raising), although homesteads and small villages—some related to mining—began to appear in the region (Scheick et al. 1996). For example, during the middle to late nineteenth century, settlements were established at Canones (1849) and Coyote (1862), while the eighteenth century settlement of Cuba was re-established (1879). In the 1880s and 1890s, the settlement of Jemez Springs (1888) was founded, while the small mining camp of Señorito (1893) was settled (Julyan 1996). By the beginning of the twentieth century, these were joined by new settlements at La Jara (1911) and Regina (1911).

The Territorial Period also coincides with efforts to: (1) adjudicate the validity of earlier Spanish and Mexican land grants; and (2) following passage in 1862 of the Homestead Act, accelerated settlement of previously vacant land “public” lands. Between 1854 and 1880, under American legal processes, all of the Spanish and Mexican land grants had to be confirmed by the U.S. Surveyor General (Scheick et al. 1996). Disputes about measurements and landmarks,

compounded by outright chicanery, caused some of the grantees to lose portions of their holdings. The Sandoval decree of 1897 by the U.S. Supreme Court compounded land grant problems by effectively removing "commons"—lands shared by grantees together—from the acres in each of the land grants (Scheick et al. 1996). Passage of the Homestead Act opened up formerly vacant lands to settlers at relatively minimal cost, thereby accelerating the rate of settlement across the study area.

The most important processes contributing to change in the cultural landscape of the study area are attributable to the arrival of Anglo entrepreneurs interested in extractive industries (Scheick et al. 1996). More specifically, changes can be linked to the arrival of railroads, lumbering, mining, and the advent of large-scale agricultural operations (Scheick et al. 1996). Although railroads did not actually appear until 1890, and then only in a few areas, the study area in general provided a source of lumber for railroad construction as early as the 1880s. Accordingly, the impact of railroads was felt years before the railroads themselves were actually present. Between 1890 and 1903, a 26-mile track connecting Chama and areas east of Tierra Amarilla was operated by the Tierra Amarilla and Southern Railroad for the express purpose of obtaining timber (Robertson 1986).

Agriculture also assumed greater importance during this period. The farming villages of San Luis (date uncertain), Cabezon (1826), Guadalupe (1898), and Casa Salazar (1888) were established in the upper reaches of the Rio Puerco, north of Cuba (Scurlock 1998). Favorable but temporary climatic conditions allowed settlers to irrigate 10,000 acres of cropland, while simultaneously stocking the surrounding range with an estimated 109,000 cattle and sheep.

Territorial Period sites in the study area average 8,093 square meters in size. Sites are situated at an average elevation of 7,859 feet. There is no apparent interaction between site size and elevation among sites within the study area, although the very small sample of sites renders this conclusion tentative. All of the Territorial Period sites are structural. Sample sizes of sites are too small to allow meaningful comparisons of interwatershed variations in site size.

Of the sites containing Territorial Period components, most (18) exhibit Euro-Anglo occupations. These are followed in decreasing order by sites exhibiting Hispanic (15) and Navajo (3) components.

There are 36 sites with evidence of Territorial Period occupations in the oil-gas study area. These comprise about 1.3 percent of all known components in the forest. This proportion is significantly lower than forest-wide proportions reported in Schieck et al. (1996). Of the Territorial sites, 24 are found in the Rio Gallina watershed, 5 are in Arroyo Chijuilla-Rio Puerco de Chama, 3 are in Canada Larga, 2 are in the Rio Nutrias, and 1 each are in the Arroyo Balcon and Rio Guadalupe watersheds.

Statehood Period (A.D. 1912-1945)

The Statehood Period refers to the interval between 1912 and the culmination of World War II. During this period, additional settlements were established at Lindrith (1911), Regina (1911), Youngsville (1913), and Llaves (1942). The small coal town of La Ventana, first settled and then abandoned in the 1770s, was re-established in the 1920s, only to be abandoned with the onset of the Great Depression (Julyan 1996). Similarly, the short-lived village of Porter (1933-1937) briefly appeared on the scene, only to be abandoned (Julyan 1996).

Cuba, the once-small eighteenth century settlement re-established in 1879, began to take on a more significant role as a regional center for goods and services. Situated along the eastern margins of the Navajo Reservation, Cuba is at the interface between Anglo, Hispanic, and Navajo cultures, making it one of the more diverse settlements in the region.

As during the Territorial Period, extractive industries—railroad construction and lumbering—continued to play a significant role in the study area (Scheick et al. 1996). In 1918, a 7-mile spur line was constructed into Gallina, again to facilitate transport of lumber from surrounding forests (Myrick 1990; Robertson 1986). Shortly thereafter, yet another spur line was constructed to Llaves, again to allow extraction and transport of lumber (Myrick 1990).

Between 1922 and 1932, upwards of 100 million board feet of timber was removed from land part of the former Canon de San Diego grant, by this time part of the Santa Fe National Forest. Wood was transported by the Santa Fe Northwestern Railroad along a 40.9-mile track to Bernalillo (Robertson 1986; Scheick et al. 1996). After lumber reserves were exhausted, this spur line was dismantled in 1943 (Myrick 1990). In 1928, the Santa Fe, San Juan, and Northern Railroad constructed a spur line into La Ventana, south of Cuba, to transport coal (Robertson 1986), continuing operations through 1932. The line was abandoned in 1940. As during the Territorial Period, rail transport continued to affect and transform the study area, providing larger quantities of goods produced in factories from the East and allowing easier access to the region.

Ranching and farming also became much more important during this period. Homestead applications spike noticeably in 1909, 1920, and 1935 (Scheick et al. 1996). During World War I, ranchers were encouraged by the government to make maximum use of public lands to provide meat for the war effort (Scheick et al. 1996). To the north, the 1930s saw an influx of immigrants affected by the Dust Bowl across the southern plains. Their arrival in Lindrith and Llaves contributed substantially to the expansion of farming in this part of the study area. Among the more prominent families settling these areas during these years (and today) were the Davis and Schmidt families.

To the south, farming and ranching communities along the Rio Puerco continued their intensive land use practices largely unabated. Despite accelerating erosion, stocking rates continued largely unchanged through the early twentieth century, although irrigated agriculture began to decline. By the 1940s, most of these villages had been abandoned, their residents moving still further upstream to escape the effects of the eroding stream channel and declining forage (Scurlock (1998).

Faced with deteriorating conditions in the watershed, the government instituted a livestock reduction program (Taylor Grazing Act of 1934) whose effects began to be fully felt by the early 1940s (Scurlock 1998). Eventually the number of animals allowed on the range fell below that needed to subsist, and the Puerco villages were largely abandoned by the 1950s (Scurlock 1998).

Statehood Period sites in the study area average 7,320 square meters in size. Sites are situated at an average elevation of 7,731 feet. There is no apparent interaction between site size and elevation among sites within the study area, although the small sample of sites renders this inference tentative.

The ratio of structural to nonstructural Statehood sites is 13.0, so that there are almost 13 sites with structural remnants (e.g., hearths, structures) as those without such remnants. Nonstructural sites average 979 square meters, while structural sites average 7,924 square meters. There are insufficient numbers of sites to conduct meaningful comparisons of interwatershed variations in site size.

Of the sites containing Statehood Period components, most (35) exhibit Euro-Anglo occupations. These are followed in decreasing order by sites exhibiting Hispanic (22) and Navajo (3) components.

There are 60 sites in the oil-gas study area containing evidence of Statehood Period occupations. These comprise about 2 percent of all known components in the forest. This proportion is significantly lower than forest-wide proportions reported in Schieck et al. (1996). Of the Statehood sites, 39 are found in the Rio Gallina watershed, 7 are in the Rio Nutrias watershed, 8 are in the Arroyo Chijuilla watershed, 2 each are in the Cañada Larga and Rio Guadalupe watersheds, and 1 is in the Tapacito Creek watershed.

Atomic Period (A.D. 1945-present)

The Atomic Period refers to sites post-dating the end of World War II. During this period, farming—that began in the 1930s—expanded dramatically in the Llaves and Lindreth areas. Like the Territorial Period, the greatest change wrought in the study area is directly linked to the advent of a new extractive industry: oil-gas exploration and development. Initial oil and gas production from the San Juan Basin began in the early-1920s in the Four Corners Platform area on easily identifiable structural traps.

However, significant development and production did not occur on the Santa Fe National Forest until the early 1950s (Barnes 1950, Engler et al. 2001). In 1951, El Paso Natural Gas Company completed an interstate pipeline supplying gas to California markets and thus spurred rapid development, particularly of the Pictured Cliffs and Mesaverde reservoirs.

Most of the current producing wells on the forest were drilled between the mid-1960s and the early 1990s. Oil and gas are produced from the Mancos Formation, and gas is produced from the Pictured Cliffs and Mesaverde Formations under the forest.

Atomic Period sites in the study area average 6,854 square meters in size. Sites are situated at an average elevation of 7,705 feet. There is no apparent interaction between site size and elevation among sites within the study area, although the number of sites renders this conclusion tentative.

The ratio of structural to nonstructural Atomic Period sites is 10.0, so that there are 10 sites with structural remnants (e.g., hearths, structures) as those without such remnants. Nonstructural sites average 2,030 square meters, while structural sites average 7,422 square meters. There are insufficient numbers of sites to warrant evaluations of interwatershed variations in site size.

Of the sites containing Atomic Period components, most (30) exhibit Euro-Anglo occupations. These are followed in decreasing order by sites exhibiting Hispanic (14) and Navajo (2) components.

There are 46 sites with Atomic Period components in the oil-gas study area. These comprise about 1.7 percent of all known components in the forest. This proportion is much lower than forest-wide proportions reported in Schieck et al. (1996). Of the Atomic sites, 29 are found in the Rio Gallina watershed, 7 each are in the Rio Nutrias and Arroyo Chijuilla watersheds, and 1 each is in the Rio Guadalupe, Canada Larga, and Arroyo Balcon watersheds.

Indigenous Groups

Archeological and ethnographic studies, as well as oral historical accounts, indicate that the study area was occupied or used, sometimes seasonally, by Navajo (Scheick et al. 1996). Oral histories,

in particular, suggest that the study area was used throughout the Protohistoric, Spanish Colonial, Mexican, Territorial, Statehood and Atomic Periods. Consistent with this reconstruction, two Navajo sites contain components spanning the Protohistoric and Atomic Periods, one contains components spanning the Spanish Colonial and Territorial Periods, and the last dates to the Statehood Period.

Some traditional uses of lands in the study area by people from adjacent tribes include the cutting of firewood and the collection of oak leaves for ceremonial purposes. While the discussion of impacts focuses on effects to archeological sites because they are discreet locations that are more easily identified, traditional use areas that are accessed for the collection of traditional materials may also be affected. If tribal consultation results in the identification of additional, currently unknown, traditional uses and traditional cultural properties, impacts to those areas would be considered during the EIS or during site-specific environmental assessments that would be conducted prior to any Federal undertakings.

Among the more likely activities occurring in the project area would be ceremonial rituals, mineral and stone procurement, collection of medicinal plants, wood and wild resource harvesting, seasonal hunting, fishing, and trapping, and livestock grazing (Scheick et al. 1996). Archeological evidence of many of these activities could be quite ephemeral and difficult to identify with any degree of certainty.

For this reason, the presence of only four Navajo sites, three in the Rio Gallina watershed and one in the Canada Larga watersheds, may be highly misleading. Although these represent a small fraction of the sites in the study area, the numbers may be underrepresented. Although no Jicarilla Apache sites have been recorded in the study area, the Jicarilla Apache Reservation's boundary adjacent to the study area on the north may indicate some use of the area by Jicarilla Apache.

Summary of Archeological Sites

In the oil-gas study area, there are a total of 1,885 known archeological sites (Table OG-43). These contain a total of 2,792 identifiable components dating to time intervals ranging between 5000 B.C. to recent times. The majority of known sites are situated in the Rio Gallina and Rio Nutrias watersheds.

For the study area as a whole, sites average 3,381 square meters in size and are found at elevations averaging 7,634 feet. Overall, historic sites comprise about 3 percent of sites known in the proposed oil-gas study area, while 90 percent of the sites date to prehistoric times. The remaining sites exhibit both prehistoric and historic components.

Environmental Consequences

This section presents the results of analyses of potential alternative-specific impacts to heritage resources in the oil-gas study area. The action alternatives proposed for the oil-gas study area consider changes to lease stipulations that would reduce the potential for surface disturbance on new leases. The new construction of 20 wells, as well as about 3 miles of new roads to access those wells, have been projected within existing leases and may not be affected by the proposed new lease stipulations unless an existing lease expired or was relinquished and then re-issued. New wells in existing leases would not be a direct result of the selection of any alternative and are addressed in the "Cumulative Impacts" section.

Table OG-43. Summary of recorded archeological sites by watershed in the oil-gas study area

Watershed	Summary of Recorded Sites
Arroyo Balcon	No data
Arroyo Chijuilla	There are 64 known sites containing 79 identifiable occupations. The ratio of occupations/sites is a modest 0.89. There are about twice as many prehistoric sites (28) as historic sites (14). Sites of unknown affiliation comprise 30 percent of all sites. There are roughly equal proportions of sites dating to the Archaic, Developmental, Coalition, Classic, Protohistoric, Mexican, Territorial, Statehood, and Atomic Periods. There are about equal proportions of structural sites (i.e., those containing pit houses, room blocks, etc.) as sites without structures. Sites average 7,452 m^2 in extent.
Cañada Larga	There are 57 known sites containing 93 identifiable occupations. The ratio of occupations/sites is a modest 1.5. Almost all known sites date to prehistoric times. Fewer than 5 percent of sites cannot be assigned to a specific occupational period. In declining order of frequency, sites dating to the Coalition and Developmental Periods are most common. There are about 1.59 structural sites (i.e., those containing pit houses, room blocks, etc.; n = 35) for every nonstructural site (22). Sites average 6,352 m^2 in extent.
Rio Gallina	There are 1,429 known sites containing 2,253 identifiable occupations. The ratio of occupations/sites is a moderate 1.5. Fully 92 percent of all known sites date to prehistoric times. Only about 4 percent of sites cannot be assigned to a specific occupational period. In declining order of frequency, sites date to the Coalition, Developmental, Protohistoric, and Classic Periods. There are about 5.78 structural sites (i.e., those containing pit houses, room blocks, etc.) for every nonstructural site. Sites average 3,257 m^2 in extent.
Rio Nutrias	There are 317 known sites containing 435 identifiable occupations. The ratio of occupations/sites is a moderate 1.4. Fully 95 percent of all known sites date to prehistoric times. Only 1 percent of sites cannot be assigned to a specific occupational period. In declining order of frequency, sites date to the Coalition, Developmental, Protohistoric, and Classic Periods. There are about 14 structural sites (i.e., those containing pit houses, room blocks, etc.) for every nonstructural site. Sites average 2,644 m^2 in extent.
Rio Guadalupe	There are three known sites containing three identifiable occupations. The ratio of occupations/sites is 1.4. Most sites date to historic times and all have been dated. All known sites date to the Territorial, Statehood and Atomic Periods. All of the known sites in this watershed are structural. Sites are among the largest, averaging 10,121 m^2 in extent.
Tapacito Creek	There are 14 known sites containing 25 identifiable occupations. The ratio of occupations/sites is a high 1.8. Almost all known sites date to prehistoric times and all have been dated. Sites date equally to the Classic and Protohistoric Periods. All of the known sites contain structures. Sites average 3,522 m^2 in extent.

Overview

Under the provisions of the National Historic Preservation Act (NHPA 1966, as amended; 16 U.S.C. §470), adverse effects to heritage resources include a variety of criteria affecting the potential eligibility of heritage resources for inclusion on the National Register of Historic Places (NRHP) (36 CFR §800.9b). Specifically, effects may be deemed adverse according to the following (36 CFR §800.5[1]):

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified

> subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

Under this regulation, adverse effects may be direct, related to a specific project, or indirect, arising at a later time as a consequence of a given project. Specific examples of adverse effects cited in statute include (36 CFR §800.5[2]i-vii):

- Physical destruction of or damage to all or part of the property.
- Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for the treatment of historic properties (36 CFR, Part 68) and applicable guidelines.
- Removal of the property from its historic location.
- Changes of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.
- Neglect of a property that causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe.
- Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

In the study area, potential direct impacts to heritage resources may result from surface-disturbing activities related to the construction of new wells and associated infrastructure, notably roads. Other potential indirect impacts, such as changes to the visual quality that affects a site's setting or surroundings, impacts to the cultural landscape, the introduction of elements out of character with the surroundings, the isolation of a site from its setting, increased erosion that exposes or damages a site, deposition of sediment from offsite erosion, and impacts to standing structures from vibrations of construction or drilling equipment may affect the integrity of the sites.

Potential adverse environmental impacts to heritage resources may be caused by increases in oil-gas development; however, sites are usually protected, mainly through avoidance but sometimes through other mitigation measures, in compliance with Federal laws. The standard practice of the Santa Fe National Forest is to require identification, inventory, and evaluation of all projects—including oil and gas projects—prior to approving heritage resource clearances for a proposed undertaking.

It is important to recognize that, in compliance with Federal law and Forest Service policy, site-specific heritage resource surveys and clearance of the location of specific construction projects, like APDs or new road construction, are conducted before approval for the project is given. Any site-specific surface-disturbing activity would be preceded by Class III (100 percent) archeological surveys to locate sites, consistent with the requirements of Section 106 of the NHPA (1966) and Forest Service Manual 2360. The standard practice in the study area is to require identification, inventory, evaluation, and clearance before the Forest Service line officer

can approve heritage resource clearance for the proposed undertaking, such as a well pad, access road, or pipeline.

Following the identification and recording of archeological sites, mitigation measures appropriate to the proposed undertaking would be implemented. Such measures would most likely include avoidance of heritage resources by redesigning the alignments of roads or locations of wells, or data recovery operations at sites where construction activities would constitute an adverse effect and avoidance cannot be accomplished. In the latter instance, data recovery plans would be developed specific to individual archeological sites and appropriate consultation with various entities (e.g., SHPO, tribes) implemented prior to, and during, data recovery operations.

Consistent with the statutory requirements of Native American Graves Protection and Repatriation Act (NAGPRA) (1990 (25 U.S.C. 3001 seq.)), agreements in the form of memoranda of understanding are required with specific tribes if human remains may be encountered during excavations at some of the sites. Where the probability of encountering human remains is high, tribal representatives would be consulted regularly to ensure that such remains are accorded appropriate treatment and reburial.

Methods for Calculating Impacts

Any surface disturbance could affect heritage resources and can be considered to have a potential permanent effect. For proposed oil and gas development in the study area, adverse effects would be minimal where no surface occupancy (NSO) lease stipulations are part of each alternative. Consistent with forest policies and procedures, protection of significant archeological sites would be considered during site-specific NEPA analyses for each project. Accordingly, there are no projected impacts to heritage resources as a direct result of implementing any of the proposed alternatives.

In the event that circumstances change, impacts could be estimated by multiplying the recorded archeological site density in each watershed by the number of acres affected by a proposed undertaking. This method assumes that sites are distributed evenly on the landscape within each watershed. In reality, these assumptions may not be true, but the method could be used to predict the potential for impacts to archeological sites.

Alternative 1—No Action

Under the No Action Alternative, standard lease terms and conditions would continue to guide management of most of the oil-gas study area. Heritage resources would continue to be managed under current guidelines and practices. There are currently small management areas identified in the Forest Plan with limited surface use stipulations within the study area, and none of these limitations apply to existing leases because they pre-date the Forest Plan. Protection of significant archeological sites would be considered during site-specific NEPA analyses for each project. Tribal consultation would also continue to be conducted on a project-level basis. Based on these project-level evaluations, appropriate strategies would be implemented to avoid or mitigate adverse effects to heritage resources.

Alternative 2—Proposed Action

Under the Proposed Action Alternative, NSO stipulations would be attached to new oil-gas leases, expressly to protect two sites listed on the National Register of Historic Places totaling

200 acres. Over 30,000 additional acres would be under NSO restrictions, resulting in no surface disturbance for oil-gas facilities on 15 percent of the study area, if new leases were developed in the future. There would also be increased flexibility (200 meter offset) to avoid or minimize surface disturbance for oil-gas development offered under proposed CSU lease stipulations to protect over 2,500 acres of heritage resources within Management Area I, as well as on another 11,000 acres proposed for CSU lease stipulations.

While the proposed NSO and CSU lease stipulations are not likely to apply to the 20 new wells projected for existing leases, they would apply to 6 of the 7 EOIs. The more stringent limitations on surface locations proposed under Alternative 2 would provide increased protection of heritage resources developed in sensitive areas under new leases.

Alternative 3

In response to public scoping comments, this alternative would increase the acreage of no surface occupancy (NSO) lease stipulations, while maintaining all other lease stipulations as proposed for the Proposed Action (Alternative 2). Alternative 3 would provide increased protection from surface disturbance by proposing NSO stipulations on almost additional 3,800 acres, which would minimize the potential for surface-disturbing activities that could affect heritage resources, especially archeological sites.

Cumulative Impacts

The cumulative effects on heritage resources should take into account all surface-altering actions that have occurred or are reasonably foreseeable. Incremental increases in surface disturbance and development activity are expected to continue to occur in the study area, primarily due to the projected development of 20 well pads and associated roads under standard terms and conditions, development in the EOIs under the Proposed Action, as well as road decommissioning and extraction of salable minerals on National Forest System lands. The projects listed in Table OG-15 have the potential to cause disturbance to surface soils or vegetative cover that may affect heritage resources. Because heritage resources surveys are completed prior to Forest Service project implementation, it can be assumed that avoidance or mitigation would ensure that no damage is caused to significant sites.

Construction activities related to oil-gas development and road decommissioning in the Cuba and Coyote Ranger Districts within these watersheds would be the cause of the known and foreseeable surface-disturbing activities to consider in evaluating cumulative effects. Most of the proposed road decommissioning would not require surface disturbance, except for those roads (up to 20 percent proposed for decommissioning) that are determined to require recontouring and seeding. The extraction of salable minerals occurs in scattered small acreage and may increase associated with oil-gas development.

Other actions on private land within and near the study area have the potential to adversely affect regional heritage resources, especially if heritage resources surveys are not completed in advance. The other actions may include construction of buildings, roads, oil-gas wells, and other facilities; road maintenance like grading and ditch cleaning; cross-country travel by off-highway vehicles (OHV); installation of trenches for utilities; vegetation management activities; and agricultural activities like plowing, planting, and livestock grazing.

All of the 20 well pads projected in the RFDS are located on existing valid oil-gas leases, so none would be developed under the new lease stipulations proposed under Alternatives 2 and 3. All would be developed under standard terms and conditions, with implementation of site-specific mitigation measures to protect heritage resources evaluated in an environmental assessment during the APD process. As presented in the "Geology and Minerals" section, total short-term surface disturbance associated with oil-gas development within the next 20 years is projected to be about 100 acres within the entire study area. The RFDS (USFS 2004a) estimates that 10 wells would be developed in the Rio Gallina watershed, 6 in the Cañada Larga watershed, and 4 in the Rio Nutrias watershed.

If any of the existing leases were relinquished, and if oil or gas wells were developed under new lease terms in compliance with either Alternative 2 or 3, the proposed lease stipulations would provide additional protection of heritage resources in the areas designated for NSO and CSU.

It is important to note that the oil-gas study area contains relatively high densities of important archeological sites. Many of these sites are at least regionally significant, and some could be nationally significant because they are uncommon elsewhere. Due to the dense concentrations of heritage resources, especially archeological sites but also traditional use areas within the study area, any surface-disturbing activities from construction of new well pads and/or roads could result in significant impacts. These direct and indirect impacts, such as changes to or isolation from the surroundings of a site or altering the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, could affect the qualities that make a site or an area eligible for the NRHP.

Recreation and Wilderness Resources

Affected Environment

North-central New Mexico and the Santa Fe National Forest are considered popular recreational destinations. Due to the lack of developed recreational facilities and major water courses within the study area, camping, boating and rafting do not occur. However, many recreationists likely utilize the study area to access these recreational resources due to their proximity.

According to the Recreation Opportunity Spectrum (ROS) for the Cuba and Coyote Ranger Districts, the majority of lands within the oil-gas study area are classified as either "Roaded Natural" (82,123 acres or 43 percent of the study area), "Semiprimitive motorized" (95,154 acres or 47 percent of the study area), and "Semiprimitive nonmotorized" (19,524 acres or 9 percent of the study area) allowing for access to a variety of recreational uses (Figure OG-35). There are also 46 acres (less than one-tenth of one percent of the study area) of "Primitive" and 265 acres (0.1 percent of the study area) of "Rural" lands within the study area. Popular recreational activities within the Cuba and Coyote Ranger Districts include fishing, hunting, camping, picnicking, boating, hiking, mountain biking, horseback riding, winter sports, and wildlife viewing (USFS 2003c).

Major recreational attractions in the vicinity of the study area include the Rio Chama Wild and Scenic River; the Chama River Canyon Wilderness; the San Pedro Parks Wilderness; the San Gregorio Reservoir; a portion of the Continental Divide Trail; the New Mexico Highway 126

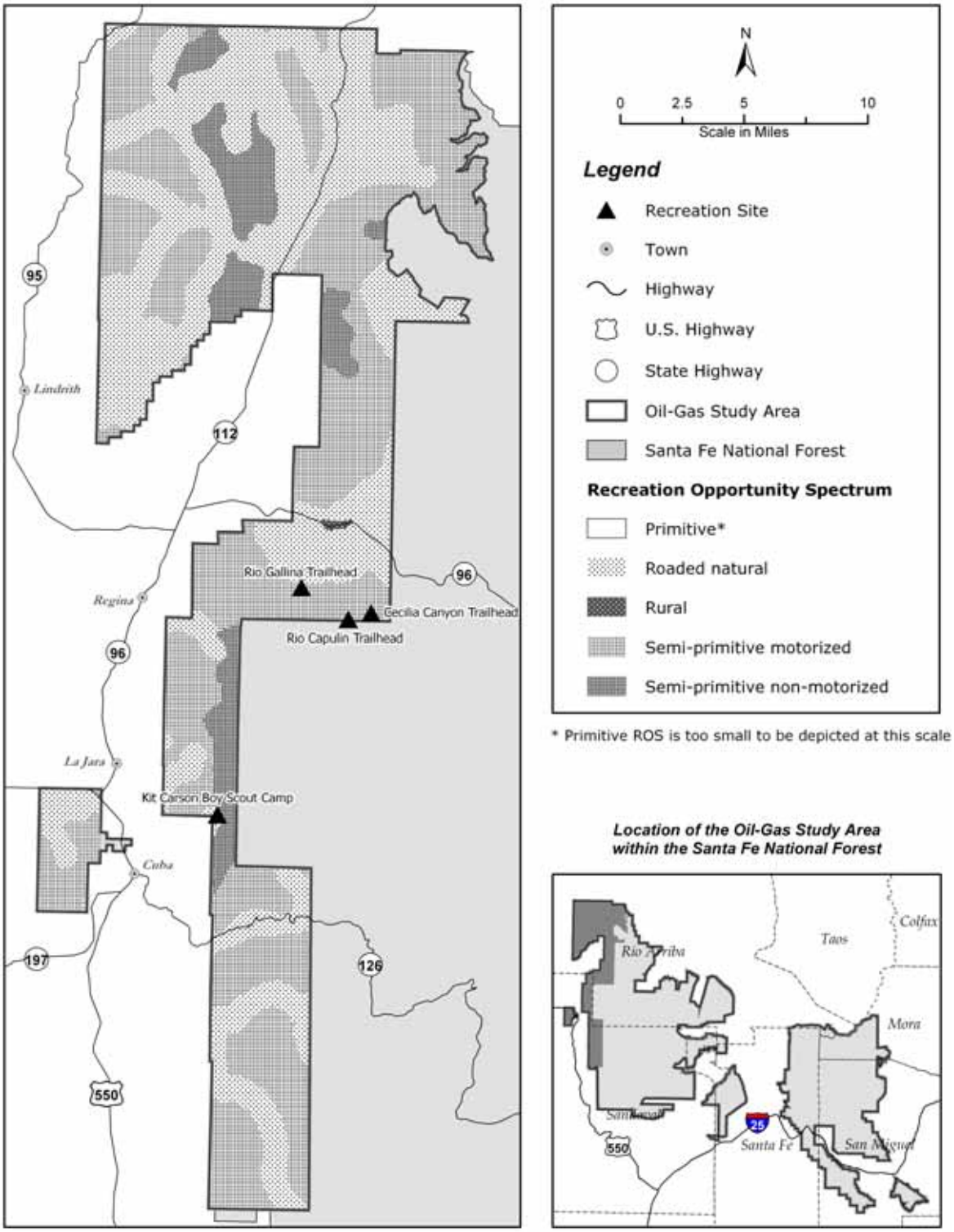

Figure OG-35. Recreational Opportunity Spectrum categories in the study area

Scenic Byway; the Jemez Mountain Trail; and the Tsi-p'in-owinge' cultural site. The few developed recreational sites within the study area itself include the Cecilia Canyon, Rio Capulin, and Rio Gallina Trailheads, as well as the Kit Carson Boy Scout Camp. Camping is permitted at the Cecilia Canyon and Rio Gallina sites. No designated wilderness areas are located within the study area.

Over the past few decades, recreational use of the forest and the Cuba and Coyote Ranger Districts has increased considerably. In order to gauge use of and satisfaction with recreation opportunities provided by the Santa Fe National Forest, the National Visitor Use Monitoring project was conducted from October 2002 through September 2003. Data obtained through this study is forest-wide and does not provide information at the district level. The basic units of measurement associated with the National Visitor Use Monitoring are national forest visits and site visits. These terms are defined as follows:

- **National forest visit**—the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A national forest visit can be composed of multiple site visits. (Kocis et al. 2004)
- **Site visit**—the entry of one person onto a national forest site or area to participate in recreation activities for an unspecified period of time. (Kocis et al. 2004)

According to National Visitor Use Monitoring data, there were 1,356,134 national forest visits and 1,522,307 site visits on the Santa Fe National Forest in fiscal year 2003 (data are not available for individual ranger districts). The site visit data includes 64,956 wilderness visits. Forest visitors indicated that their primary activities were hiking/walking (34 percent); relaxing (17 percent); downhill skiing (16 percent); viewing natural features (8 percent); and fishing (5 percent). The most used facilities/designated areas by forest visitors were trails (45 percent); scenic byways (29 percent); downhill ski area (15 percent); forest roads (14 percent); and picnic areas (11 percent) (Kocis et al. 2004). Only a small percentage of these visits occurred within the study area.

The primary identified issues associated with recreation within the Cuba and Coyote Ranger Districts are related to the compatibility of grazing and recreation within the districts, the compatibility of mountain biking with other recreational uses, and the growth in the amount of recreational activity (USFS 2003c).

Designated trails with trailheads in the study area include the Rio Gallina, Rio Capulin, and Cecilia Canyon Trails, which are used to access San Pedro Parks Wilderness. The Rio Gallina trailhead is accessed from Forest Road (FR) 76, and the Cecilia Canyon and Rio Capulin trailheads are accessed from FR 171. Developed trails within the study area are limited, although other unnamed trails occur (USFS Undated c).

Fishing for trout is a popular activity within the forest, and occurs within the study area at small streams such as Rio Capulin, Cecilia Creek, Cañoncito de Las Lenguas, and Rio Gallina. Local lakes and streams are stocked by NMDGF with rainbow trout, and brown trout were introduced to the State's waters in the early 1900s and, although no longer stocked, are quite common. Rio Capulin and Cecilia Creek are also identified by NMDGF as native Rio Grande cutthroat trout streams.

Rocky Mountain elk and Merriam's turkey are the most popular game species on the forest, and habitat for these animals is available in the study area. Deer and bighorn sheep are also hunted on the forest, but at a much lower level due to small populations. The study area is largely contained

within New Mexico Big Game Hunt Units 5B and 6A. The number of cow elk permits for hunters has been increasing over the past decade to keep the growing elk population at the desired size. The elk hunting season for bow hunters generally occurs during the first 3 weeks of September, for muzzleloaders October 8-12 (Unit 6A only), and for any legal sporting arm generally from mid-October through mid-November. A second elk hunting season sometimes occurs in January. NMDGF in recent years has had both spring and fall seasons for wild turkey. The spring season is April 15 through May 10, while the fall season is September 12 to 20.

Several developed roadways that pass through the study area provide access for dispersed recreation, including New Mexico Highways 126, 112 and 96. An approximately 4-mile long portion of the Jemez Mountain Trail National Scenic Byway passes through the study area along New Mexico Highway 126. This scenic byway, which also includes portions of New Mexico Highway 4 and U.S. 550, encompasses a total of 163 miles starting at Bandelier National Monument to the east and ending to the south at Jemez Pueblo and the Village of San Ysidro. It is considered one of the most popular scenic drives in New Mexico (Public Lands 2003). Unpaved roads suitable for passenger cars (Maintenance Level 3), as well as those suitable only for high-clearance vehicles (Maintenance Level 2), are located throughout the study area.

The Rio Chama, which runs through private, BLM, and USFS-administered lands nearby, is a popular location for whitewater boating, fly fishing, and car camping. Although it is not located within the study area, it is adjacent to the study area's northern and eastern boundaries. The portion of the river designated wild and scenic comprises about 20 miles of designated "Wild" and about 5 miles of designated "Scenic" river. It is believed that whitewater rafting on the Rio Chama has significantly increased over the past few decades, and several private rafting outfitters currently operate on the river, offering trips of 1 to 3 days under special use permits administered by the BLM Taos Field Office. Permits for whitewater boating are provided through a lottery system administered by the BLM. Rafting primarily occurs during the spring months of April through June in association with releases from El Vado Dam. Also, 10 recreational releases may occur throughout the summer season, usually on weekends from July through September.

Chama River Canyon Wilderness comprises 50,000 acres within the Santa Fe National Forest and is located adjacent to the eastern boundary of the study area. This wilderness comprises rugged canyon terrain and has only limited trail access. The Ojitos Canyon Trail (298), part of the Continental Divide National Scenic Trail, is located within this wilderness and is 4.5 miles long (USDA Forest Service, Undated a). The 1.5-mile Hart Canyon Trail (293), which provides scenic views of the Rio Chama and canyon, is also located within Chama River Canyon Wilderness (USDA Forest Service, Undated b).

San Pedro Parks Wilderness comprises 41,000 acres within the Cuba Ranger District and is located adjacent to part of the study area's eastern boundary. It provides opportunities for fishing, hiking/backpacking, horseback riding, hunting, winter sports, and wildlife viewing (Public Lands 2003). San Gregorio Reservoir is a popular location for fishing within the boundaries of the San Pedro Parks Wilderness.

Four public campgrounds are located within the Cuba and Coyote Ranger Districts but outside the study area: Clear Creek, Rio Chama, Rio de las Vacas, and Rio Puerco. Clear Creek, Rio Chama, and Rio de las Vacas all offer developed campsites, while the Rio Puerco Campground is a remote, marginally developed site. The first three sites offer drive-in campsites, including sites for trailers, and Clear Creek also offers sites for 30-foot recreational vehicles. Rio Puerco Campground provides access to hiking and fishing and is heavily used during hunting season. The Kit Carson Boy Scout Camp is located within the study area boundaries.

Environmental Consequences

The primary concern associated with recreation and wilderness resources is the potential for displacing or significantly altering existing recreational opportunities within and adjacent to the study area. These changes could result from land requirements and operations related to oil-gas development.

Direct impacts would result if recreational areas and uses are displaced or excluded due to other activities. Indirect impacts would occur when other actions affect the visual quality, noise environment, heritage resources, or health of vegetation and wildlife that contribute to the recreational experience.

The main issues associated with potential oil and gas effects on recreation and wilderness resources in the study area include the following:

- Noise from oil and gas compressors affecting the quiet environments that are desirable in many dispersed and wilderness recreational activities.
- Noise from motorized vehicles disturbing recreationists and wildlife.
- New oil and gas access roads may bring people seeking different kinds of recreational experiences into direct contact. For example, motorized vehicles can cause noise that interferes with hunting, hiking, and back-country camping. Motorized vehicle traffic may cause unsafe conditions for mountain bikers and horseback riders.
- Vandalism may increase as road access increases. Common acts of vandalism include destruction of well equipment, theft or destruction of signs, graffiti, and littering.

The primary source of noise impacts associated with oil-gas development is the wellhead compressors. Additional noise is generated from road and well pad construction operations and traffic associated with routine gas maintenance operations.

Alternative 1—No Action

Because Alternative 1 would not result in oil-gas development or any other action that would directly affect recreation within the study area, there would be no effect on recreational or wilderness resources within or near the study area. Potential effects to recreational and wilderness resources related to Alternative 1 would be a result of future oil-gas leases, including the EOI areas, within the study area, and are discussed under “Cumulative Impacts.”

Alternative 2—Proposed Action

The RFDS projected all new development on existing leases within the study area based on the potentially productive oil-gas bearing formations. Alternative 2 would not result in oil-gas activities that would directly affect recreation or wilderness resources in the study area. Except for the northwest corner of San Pedro Parks Wilderness, the Roadless Recreation, Management Area L NSO stipulation would be applied to the current expressions of interest area bordering the west boundary of San Pedro Parks Wilderness. The NSO stipulation would effectively prohibit any oil-gas activities within ¾-1 mile of the wilderness. Additionally, the steep, rugged terrain and geology of this part of the San Juan Basin would discourage oil-gas activities. Therefore, there would be little or no effect on recreational or wilderness resources.

Alternative 3

Under this alternative, the NSO stipulation includes the northwest corner of San Pedro Parks Wilderness not currently covered in the Proposed Action, prohibiting any oil-gas activities within one-half mile of the wilderness boundary. Although the area is within a current expression of interest, these impacts would only result if oil-gas development occurred outside of areas projected in the RFDS. This alternative would increase protection of recreational and wilderness resources better than under the Proposed Action.

Cumulative Impacts

Cumulative impacts to recreational and wilderness resources should consider the effects of the EIS alternatives in combination with other reasonably foreseeable actions on Federal and non-Federal land in the region. This includes construction and operation of 20 oil-gas well locations and associated access roads projected to be developed on valid existing leases, in addition to proposed changes to the road system within the Cuba and Coyote Ranger Districts. Road management decisions may result in changes to the roads currently used by the public, but since most roads proposed for closure or decommissioning are extraneous and not necessary to access recreational sites, there would be little impact to recreational uses.

The projects listed in Table OG-15 that are planned for the near future within the Cuba and Coyote Ranger Districts would not affect recreational uses and wilderness resources. Other possible construction activities on non-Federal land in the region are likely to occur with unknown extent, but are not likely to affect the recreational experience on National Forest System lands.

Under all alternatives, the construction and operation of 20 projected oil-gas well locations within the study area would contribute incrementally to cumulative impacts on recreational resources within and near the study area. About 1.5 miles of new roads associated with oil-gas development are anticipated within “Roaded Natural” portions of the study area, while about 1.4 miles of new roads are anticipated within the “Semiprimitive Motorized” portion of the study area. Direct impacts on recreation and wilderness resources generated by oil-gas development, including associated roads, would include noise (well compressors, vehicle traffic, construction), visual impacts (oil and gas structures, roads, vegetation removal), and safety (compatibility of additional oil and gas traffic with recreational users of study area roads). Indirect impacts could include reduced hunting opportunities success due to construction, noise, and oil and gas activities that could affect and displace wildlife in the study area; and an increase in vandalism related to access provided by new roads. Conditions of approval and/or mitigation measures that would be implemented during second level, site-specific NEPA analysis for individual projects could reduce these impacts to recreation and wilderness.

The addition of new lease stipulations under Alternative 2 would reduce potential future impacts to recreation and wilderness resources as compared to Alternative 1, but only as they would apply to new leases. Implementation of the NSO lease stipulation for Roadless Recreation in Management Area L would protect recreational opportunities that feature natural integrity and appearance and the opportunity for quiet and solitude. This stipulation on new leases would also minimize potential indirect impacts to the adjacent San Pedro Parks Wilderness. Implementation of the NSO stipulation for the Nogales Cliff House and Rattlesnake Ridge would also avoid direct impacts on those recreational resources. Additionally, implementation of timing limitations on wildlife habitat such as deer and elk winter range and fawning/calving areas would minimize

potential adverse impacts to big game species, and may serve to maintain hunting opportunities. Because Alternative 2 would provide oil-gas lease stipulations to avoid and/or minimize potential impacts to important recreational and wilderness resources that are not provided under Alternative 1 (No Action), Alternative 2 is considered to have a beneficial impact to recreational and wilderness resources. This beneficial impact would only result if oil-gas wells in addition to those projected for valid existing leases were developed in the future.

Under Alternative 3, additional oil-gas lease stipulations within inventoried roadless areas outside Management Area L, plus the proposed one-half mile buffer of NSO around San Pedro Parks Wilderness would protect and maintain recreational and wilderness resources better than under the Proposed Action. These impacts would only result if oil-gas wells in addition to those projected for valid existing leases were developed in the future.

Visual Resources

Visual resources within the oil-gas study area are assessed according to the Forest Service Visual Management System (VMS). The VMS was developed in response to increased environmental concerns to maintain and enhance the landscape while benefiting from its natural resources (USFS 1973). Chapter 2380 of the Forest Service Manual, Landscape Management, addresses these concerns, which are further detailed in Agriculture Handbooks 434 and 462; however, the VMS in Chapter 2380 has been replaced with the Scenery Management System (SMS) and now corresponds with Agriculture Handbook 701. The SMS increases the role of constituents throughout the inventory and planning process, in addition to integrating the concepts and terminology of ecosystem management, in order to integrate aesthetics with other biological, physical, and social/heritage resources (USFS 1995). However, at this time, the Santa Fe National Forest has not yet been reclassified under the new SMS integrity classes; therefore, this analysis will refer to the Visual Quality Objective (VQO) classes under the VMS.

The VMS first identifies existing visual conditions in comparison to the natural landscape. This is done in order to monitor and evaluate management efforts using seven different types of classifications (USFS 1973). Next, physical and manmade features are evaluated based upon the surrounding physiographic conditions as distinctive, common, or minimal, in addition to sensitivity levels that are determined based upon the number of users. These criteria are used to create VQO classes that incorporate both physical components and sensitivity. There are five levels of modification used to describe existing conditions: Maximum Modification, Modification, Partial Retention, Retention, and Preservation (USFS 1973). Maximum Modification does not normally describe an objective (VQO), but may be an existing visual condition.

A classification of existing visual condition allows for comparison of current conditions to the desired conditions. Maximum Modification is not a desired condition as it denotes visually dominant, out-of-scale form and texture when viewed as middle or foreground. The SMS approaches the process with some variation, as it identifies the landscape character, visual sensitivity, and scenic integrity of landscapes by assigning one of five integrity classes to characterize the setting: Very High, High, Moderate, Low, Very Low, and Unacceptably Low. The first four categories of the SMS may also be used to describe objectives for desired conditions. The SMS classifications correspond with those of the VMS, as shown in Table OG-44.

Table OG-44. Corresponding SMS and VMS classifications (USFS 1995)

Scenery Management System	Visual Management System
Very High	Preservation
High	Retention
Moderate	Partial Retention
Low	Modification
Very Low	Maximum Modification
Unacceptably Low	

Affected Environment

The oil-gas study area is primarily located within the San Juan Basin, and falls within the Cuba and Coyote Ranger Districts. Both the Cuba and Coyote Ranger Districts are located along the boundary between the Colorado Plateau Semi-Desert and Arizona-New Mexico Mountains Semi-Desert-Open Woodland-Coniferous Forest-Alpine Meadow Provinces (Bailey 1995). The Colorado Plateau Semi-Desert Province consists of tablelands with moderate to considerable relief. The other province represented consists chiefly of steep foothills and mountains, but includes some deeply dissected high plateaus (Bailey 1995). The vegetation type covering the largest area is Montane Coniferous Forest (ponderosa pine forests and higher elevation forests), followed by Coniferous and Mixed Woodland, Subalpine Coniferous Forest, and Desert Grassland (ecotone), respectively (Dick-Peddie 1993).

The majority of the oil-gas study area is designated as VQO Modification (42 percent). The remaining area consists of the VQO designations Maximum Modification (23 percent), Partial Retention (15 percent), and Retention (14 percent). The residual property has either not been classified (unknown) or is private property (5 percent). Figure OG-36 shows the VQO classes within the study area.

Management of the VQO classes is described below (USFS 1973):

- Maximum Modification—Management activities including vegetative and landform alterations may dominate the characteristic landscape as foreground or middle ground; however, when the landscape is viewed as a background, it must visually appear as a natural occurrence within the surrounding landscape or character type. In addition, reduction of contrast should be accomplished within 5 years.
- Modification—Management activities may visually dominate and dictate the characteristic of the landscape; however, any landform or vegetative alterations must mimic the surrounding landscape in form, line, color, or texture in order to maintain scenic integrity. The objectives under Modification should be met within 1 year of project completion.
- Partial Retention—Management activities must remain visually subordinate to the characteristic landscape and any associated visual impacts in form, line, color, or texture must be reduced within no more than 1 year after project completion.

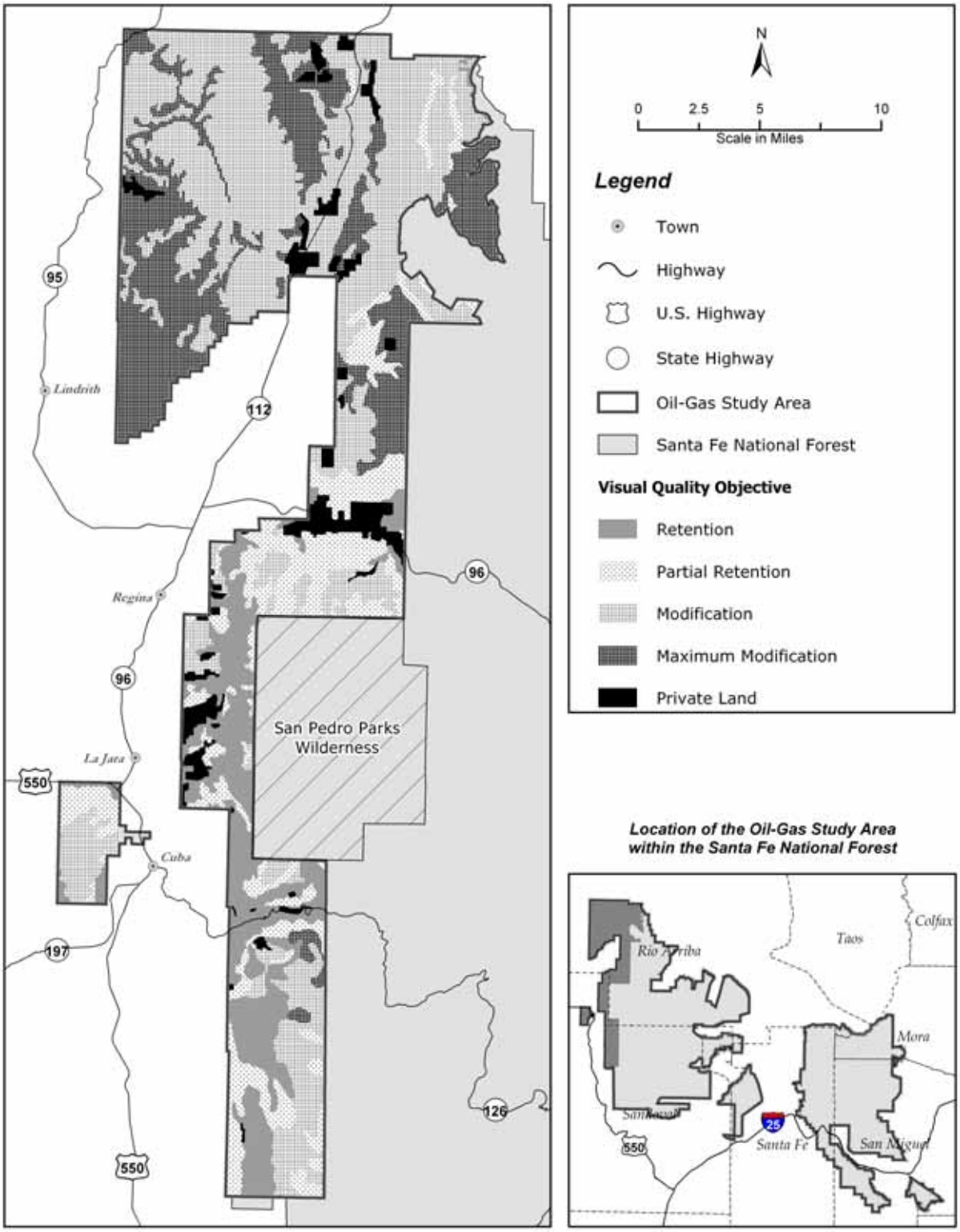

Figure OG-36. Visual management system classifications in the oil-gas study area

- Retention—Management activities may not be visually evident, and contrasts in form, line, color, or texture must be reduced during or immediately after the management activity.

Management Area R is located at the north end of the study area and is the largest single management area represented (38 percent) in the oil-gas study area. Management Area R primarily emphasizes heritage resources, habitat improvement, grazing, and timber activities (USFS 1987). Several existing oil and gas wells are located within Management Area R, which is primarily classified as Maximum Modification and Modification VQOs, in which visual resource protection is a low priority.

The next largest is Management Area A (21 percent), located south of Management Area R, in the central and southern portions of the study area. Management Area A consists primarily of lands suitable for growing commercial timber and that provide suitable wildlife habitats. Management emphasis focuses on timber production and the enhancement of wildlife (USFS 1987). Most of the land is classified with VQOs of Partial Retention and Retention, which coincides with the management objectives. No current oil-gas wells are located within Management Area A.

Management Area E (12 percent) and Management Area D (4 percent) both currently emphasize management of visual resources, which is evident in the VQO designations of Partial Retention and Retention. Management Area D does not encompass any existing oil-gas wells, but there are existing wells in Management Area E.

Additional portions (9 percent) of the oil-gas study area are designated Management Area S under the Forest Plan. Management Area S is managed for heritage resources and key wildlife habitat protection. VQOs established in Management Area S include Modification, Partial Retention, and Retention.

The Forest Service has designated inventoried roadless areas, identified as Management Area L, which comprises 5 percent of the study area. Management Area L is managed for semiprimitive, nonmotorized recreation opportunities and has a VQO classification of Retention (USFS 1987) and does not contain any active wells. Inventoried roadless areas are managed to preserve their roadless characteristics unless the Chief or Regional Forester determines an exception (USFS 2004a).

Management Area G (5 percent) and Management Area P (2 percent) do not have existing wells within their boundaries. Management of visual resources is a lower priority within these areas, because they are classified primarily as Modification and Maximum Modification.

Environmental Consequences

No wells would be developed as a direct result of the leasing decision, and all new wells are projected to be constructed on existing leases. The action alternatives propose limits on oil and gas development that could provide additional protections to visual resources only as they apply to new leases. The following discussion of environmental consequences documents the most likely areas where visual resources would be affected by new development.

Alternative 1—No Action

Under Alternative 1, standard lease terms and conditions or limited surface uses, as identified in the Forest Plan, would continue to guide management of the oil-gas study area; therefore, siting oil-gas facilities would have few restrictions, but would be expected to meet established VQOs to the extent possible on existing leases. Most of the projected wells (7) and roads (almost 2 miles) would be developed within Management Area R, in which visual resources management is a low priority. As a result, visual resource integrity would most likely be affected in this management area under Alternative 1, as continuing the current management and VQO classifications may not adequately protect the area from the potential impacts of future development.

Future leases for oil-gas development are unlikely within Management Areas A and D, according to the RFDS (Gore 2003). Therefore, impacts to visual resources in these management areas would be negligible under Alternative 1.

If future leases were to be issued in Management Area E under Alternative 1, VQOs of Partial Retention and Retention could be affected if restrictions were not imposed and visual resource integrity objectives not upheld.

Under Alternative 1, visual resource impacts could occur in Management Area L, although no wells are projected to be located in this area. The effects of future development would most likely have few impacts, as the existing Forest Plan management direction imposes surface use restrictions, and current VQO designations ensure higher resource integrity.

Management Area S is located in an area with a high density of existing oil-gas wells where many of the new wells (13) are projected. The current Forest Plan applies only standard lease terms and conditions, and VQOs are designated Maximum Modification or Modification, so managing for visual resource integrity would continue to be a low priority.

Management of visual resources is a lower priority within Management Areas G and P. Impacts to visual resource integrity would be negligible under Alternative 1, because well development in these areas is unlikely.

Alternative 2—Proposed Action

Under Alternative 2, stipulations of NSO, timing limitations, and CSU would be applied to new leases in order to protect surface resources and wildlife. The portions of the oil-gas study area where these stipulations are not proposed would remain subject to standard lease terms and conditions as currently identified in the Forest Plan.

The proposed NSO stipulation on new leases would provide visual resources with increased protection within limited areas by restricting surface development. It would prohibit the future development of new leases in areas with unstable slopes, roadless recreation designations, and important heritage resources. The degree of visual integrity retained would depend on whether oil-gas development is likely and the VQO designation is to be maintained.

Within existing oil-gas development and production locations, which are mostly in the northern portion of the study area, NSO stipulations completely contain what is presently managed under the Forest Plan as Management Area L and parts of Management Areas R and S. Implementing NSO lease stipulations within Management Area L under Alternative 2 would most likely provide more protection to visual resource integrity than Alternative 1. Management Areas R and S would maintain the VQO designations primarily of Maximum Modification and Modification, so, while

the proposed NSO lease stipulations would help to retain visual resource integrity in these areas, other modifications could be allowed.

The proposed timing limitations do not prohibit drilling operations and construction activities, but limit these activities during specific times of the year on new leases. As a result, Alternative 2 would potentially increase visual resource vitality in these areas, and perhaps slow visual degradation in the short term.

The CSU stipulation would provide increased protection for visual resources, as it would place restrictions on oil-gas development in riparian areas and wetlands, VQO areas designated as Retention, and near heritage resources. Encouraging effective execution of practices consistent with VQO Retention, in addition to utilizing industry BMPs, would limit short-term and long-term surface impacts to visual resources, as compared to Alternative 1, and potentially increase visual resource integrity in disturbed areas not currently designated as Retention.

CSU stipulations in current oil-gas development and production locations are mostly contained within Management Area R. The locations of the proposed CSU stipulations within Management Area R are mostly designated Maximum Modification and Modification, which do not emphasize maximum visual resource protection. As a result, Alternative 2 may provide more protection to visual resource integrity than Alternative 1.

Alternative 3

Under Alternative 3, the boundaries of proposed NSO stipulations on new leases would be expanded to include designated roadless areas in addition to Management Area L and the one-half mile buffer around San Pedro Parks Wilderness within the study area. Increased NSO stipulations would provide additional protection to visual resources, as oil-gas development would be prohibited where they apply on new leases. The expanded NSO area would encompass all of Management Area L, although no new wells are projected there. Increased areas with NSO stipulations on new leases would provide more protection to visual resource integrity than both Alternatives 1 and 2; however, the increased protection would be minimal due to the small size of the expanded NSO area.

Cumulative Impacts

Alternatives 2 and 3 would apply only to future leases in the oil-gas study area. Current leases would continue to be subject to standard lease terms and conditions under the Forest Plan. Furthermore, leasing of an area does not guarantee well development, as permissions and site-specific requirements for drilling are obtained during the APD process that includes an environmental assessment. Reasonably foreseeable development projections indicate about 20 new well locations that would be constructed on existing leases in the oil-gas study area, subject to standard terms and conditions, not proposed lease stipulations. Since the foreseeable well development would most likely occur on current leases, projected new wells would not be subject to the lease stipulations presented in Alternative 2 or 3 unless some leases were relinquished and re-issued EOIs. Visual quality may be affected in localized areas and would require a reduction in contrast within 5 years of construction of oil-gas facilities.

Other foreseeable actions that would have cumulative effects on visual resources include proposed road closures and decommissioning within the Cuba and Coyote Ranger Districts within and adjacent to the study area. If decisions are made to close and decommission roads, the

resulting decrease in vehicle traffic and reduction in fragmentation of the landscape would result in improved visual resources over the long term. Of the other foreseeable Forest Service projects listed in Table OG-15, tree thinning and prescribed fire would have the greatest potential to affect visual resources.

Livestock Grazing

Affected Environment

Portions of 22 allotments, comprising about 12,448 Animal Unit Months (AUM) occur within the oil-gas study area (Figure OG-37 and Table OG-41). The Chama Canyon and San Pedro allotments are excluded from this discussion because less than 1 percent of their total acreage falls within the study area. One Animal Unit (AU) is defined as a 1,000-pound (450 kg) beef cow with or without a nursing calf with a daily requirement of 26 pounds (11.8 kg) of dry matter forage per day. For forage calculations, this is typically simplified to be about 750 pounds of dry forage per month (Vallentine 1990). Therefore, two AUs grazing on an allotment for a total of 7 months represent a total of 14 AUMs, or about 10,500 pounds of dry forage consumed. Different areas have different levels of forage productivity, based on available moisture, soil fertility, grazing pressure, and other factors, so the number of acres required to provide one AUM, or 750 pounds of forage, varies among sites and within allotments. The number of acres per AUM varies greatly within the study area, ranging from about 6.6 to 99.2 acres per AUM (Table OG-41).

Most grazing allotments are used by one or two permittees, but can vary substantially from allotment to allotment (Table OG-45). The primary grazing system is deferred rotational grazing—cattle are allowed to graze in pastures for relatively short periods of time before they are moved to another pasture within the allotment. At lower elevations, the season of use is typically from May 1 through the end of November. For mountain allotments, the season of use is shorter, from June 1 through the end of October (Eaton 2005).

Surface disturbing activities, such as oil-gas development, can adversely affect rangeland health and forage productivity by introducing weeds into an area and/or increasing the extent of existing invasive plants. Table OG-42 shows the types of invasive plants and the estimated extent of infestation found on allotments that may be affected by the change in oil-gas lease stipulations. Note that the acreage of weeds shown in Table OG-46 is for the entire allotment, and not limited to the oil-gas study area. Fifteen of the 20 allotments within the study area have known invasive plant problems, predominantly thistle and knapweed species.

Environmental Consequences

Impacts to livestock grazing result from actions that change the number or kind of livestock, or result in a change in the management of livestock currently grazed on Forest Service administered allotments within the oil-gas study area. Direct impacts to livestock grazing result from changes in range or livestock management. Indirect impacts on livestock grazing result from management actions for other resources or resource uses that could affect forage, range improvement projects, or livestock management.

Oil-gas development can result in the direct removal of forage available to livestock. Rangeland health and forage production can be indirectly affected by oil-gas development through the introduction and spread of noxious weeds and soil loss. Both the direct and indirect impacts of oil-gas development are associated with ground disturbances caused by constructing road

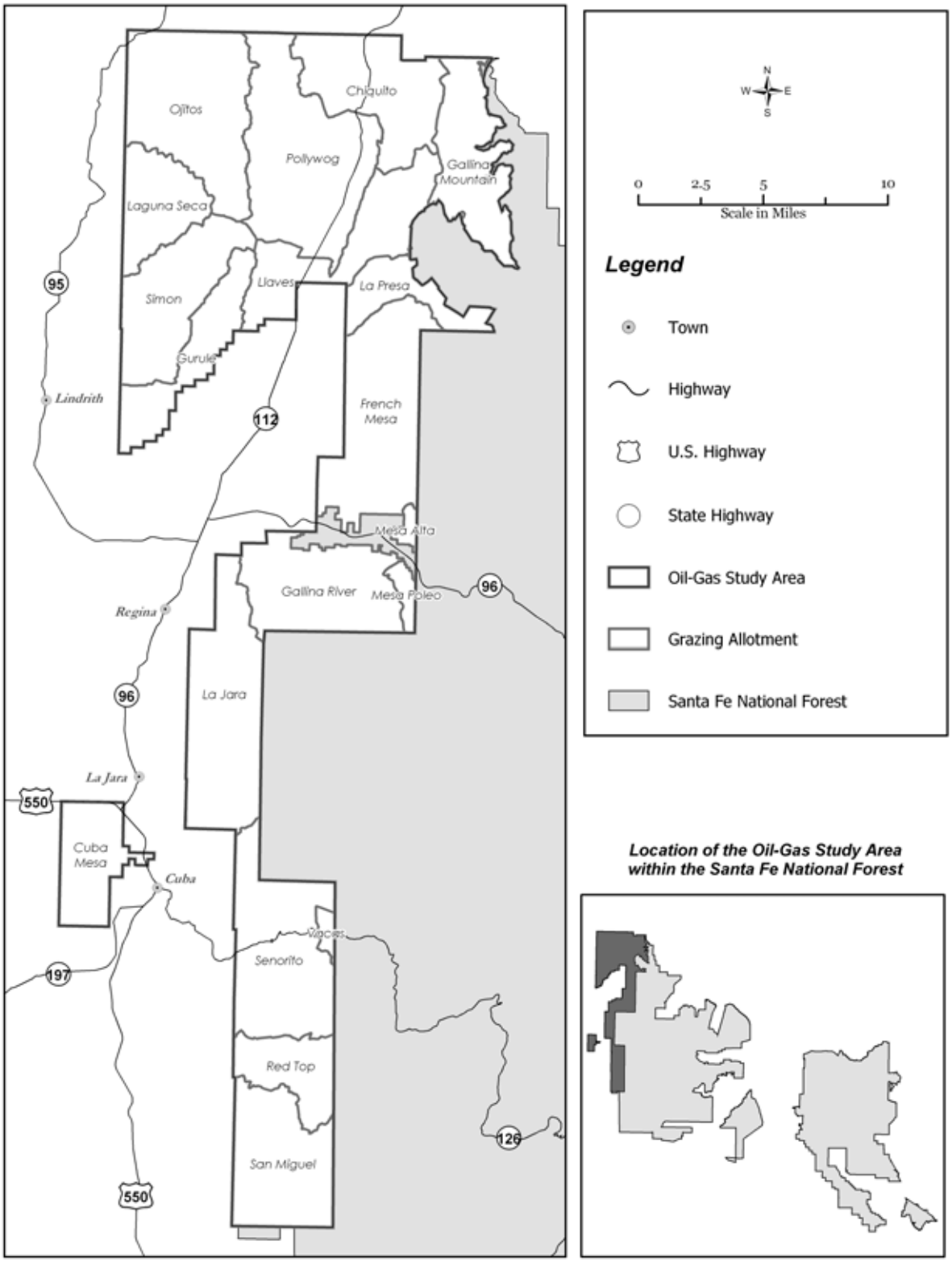

Figure OG-37. Grazing allotments in the oil-gas study area

Table OG-45. Livestock grazing allotments occurring within the oil-gas study area

Allotment Name	Number of Permittees	Total Allotment Acres	Total AUMs	Acres per AUM	Within Oil and Gas Study Area			
					Santa Fe National Forest (acres)	Private (acres)	Percent Allotment in Study Area	Total AUMs in Study Area
Chiquito	1	13,104	946	13.9	11,719	1,385	100.0	946.0
Cuba Mesa	1	7,375	265	27.8	7,333	0	99.4	263.5
French Mesa	10	25,191	1,647	15.3	17,023	666	70.2	1,156.5
Gallina Mountain	4	11,268	677	16.6	11,065	0	98.2	921.8
Gallina River	9	22,521	1,498	15.0	13,589	207	61.3	917.6
Gurule	1	8,359	673	12.4	8,356	0	100.0	672.8
La Jara	2	17,395	224	77.7	14,738	2,628	99.8	223.6
La Presa	1	11,086	265	41.8	5,174	209	48.6	128.7
Laguna Seca	1	7,740	1,080	7.2	7,253	485	100.0	1,079.6
Llaves	2	11,926	1,057	11.3	10,889	1,026	99.9	1,056.0
Mesa Alta	8	37,156	1,742	21.3	730	0	2.0	34.2
Mesa Poleo	12	26,123	1,606	16.3	1,225	0	4.7	75.3
Ojitos	1	18,444	186	99.2	18,271	146	99.9	185.7
Pollywog	2	21,159	1,261	16.8	20,403	756	100.0	1,261.0
Red Top	2	9,511	397	24.0	6,541	0	68.8	273.1
San Miguel	1	21,847	517	42.3	12,95	60	59.6	308.0
Senorito	3	21,978	2,130	10.3	16,184	437	75.6	1,610.8
Simon	1	12,474	1,213	10.3	12,471	0	100.0	1,212.7
Vacas	4	8,231	1,250	6.6	787	11	9.7	121.2
Total	**66**	**—**	**—**	**—**	**183,751**	**8,016**	**—**	**12,448**

networks, drilling, and installation of well pads, pumps, pipelines, water detention facilities, other associated infrastructure, and ongoing maintenance. Both short-term and long-term impacts to AUM allocations may occur, however, long-term impacts are of greater concern to livestock grazing permittees. Short-term reductions in forage production and AUMs would have local impacts, but are not expected to occur simultaneously (i.e., all wells developed at the same time). Therefore, the overall direct impact of short-term surface disturbances from oil-gas development on forage production and AUMs in the study area is expected to be negligible. No impacts to the construction or maintenance of rangeland improvement projects or facilities are expected under any of the alternatives.

Table OG-46. Grazing allotments with known weed infestations within the oil-gas study area

Allotment Name	Invasive Weed Species	Estimated Acres Infested[1]
Chiquito	Musk thistle, Canada thistle	5
Cuba Mesa	Musk thistle, Canada thistle	5
French Mesa	Canada thistle, musk thistle	108
Gallina River	Musk thistle, Canada thistle	293
La Jara	Russian knapweed, musk thistle	30
La Presa	Canada thistle, musk thistle	111
Llaves	Spotted knapweed, diffuse knapweed, Canada thistle, bull thistle	39
Mesa Alta	Canada thistle, musk thistle	186
Mesa Poleo	Canada thistle, musk thistle	119
Ojitos	Musk thistle, Canada thistle, bull thistle	38
Pollywog	Canada thistle, saltcedar	26
Red Top	Musk thistle, Canada thistle, Scotch thistle	9
San Miguel	Bull thistle, musk thistle	36
Senorito	Musk thistle, diffuse knapweed, bull thistle	129
Vacas	Musk thistle, Canada thistle	8

Source: USFS 2004c

[1] The extent of noxious weeds is for the entire allotment, and not specific to the oil-gas study area.

Alternative 1—No Action

In general, the proposed changes to oil and gas leasing in the study area would have limited direct impact on livestock grazing from any of the alternatives. The No Action Alternative would likely have the greatest indirect impact on rangeland health and forage production, due to the less restrictive oil and gas leasing stipulations, and a corresponding potential to increase the extent of surface disturbance and noxious weeds already found within the study area. This is of more concern in areas of lower productivity (i.e., higher number of acres to support one AUM), such as the Cuba Mesa, La Jara, La Presa, Mesa Alta, Ojitos, Red Top, and San Miguel allotments that already require over 20 acres to support one cow for one month.

Alternative 2—Proposed Action

When compared to the No Action Alternative, the Proposed Action would likely benefit rangeland health throughout the oil-gas study area. NSO and CSU stipulations for steep unstable soils, roadless recreation areas, heritage resources, riparian areas, and scenic integrity would result in decreased oil-gas development on the surface of the remaining 55 percent of the oil-gas study area not currently leased, thereby decreasing the potential for the direct loss of forage and the indirect adverse impacts on forage production and rangeland health from noxious weeds.

If new leases issued under the Proposed Action were developed for oil or gas, all allotments would benefit from the proposed CSU and NSO stipulations on new leases; however, allotments that would be the most affected are Ojitos, Pollywog, Chiquito, Gallina River, La Jara, Señorito, Red Top, and San Miguel.

Alternative 3

Similar to the Proposed Action, Alternative 3 would likely benefit rangeland health throughout the oil-gas study area. The additional NSO stipulations in the inventoried roadless areas and San Pedro Parks Wilderness buffer under Alternative 3 would benefit livestock grazing by limiting surface disturbance if new leases were developed. Under Alternative 3, all allotments would benefit from CSU and NSO stipulations; however, allotments that would be the most affected are Ojitos, Pollywog, Chiquito, Gallina River, La Jara, Señorito, Red Top, and San Miguel.

Cumulative Impacts

Currently 20 new oil wells are expected to be installed under any of the oil and gas alternatives and would require almost 3 miles of new road construction. These wells and roads are located on existing leases and, therefore, subject to standard terms and conditions. The surface disturbance during construction, in addition to the earthmoving to decommission roads in the Cuba and Coyote Ranger Districts would directly affect forage production of small areas, and indirectly affect forage production through the likely introduction and/or spread of noxious weeds. Project 4, forest-wide invasive plant control (see Table OG-15), would improve grazing allotments by controlling competitive plants that reduce forage production. Other projects listed in Table OG-15 that would benefit forage production and livestock grazing over the long term are projects 2, 3, 4, 6, 7, and 8.

Fire Management

Affected Environment

Before the arrival of European settlers in the Southwest, low-intensity surface fire was a common natural occurrence, often affecting vegetation communities over wide areas (USFS 2004c). Historically, fires burned through piñon-juniper woodlands and ponderosa pine forests in the region on an average of every 10 to 30 years. High-montane forests may have burned less regularly and at a higher intensity. Overall, however, the occurrence of fire promoted a more open structure of all wooded communities. Open forests were associated with a grass cover, which in turn allowed fire to cover large areas (USFS 2004c). The arrival and settlement of Europeans in the region led eventually to decades of fire suppression, logging, and grazing that drastically affected the structure of Southwestern forests (USFS 2004c). The natural process of succession was altered, resulting in an increase in tree density and an increased potential for large catastrophic fires (USFS 2004c).

Current Fire Regime and Management

Fire management is an important priority in the study area (USFS 2004c). The fire season on the Santa Fe National Forest generally occurs from the end of May to the end of September (Johnston 2005). About 300 fires occur annually on the forest, 90 percent of which are extinguished during the initial attack phase. Only 10 percent of wildfires burn past the first day and may require an

extended attack. Eighty-two percent of all wildfires on the forest are caused by lightning strikes, the remaining 18 percent are caused by humans. The majority of human-caused fires are accidental. The Cuba Ranger District, which is in the "lightning belt," experiences a higher incidence of lightning-caused fires than elsewhere on the forest. In contrast, the Coyote Ranger District is outside the lightning belt, experiencing a lower than average incidence of lightning-related wildfires (Johnston 2005).

Due to the high density of trees on the forest including many parts of the oil-gas study area, as well as recent drought conditions, the number and size of wildfires has increased (Johnston 2005). In particular, the average size and number of fires on the forest during the last 12 years was higher than for the previous 25 years (Johnston 2005). In recent years, the Santa Fe National Forest has experienced several stand-replacing fires, such as the "BMG fire" that burned 484 acres in the northwestern portion of the Cuba Ranger District in 2002. Over much of the oil-gas study area, dense trees and heavy fuel loads entail a high risk of catastrophic fires. Fires that burn under these conditions are often followed by soil erosion and increased stream peak flows (USFS 2004c).

The approach to fuels management is aggressive on the forest. However, because of the layout of the land in the oil-gas study area, local fire management activities are based less on broadcast burns than on mechanical treatment followed by burning of slash piles (Johnston 2005). The reliance on mechanical treatment (rather than broadcast burns) in the oil-gas study area means that greater manpower is required for the same acreage of land treated. Consequently, the number of acres that can benefit from fuels reduction is limited. However, with $1 million and $880,000, respectively, the Coyote and Cuba Ranger Districts have among the largest fuels reduction budgets of the forest (Johnston 2005).

Fire-Related Issues in the Study Area

The current vegetative conditions (composition and structure) within the study area are a reflection of the fire ecology of these ecosystems. Changes to this ecology through fire suppression, logging, and grazing have dramatically altered the vegetation conditions across the study area in the past century. The most striking example occurs within stands of ponderosa pine where the exclusion of fire resulted in areas of dense, suppressed or dwarf bent trees forming "doghair" thickets (USFS 2004c). Another example of prolonged mid-succession dominance caused by fire exclusion occurs in the oak woodland (Dick-Peddie 1993).

Lack of fire is also an issue in high montane forests where ponderosa pine is a natural component, occurring as a seral species. Currently, ponderosa pine regeneration is being adversely affected by the existing high density of white fir, which creates a shade effect (USFS 2004c). In addition, lack of fire is adversely affecting the distribution and size of aspen stands and montane meadows. Aspen stands are present but are declining due to changes in the fire ecology of the area (USFS 2004c).

The study area includes native grasslands and sagebrush communities that reflect a lack of low-intensity fire. Juniper encroachment into sagebrush communities and grasslands has been linked to changes in the natural fire regime (USFS 2004c). Exotic, invasive species are another concern for management, and may result, in part, due to a lack of regular low-intensity fire (USFS 2004c).

Environmental Consequences

Alternative 1—No Action

No changes to fire hazard management activities would occur under the No Action Alternative.

Alternative 2—Proposed Action

Under the Proposed Action, more areas within the study area would have NSO, CSU, and timing limitations for oil-gas leasing and development activities under new leases. These stipulations would not relate to fire management activities; however, prescribed fire may be a more viable management tool in NSO areas than under the No Action as there may be fewer well locations to protect in these areas.

Alternative 3

The impacts on fire management would be similar to those described under Alternative 2.

Cumulative Impacts

Within the oil-gas study area neither the No Action Alternative nor the action alternatives (Alternatives 2 or 3) would be expected to significantly affect fire management. The Proposed Action and Alternative 3 would broaden the spectrum of fire management suppression tools by creating NSO areas where prescribed fire could be used if the appropriate conditions and opportunity coincided. However, due to the fact that the 20 new well locations are projected to occur on existing leases, these new lease stipulations proposed under Alternatives 2 and 3 are not likely to affect the foreseeable future well locations under any alternative, unless new wells were developed on new leases under the proposed NSO stipulations. There are several areas within the Cuba and Coyote Ranger Districts where prescribed fire and forest thinning is planned in the near future to reduce the potential for wildfires (see Table OG-15). It is expected that these and other similar projects would benefit fire management and have greater impacts than implementing any of the alternatives or developing new wells.

Social Environment

Affected Environment

For the purposes of this study, the term “social environment” refers to the various values perceived by the people who use the forest for different purposes. These uses primarily include economic (e.g., employment, resource extraction, etc.), recreational (e.g., hiking, camping, hunting, etc.), and intrinsic (e.g., wildlife habitat, spiritual, etc.) values. These social considerations are taken into account in light of the Forest Service’s multiple-use management principles to meet the needs and desires of different user groups.

The oil-gas study area and surrounding region are a source of both direct and indirect employment and revenue for many of the small communities and residents of areas surrounding the national forest and study area. Employment associated with the forest is generated by Federal (e.g., Forest Service, BLM) and State (e.g., NMDGF) agencies that are responsible for management of the forest and/or its resources; private oil-gas and minerals extraction companies operating within the study area; local ranchers that utilize grazing allotments within the study area; and local hunting, fishing, and boating guides that operate within and adjacent to the study

area. Visitors to the forest help support local businesses including gas stations, restaurants, and motels located near and within the study area. However, the study area is not a major oil and gas producing area or recreational destination relative to other areas in the region. Refer to the "Economics" section for detailed information on employment and revenue associated with the oil-gas study area.

The forest is an important provider of recreational opportunities for nearby residents and tourists. Recreational activities provided in the region include hunting and fishing, hiking and backpacking, sightseeing, camping, boating and rafting, horseback riding, mountain biking, wildlife viewing, and winter sports. Because the study area lacks developed recreational facilities and major watercourses, boating and rafting do not occur, although recreationists likely utilize the study area to access these recreational resources due to their proximity. Refer to the "Recreation and Wilderness Resources" section for more detailed information on recreational opportunities.

Intrinsic values associated with public lands and national forests, while intangible and difficult to quantify, are an important issue to many people. These include the belief that Federal lands are important as habitat for wildlife and plants outside of any monetary or other personal gain that these resources can provide to people. Public lands generally provide the most extensive and intact habitat for many wildlife and plant species, including popular and rare species. Refer to the "Vegetation and Wildlife" section for more detailed information on wildlife and sensitive species.

Native Americans and proponents of Native American culture value these lands because of the spiritual and historic connections that these lands have to nearby tribes. Several tribal lands are located near the forest, including the Jicarilla Apache Nation, Pueblo of Zia, and Pueblo of Jemez.

Environmental Consequences

The primary concern associated with the social environment is how decisions and actions that affect the forest relate to and affect the values that certain groups or individuals have regarding how the forest's resources should be managed. The values that different people have will affect how they perceive management decisions related to oil-gas development on the forest.

The primary social values placed on forest resources include economic, recreational, and intrinsic or cultural values. While certain groups or individuals may strongly favor one of these values over the others, the Forest Service's stated principles seek to manage the forest based on multiple-use management that balances these primary values. Additionally, within each of the primary values, there may be different groups or individuals that favor one activity over another. For example, some favor the economic value of the forest's oil and gas resources over its economic value for livestock grazing, and some may favor motorized recreational opportunities over recreational activities such as hiking.

Alternative 1—No Action

Under Alternative 1, the decision not to place additional stipulations on oil-gas leasing would favor the oil-gas industry, and would not address the Forest Service's conclusions that certain surface resources need increased protection. Although Alternative 1 would have no effect on existing oil-gas leasing, those that favor and/or benefit from forest management that minimizes constraints on oil-gas leasing would likely agree with this decision for the management of the forest. However, those that favor the recreational and/or intrinsic values of the forest would likely

believe that additional restrictions would be needed to adequately protect sensitive surface resources from the potential effects of future oil-gas leasing on the forest, and that multiple-use management of the forest does not adequately balance the different uses of the forest.

Alternative 2—Proposed Action

Alternative 2 would have no effect on the projected oil-gas development, although the change in oil-gas stipulations on new leases, including areas where there are currently EOIs, would represent a shift in forest management that would increase protection of natural and heritage resources above current levels in the Forest Plan. As such, Alternative 2 would balance recreational and intrinsic values of the forest with oil-gas development by providing for more stringent restrictions on the use of some areas in order to minimize adverse impacts to wildlife habitat, erodible soils, riparian areas, roadless areas, and heritage resources.

Alternative 3

The proposed lease stipulations under Alternative 3 would expand the area of proposed NSO stipulations by 18 percent, resulting in slightly greater surface protections to many surface resources over a larger area, by limiting surface disturbance due to oil-gas development on new leases.

Cumulative Impacts

The combination of the proposed oil-gas lease stipulations under Alternative 2 or 3 with the proposed road closure and decommissioning within the Cuba and Coyote Ranger Districts would result in less overall surface disturbance and activities by restricting oil-gas development on new leases and public access to many miles of roads in the study area. This is likely to lead to more opportunities for quiet recreation experiences, maintaining nonmotorized recreation and some highly valued backcountry experiences within the study area while still allowing for oil-gas development and motorized access.

Economics

Affected Environment

Residents of Rio Arriba and Sandoval Counties derive economic benefits from oil-gas development and production on national forest land in the oil-gas study area. In addition, many of the companies that provide equipment and services for oil-gas development and production come from Farmington or Aztec in San Juan County. Most of the workers and small companies in the oil-gas fields in the study area live in or near Lindrith, in Rio Arriba County, or Cuba, in Sandoval County.

This section provides a summary of current and recent economic conditions in the towns and counties that could be affected by the proposed action. Specifically, it includes information on population, housing, employment, unemployment, income, and tax revenues that result from oil-gas development and production. In addition to Rio Arriba, Sandoval, and San Juan Counties, the areas described in this section include the nearby towns of Cuba, Regina, La Jara, and Torreon. Although data are not available for the Village of Lindrith alone, this section includes data for the Coyote Census County Division (CCD) within Rio Arriba County, which encompasses Lindrith as well as most national forest land that lies within Rio Arriba County, shown on Figure OG-38.

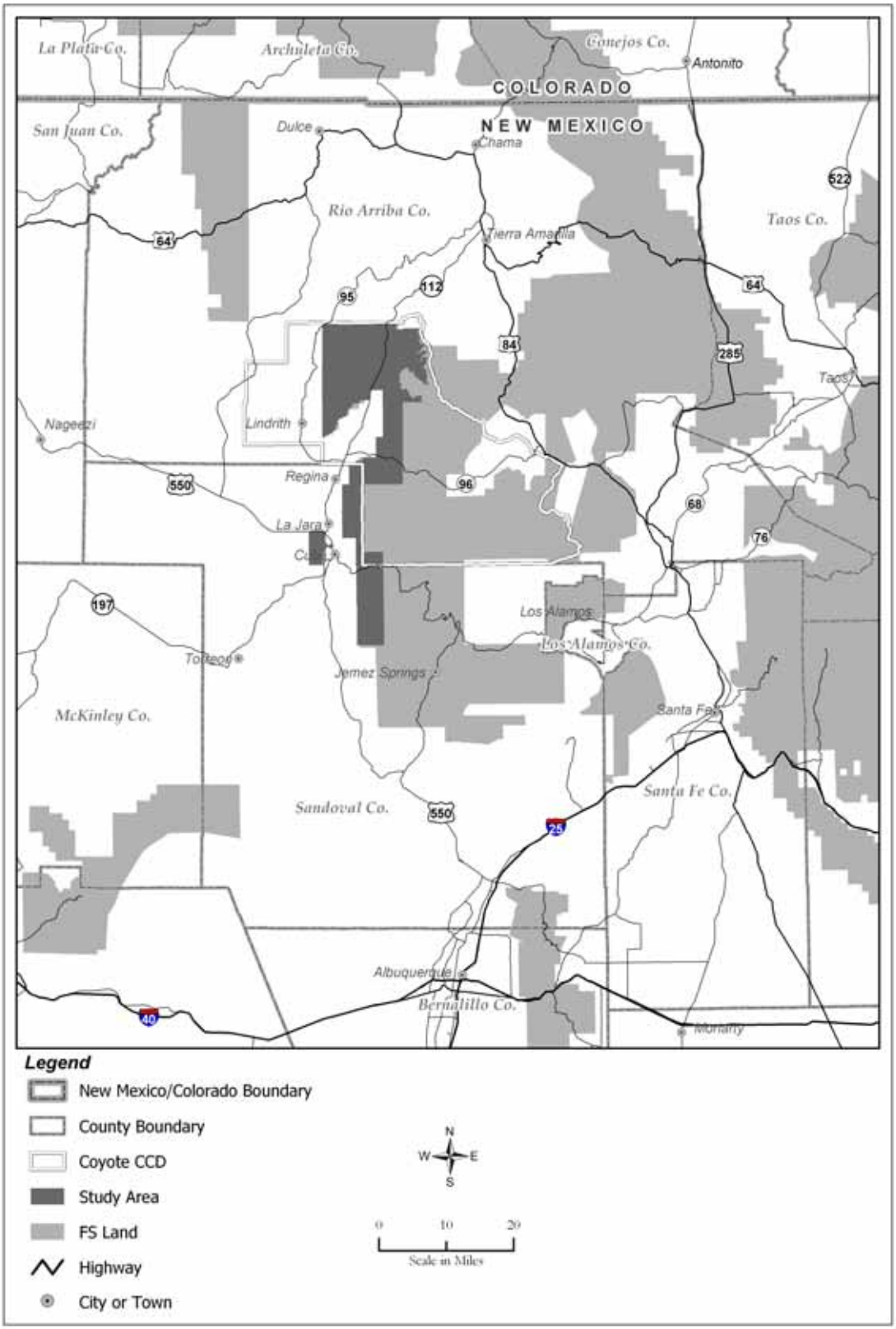

Figure OG-38. Economic environment for the study area

Table OG-47. Population and housing, 1990 to 2000

Area	1990 Population	2000 Population	Average Annual Population Growth, 1990 to 2000	Housing Units, 2000	Housing Vacancy Rate, 2000
Rio Arriba County	34,365	41,190	1.8%	18,016	16.5%
Sandoval County	63,319	89,908	3.6%	34,866	9.9%
San Juan County	91,605	113,801	2.2%	43,221	12.7%
Coyote CCD	1,530	1,559	0.2%	769	28.4%
Cuba	760	590	-2.5%	290	21.1%
La Jara	nd	209	nd	140	32.3%
Regina	nd	99	nd	106	41.4%
Torreon	nd	297	nd	98	31.6%
New Mexico	1,515,069	1,819,046	1.8%	780,579	13.1%
United States	248,709,873	281,421,906	1.2%	115,904,641	9.0%

nd = no data

Sources: U.S. Census Bureau 2002 (2000 data); U.S. Census Bureau 1993 (1990 data)

Population and Housing

Table OG-47 provides a summary of population and housing information for the communities in and near the study area. As the table shows, according to the 2000 Census, about 41,000 people lived in Rio Arriba County in 2000, about 90,000 lived in Sandoval County, and about 114,000 people lived in San Juan County. The Coyote CCD contained 1,559 people, which is about 4 percent of the total population of Rio Arriba County (U.S. Census Bureau 2002).

Although the counties all grew faster than the nation as a whole between 1990 and 2000, Census data suggests that the individual towns and Coyote CCD either shrank or grew relatively slowly between 1990 and 2000. In 1990 there were 1,530 people in the Coyote CCD, about the same as in 2000, and 760 people in the town of Cuba, which was more than in 2000. The 1990 Census did not report data for Torreon, La Jara, or Regina (U.S. Census Bureau 1993). For comparison, there were 1.5 million people in New Mexico in 1990 and 1.8 million people in New Mexico in 2000.

The 2000 Census showed relatively high vacancy rates for housing in the towns around the study area, compared to the State and National average. Of the 790 housing units counted in the Coyote CCD, 224, or 28 percent, were vacant. Cuba had 61 of 289 housing units vacant, or 21 percent; 41 of the 127 housing units in La Jara were vacant, or 32 percent; and 48 of the 116 housing units in Regina, or 41 percent, were vacant in 2000. Vacancy rates in the surrounding counties were somewhat lower: vacancy was 16 percent in Rio Arriba County, 10 percent in Sandoval County, and 13 percent in San Juan County. For comparison, 13 percent of housing units in New Mexico were vacant in 2000, and the national rate was 9 percent (U.S. Census Bureau 2002).

Employment and Unemployment

Table OG-48 provides a summary of unemployment for counties and towns near the study area, as well as for New Mexico and the U.S. As the table indicates, unemployment in Rio Arriba, Sandoval, and San Juan Counties declined between 1990 and 2000, but has increased between 2000 and 2003. Unemployment followed a similar trend in New Mexico and the country as a whole. The table also shows that all three counties had somewhat higher unemployment than the State or the country in 2003. Unemployment in the Coyote CCD was slightly higher than that for Rio Arriba County in 2000, and unemployment in both Cuba and Regina was substantially higher than for Sandoval County or other counties. According to the U.S. Census, there was no unemployment in La Jara or Torreon in April 2000. However, the Census data for small areas may be less reliable than the data shown for the counties, State, and Nation (which is from a different source), because the Census data uses a smaller sample size and a shorter survey timeframe.

Table OG-48. Unemployment rates in the oil-gas study area and the U.S.: 1990–2003

Area	2003	2000	1990
Rio Arriba County[1]	7.7%	7.0%	13.5%
Sandoval County[1]	6.5%	3.5%	5.5%
San Juan County[1]	8.2%	7.2%	8.5%
Coyote CCD[2]	nd	7.7%	24.7%
Cuba[2]	nd	17.5%	11.5%
La Jara[2]	nd	0.0%	nd
Regina[2]	nd	22.9%	nd
Torreon[2]	nd	0.0%	nd
New Mexico[1]	6.4%	5.0%	6.5%
United States[3]	6.0%	4.0%	5.6%

nd = no data

Notes: [1] Annual average data from BLS 2004a

[2] Data for April, not seasonally adjusted, from U.S. Census Bureau 2002 (2000 data) and U.S. Census Bureau 1993 (1990 data)

[3] Annual average data from BLS 2004b

Table OG-49 provides a summary of employment by sector for the counties and communities in and near the study area. As the table shows, public administration (government) contributes significantly to employment in all three counties, although it is less important in the Coyote CCD and Cuba. Educational, health, and social services is an important sector in all three counties and contributes more than any other sector in the Coyote CCD and Cuba. Retail trade is also a major contributor in all areas. Mining (which includes oil and gas extraction) contributes about 8 percent of full-time and part-time jobs in San Juan County and in the Coyote CCD, but fewer than 1 percent of jobs in Sandoval and Rio Arriba Counties. Agriculture, forestry, fishing, and hunting represent a significant source of employment in both the Coyote CCD and Rio Arriba County as a

Table OG-49. Full-time and part-time employment by sector

Sector	United States[1]	New Mexico[1]	Rio Arriba County[1]	Sandoval County[1]	San Juan County[1]	Coyote CCD[2]	Cuba[2]
Agriculture, forestry, fishing and hunting	2.4%	2.8%	7.1%	1.4%	2.0%	14.1%	1.6%
Mining	0.5%	1.8%	0.9%	0.3%	8.4%	8.2%	3.2%
Construction	5.9%	6.3%	6.0%	8.7%	8.0%	8.0%	6.9%
Manufacturing	9.5%	4.4%	3.8%	20.0%	2.8%	3.4%	0.5%
Wholesale trade	3.7%	2.8%	1.2%	nd	3.3%	3.0%	0.0%
Retail trade	11.0%	11.3%	10.7%	10.0%	12.5%	7.6%	11.6%
Transportation and warehousing	3.2%	2.4%	1.8%	1.2%	2.7%	7.0%	8.5%
Utilities	0.4%	0.4%	0.7%	0.4%	2.2%	1.8%	2.1%
Information	2.3%	1.9%	0.6%	nd	0.9%	0.6%	1.1%
Finance, insurance, real estate and rental and leasing	8.6%	6.7%	4.0%	6.9%	4.6%	3.0%	2.1%
Professional, scientific, management, administrative, and waste management services	13.0%	12.1%	5.1%	8.3%	6.8%	5.8%	3.7%
Educational, health and social services	11.5%	10.9%	14.3%	5.6%	9.8%	23.9%	34.4%
Arts, entertainment, recreation, accommodation and food services	8.5%	9.8%	8.4%	7.7%	10.0%	4.8%	15.9%
Other services (except public administration)	5.5%	5.1%	5.4%	5.0%	5.7%	3.4%	4.2%
Public administration	14.0%	21.2%	32.5%	19.0%	20.2%	5.6%	4.2%
Total Employment	**167,033,500**	**992,611**	**16,705**	**33,349**	**57,354**	**502**	**189**

nd = no data. Data were not disclosed due to BEA confidentiality requirements (there are very few employers in the sector)

Notes: [1] Data for 2002 (average over the year), from BEA 2004
[2] Data for April 2000, from U.S. Census Bureau 2002

whole. Although data are available for La Jara, Torreon, and Regina, the small sample size can produce misleading conclusions. For example, total employment was 81 people in La Jara, 34 people in Torreon, and 27 in Regina, and on average 1 in 6 of these people would have been surveyed in the 2000 Census (U.S. Census Bureau 2002). Thus, data for these communities are not shown.

Income

A common statistic used to measure the financial health of a community is median household income. The median household income represents a midpoint of household incomes in a community: half of households have an income greater than the median, and half have an income less than the median. Table OG-50 provides a summary of median household income as of 1999, from the 2000 Census. As the table shows, Rio Arriba and San Juan Counties had a median income somewhat lower than the State or the Nation, and median income in the Coyote CCD was lower than that for Rio Arriba as a whole. While the median income in Sandoval County was higher than either the State or the Nation, this was not true in Cuba or Regina, where median income were below the State and National figures. Note, however, that the median household income in Sandoval County as a whole is not necessarily representative of the median income for the northern part of the county near the study area. Sandoval County includes the relatively high-income city of Rio Rancho, in the Albuquerque metropolitan area, which contains over half the county's population. Median income in La Jara was higher than the State but lower than the Nation.

Table OG-50. Median household income, 1999

Area	Median Household Income
Rio Arriba County	$29,429
Sandoval County	$44,949
San Juan County	$33,762
Coyote CCD	$24,405
Cuba	$21,538
La Jara	$39,444
Regina	$13,355
Torreon	$22,292
New Mexico	$34,133
United States	$41,994

Source: U.S. Census Bureau 2002

Table OG-51 shows labor earnings by sector—parallel to Table OG-45, but showing earnings rather than employment. Labor earnings are available by sector only for counties, the State, and the Nation, so earnings are not shown for the Coyote CCD or for individual towns. Table OG-47 shows that mining contributed about one-sixth of the labor earnings in San Juan County in 2002, and about 1.5 percent of the earnings in Rio Arriba County. Agriculture, forestry, fishing, and hunting contributed 4 percent of earnings in San Juan County, but contributed minimally in Rio

Arriba and Sandoval Counties. The top contributors to earnings in Rio Arriba County were public administration, educational, health, and social services, and retail trade. The leading contributors to earnings in Sandoval County were manufacturing, public administration, and construction. The top contributors to earnings in San Juan County were public administration, mining, and educational, health, and social services.

Table OG-51. Labor earnings by sector, 2002

Sector	United States[1]	New Mexico[1]	Rio Arriba County[1]	Sandoval County[1]	San Juan County[1]
Agriculture, forestry, fishing and hunting	1.0%	2.3%	0.2%	0.2%	4.0%
Mining	0.8%	3.3%	1.5%	0.2%	16.7%
Construction	6.1%	6.5%	7.9%	10.3%	7.9%
Manufacturing	13.2%	6.0%	3.5%	41.0%	3.3%
Wholesale trade	5.2%	3.3%	1.0%	nd	3.5%
Retail trade	6.9%	7.9%	9.8%	5.7%	8.0%
Transportation and warehousing	3.4%	2.8%	1.8%	0.7%	3.6%
Utilities	1.0%	0.9%	1.8%	0.5%	5.6%
Information	3.8%	2.2%	0.4%	nd	0.8%
Finance, insurance, real estate and rental and leasing	10.0%	5.8%	2.6%	3.2%	3.0%
Professional, scientific, management, administrative, and waste management services	15.1%	13.8%	3.5%	6.0%	5.3%
Educational, health and social services	10.5%	9.9%	13.8%	3.3%	9.1%
Arts, entertainment, recreation, accommodation and food services	3.8%	4.1%	4.0%	2.5%	3.7%
Other services (except public administration)	3.1%	3.0%	2.9%	2.9%	3.6%
Public administration	16.2%	28.4%	45.7%	18.4%	22.0%
Total Earnings (by place of work), in millions of dollars	**6,807,941**	**33,214**	**384**	**1,209**	**1,949**

nd = no data. Data were not disclosed due to BEA confidentiality requirements (there are very few employers in the sector).

Source: BEA 2004

Economic Activity

Of the 1.6 trillion cubic feet (Tcf) of gas produced in New Mexico in 1997, almost 1.1 Tcf (about two-thirds) was from the San Juan Basin. This increased slightly to 68 percent of the State's production by 2000 (BLM 2003a). The western portion of Rio Arriba County lies in the San Juan Basin, which also contains a portion of Sandoval County, San Juan County, and parts of other counties. Most Santa Fe National Forest land in the San Juan Basin is located in Rio Arriba County.

Rio Arriba is the second largest natural gas-producing county in the State, producing about 391 billion cubic feet (Bcf)—about 24 percent of the total—in 2002. Sandoval County produced just 1.4 Bcf in 2002, less than 1 percent of the State's total (NMEMNRD 2004). The value of gas production in New Mexico in 1997 was $3.6 billion, of which 64 percent, or $2.3 billion, came from the San Juan Basin. Rio Arriba County accounted for about $0.9 billion of this production; that is, it accounted for about one-quarter of the value of production in the State.

Gas prices have fluctuated widely in recent years, rising dramatically in 2000, falling in 2001, rising again in the last quarter of 2002, and holding steady for most of 2003 (NMEMNRD 2004). Gas prices were about $3.60 per thousand cubic feet (Mcf) for the fiscal year ending June 30, 2003, and $4.74 per Mcf for the fiscal year ending June 30, 2004, according to the New Mexico State Board of Finance (NMSBOF 2004a). In October 2004, gas prices were forecasted at $4.85/Mcf in 2005, $4.60/Mcf in 2006, and $4.25 for 2007 through 2009 (NMSBOF 2004a).

Gas production on Federal land accounts for a major proportion of the gas produced in Rio Arriba and Sandoval Counties; for example, from July 2003 to June 2004, 74 percent of the gas produced in Rio Arriba, and 29 percent of the gas produced in Sandoval, was from Federal surface estate, based on data from NMTRD (2005a). However, gas production in the study area, which is on the fringe of the San Juan Basin, accounts for a relatively small proportion of the gas produced in Rio Arriba and Sandoval Counties.

Between 1992 and 2002, only three wells were drilled on national forest lands in the study area, and between 2000 and 2003, at least eight wells in the study area were plugged, indicating that more wells are being plugged than are being drilled in the study area (USFS 2004a).

The San Juan Basin area produces a much smaller proportion of New Mexico's oil. The State produced 67.4 million barrels (bbls) of oil in 2002, of which about 1.3 million bbls were from Rio Arriba County, and just 0.1 million bbls were from Sandoval County (NMEMNRD 2004). Most of the oil in New Mexico is produced from Lea and Eddy Counties in the southeast (NMEMNRD 2004). Oil prices have risen steadily in recent years, from $27.25/barrel in December 2002 (NMEMNRD 2004) to $27.80/barrel in 2003 and $30.82/barrel in 2004 (NMSBOF 2004a). In October 2004, oil prices were forecasted at $40/barrel in 2005, $35/barrel in 2006, and $32.50/barrel for 2007 through 2009 (NMSBOF 2004a).

In addition to oil-gas development and production, national forest land in the study area provides opportunities for economic activity due to recreational activities. A survey by the U.S. Fish and Wildlife Service and Census Bureau suggests that state residents and nonresidents spent about $1 billion on wildlife-related recreation in New Mexico, including expenses on food, lodging, outfitters and guides, equipment, licenses, and other types of expenses (USFWS and U.S. Census Bureau 2003). Recreation in the study area is generally limited to dispersed recreation uses such as hunting, fishing, hiking, mountain biking, and horseback riding. Most developed campgrounds and picnic areas in the Cuba and Coyote Ranger Districts are located outside the study area. Recreational use within the study area is estimated in terms of Persons At One Time (PAOT), which represents the estimated capacity of persons for a specific area (USFS 2004a). PAOTs for

the Coyote Ranger District are estimated at 890, and PAOTs for the Cuba Ranger District are estimated at 384. However, these PAOT data are associated with developed recreation areas and other popular destinations (such as trails, boating areas, and cultural sites) outside of the study area. For this reason, it is assumed that recreational use within the study area is considerably lower than indicated by PAOTs for the Cuba and Coyote Ranger Districts (USFS 2004a).

National forest land in the study area is also used for livestock grazing. There are 22 grazing allotments used by 74 permittees within the study area. Together, these allotments contain about 3,200 animal unit months (AUMs) of forage (USFS 2004a). One animal unit month is the amount of forage consumed by one animal unit (generally equivalent to one steer) for 1 month. The main grazing system is deferred rotational grazing; the season of use is from May or June through October (USFS 2004a). The value of cattle and calf production from Rio Arriba and Sandoval Counties was about $14.2 million in 2003 (NMDA 2004). Federal grazing fees are generally lower than fees on private land; this means that Federal grazing allotments provide important support to the livestock and ranching industry.

Tax Revenues

Commercial activities on Federal land in New Mexico generate millions of dollars annually. The Federal, State and local governments receive tax revenues from the energy extractive industry and from licenses, permits, and sales and use taxes associated with recreation on lands in the study area. Although there are also tax revenues associated directly with recreational activities, due to sales and use taxes, revenues from the energy extractive industry are of particular interest in and near the San Juan Basin.

Federal royalties on oil and gas production that occurs on Federal land are collected by the U.S. Treasury, with portions reverting back to New Mexico and disbursed to the relevant counties where production has occurred. In addition, the New Mexico Taxation and Revenue Department administers one tax on the processing of natural gas, one tax on oil and gas production equipment, and four taxes on the production of oil and gas products. Two of the taxes are typically paid to the county of origin, and four are paid to the State:

- The Natural Gas Processors Tax is levied on natural gas processing plants operating in New Mexico. This tax is paid to the State of New Mexico, and is levied on the amount of BTUs of gas delivered to the processor at the inlet of the plant after subtracting certain deductions (NMTRD 2004). The revenues go into the State general fund (NMSBOF 2004b, Muncrief 2005).
- The Oil and Gas Production Equipment Ad Valorem Tax is a tax on oil and gas production equipment. The taxable value of the equipment of each production unit is calculated as 27 percent of the value of the products of each production unit for the prior year. The assessed value is determined by applying the uniform assessment ratio (1/3) to the taxable value. This tax is paid to the county of origin (NMTRD 2004, Clifford and Maury 2004).
- The Oil and Gas Severance Tax is levied at the rate of 3.75 percent (for most production) of the taxable value of oil and gas produced. The taxable value is defined as production value minus Federal, State, and Indian royalties and reasonable trucking expenses to the first place of market. This tax is paid to the State of New Mexico (NMTRD 2004, NMSL 2004). The revenues are put into a bonding fund, and the earnings from the fund are put into the State general fund (Muncrief 2005).

- The Oil and Gas Conservation Tax is levied on the sale of oil and gas products. The tax rate, a percentage of the taxable value of sold products, varies with the unencumbered balance in New Mexico's oil and gas reclamation fund, but is generally set at 0.19 percent of taxable value. This tax is paid to the State of New Mexico (NMTRD 2004, NMSL 2004). The revenues go into the State general fund (NMSBOF 2004b, Muncrief 2005).
- The Oil and Gas Emergency School Tax is levied on gas and oil production in the State. Natural gas is taxed at 4 percent of taxable value and oil is taxed at 3.15 percent, although allowances are given for low-producing ("stripper") wells and for other conditions. This tax is paid to the State of New Mexico (NMTRD 2004, NMSL 2004). The revenues go into the State general fund (NMSBOF 2004b, Muncrief 2005).
- The Oil and Gas Ad Valorem Production Tax is levied, in lieu of property tax, on the value of oil and gas natural reserves, but annual production is used as an approximation of the value of reserves. This tax is typically paid to the county of origin, and ultimately distributed to school districts and other recipients. The tax rate changes from year to year, and is a composite of rates imposed by local taxing authorities, including counties and school districts (NMTRD 2004, Clifford and Maury 2004).

Based on data from the New Mexico Department of Taxation and Revenue, oil and gas production in Rio Arriba and Sandoval Counties contributed $57 million in tax revenues to the State general fund in Fiscal Year (FY) 2004 (July 2003 through June 2004) due to the oil and gas emergency school tax and the oil and gas conservation tax. This represents 18.4 percent of total state revenues due to these taxes (total state revenue from these taxes was $310 million in FY 2004). In addition, the State general fund received about $324 million from distributions of Federal oil and gas royalties due to the production of oil and gas from Federal surface (Muncrief 2005). For comparison, total State general fund revenues from oil and gas activity were $1,114 million in FY 2004, and total general fund revenues from all sources were $4,612 million (Muncrief 2005).

In addition to State general fund revenues, oil and gas production benefits the State severance tax bonding fund. Oil and gas production in Rio Arriba and Sandoval Counties contributed 24 percent of total FY 2004 revenues to the State severance tax bonding fund—that is, $52 million of the total of $217 million. Interest earned on the bonding fund, which is a source of revenue for the State general fund, was $138 million in FY 2004 (Muncrief 2005).

In addition to the State general fund, oil and gas taxes due to production in Rio Arriba and Sandoval Counties contributed nearly $21 million to county and subcounty budgets (including school districts) in FY 2004. Table OG-52 provides a summary of State and local tax revenues from oil and gas activities on land in Rio Arriba and Sandoval Counties.

The Federal government also makes payments to local governments to offset the loss of property taxes because of nontaxable Federal lands within their boundaries. These payments are called Payments in Lieu of Taxes (PILT). PILT payments are used by local governments to finance vital services such as firefighting, police protection, and the construction of roads and public schools. The BLM administers the program using formulas for fair distribution established by law. Table OG-53 shows the PILT payments to Rio Arriba and Sandoval Counties as well as the total figure paid to the State of New Mexico. Together, Rio Arriba and Sandoval Counties received about 13 percent of the total PILT payments to New Mexico in FY 2005.

Table OG-52. State and local tax revenues from oil and gas activity ($ thousands)

Tax Type	Revenues Due to Activity in Rio Arriba County	Revenues Due to Activity in Sandoval County	Revenues Due to Activity Statewide	Percent of Statewide Revenues Attributable to Activity in Rio Arriba and Sandoval
State Taxes				
Oil and Gas Emergency School Tax	$53,813	$210	$297,090	18.2%
Oil and Gas Conservation Tax	$2,615	$12	$12,568	20.9%
Oil and Gas Severance Tax	$51,632	$240	$216,522	24.0%
Local Taxes				
Ad Valorem Production Tax	$19,294	$78	NC	NC
Ad Valorem Production Equipment Tax	$1,225	$14	NC	NC

NC = Not calculated

Source: NMTRD 2005b (Revenues by county for state taxes and ad valorem production tax); Muncrief 2005 (statewide revenues for state taxes, and revenues from ad valorem production equipment tax).

Table OG-53. Payments in lieu of taxes to New Mexico and select counties—2004-2005

Area	FY 2004 Payment ($)	FY 2005 Payment ($)
Rio Arriba County	1,537,626	1,541,623
Sandoval County	1,327,444	1,344,264
New Mexico Totals	**21,999,459**	**22,386,899**

Source: DOI 2005.

Environmental Consequences

Direct impacts would be identified if any of the following resulted from an alternative:

- Potential changes in jobs for oil and gas workers
- Changes in the cost of developing or operating new wells
- Changes in production payments (such as royalties), taxes, and disbursements to Federal, State, and local governments
- Changes in PILT payments to local governments.

Indirect effects would be identified if there were changes in associated economic activity brought about by direct effects, such as changes in jobs and revenues in industries that provide inputs to the oil and gas sector.

It should be noted that the issuance of an oil-gas lease has no direct economic impact. Only the development of leases would have direct impacts on the economics of the region and industry. According to the RFDS (USFS 2004a), all reasonably foreseeable new oil-gas wells are projected to occur on existing leases and, therefore, would not be affected by the lease stipulations proposed under the action alternatives. The economic impacts of mineral development are addressed under "Cumulative Impacts."

Alternative 1—No Action

The No Action Alternative would continue existing Forest Service policies for resource management, including standard lease terms and conditions as identified in the current Forest Plan. COAs and mitigation measures developed during project-level, site-specific NEPA analysis for APDs would continue to apply. The No Action Alternative would not result in impacts to economic conditions in the communities near the study area, compared to current conditions. New oil-gas development on new and existing leases would continue to be driven by national and international energy prices, operator business strategies, and production conditions within the study area.

Alternative 2—Proposed Action

The Proposed Action has the potential to affect economic conditions in the communities in and near the study area by increasing the costs to develop and produce oil and gas from areas that would be affected by the stipulations on new leases. Note that leasing has no direct economic impacts; rather, it is the development of mineral resources on the leases that has direct impacts. Because the Proposed Action would not change stipulations on existing leases, there would be no direct or indirect effects on economic conditions associated with new wells on existing leases.

Oil-gas development on new leases could be more expensive if the stipulations were to create the need for alternative drilling technologies, such as directional drilling, in order to access oil and gas reserves in NSO areas. The value of produced oil and gas determines the economic viability of producing the reserves with alternative drilling technologies, which may incur additional costs and risks over conventional methods. In addition, some reserves may be unrecoverable using directional drilling, depending on the physical constraints of the subsurface. A combination of factors, including national and international energy prices, operator business strategies (e.g., whether an operator would invest resources at the location where stipulations would apply), local production conditions, and the cost to develop new wells, would determine the quantity of reserves that would be economically viable to recover.

The quantity of economically recoverable reserves could be lower under the Proposed Action due to implementation of the proposed lease stipulations that would result. This could result in reduced employment, income, and tax revenues in and near the study area (including Federal, State, and local tax revenues as well as those Federal production royalties that are disbursed to State and local governments). However, reductions in employment, income, and tax revenues would occur only if there were wells drilled on new leases and the stipulations resulted in increased development costs for those wells. If no wells were drilled on new leases, the Proposed Action would not have direct or indirect economic impacts caused by the addition of more

stringent drilling limitations. No new wells have been projected by the RFDS for any currently unleased areas, including those within the expressions of interest.

Changes in PILT payments would not occur under Alternative 2 because there would be no disposal or acquisition of lands under this alternative.

Alternative 3

The economic impacts under Alternative 3 would be similar to those described under Alternative 2, but would apply to a larger area as more acreage that may require directional drilling is proposed. This would only apply to new oil-gas leases.

Cumulative Impacts

Cumulative impacts may result from past, present, and reasonably foreseeable actions related to the action alternatives. For this EIS, cumulative economic impacts could arise as a result of foreseeable drilling activity. If it is reasonably foreseeable that wells could be drilled on new leases in the study area, and that directional drilling may be required for those wells, there could be future economic impacts related to the increased costs of directional drilling. The RFDS (USFS 2004a) projects 20 new wells in the study area, all on existing leases. Thus, there is no reasonably foreseeable development on new leases, and no cumulative economic impacts as a result of implementation of either the Proposed Action or Alternative 3. However, if market factors, such as increased national and international energy demand and prices, result in development of wells on new leases, there could be economic impacts to industry if the lease stipulations result in the need for more expensive directional drilling techniques.

Other planned projects in the Cuba and Coyote Ranger Districts, listed in Table OG-15, may benefit livestock grazing and recreational uses, over the long term, but would have little effect on the economics in the region, when considered in combination with oil-gas development.

Environmental Justice

Regulatory guidance for the evaluation of environmental justice includes both Executive Order 12898 and 13045. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, states "…each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States (US 1994)."

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, addresses the vulnerability and sensitivity of children stating, "…each Federal agency shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks (US 1997)."

Affected Environment

According to the Council on Environmental Quality (CEQ), a minority consists of individuals belonging to one of the following groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. The oil-gas study area is located in Rio Arriba County and Sandoval County. The Jicarilla Apache Nation, Navajo Nation, Pueblos of Jemez and Zia and other Native Americans live in the region; therefore, compared to both the U.S. and New Mexico, higher proportions of Native Americans reside in the area (Table OG-54). American Indian populations are proportionally greater in Rio Arriba County; however, the overall majority of the population represents Hispanic or Latino ethnicities.

Table OG-54. Population, ethnicity, and race in the region—2000 data

Population	United States		New Mexico		Sandoval County		Rio Arriba County	
	No.	%	No.	%	No.	%	No.	%
Total Population	281,421,906	100	1,819,046	100	89,908	100	41,190	100
White Non-Hispanic	194,552,774	69.1	813,495	44.7	45,227	50.3	5,619	13.6
Minorities	86,899,132	30.9	1,005,551	55.3	44,681	49.7	35,571	86.4
Hispanic or Latino (of any race)	35,305,818	12.6	765,386	42.1	26,437	29.4	30,025	72.9
Black or African American (non-Hispanic)	33,947,837	12.1	30,654	1.7	1,418	1.6	85	0.2
American Indian and Alaska Native (non-Hispanic)	2,068,883	0.7	161,460	8.9	14,239	15.8	5,002	12.1
Asian, Native Hawaiian and Other Pacific Islander (non-Hispanic)	10,476,678	3.7	19,249	1.1	943	1.0	72	0.2
Some Other Race (non-Hispanic)	467,770	0.2	3,009	0.2	206	0.2	43	0.1
Two or More Races (non-Hispanic)	4,602,146	1.6	25,793	1.4	1,438	1.6	344	0.8

Source: U.S. Census Bureau, Census 2000

According to 2000 Census population estimates, the percentage of children under 18 years in Sandoval and Rio Arriba Counties was about the same at 29.6 percent and 28.6 percent, respectively. Overall, these proportions compare closely to the entire state of New Mexico, but are slightly higher than in the United States overall (Table OG-55).

Table OG-55. Children in population—2000

Geographic Area	Children Under 18 in 2000	Percent of Population
United States	72,293,812	25.7
New Mexico	508,574	28.0
Sandoval County	26,590	29.6
Rio Arriba County	11,774	28.6

Source: U.S. Census Bureau, Census 2000

According to Executive Order 12898, a low-income population is determined using annual statistical poverty thresholds from the United States Census. Estimates from 1999 indicated that Sandoval County had a smaller proportion of individuals living in poverty as compared to New Mexico. Rio Arriba County, however, had a greater proportion of individuals living in poverty as compared to the United States, New Mexico, and Sandoval County. In addition, New Mexico and Rio Arriba County both demonstrate higher proportions of children under the age of 18 living in poverty (Table OG-56).

Table OG-56. Poverty rates—1999

Geographic Area	Individuals Below Poverty Level	Percent of Population	Children Under 18 Below Poverty Level	Percent of Total Children Under 18
United States	33,889,812	12.4	11,746,858	16.6
New Mexico	328,933	18.4	125,218	25.0
Sandoval County	10,847	12.1	4,164	15.8
Rio Arriba County	8,303	20.3	2,732	23.4

Source: U.S. Census Bureau, Census 2000

Environmental Consequences

Primary impacts related to environmental justice may include job opportunities, resource use, community displacements, and health and safety risks. Most of the activities in the oil-gas study area do not affect community displacement, income levels, and health and safety; however, activities may impact economics through resources such as recreation, grazing, cultural sites, mineral development, and visual integrity.

Alternative 1—No Action

Under Alternative 1, standard lease terms and conditions or limited surface uses would continue to guide oil and gas leasing and development of the study area. While the leasing decision would have no direct effects on environmental justice concerns, it is possible that resources and resource uses such as hunting, grazing, wood gathering, property access (see “Recreation” section), cultural uses (see “Heritage Resources” section) and visual resources (see “Visual Resources” section) may be adversely affected by projected future development according to the standard

lease terms and conditions. However, it should be noted that oil-gas development has occupied this area in the past and most likely has had only slight adverse impacts on surface resources, while providing job opportunities that benefit some local people.

Alternative 2—Proposed Action

The leasing decision to be made would have no direct effect on environmental justice concerns, especially because all new wells are projected to occur on existing leases. Under the Proposed Action, specific stipulations of NSO, CSU, and TL would be applied to new leases in order to protect surface resources. The fact that well development projected by the RFDS (USFS 2004a) is predicted to occur on existing leases means that little foreseeable effect on local job opportunities in the oil-gas industry would result. If new leases were developed under the proposed stipulations, Alternative 2 would most likely result in fewer adverse impacts to surface resources than Alternative 1, by protecting visual integrity, roadless areas, and heritage resources, which attract recreational visitors to use the forest and benefit the local economy. The proposed stipulations would be unlikely to deter industry from developing wells in the study area, so impacts under the Proposed Action may benefit local populations through maintaining recreation and visual resources, while still allowing projected oil-gas development.

Alternative 3

Under Alternative 3, increased lease stipulations would have similar economic effects as Alternative 2. In addition, Alternative 3 would most likely provide surface resources of concern with more protection than under Alternatives 1 and 2, as it would prohibit development under leases in inventoried roadless areas and immediately adjacent to wilderness areas under new leases.

Cumulative Impacts

The Proposed Action and Alternative 3 would apply only to future leases in the oil-gas study area, not existing leases, so the direct effect of proposed stipulations on new leases would not affect foreseeable development and would be the same as that under Alternative 1. In addition, leasing of an area does not guarantee well development, as permissions for drilling are obtained by applying for an Application for Permit to Drill (APD). Reasonably foreseeable oil-gas development projections indicate about 20 new well locations would be constructed on valid existing leases in the study area that are subject to standard terms and conditions. Since the foreseeable well development would most likely occur on current leases, industries would not be subject to the stipulations presented in the Proposed Action or Alternative 3. As a result, industries and their associated economic benefits to the region would experience virtually no impact unless a new lease was awarded.

Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of minerals. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road.

Few irreversible and irretrievable commitments of resources would result directly from the leasing decision to be made, but would result from the development of oil-gas wells. Due to the projected extraction of Federal oil and gas from beneath the study area, these resources would no longer be available for future use. Extraction of oil and gas resources would vary according to the lessee's ability to access subsurface hydrocarbon resources under each alternative. It is unlikely, but possible, that all of the oil and gas may not be extracted from some of the areas designated as NSO for new leases, due to the limitations of directional drilling in some formations.

Other irretrievable impacts would occur from excavating or otherwise altering the natural soil horizons through the surface-disturbing activities projected to occur to construct well pads, roads, and pipelines. This would result in a loss of soil productivity on less than 200 acres within the study area.