APPENDIX A
JURISDICTION OVER ENERGY RESOURCE DEVELOPMENT ON THE SOUTHERN UTE INDIAN RESERVATION

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INTRODUCTION

The coordinated undertaking of the Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), and Southern Ute Indian Tribe (SUIT) to prepare a comprehensive study of environmental impacts associated with tribal energy mineral development poses numerous challenges, not the least of which is mastering the complex jurisdictional principles at work on the Reservation. Some aspects of the Southern Ute jurisdictional maze are associated with developments in Indian law that are national in scope. Others derive from the unique history of the SUIT people and their reservation. A snapshot of the jurisdictional roles of federal, tribal, state and local governmental entities in relation to energy resource development on the Reservation may be helpful to those reviewing this document; however, debate or disagreement may accompany opinions about the precise limits of their governmental authority. While neither exhaustive nor definitive, this appendix is intended as a guide to those seeking a greater understanding of the jurisdictional aspects of federal development of reservation land and resources.

THE FEDERAL TRUST RESPONSIBILITY

Because of the pervasive role of the federal government in Indian affairs, a discussion of jurisdiction must include consideration of the federal trust responsibility. From the inception of the United States, the relationship between Indians and non-Indians has been a distinctly federal, rather than a state, governmental matter.[2] The United States Constitution vests in the national government exclusive regulatory authority over commerce with Indian tribes.[3] Judicial decisions construing that authority, as well as subsequent congressional enactments, have recognized a correlative federal duty of protection of Indian tribes, the "federal trust responsibility." Thus, it is legally well established

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[2] *See Worcester v. Georgia,* 31 U.S. (6 Pet.) 515, 561 (1832).

[3] *U.S. Const. art. I, § 8, cl. 3.*

that Indian tribes, in exchange for ceding vast territories and relinquishing their inherent powers of war and foreign diplomacy, secured federal governmental protection of tribal lands, much of which is legally held in trust by the United States for the benefit of specific tribes.[4] Additionally, as quasi-sovereigns, tribes continue to possess the power to control their internal affairs, subject only to ultimate defeasance by Congress.[5]

Federal protection of tribal lands and the laws and regulations implementing that protection directly affect the manner in which tribal energy resources may be developed. Statutes initially enacted as far back as the 1790s continue to render void any sale or lease of tribal land, unless accomplished pursuant to treaty or congressional act.[6] The Indian Mineral Leasing Act of 1938[7] and Indian Mineral Development Act of 1982[8] are two key statutes authorizing the leasing and development of tribal mineral resources. Under both of these acts, Congress requires tribal consent as a condition to the leasing of tribal lands. Under the earlier act, standard form leases written by the Department of the Interior were utilized in conjunction with an auction or bonus bid process in which interested industry representatives could compete for tribal mineral lease acreage. Under the Indian Mineral Development Act of 1982, tribes are encouraged to negotiate directly with industry companies. The customized minerals agreements generated by tribes under that act include everything from complex joint venture arrangements between companies and tribes to simple, negotiated leases similar to those authorized under the 1938 act.

In addition to tribal leasing statutes, Congress has also authorized the leasing of Indian allotted land.[9] These properties are held under trust patents by the United States or restricted patents under United States supervision for the benefit of individual Indians. The allotment process, which was discontinued by Congress in 1934, had been the bulwark of federal Indian policy for almost half a century.[10] It involved the distribution of small parcels of tribal acreage to individual tribal members for agricultural development. The balance of Reservation lands, known as "surplus" land, was then opened for non-Indian homesteading on many reservations.

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[4] See, e.g., County of Oneida v. Oneida Indian Nation, 470 U.S. 226 (1985).

[5] *See generally* Felix S. Cohen, *Handbook of Federal Indian Law 229-257* (2d ed. 1982) ("*Cohen"*).

[6] Nonintercourse Act of 1793 (codified as 25 U.S.C. § 177).

[7] 25 U.S.C. § § 396a, *et seq.*

[8] 25 U.S.C. § § 2101, *et seq.*

[9] *See, e.g.,* Act of March 3, 1909, 35 Stat. 781 (codified as 25 U.S.C. § 396).

[10] *Cohen at 127-143.*

Regardless of the particular statutory scheme, however, administration of Indian mineral leasing and development has been delegated by Congress to the Secretary of the Interior and is subject to a set of comprehensive federal regulations.[11] Approval of leases and land record documents, such as assignments and communitization agreements, is the responsibility of the BIA.[12] The BLM approves well density, underground activities, well operations, and resource measurement.[13] A third Interior agency, the Minerals Management Service (MMS) oversees production, valuation accounting, and auditing.[14] Federal statutes[15], regulations[16], executive orders[17], and case decisions[18] require that tribes be given an opportunity to expand their governmental presence in all phases of Indian mineral development in cooperation with each of these federal agencies. Additionally, in keeping with the principle that tribes retained inherent authority to control their internal affairs unless divested by Congress, tribes have significant supplemental powers related to mineral development, including those of taxation and land use control.[19]

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[11] 25 C.F.R. Parts 211, 212, 225 (1996).

[12] 25 C.F.R. § § 211.20 , 211.29, 225.22, 225.33 (1996).

[13] 25 C.F.R. § 211.3 (citing 43 C.F.R. Parts 3160, 3180, 3260, 3280, 3480 and 3590).

[14] *See* Federal Oil and Gas Royalty Management Act of 1982 , 96 Stat. 2448 (codified as 30 U.S.C. § § 1701, *et seq.*).

[15] *E.g.,* 30 U.S.C. § 1732 (authorizing cooperative audit agreements between MMS and tribes regarding tribal lands); *e.g.,* Indian Self-Determination Act of 1975, Pub. L. No. 93-638 (codified at 25 U.S.C. § § 450f-450n) (permitting tribes to contract to perform Indian program services of the Departments of the Interior and Health and Human Services).

[16] *E.g.,* 25 C.F.R. § 211.29 (authorizing Indian Reorganization Act tribes to enact tribal laws superseding those contained in 25 C.F.R. Part 211).

[17] *E.g.,* United States President, *Memorandum for the Heads of Executive Departments and Agencies* (Apr. 29, 1994); United States Department of the Interior, *Departmental Responsibilities for Indian Trust Resources,* Order No. 3175 (Nov. 8, 1993) (requiring consultation with tribes prior to issuing policy directives affecting tribes and their resources).

[18] *E.g., City of Albuquerque v. Browner,* 97 F.3d 415 (10th Cir. 1996) (recognizing authority of Pueblo of Isleta to promulgate water quality standards applicable to upstream municipality).

[19] *E.g., Merrion v. Jicarilla Apache Tribe,* 455 U.S. 130 (1982).

Thus, the basic structure of Indian mineral leasing and development flows from the power and responsibility of the federal government to protect Indian lands and to take such action as serves the best interests of Indian constituents. Tribes are encouraged to assume an increasing role in the day-to-day and long-range management of their own resources. In that regard, over the last decade, the SUIT has taken major steps to manage development of its energy resources in cooperation with its federal trustee.

THE SOUTHERN UTE INDIAN RESERVATION

The present-day Reservation is a remnant of a much larger territory: approximately the western third of the state of Colorado, which was set aside for the confederated Ute bands in 1868.[20] Expanding western settlement throughout the late nineteenth and early twentieth centuries, coupled with ever-changing federal Indian policies, resulted in the substantially reduced current Reservation.[21] By federal statute, all lands within the boundaries of an Indian reservation, regardless of ownership, are deemed to be part of "Indian Country,"[22] the territory within which Indian tribes may exercise certain governmental powers.[23] Determining the boundaries of reservations and of "Indian Country," however, can be extremely difficult.[24] Particularly on reservations that have undergone allotment and homesteading, ascertaining reservation boundaries often involves major, complex litigation.[25]

Because the Reservation was one of many Indian reservations subject to allotment and homesteading, uncertainty as to its boundaries persisted until Congress enacted legislation on the subject in 1984.[26] Public Law No. 98-290 reflected a consensual resolution of boundary and jurisdiction issues among the SUIT, State of Colorado, Archuleta and La Plata counties, Town of Ignacio, and the United States government. That legislation confirmed exterior Reservation

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[20] Treaty with the Ute Indians, 15 Stat. 619 (1868).

[21] *See* Act of May 21, 1984, Pub. L. No. 98-290, *reprinted in* 25 U.S.C.S. §668 historical note (confirming exterior boundaries of the Southern Ute Indian Reservation) ("P.L. 98-290").

[22] 18 U.S.C. § 1151.

[23] *See, e.g., Oklahoma Tax Commission v. Sac and Fox Nation,* 508 U.S. ____, 124 L.Ed 2d 30, 39-41 (1993).

[24] *See, e.g., Hagen v. Utah,* 510 U.S. ____, 127 L.Ed 2d 252 (1994).

[25] *See, e.g., Solem v. Bartlett,* 465 U.S. 463 (1984); *Rosebud Sioux Tribe v. Kneip*, 430 U.S. 584 (1977); *Mattz v. Arnett,* 412 U.S. 481 (1973); *Seymour v. Superintendent,* 368 U.S. 351 (1962).

[26] Act of May 21, 1984, Pub. L. No. 98-290, *reprinted in* 25 U.S.C.S. § 668 historical note.

boundaries based on various treaties and statutes and established an "Indian Country" land area of approximately 700,000 acres, including tribal trust lands, Indian allotments, homesteaded fee tracts, Bureau of Reclamation lands, and National Forest lands. The SUIT currently owns approximately 300,000 acres of the surface estates within the Reservation. This patchwork pattern of land ownerships is typical of "checkerboard" reservations opened for homesteading in the West.

The checkerboard of land ownerships, however, is not limited to surface lands. The varied ownership of severed mineral and surface estates creates a multidimensional situation that can be understood only by reviewing some Reservation history.[27] Following the completion of individual Indian allotment in 1899, non-Indian homesteading took place over the next approximately 35 years. National attitudes about conservation of mineral resources also evolved during that period, as reflected in a series of homestead laws that reserved different mineral estates to the federal government. For example, under the homestead laws of 1909 and 1910, coal estates on federally designated coal lands were reserved from agricultural homestead patents.[28] Substantial portions of the Reservation were so designated. In 1916, Congress enacted the Stock-Grazing Homestead Act, which reserved all minerals, including coal and oil and gas estates from homestead patents.[29] By 1934, substantial homesteading under various laws had taken place within the Reservation along the La Plata, Animas, Florida, and Pine river drainages, as well as Florida Mesa; however, several hundred thousand acres of surplus land remained unpatented.

Passage of the Indian Reorganization Act of 1934 signaled a major shift in federal Indian policy and also provided a mechanism for tribes, such as the SUIT, to resume control of their surplus lands.[30] Under that act, those tribes that adopted written constitutional forms of government in federally supervised elections were entitled to restoration of all undisposed of surplus lands still left in the wake of allotment and homesteading. In 1936, the SUIT adopted its first written constitution, and by Presidential Order issued in 1938, the United States restored to tribal trust ownership all unpatented lands and estates within the Reservation.[31]

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[27] For more detailed historical background the following sources are instructive: *Southern Ute Indian Tribe v. Amoco Production Co.,* 863 F. Supp. 1389, 1394-1399 (D. Colo. 1994), *appeal filed,* Case No. 94-1579 (Dec. 9, 1994, 10th Cir.); *Confederated Band of Ute Indians v. United States,* 100 Ct. Cl. 413 (1943); *Restoration to Tribal Ownership-Ute Lands,* I Dept. Of Interior, Op. Solicitor 832 (June 15, 1938).

[28] Act of March 3, 1909, 35 Stat. 844 (codified at 30 U.S.C. § 81); Act of June 22, 1910, 36 Stat. 583 (codified at 30 U.S.C. § § 83-85).

[29] Act of December 29, 1916, 39 Stat. 862 (codified at 43 U.S.C. § § 291-299).

[30] 48 Stat. 984 (codified at 25 U.S.C. § § 461 *et seq.*).

[31] Order of Restoration, 3 Fed. Reg. 1425 (Sept. 14, 1938).

Restoration to the SUIT under the Indian Reorganization Act included approximately 300,000 acres of land involving both surface and mineral estates (fully undisposed surplus lands); the complete severed mineral estates underlying approximately 100,000 additional acres of land (surface estates patented to non-Indians under the Stock-Grazing Homestead Act of 1916); and the severed coal estates underlying approximately 200,000 additional acres of land (agricultural surface patents issued to non-Indians under the Coal Land Entry Acts of 1909 and 1910). Thus, today, the Reservation checkerboard remains three dimensional.

The land ownership pattern within the Reservation boundaries confirmed in 1984 by Public Law No. 98-290 has been and continues to be a source of jurisdictional confusion. In that legislation, however, Congress addressed several jurisdictional issues in a manner supported by affected governmental entities. As reflected in the language and legislative history of the statute, tribal territorial jurisdiction over non-Indians within the reservation was limited to Indian lands. Federal jurisdiction over non-Indians under Indian Country laws was similarly confined to Indian lands. These concessions by the SUIT and the federal government eliminated a likely and contentious category of potential jurisdictional disputes by generally ensuring that the SUIT would not regulate the activities of non-Indians undertaken on their own lands within the Reservation. Conversely, the SUIT and the federal government retained full Indian Country jurisdiction over Indians everywhere within the boundaries of the Reservation, regardless of the ownership status of such lands. Finally, the act treated incorporated municipalities within the Reservation, such as the Town of Ignacio, as islands in which municipal and tribal governments could exercise concurrent criminal jurisdiction over tribal members. While the clarifications contained in P.L. 98-290 provided congressional direction in several key areas, subsequent efforts to apply the legislation to lands involving split estates or to environmental protection programs have proven difficult.

The most exacting review of P.L. 98-290 to date has been provided in the context of environmental litigation. In the case of *Lyon v. Amoco Production Company*,[32] a group of landowners sued seven energy companies for monetary and equitable relief for water well contamination allegedly caused by regional oil and gas development. The Court of Appeals upheld the lower court's dismissal of the case on jurisdictional grounds. Specifically, the court found that most of the development in the region took place within Indian Country as defined by P.L. 98-290, and most of the company wells were drilled on tribal mineral lands pursuant to federally approved leases. While recognizing that the parties to the case were non-Indians, the court concluded that, because the allegedly wrongful conduct commenced on tribal land and because the economic and political integrity of the SUIT was principally involved, state courts lacked authority to proceed with the case. The *Lyon* case amply demonstrates the jurisdictional tension that can arise in the midst of conflicting interests within the Reservation boundaries.

[32] 923 P.2d 350 (Colo. App.), *cert. withdrawn* 20 Colo. J. V (Colo. App. 1996).

JURISDICTION OVER RESERVATION ENERGY DEVELOPMENT

To some extent federal, Tribal, state, and local governments each have a role in regulating on-Reservation energy development. Mineral development generally involves a series of steps including leasing by the mineral owner to a mineral development company; permitting and drilling of wells; installation of gathering and treating facilities; ongoing production-related activities; and reclamation. The precise role of each government turns not only upon the proposed activity at issue, but also upon the party undertaking the activity; the location of the activity; and the purpose and relative governmental importance of the activity. Application of these factors is most easily illustrated by hypothetical.

Assume that Mary Mayflower, a non-Indian, owns a tract of land originally homesteaded by her grandparents on the Reservation in 1906. Under the homestead laws then in place, her grandparents received a fee simple absolute patent that included all surface and mineral rights to the property. Mary has been approached by Wellbore Oil Company, a non-Indian-owned independent company, which has proposed to lease her oil and gas minerals and to drill a well on her back forty. No governmental entity at this point has a direct role in deciding whether Mary issues a lease. Let's further assume that Mary Mayflower issues a lease to Wellbore Oil Company. Before Wellbore may proceed with well-drilling, state law requires Wellbore to obtain a well permit. Such a permit would not be issued unless the location of Wellbore's well conforms to fieldwide spacing rules issued by the Colorado Oil and Gas Conservation Commission establishing the pattern and density of well locations. Assuming that Wellbore's well is successful, Wellbore may wish to construct its regional headquarters on Mary's property under the terms of a separate surface lease. Wellbore would need to obtain appropriate approval from the local county officials with respect to construction of such a facility. In the Mary Mayflower hypothetical, there is no direct Tribal or federal role; however, that is easily changed.

Assume that Mary Mayflower's grandparents homesteaded in 1926, instead of 1906. Under the homestead laws then in place, the United States reserved all minerals from the Mayflower patent. In 1938, those reserved minerals were restored to trust ownership for the benefit of the SUIT. Wellbore Oil Company, a non-Indian-owned independent company, has approached the Tribal Council with a joint-venture proposal under the Indian Mineral Development Act of 1982 and has suggested that the SUIT and Wellbore split the cost of drilling a well into the Tribal minerals underlying Mary's back forty. If the SUIT accepts the Wellbore joint venture proposal, the proposal is invalid unless it is reduced to writing and approved by the BIA. Should such approval be obtained, Wellbore must obtain a well permit from the BLM. Although the BLM may consider the spacing rules of the Colorado Oil and Gas Conservation Commission, issuance of the permit is not conditioned upon compliance with those rules. Rather, the BLM's permit decision must be guided by the best interests of the SUIT. While Mary, who opposed the drilling of a well on her property, may have certain federal administrative appellate rights to challenge the BLM permit decision, it is unlikely that such a decision would be reversed.

Further, assume that Mary issued a surface lease to the SUIT so that the SUIT could build a small well supply store on her property. In that instance, the SUIT would not be required to obtain a county land use permit because the SUIT has the right to regulate its own affairs to the exclusion of the state or local government within Indian Country.

The foregoing hypothetical situations illustrate how ultimate determinations of jurisdiction are affected by variables, such as the status of the actor, the ownership and location of the affected land, and the purpose of the activity. While many situations present greater complexities than those reflected in the hypothetical situations, the hypothetical situations should indicate the potential for disagreement between affected individuals and governmental entities about resource development within the Reservation. In the interest of minimizing conflicts, the federal government, the SUIT, and state and local governments have recognized the value of cooperative, though not necessarily joint, decision-making. For example, the BLM, BIA, SUIT, and Colorado Oil and Gas Conservation Commission have entered into agreements intended to facilitate communication and governmental cooperation with respect to on-Reservation well density and spacing.[33]

ENVIRONMENTAL RESOURCE PROTECTION

Mineral development on tribal and non-tribal lands within the Reservation commenced in approximately 1950, and since that time, companies have drilled thousands of gas wells in the northern San Juan Basin. Since the 1950s, heightened sensitivity to unnecessary environmental degradation has resulted in a number of major laws which impact the manner in which tribal mineral development is conducted. Perhaps the most significant of these laws is the National Environmental Policy Act[34] (NEPA). Under NEPA, before taking any major federal action that might significantly affect the quality of the human environment, a federal agency must conduct a thorough analysis of the alternatives and effects of that action and compile its study in a written statement that can be submitted to and commented upon by the public. Because of the pervasive federal regulatory role associated with Indian mineral resource development, federal agencies, such as the BIA and the BLM, are regularly called upon to take action with respect to that mineral development. In conducting an initial environmental assessment of particular decisions related to Indian mineral development, such agencies may conclude that a specific decision does not have a significant impact on the environment. If, however, the agency concludes that significant impacts may result from a specific decision or from the cumulative effect of numerous similar decisions, then it must perform

[33] Memorandum of Understanding between Southern Ute Indian Tribe and Bureau of Land Management and Interagency Agreement between Bureau of Indian Affairs and Bureau of Land Management (Aug. 22, 1991); Memorandum of Understanding between the Colorado Bureau of Land Management and the Colorado Oil and Gas Conservation Commission (Aug. 22, 1991).

[34] Act of January 1, 1970, Pub. L. No. 91-190 (codified at 42 U.S.C. § § 4321, *et seq.)*.

the detailed analysis and complete the environmental impact statement process. Only if the action agency concludes that the proposed action is reasonable when measured against the studied alternatives, may the action proceed. [35]

Aside from the normal considerations of federal agencies in applying NEPA or other environmental statutes, the trust responsibility imposes special concerns when applying those laws to Indian Country. So long as not in violation of applicable federal law, federal agencies are required to act reasonably and prudently in furthering the best interests of tribes and to consult with tribes in ascertaining tribal best interests.[36] As stated in a leading case on this subject, a federal official "cannot escape his role as trustee by donning the mantle of administrator."[37] In some cases, Congress has even required that federal agencies comply with tribal law in the course of managing tribal natural resources.[38] Thus, if a federal agency is confronted with two lawful courses of action--one of which would further tribal best interests, and the other of which would be preferable from a policy or administrative standpoint to the agency administrators--the trust responsibility requires that the federal agency take the action that furthers tribal best interests. This aspect of the federal trust responsibility not only adds tension to the already difficult duties of many federal officials, but also is the reason why a decision affecting Indian land might be different from that reached in a similar setting involving public land. In the public land situation, the best interests of a single constituent group does not legally dictate a result, and implementation of then-current policy may be paramount to the desires of any particular special interest.

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[35] In determining the reasonableness of activity on tribal land that involves an environmentally significant federal decision, the action agency arguably must weigh heavily the importance of the proposed activity to the tribe in order to comply with federal trust responsibility.

[36] *See, e.g., Jicarilla Apache Tribe v. Supron Energy Corp.*, 728 F.2d 1555, 1567 (10th Cir. 1984), (Seymour, J. concurring in part, dissenting in part), *aff'd in part, rev'd in part,* 782 F.2d 855 (10th Cir.), *modified*, 793 F.2d 1171 (10th Cir.) (adopting concurring dissent of Seymour, J. In 728 F.2d 1555), *cert. denied, sub nom. Southern Union Co. v. Jicarilla Apach Tribe,* 479 U.S. 978 (1986).

[37] *Id.*

[38] The National Indian Forest Resources Management Act of 1990, Title III, § 309 (codified at 25 U.S.C. § 3108); American Indian Agricultural Resource Management Act of 1993, Title I, § 102 (codified at 25 U.S.C. § 3712).

In addition to NEPA, development of tribal mineral resources is conducted in accordance other national environmental legislation, such as the Endangered Species Act[39], Clean Air Act[40], Clean Water Act[41], and Safe Drinking Water Act.[42] Amendments to the Clean Air Act, Clean Water Act, and Safe Drinking Water Act,[43] passed by Congress since enactment of Public Law No. 98-290 in 1984, are intended to permit Indian tribes to assume primary programmatic and enforcement authority from the Environmental Protection Agency (EPA) with respect to Indian reservations. The actual transfer of authority from the EPA to tribes requires that the EPA review and approve the capacity of tribes to carry out the purposes of the environmental programs within their reservations. In this regard, EPA has a strong preference, if not a requirement, that an applying tribe possess regulatory jurisdiction over all persons throughout the boundaries of a reservation. Understandably, EPA has concluded that administration of environmental protection programs is less effective when undertaken on a checkerboarded basis than when conducted on a regional or reservation-wide basis.

Under authority of the Clean Water Act amendments, the SUIT has adopted reservation-wide water quality standards and has applied to EPA for delegation under the "treatment as a state" regulations for recognition of those water quality standards. EPA is aware of Public Law No. 98-290 and is currently reviewing the jurisdictional authority of the SUIT to adopt such standards in light of the amendments to the Clean Water Act. While there seems little question under Public Law No. 98-290 that the SUIT has authority to adopt Reservation-wide standards applicable to Indians, the EPA has not yet concluded whether the Clean Water Act amendments supersede the Public Law No. 98-290 tribal jurisdictional limitations with respect to non-Indians conducting activities on non-Indian lands within the Reservation. Thus, it is not clear if the SUIT will assume Reservation-wide primacy over environmental programs the EPA may delegate or whether EPA will retain principle jurisdiction over such programs. To the extent that such environmental programs apply to energy development activities, the answer to the EPA delegation question will be significant in determining the governmental entity with primary jurisdiction.

CONCLUSION

The concept of jurisdiction on the Reservation, as on other Indian reservations, is necessarily complex. Specific legislation related to the SUIT answers basic questions about Reservation

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[39] 16 U.S.C. § § 1531, *et seq.*

[40] 42 U.S.C. § § 7401, *et seq.*

[41] 33 U.S. C. § § 1251, *et seq.*

[42] 42 U.S.C. § § 300f-300j-12.

[43] 42 U.S.C § 7601 (d) (Air); 33 U.S.C. § 1377 (Water); 42 U.S.C. § 300j-11 (Safe Water).

boundaries and Indian Country. Other aspects of that legislation, however, make it difficult to identify which governmental entity has jurisdiction over a proposed energy related activity without considering a variety of factors. Only after reviewing such variables and the relative interests of the federal, state, tribal or local governments, can one reach a conclusion about ultimate jurisdiction. In order to avoid needless litigation on such points, however, those governments have embarked to some extent on a course of cooperation and discussion, in which the relative concerns of each government can be aired. Perhaps as such dialogue continues, additional clarity can be provided through more intergovernmental agreements or congressional legislation.

APPENDIX B
AUTHORITY AND RESPONSIBILITY FOR ENERGY RESOURCE OPERATIONS

The Bureau of Indian Affairs (BIA) and Bureau of Land Management (BLM) have federal responsibility for environmental protection, public health and safety, and operation and production oversight related to mineral leasing and development on Indian lands ("tribal minerals). There are four principal pieces of legislation that give primary direction to the BIA and BLM for these operations: the Allotted Lands Leasing Act of March 3, 1909; Indian Mineral Leasing Act of May 11, 1938 (Tribal); 1982 Indian Mineral Development Act (IMDA); and National Environmental Policy Act (NEPA) of 1969. In addition, the federal government has a special trust or fiduciary responsibility to the Indian people when considering actions which will impact tribal resources and interests. Other legislation, most notably laws to protect cultural resources and endangered species, also affect various aspects of energy resource development. Table B-1 lists the major federal, state, and county authorizing actions that pertain to this project.

NEPA directs all federal agencies to analyze and disclose to the public the impacts of federal actions. The Southern Ute Indian Tribe (SUIT), BIA, and BLM are preparing this environmental impact statement (EIS) to fulfill the mandate of NEPA.

Persons or companies may obtain rights to explore and develop tribal minerals, either by a traditional lease agreement or through geophysical exploration. Under the traditional lease agreement for tribal and allotted lands under the 1909 and 1938 acts, an application to lease lands may be submitted to the BIA. Leases are awarded through a sale process to the highest competitive bidder. Lessees pay a rental of $1.25 per acre per annum that may be credited to the royalty, which is a minimum of 12½ percent of the value or amount of production. Most leases on the Southern Ute Indian Reservation (Reservation) have a royalty of 16⅔ percent. The primary term of a lease is 10 years and may continue in effect as long as there is production in paying quantities. Rents and royalties accruing from the lease are returned to the SUIT or allottee.

Most recent grants of exploration and development rights on the Reservation have been issued under the IMDA, under which a mineral agreement is negotiated between the operator and the SUIT and then approved by the BIA. BLM also provides technical input on operational matters. An individual Indian allottee may include their mineral resources in an agreement subject to concurrence of the parties and approval of the Secretary of the Interior. The purpose of the IMDA is to provide tribes with more responsibility and flexibility to maximize their best economic interest and minimize adverse environmental or cultural impact. All terms of a mineral agreement (term, royalty, performance clauses, etc.) are negotiable. As with leases, proceeds from the agreement are returned to the SUIT or allottee. Although a minerals agreement may be more elaborate than a standard lease, it is often loosely referred to as a lease and is treated as a lease for the purposes of permitting operations and conducting compliance inspections.

TABLE B-1 MAJOR FEDERAL, STATE, AND COUNTY AUTHORIZING ACTIONS[1]			
Agency and Permit/Approval	**Nature of Action**	**Authority**	**Application**
FEDERAL PERMITS, APPROVALS AND AUTHORIZING ACTIONS			
Bureau of Land Management			
Decision Record for Preferred Alternative	Evaluate environmental impacts of Preferred Alternative.	National Environmental Policy Act of 1969, 42 USC 4321 *et seq*. Council on Environmental Quality, 40 CFR 1501, 1502	Preferred Alternative
Permit to Drill, Deepen, or Plug Back (APD)	Provide for compliance with regulations and requirements during the drilling and completion phase of the well.	Mineral Leasing Act of 1920 (30 USC 181 et seq.), 43 CFR 3160; Federal Oil and Gas Royalty Management Act of 1982, 43 CFR Part 3160 series, subparts 3160.0-1 Purpose, 3160.0-1 Authority, and 3161.1 Jurisdiction; Secretarial Order No. 3087, Amendment No. 1, February 7, 1983; Indian Mineral Development Act of 1982, 43 CFR, Part 3160.0-3	Nitrogen injection wells and gas production wells
U.S. Bureau of Indian Affairs			
Approval of Unitization	Provide for efficient and timely development and production of Tribal oil and gas leases.	Indian Minerals Leasing Act of May 11, 1938, 25 USC 396a-396q, 25 CFR, Part 211; Act of March 3, 1909, 25 USC 396, 25 CFR, Part 212; Indian Mineral Development Act of December 22, 1982, 25 USC 2102-2108, 25 CFR Part 225	Unit area
Rights-of-Way	Grant rights-of-way and issue temporary permits.	Act of March 3, 1901, c.832 ss4.31.Stat.108; 209DM8 Secretaries Order 3150 and 3177, as amended, 10 BIAM, bulletin 13, as amended, and Albuquerque Area Addendum Release 9401	Pipelines, roads

TABLE B-1
MAJOR FEDERAL, STATE, AND COUNTY AUTHORIZING ACTIONS[1]

Agency and Permit/Approval	Nature of Action	Authority	Application
Archaeological Clearance	Issue antiquities or archaeological resource permits to remove or excavate archaeological resources on land administered by BIA.	Antiquities Act of 1906, 16 USC Secs. 431-433; Archaeological Resources Protection Act of 1979 (16 USC Secs. 470a-47011), 43 CFR, Parts 3 and 7; National Historic Preservation Act, Section 106 and 36 CFR Part 800	All Preferred Alternative components
U.S. Army Corps of Engineers			
Section 404 Permit	Issue a permit for placement of fill or dredged material in waters of the United States or their adjacent wetlands.	Sec. 404, Clean Water Act, 40 CFR Parts 122-123; 33 USC Sec. 1344; 33 CFR, Parts 323 and 325	Pipelines
U.S. Fish and Wildlife Service			
Consultation Process, Endangered or Threatened Species	Review of impact on federally listed and candidate threatened and endangered fish, wildlife, and plant species.	Sec. 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. Sec 1344), 33 CFR Parts 323 and 325	See Appendix A. All Preferred Alternative surface-disturbing activities
U.S. Environmental Protection Agency			
Produced-Water Disposal	Issue a permit to allow for underground injection of produced water.	Safe Drinking Water Act (42 USC 300F-300-9), 40 CFR Parts 144 and 147	Underground injection control
Permit for Underground Injection Control	Regulate underground injection of nitrogen.	CRS 1973, 34-60-106(2)(d) and 34-60-106(9)	Underground injection control wells
TRIBAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS			
Southern Ute Indian Tribe			
Approval of Unitization	Provide for efficient and timely development and production of Tribal oil and gas leases.	Indian Minerals Leasing Act of May 11, 1938, 25 USC 396a-396q, 25 C.F.R., Part 211; Act of March 3, 1909, 25 USC 396, 25 CFR, Part 212; Indian Mineral Development Act of December 22, 1982, 25 USC 2102-2108, 25 CFR Part 225	Unit area

TABLE B-1
MAJOR FEDERAL, STATE, AND COUNTY AUTHORIZING ACTIONS[1]

Agency and Permit/Approval	Nature of Action	Authority	Application
Rights-of-Way and Permits to Drill	Approve rights-of-way, temporary permits, and permits to drill.	Act of March 3, 1901, c.832 ss4.31.Stat.1084; 209DM8 Secretaries Order 3150 and 3177, as amended, 10 BIAM, Bulletin 13, as amended, and Albuquerque Area Addendum Release 9401	Pipeline, facility, and well locations
Air emissions inventory data[2]	Accumulating emissions data.	Clean Air Act.	All air pollutant emission sources
STATE PERMITS, APPROVALS AND AUTHORIZING ACTIONS			
Colorado State Historic Preservation Office			
Archaeological Clearance	Programmatic agreement and/or consultation for cultural resource inventory, evaluation, and mitigation.	National Historic Preservation Act, Section 106 and 36 CFR Part 800	Pipeline and unit area
Colorado Department of Public Health and Environment			
Air Pollutant Emissions Permit	Issue an air pollutant emissions permit which limits emissions from new or modified sources.	CRS 25-7-112; 5 CCR 1001-5	All air pollutant emission sources.
Colorado Department of Highways			
Transport Permit	Issue a permit for oversize, over-length and overweight loads.	CRS 42-4-409; 2 CCR 602-4	Transportation of equipment and materials on state roads
Utility Permit	Issue a permit for right-of-way easement crossing state highways.	CRS - 43-1-105	Pipeline highway crossings
Colorado Department of Natural Resources - Oil and Gas Conservation Commission			
Permit to Drill, Deepen or Re-Enter and Operate an Oil and Gas Well	State approval of drilling on all non-federal lands within the state.	CRS 1973, 34-60-106(2)(d) and 34-60-106(9)	Nitrogen injection wells
Produced-Water Disposal	Issue a permit to allow for underground injection of produced water.	Safe Drinking Water Act (42 USC 300F-300-9), 40 CFR Parts 144 and 147	Underground injection control
Permit for Underground Injection Control	Regulate underground injection of nitrogen.	CRS 1973, 34-60-106(2)(d) and 34-60-106(9)	Underground injection control wells and production wells converted to injection wells

TABLE B-1
MAJOR FEDERAL, STATE, AND COUNTY AUTHORIZING ACTIONS[1]

Agency and Permit/Approval	Nature of Action	Authority	Application
Approval of Unitization	Provide for efficient and timely development and production of non-federal and non-Tribal oil and gas leases.	Cause 112, Order #112-122 issued June 9, 1996	Unit area
Colorado Department of Public Health and Environment			
Stormwater Permits	Regulate discharge of stormwater.	Clean Water Act, 40 CFR Section 401; Colorado Water Quality Control Act 25-8-101, 6.4.2(5)(c)(x)	Pipeline installation
Utility Notification Center of Colorado			
Point of Contact Before Excavating	Advise on existence and locale of underground facilities.	CRS 9-15-103	Pipelines and wells
LOCAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS			
La Plata County			
Special Use Permit	Issue a permit for surface facilities on private lands not connected with downhole operation.	Land Development Code	All Preferred Alternative components in La Plata County not located on Tribal land
Road Use Permit	Issue a permit to allow for overweight and overlength loads on County roads.	Land Development Code	Transportation of equipment and materials on County roads
Road and Bridge Application for Permit to Work on County Right-of-way	Issue permit for crossing county roads.	Land Development Code	Pipelines

[1] This permit and approval list is not all inclusive. It is the responsibility of the operator to ensure that all permits and approvals are secured before the project may proceed.
2 The Southern Ute Indian Tribe and state of Colorado are cooperatively developing a joint commission through which to manage air quality within the exterior boundaries of the Reservation.

Separate from leasing actions, geophysical explorers may explore for oil and gas on Indian land. Geophysical exploration on Indian land requires approval of the methods employed and mitigation of impacts. The BIA Agency Office must receive a copy of the proposal to perform geophysical operations on the Reservation. The exploration plan is analyzed for conformance with the SUIT's natural resource management plan and existing leases, and mitigative measures and reclamation requirements are attached to the approval. Specialists examine the plan of operations and the site, line, or area to be explored in determining appropriate mitigative measures and reclamation requirements.

The majority of geophysical exploration operations on Indian lands is conducted by exploration companies. Some are associated with petroleum producers; many are not. Geophysical exploration operations also may be conducted on a lease held by the lessee with the same requirements for mitigation of impacts and reclamation.

A well must be drilled in order to produce oil and/or gas from a lease. Before drilling a well on the Reservation, the lessee or an operator for the lessee must file an Application for Permit to Drill (APD). The operator must file the application with the BLM's San Juan Field Office. Copies of the APD are also sent to the SUIT and the BIA Agency Office in Ignacio, Colorado. The application must include a drilling plan and a surface use plan. The drilling plan contains information as to the depth of the well, how it will be constructed, how groundwater and other mineral resources will be protected, and how blow-outs and other emergencies will be prevented or handled. The surface use plan addresses such concerns as the location and amount of surface disturbance and how that disturbance will be reduced or eliminated. It identifies mitigation of impacts on wildlife, cultural resources, vegetation, soil, surface water, and other land uses and values. The operator is responsible for setting forth its plans for addressing these matters in the proposed APD. If the APD does not have the appropriate information and mitigation incorporated, the application may be modified or rejected. In approving an APD, BLM may impose requirements related to these issues as Conditions of Approval (COAs).

At a minimum, each APD is reviewed by a BLM geologist, petroleum engineer, and surface reclamation specialist; a BIA realty/minerals specialist; tribal minerals and surface reclamation personnel; and the management for the agencies and the SUIT. The geologist evaluates the need for groundwater and other mineral resource protection and the structural competency of casing point formations. The petroleum engineer evaluates the drilling plan, well construction, and safety of the operation. The surface reclamation specialist evaluates the surface plan, checks the proposal against other guidance, conducts the on-site inspection, analyzes impacts, proposes mitigation, and writes the environmental assessment (EA). The surface reclamation specialist also calls upon other expertise as needed in the analysis of impacts and recommendation of mitigation and reclamation requirements. For example, an archaeologist would recommend any needed mitigation for impacts on cultural resources.

Each lease where an APD is proposed is checked to see if a bond has been posted to cover abandonment of the well should the lessee/operator default on their obligations under the lease. Each application is evaluated as described above, and subjected to a field inspection of all proposed disturbed areas. Appropriate site-specific mitigation is then attached to the APD as COAs. A cultural resource inventory is conducted for each APD. In designated areas, endangered species or other inventories may be conducted. The proposal is subjected to NEPA review (an EA) that checks for conformance and determines whether or not there is a need for additional review (i.e., an expanded EA or EIS). EAs are prepared for all APDs on Indian lands. When all impacts are analyzed and all necessary mitigation incorporated, the APD may be approved. The BLM will not approve an APD without the appropriate concurrences from the SUIT and BIA, who may also attach COAs (see Appendix E).

In cases where the proposed well is obviously part of a larger field development and such development has not already been evaluated by another NEPA document, a "field development" EA is prepared. This EA evaluates conformance of the specific field development with the general development previously analyzed. If the projected field development does not substantially conform or is considerably outside the scope of previous analysis, an expanded EA or possibly an EIS may need to be prepared.

Over the life of a field, other operations, such as construction of power lines, pipelines, use of secondary and tertiary recovery methods, and other production facilities may become necessary. These projects may be approved under right-of-way by BIA or under Sundry Notice by BLM depending on whether the action is occurring on or off the lease and the lease interest is held by the operator. Each new surface disturbance is subjected to the same test. Each is analyzed to determine impacts and mitigation. New ideas and technology are incorporated into new mitigative measures as they become available and when they do not impact the lease rights granted. New ideas and technology may also require amendment or maintenance of the EIS prior to use as mitigation.

As a well reaches its economic limit, it is abandoned and the disturbed area reclaimed. The operator must submit an abandonment notice for approval. The notice is evaluated by a BLM petroleum engineer to determine that the well will be plugged so as to protect freshwater zones, other mineral resources, and the surface from contamination by any oil or gas that might leak up from the depleted reservoir or other fluids and gases up hole or on the surface that could migrate through the old well bore (and casing if left in place). The surface reclamation specialist for the SUIT and BIA checks the final reclamation proposal to ensure it is in accordance with the original APD requirements, and, in some cases, incorporates the latest methods of reclamation. Reclamation is required to restore the well site, road and other disturbances to as original (or better) a condition as reasonably possible. The SUIT surface reclamation specialist also inspects the location once or twice at approximately one-year intervals to monitor the progress of reclamation. If the reclamation does not meet the requirement set out in the APD, the operator will revegetate those portions necessary to complete the goals for the reclaimed area. The well site will continue to be monitored until the SUIT surface reclamation specialist is satisfied that the reclamation has succeeded and the location is stable.

Field operations are inspected by various personnel from the SUIT, BIA, and BLM to ensure accountability for royalty obligations, compliance with the lease, permit safety, and environmental requirements. Field inspections are made at wells during the pre-drill, construction, drilling, and production phases. Inspections are also made during the plugging of the well, during reclamation, and periodically thereafter as necessary to ensure the reclamation is effective. Petroleum engineering technicians and surface reclamation specialists have primary responsibility for field inspections; however, other specialists may inspect wells as needed. Typically, these specialists include petroleum engineers, geologists, archaeologists, wildlife biologists, range conservationists, and others.

The primary function of the BLM petroleum engineering technicians is to account for accurate and complete measurement of production. They perform inspections to check the installation and calibration of measuring devices such as tanks for oil and flow meters for gas. BLM petroleum engineering technicians also inspect for routine environmental, public health, and safety concerns.

Operators are required to submit monthly production reports which go to the Minerals Management Service (MMS) and are available to the BLM inspectors electronically. The BLM verifies the report in the field to ensure the production volume is accurately reported. On the Reservation, the SUIT has a cooperative agreement with the MMS to verify that royalty payment is accurate. The three agencies work together to insure that all production is accounted for and that royalty is properly paid.

Operations within the jurisdiction of other federal agencies may also be field inspected by those agencies. The BLM has several agreements with other agencies that specify conditions where the BLM will notify the agency of violations within that agency's jurisdiction. In turn, the agency will notify the BLM of violations within its jurisdiction.

APPENDIX C
POTENTIAL FOR OIL AND GAS OCCURRENCE AND DEVELOPMENT

INTRODUCTION

The estimate potential impacts on the environment, the BLM provides guidance (BLM H-1624-1) for estimating the potential for oil and gas resources and for projecting the extent of development that is reasonably foreseeable over a certain period of time. In this case, it is the development of coalbed methane (CBM) that is most likely to occur on the Southern Ute Indian Reservation (Reservation) over the next 20 years.

The following sections contain explanations of: 1) the potential for oil and gas resources within the Reservation boundaries, and 2) reasonable foreseeable development and the three different alternatives that are addressed in this EIS.

POTENTIAL FOR OIL AND GAS RESOURCES

An estimate of oil and gas resources is accomplished using many sources of information including established files and databases, professional and academic literature, available oil and gas maps, well location cards, well completion reports, production reports, and previous mineral assessments.

The Reservation lies almost entirely within the San Juan Basin petroleum province. The entire Reservation can be described as prospectively valuable for oil and gas. “Prospectively valuable” is a federal classification for lands meeting certain criteria depending on the minerals involved. For oil and gas, and in the case of the Reservation, the lands are underlain by sedimentary rocks that lie within a favorable geologic and structural setting, are of sufficient thickness to contain economic volumes of hydrocarbons, and show evidence of oil and gas potential (e.g., seeps, well tests, production).

Most of the Reservation is considered to have high potential for oil and gas resources. Areas of high potential are characterized by the demonstrated existence of hydrocarbon source rock, appropriate thermal maturation regimes, reservoir strata possessing permeability and/or porosity, and traps to facilitate accumulation of hydrocarbons. In addition, the U.S. Geological Survey (USGS) has defined several plays in the San Juan Basin, six of which occur on the Reservation. A play is a target or zone that the USGS considers to have high potential for oil and gas resources. These plays fall within the area of high potential. A detailed discussion of each play can be found in Huffman (1988). Map 11 in the Map Volume of this EIS shows well development that has occurred within the Reservation to date. Map 11 shows that most of the exploration and development has occurred in the areas of high potential. The bulk of future activity is expected to occur in or near areas of high potential that have been explored or developed previously.

REASONABLE FORESEEABLE DEVELOPMENT SCENARIO

Projections of future oil and gas development and production are difficult to make. Several variables complicate such projections, including increases or decreases in demand for oil and gas; price increases or decreases; and new exploration, development, or production techniques that may prompt larger development and production programs. For this EIS, a combination of historical trends, present activity, government and industry estimates, and professional judgements were used in establishing the estimate of reasonable foreseeable development.

For the estimate of reasonable foreseeable development, it was assumed that all development would occur evenly over the ensuing 20-year period. Because of the many different entities operating on the Reservation and the great differences in production characteristics of wells, many different strategies may be pursued in future development of CBM leases. Some operators may elect to accelerate development if they have tax-credit qualified well bores available for recompletion as infill wells. Other operators may have equally compelling reasons to infill slowly (e.g., capital constraints). External forces such as rig availability or gas price changes also could affect development timing. In short, the exact pattern of future development is impossible to predict, so a flat development profile was selected as the most reasonable model for reasonable foreseeable development.

Throughout the environmental impact statement, a distinction is made between: 1) Tribal acreage, where the title both to conventional oil and gas and to CBM clearly rests with the federal government for the benefit of the Southern Ute Indian Tribe (SUIT) or its individual members, and 2) non-Tribal acreage, where title to the oil and gas resources and reserves, including CBM resources and reserves, belongs to Non-Tribal entities, primarily private citizens. Chapter 1.4 of this EIS contains a description and further explanation of this issue.

Reasonable foreseeable development on Tribal land is addressed in this EIS in three strategies, or alternatives: 1) continuation of the current or standard development, which would include both conventional and CBM development, including a component of CBM infill, 2) increased CBM production via widespread development of infill wells in addition to the current development, and 3) development of enhanced coalbed methane (ECBM) projects in addition to the widespread development of infill wells and current development. Anticipated numbers of wells for the three alternatives are summarized in Table C-1 and explained below. Development on non-Tribal lands within the Study Area was estimated for each alternative and used in assessing cumulative impacts.

Current or Standard Development

Current or standard development includes conventional oil and gas production from formations including the Dakota, Mesa Verde, and Pictured Cliffs and production of CBM from the Fruitland Formation. Although most of the Ignacio Blanco Fruitland field is spaced at one well per 320 acres, orders allowing optional infill wells to be drilled have been approved for over 175 units. Development activity peaked in 1990 when over 200 wells were permitted within the exterior boundaries of the Reservation, spurred by tax incentives offered for development of unconventional reservoirs, such as CBM. The window for drilling tax credit qualified wells ended in 1992. More recently, activity on the Reservation has ranged between 15 and 20 newly developed wells per year on Tribal lands. Based on this trend, the RFD for standard development on the Tribal lands is projected to be approximately 350 wells over the next 20 years. For the RFD, only 81 of these were projected to be CBM wells; the balance would be conventional wells. On the non-Tribal acreage, 62 CBM wells are anticipated. On both Tribal and non-Tribal acreage, many of the CBM wells that are developed could be infill wells.

TABLE C-1
Projected Number of Wells by Alternative

	Alternative 1 Continuation of Present Management (No Action)			Alternative 2 CBM Infill Development			Alternative 3 ECBM Recovery (Proposed Action)			
	Conv	**CBM**	**Total**	**Conv**	**CBM**	**Total**	**Conv**	**CBM**	**Inj**	**Total**
Tribal Minerals	269	81	350	269	367	636	269	367	70	706
*Non-Tribal Minerals**	NA	70	70	NA	519	519	NA	519	67	586

Conv = Conventional
CBM = Coalbed Methane
Inj = Injection
NA = Not Applicable

* Note: The state has jurisdiction over oil and gas exploration and development on these lands. The described development may take place regardless of the status of this EIS.

Increased Coalbed Methane Development (Infill)

This component addresses the possibility of widespread infill development, essentially increasing CBM well density from one well per 320-acre spacing unit to two wells per 320-acre spacing unit over most of the Study Area. Widespread development of infill wells would be in addition to the current or standard development. Infill development would include recompletions of existing wells, drilling from existing pads, and drilling from newly constructed sites. Only approximately 50 percent of the infill wells are anticipated to be developed on newly constructed sites.

Known resource conditions, such as production rates and water disposal issues, suggest that infill development is unlikely to be strategic for every 320-acre CBM spacing unit within the Reservation. For the purpose of this analysis, it is projected that up to 367 CBM wells, including 286 infill wells, will be developed on Tribal lands. On the non-Tribal acreage, assuming the same level of development as for the Tribal lands, 326 CBM wells, including 264 infill wells, are assumed to be developed. Total infill development on both Tribal and non-Tribal lands is thus projected at 693 wells.

Enhanced Coalbed Methane Development Projects

Industry was asked to provide for this EIS projections of potential ECBM projects assuming positive factors such as successful results from pilot projects and a strong economic climate. Currently, nitrogen injection has been pilot tested and is being implemented on a small scale in BP/Amoco's Tiffany project. Other operators indicated that they are analyzing or plan to analyze the effectiveness and economics of nitrogen injection on their acreage. Carbon dioxide injection is also being considered, although no specific project using carbon dioxide has been proposed at this time.

Nitrogen injection has been pilot tested on a five-spot pattern (four injections wells surrounding a producing well). Following successful pilot testing, the Tiffany project was designed as a field demonstration project. In this isolated, small scale project, there are 13 injectors and 35 producing wells, a ratio that is probably not characteristic of future, larger injection projects. Based on professional judgment, an injection pattern was defined for the purpose of this analysis as one injector well and two production wells (three wells total).

ECBM development would occur concurrently with the standard and widespread infill development. Consequently, it is assumed for this analysis that all necessary production wells are in place and that only injection wells need to be developed. To date, approximately 50 percent of the well bores used or designed for ECBM projects have utilized recompletion of existing well bores rather than drilling new injection wells. Thus, for the RFD, it is projected that approximately 50 percent of the injector wells needed would involve recompletion of existing well bores or drilling new well bores from existing pads. Pilot test projects would not be considered separately because they take advantage of existing wells to the maximum extent possible, and their impacts are substantially the same. As with infill development, ECBM projects are not likely to be implemented on all the available acreage for a variety of strategic reasons. Using the above assumptions, 137 injection patterns would be expected within the exterior boundaries of the Reservation, requiring development of 137 injection wells under the RFD. ECBM development is likely to be more applicable on the Tribal acreage than on the non-Tribal acreage due to reservoir conditions. This is reflected in the distribution of injection wells to Tribal and non-Tribal acreage as shown in Table C-1.

APPENDIX D
METHODOLOGY FOR ESTIMATING SURFACE DISTURBANCE IMPACTS

The inherent difficulty of a programmatic environmental impact statement (EIS) is to describe potential project impacts while the exact locations of future project sites are not known. To be able to consistently evaluate impacts on surface resources, as opposed to subsurface resources such as geology or hydrology, an impact assessment methodology was developed that utilized the geographic information system (GIS). Separate methodologies were developed for the conventional gas wells and for the coalbed methane (CBM) wells.

CBM AND ECBM WELLS

GIS provides a powerful computer tool to map, display, and analyze impacts. To take advantage of the power of these systems, a concept of "development windows" was developed for the CBM wells in the study area. Each development window corresponds to an area in which a CBM well could be drilled. Surface impacts were estimated by evaluating how much of which resources would be overlapped by development windows that would be developed under each of the Alternatives.

A typical 320 acre CBM spacing unit comprises half of a section, e.g., the north half of Section 11 Township 33 North, Range 11 West. Because of COGCC spacing rules, each unit is typically developed first by one well located near the center of a quarter section, not in the center of the half section. This development pattern leaves the other half of the spacing unit (a quarter section, or 160 acres) as a natural development window for a second, or "infill" well. In addition, existing conventional well pad locations were assessed for each of the development windows to identify opportunities to reduce surface impacts through use of existing well pads. Injection wells are not considered in the production well spacing and therefore do not have to be located in undeveloped "development windows".

Development Windows

A GIS analysis of the locations of existing CBM wells and of undeveloped spacing units and quarter sections provide the base for determining the development windows which could be developed under each alternative. Two types of development windows were used for estimating potential impacts from development of CBM production wells, 320 acre development windows and 160 acre development windows. The 320 acre development windows correspond to the undeveloped 320 acre CBM spacing units within the Study Area (Map 3). The 160- acre windows correspond to the quarter sections in the CBM development area which do not already contain a CBM well (Map 4). The 160 acre development windows are thus the quarter sections in which infill wells could be drilled. The presence of an existing conventional gas well within a spacing unit was not relevant to the identification of CBM development windows and therefore did not affect whether or not the spacing unit became a development window. Each development window was designated as Tribal or non-Tribal, depending on the category of mineral ownership that holds the majority interest in the development window.

Determination of Number of Wells

The number of CBM wells for Alternative 1 (81 CBM wells on Tribal land) corresponds to the number of undeveloped CBM 320-acre spacing units on Tribal land in the Study Area. However, it is understood that some of the CBM wells developed under this Alternative would be infill wells. The number of conventional wells developed under Alternative 1 (269) corresponds to the difference between the total number of wells predicted based on recent development (350) and the 81 CBM wells predicted. This number of conventional wells was held constant in all three Alternatives.

For Alternatives 2 and 3, the Bureau of Land Management, Bureau of Indian Affairs and the Southern Ute Indian Tribe (SUIT) determined that approximately 80 percent of the available CBM development windows would actually receive wells. Therefore, a total of 367 CBM production wells would be constructed on Tribal lands under Alternative 2 or Alternative 3.

Because of the patchwork of Tribal and non-Tribal lands in the Study Area, the number of enhanced coalbed methane (ECBM) wells for Alternative 3 was determined by first evaluating the total number of ECBM wells which might be developed to support ECBM projects in the Study Area and then estimating the number on Tribal land alone. From this evaluation, it was determined that 70 injectors would be developed on Tribal land under Alternative 3.

Analysis of Impacts

Analysis of impacts for surface resources was obtained by counting all development windows that contain the resource (the overlap of the resource with development windows being developed under each alternative) and multiplying that total by the appropriate disturbance factor (Construction or Production Disturbance Factor). In other words, if a development window contained a particular resource, then that development window was assigned a CBM well. The number of development windows that would receive a CBM well was then totaled and multiplied by the appropriate disturbance factor.

Potential impacts from CBM development under Alternative 1 used the 320-acre CBM development windows because a large fraction of the 81 CBM wells that would be developed under that alternative were assumed to be parent wells, not infill wells. Potential impacts from CBM development under Alternatives 2 and 3 were evaluated using 160-acre CBM development windows because the majority of the CBM wells that would be developed under either of those alternatives would be infill wells. The ECBM wells of Alternative 3 are not subject to spacing, although the environmental impacts of ECBM wells are analyzed.

There are two classifications of Construction Disturbance Factors for CBM and enhanced-recovery wells; these include wells requiring a new pad and wells drilled on existing pads. The Construction Disturbance Factor for a CBM well on a new pad requires a well pad (2 acres) and an access road and flowlines (0.25 mile x 35 feet wide = 1.06 acres) for a total of 3.06 acres. The access road and flowlines will generally occupy the same disturbed area. The construction disturbance factor for a well on an existing well pad includes only 1 additional acre of disturbance at the well pad. The construction disturbance factor is identical for CBM and ECBM wells.

The Production Disturbance Factor assumed that some interim reclamation of portions of disturbed sites would occur following construction. Therefore, the Production Disturbance Factor for new CBM and enhanced-recovery injection well pad sites was 2.06 acres (after reclamation of 1 acre around the wellhead) and 1 acre for installations on existing well pads. The Production Disturbance Factor is identical for CBM and enhanced-recovery injection wells.

Construction of a well on an existing conventional gas well pad reduces the area of surface disturbance. Through GIS, a querie was conducted to identify existing well pad sites within each resource. The analysis assumed that existing well pads would be used where available.

The number of CBM wells that could occur within each surface resource is a factor of the extent of that resource. Therefore, the more widespread a resource then the higher the number of CBM wells that could occur in that resource. It is possible that the number of wells delegated to a widespread resource (e.g., deer winter habitat) could exceed the total number of wells projected for an alternative. Where such a situation occurred, the number of wells delegated to that resource was limited to the number of wells for the alternative being analyzed.

If a given resource constituted less than 2 acres within a development window, then the resource was not evaluated for surface impacts within that particular development window. This decision was based on the assessment that any resource which was present within a development window in less than 2 acres could reasonably avoid project impacts through relocation of the installation.

Disturbances were not considered for central delivery points and treatment facilities because future expansion or modification of these facilities is anticipated to occur within the existing disturbance areas.

Conservative Nature of the Impact Analysis

Using GIS, it is possible to accurately assess the acres of various resources which could potentially be impacted by development of a specific development window. However, with a programmatic

EIS, it is not possible to accurately choose which development windows would receive a CBM well and which would not receive a CBM well. Many assumptions were made in doing the GIS analysis of the development windows. These assumptions were always made in the direction of being conservative in the estimation of impacts, i.e., to make the impacts appear, if anything, greater than they are likely to be. Actual impacts will likely be less than described. The following text provides descriptions of the "conservative" nature of this development window concept.

It is projected for the purpose of determining the number of wells that might be developed under Alternatives 2 and 3 that 80 percent of the development windows will be drilled for CBM. However, it is not possible to predict which development windows would be drilled and which would not. It was assumed all windows would have an equal probability to be developed. Consequently, impacts were assessed as if all (100 percent) of the development windows were actually drilled. Described impacts are therefore conservative since they are overstated by the difference between the projected CBM development of 80 percent and the analysis of total CBM development for 100 percent of development windows.

The development windows analysis is conservative in terms of estimating surface disturbances on resources. Every development window was evaluated if it overlapped a resource. If two resources were present in one development window, both resources would be counted as impacted by that development window. Consequently, a given development window could register impacts for a number of resources present within that development window (e.g., coniferous forest = 3.06 acres, grassland = 3.06 acres) even though the actual construction will impact only a total of 3.06 acres. This situation is referred to as "impact loading." Obviously, surface impacts are not intended to be additive between resource types with the model. For Alternative 1, the impact loading is even more extreme because the 320-acre development windows rather than the 160-acre development windows were used in evaluating impacts.

The 2-acre threshold for determining when a given resource occurs within a development window for impact analysis is also conservative. Under the regulations and the lease terms, a proposed drill pad (or other surface disturbance) can be moved up to 200 meters to avoid impacts on sensitive resources. The area of a circle with a 200-meter radius represents approximately 31 acres. Consequently, impacts on resources with small acreage representation within a development window (but larger acreage representation than 2 acres) could probably be avoided by relocating the disturbance.

CONVENTIONAL GAS WELLS

As discussed under CBM and ECBM Wells, the number of conventional gas wells (269 wells) was projected by combining recent drilling trends with projections about future development. The number of conventional gas wells (269 wells) remains a constant for all alternatives.

New conventional wells could be assumed to be drilled anywhere within the study area, as opposed to CBM wells which would be drilled east of The Hogback. In order to evaluate the surface disturbance impacts from the proposed conventional wells, the extent of impacts on a surface resource was considered to be proportional to the area of the resource within the study area. Specifically, the percentage of a resource within the study area was calculated by dividing the resource acreage by the total acreage of the study area. The resulting percentage was then multiplied by the total number of projected conventional wells (269) to determine the number of conventional wells which could impact that particular resource. To obtain the area of surface disturbance, the number of wells was multiplied by the appropriate disturbance factor (e.g., construction or production; new well pad or existing well pad). Through the GIS system, a querie was conducted to determine the number of existing well pads within each resource. The impact analysis assumed that existing well pads would be utilized where available. The presence of a conventional well within a spacing unit (e.g., a Mesa Verde completion) does not preclude the presence of a future conventional well completed from a different formation (e.g., a Dakota completion).

The Construction Disturbance Factor for a new well includes 2 acres for the well pad and 1.06 acres for the access road and flowline (0.25 mile x 35 feet wide = 1.06 acres) for a total of 3.06 acres. The roads and flowlines will generally occupy the same disturbed area. The Construction Disturbance Factor for development of a conventional well on an existing well pad includes only 1 additional acre of disturbance to the existing well pad.

The Production Disturbance Factor assumed that some interim reclamation of disturbed sites would occur following construction. Therefore, the Production Disturbance Factor for new well pad sites was 2.06 acres (after reclamation of 1 acre around the well head) and 1 acre for sites developed on existing well pads.

APPENDIX E

EXISTING ENVIRONMENTAL PROTECTION MEASURES FOR OIL AND GAS OPERATIONS ON THE SOUTHERN UTE INDIAN RESERVATION

The following regulations and orders (not included due to their size) are the basis for oil and gas development on the Southern Ute Indian Reservation:

- 43 CFR 3160; Onshore Oil and Gas Operations Regulations, which include the following Onshore Oil and Gas Orders:
  - Onshore Order #1; Approval of Operations,
  - Onshore Order #2; Drilling Operations,
  - Onshore Order #3; Site Security,
  - Onshore Order #4; Measurement of Oil,
  - Onshore Order #5; Measurement of Gas,
  - Onshore Order #6; Hydrogen Sulfide Operations,
  - Onshore Order #7; Disposal of Produced Water.

The following documents contain existing environmental protection measures applicable to oil and gas development on the Southern Ute Indian Reservation, and are included in this Appendix:

- Notices to Lessees:
  - NTL-88-1; Well Abandonment and Bonding Requirement Revisions.
  - NTL-88-2-Colorado; Paying Well Determinations and Venting and Flaring Applications on Jurisdictional Coal Bed Methane Wells.
  - NTL-MDO-91-1 (Change 1 and Change 2); Bradenhead Testing.
  - IB 95-1; Prevention of Potential Bird and Bat Mortalities.
- SUIT General Well Site Conditions of Approval;
- SUIT General Pipeline Right-of-Way Stipulations ; and
- Mitigation Measures from the Environmental Assessment of Oil and Gas Leasing and Development on Southern Ute Indian Reservation, BIA, 1990.

Residual impacts are those which remain after reclamation of abandoned wells, facilities and roads. They would consist primarily of small areas which would not successfully revegetate. There is no way of estimating total acreage which would not return to native vegetation. However, the significance of this impact in relation to the value of the oil/gas extracted is considered very small.

Visual impacts of wells, facilities and pipelines places in areas of extreme topogr
for an unknown period of time.

The additional 400-500 new wells predicted to be drilled over the next 20 years
very small contribution to cumulative impacts on the Southern Ute Indian Reserv
additional 400-500 wells seem to be a major impact, the impact is expected to
the following reasons: 1. The oil and gas exploration, development and produ
existing areas of development or adjacent to such areas, and 2. Those areas c
outside of previously disturbed areas will constitute very small acreage
development.

Alternative B, the No Action Alternative has been discounted due to the fact that it v
the Tribe from developing its natural resources for the benefit of its members.

The selection of Alternative A (full development) over Alternative C (limited or restricted development) is based upon the conclusion that the cumulative impacts of these alternatives are basically the same (see Evaluation and Comparison of Alternatives on page 8). Under Alternative B, though parts of the reservation that would be restricted would be restricted due to archeological, cultural, historical, human or environmental concerns. It has been determined that the present federal regulations in place adequately protect the archeological, historical and cultural resources. The federal government through its field agencies (BIA, BLM, USFW, EPA, etc.) are responsible for the protection of the environment and other resources of the Tribe. With the implementation of all mitigation measures as described within this EA and the enforcement of federal regulations and laws by those federal agencies responsible for such enforcement, the selection of alternative A will allow the Tribe to develop their mineral resources while at the same time protecting the other resources that will be affected by this action.

The primary source of revenue for the Southern Ute Tribal Government is the oil and gas operations and enterprises on Tribal lands. Proper management of the Tribe's resources will assure prosperity and an environmentally sound reservation in the future.

V. MITIGATION

Post lease/permit/mineral agreement mitigation is implemented through stipulations attached to the lease/permit/mineral agreement and the site-specific environmental documentation (i.e., APD, specific seismic permit EA, Right-of-Way EA). As impacts are identified in the site specific environmental documentation, changes in the proposal are considered and implemented if possible: pads are rotated to avoid major cuts and fills, corners of pads are rounded to avoid large cuts, pads and roads are moved to avoid archaeological sites, pads and roads are moved to take out a minimum of trees, locations are moved to save rangeland, locations are moved to

1990 BIA EA for SUIT

use existing nearby pads and roads, steep hillsides are avoided when feasible, tree screens are left in place to hide locations from distant viewing, existing operable stockponds are left undisturbed, riparian and wetlands are avoided at almost all costs and reserve pits are prohibited near such areas (steel tanks substitute), locations are moved away from nearby residences, locations and access roads are moved so that irrigated fields are not unduly disrupted, major drainages are protected by adequate culverts or bridges, locations are protected from floodwaters by adequate drainage ditches around the location and reserve pits, 6 to 8 inches of topsoils are required to be stockpiled for use in later reclamation of the wellpad, proposed wellpads and reserve pits are reduced in size where applicable, and timber is required to be salvaged by cutting into post and firewood lengths with slash to be chipped and scattered.

In addition to site-specific Tribal stipulations being attached to each lease/permit/minerals agreement as conditions of approval for surface use, in those instances where subsurface archaeology is suspected, archaeological monitoring is required for all initial surface disturbing activity. Also required is 48 hour notification to the Tribe, BIA, and BLM prior to initial surface disturbing activity so that this work can be monitored.

A general mitigation recommendation is that a comprehensive monitoring program be developed for the reservation, by BIA and BLM, to assess the effectiveness of mitigation in the oil and gas program.

Although well pad dimensions vary, an average size is 300 feet long by 250 feet wide, disturbing about 1.7 acres. An average new access road would be about 300 feet long and 20 feet wide, disturbing an additional 0.2 acre. Associated pipelines would parallel existing roadways for an additional disturbance of 0.2 acre. This totals to about an average of 2 acres surface disturbance for each new well.

On any given site, the order of construction is:

1. Remove all salvageable wood products for fence posts and firewood.

2. Chip and scatter all slash material (limbs and small branches).

3. Strip and stockpile 4 to 6 inches of topsoil.

4. Construct wellpad, reserve pit, and access road.

The drill rig is moved onto location and drilling operations begin. Upon completion of drilling, well casing is set, and drill rig moves out.

A smaller drilling rig (completion rig) moves on location to complete the well (usually perforates the casing in the production zones, fractures the producing formations if needed, and sets production tubing).

Generally, after the completion rig moves off location, production equipment (heater treaters, dehydration units, water and/or oil storage tanks, compressor units, and meter runs) are set up and made operational. Pipelines are constructed to the well site so that produced gas and produced water can be removed from location.

When the reserve pit is dry, it is reclaimed (filled in, contoured, topsoil spread, and reseeded), and those portions of the wellpad not needed for production are also reclaimed.

When the well is exhausted, it is plugged downhole with cement, all surface equipment is removed, and a dry hole marker is placed over the wellbore. Stockpiled topsoil is spread across the wellpad and reseeded, and the access road is reclaimed by similar procedures.

A. Minerals

No additional mitigation measures are required.

B. Soils

Reclamation and erosion control measures can be used to mitigate high to low levels of impacts on soils resulting from construction and operation of proposed facilities. The following mitigation measures should be employed on a site/soil-specific basis. Soils that are identified as being susceptible to high levels of impact. Those occupying steep slopes, have high susceptibility to erosion, and/or being poorly suited for reclamation/revegetation should receive particular emphasis. Possible measures to minimize disturbance, stabilize disturbed soil materials to reduce soil loss due to erosion, revegetate disturbed areas and restore soil productivity during and following facility construction are:

1 Selective salvage and replacement of topsoil for agricultural lands and those lands for which the landowner requests that topsoil be salvaged and replaced.

2. Construction or placement of erosion control features to limit the steepness and length of slope (e.g., water bars, terraces, rip rap, sand bags, or straw bales for temporary control).

3. Grading of disturbed areas to contour.

4. Soil which has been excavated during construction and not used should be evenly backfilled into the cleared area or removed from the site. The soil should be graded to conform within the terrain and the adjacent land.

5. Dumping of excess material or material on downhill slopes should be minimized.

6. Replacement of earth adjacent to water crossings should be at slopes less than the normal angle of repose for the soil type involved.

7. Cut and fill slopes should be rounded to break sharp unnatural edges formed at the contact point between the constant-pitch out-slope and the rounded

natural landform (BLM, 1982).

8. Preparation of the surface soil to receive seed, including ripping/chiseling, surface roughing and tilling across slope.

9. Seeding with a seed mixture of adapted grass or other plant species approved by BIA.

10. Addition of soil amendments, including fertilizer, and use of appropriate seeding methods (e.g., drill seeding and broadcast seeding) to aid in the development of a positive growth medium.

Mulching with straw, hay or wood fiber.

12. Crimping of hay or straw mulch on the contour into the soil or tacking netting over an organic mulch on steeper, more erodible slopes to hold the mulch, soil and soil moisture.

Monitoring of disturbed areas to identify potential soil instability or erodible areas and to implement the necessary mitigation measures to restabilize the soils.

Mandatory control of noxious weeds on all disturbed areas.

Reclamation and revegetation will be done as rapidly as possible to protect the soil.

No surface disturbance will be allowed in areas with slopes exceeding 25 percent unless the lessee/operator and BIA arrive at an acceptable plan for mitigation of anticipated impacts. The plan must be prepared prior to development of the site and will become a condition for approval when authorizing the action.

C. Water Resources

Potential mitigation measures for surface and ground water resources are grouped together based on their interdependence, but have been divided into six categories: general, construction, operation, control measures, monitoring and spills. The potential mitigation measures are presented below.

General

1. Ensure that all applicable water quality standards are met.

2. In accordance with existing regulations, monitoring and mitigation of injected water remains under EPA control (a permit for a disposal well is required from EPA).

Construction

1. Witness casing cementing to ensure that the fresh water zones are protected.

2. Avoid construction activities near or through irrigation systems during the growing season.

3. Minimize time of construction and any temporary water diversions and revegetate as quickly as possible.

4. Avoid construction activities near or through streams during high flows or rainfall events.

5. For road and pipeline stream crossings, minimize the time and area of disturbance and stabilize immediately.

6. Cathodic protection wells monitored and placed in deeper zones to protect fresh potable water zones and cement other zones.

7. Divert all surface runoff around facilities.

8. Utilize special erosion control measures for all well pads cut into hillslopes.

9. Route surface runoff from drilling locations into reserve pits.

10. Use fabric filter of various types as appropriate, to reduce erosion and sedimentation.

11. Well pits should be placed on the upslope (cut) portion of the pads.

12. All pits on Fruitland wells will be sealed or lined.

13. Stay out of floodplains -- Floodplains Protection Act.

Operation

1. Use care when conducting fuel or chemical transfers within 0.25 mile of streams, rivers, ponds or lakes.

2. Place strict control on materials placed in reserve pits used for drilling.

3. Since snowmelt can contribute significant material input into streams, contain all spills during winter months.

Control Measures

1. Riprap stream beds as needed for road (culvert) crossings of ditches and streams.

2. Maintain or seed vegetation on runoff ditches.

3. Riprap stream beds and seed vegetation as needed.

4. Gravel all roads that have heavy truck traffic.

Monitoring

1. Sample and analyze water quality of produced water on a routine basis.

2. Conduct site inspections during periods of high rainfall, runoff and stream flow to evaluate potential effects of erosion, sedimentation, leaks and spills.

3. Conduct routine maintenance checks and site inspections of facilities to examine for potential erosion problems and spills or leaks.

4. For buried produced water pipelines, provide control/evaluation to ensure no leakage is occurring.

5. Monitor injection wells for integrity and compliance.

6. Witness casing and plug and abandon cementing jobs.

Spills

1. Develop and implement a Spill Contingency and Response Plan, including specific containment, clean-up and mitigation procedures.

2. Provide spill control measures.

D. **Wildlife**

In addition to the use of good construction practices, implementation of the following mitigation measures is recommended:

1. Compliance with regulatory requirements of the U.S. Fish and Wildlife Service and other relevant resources management agencies.

2. If practicable, avoid conducting exploration, development or production operations in important wildlife habitat types.

3. If practicable, avoid conducting activities during wildlife critical use periods in important habitat types.

4. Revegetate all disturbed areas following disturbance according to BIA requirements.

5. Conduct work in streams in a manner that minimizes siltation and erosion, including minimization of areal and temporal disturbance, and use of specific control measures.

6. If practicable, avoid placement of facilities in habitat that support special plant species and sensitive and valuable vegetation types, including wetland/riparian areas.

7. Limit construction clearing in woodland areas to trimming or crushing whenever possible.

8. During construction in shrubland and woodland areas, pile some of the cleared or clipped vegetation from construction areas in small thickets located off of the area to provide cover for displaced animals.

9. Utilize erosion controls during construction activities.

10. Limit off-road vehicle use.

Prohibit the use of firearms to reduce potential poaching activities by workers.

12. Complete revegetation of disturbed areas with fast-growing plant species as appropriate for short term soil stabilization.

13. Control dust during operations.

Avoid placement of construction lay-down areas at stream crossings, and wetland/riparian and other sensitive areas.

Install pipelines in a manner to restore the topsoil and associated seed source when backfilling.

16. Minimize the spread of noxious weeds with annual mandatory control measures.

17. Potential adverse construction impacts to streams and irrigation ditches and rivers may be significantly reduced by completing during periods of little or no flow.

Minimize erosional processes at streams and river crossings by stockpiling trench spoils above full-bank elevations.

19. Stabilize excess material at streams and rivers in place or remove off-site.

Place pipe below channel scour depths in streams and rivers to avoid partial diversion of channel discharges.

21. Complete fueling and lubrication away from aquatic environment.

22. Periodically check all equipment for leakage to avoid spills. Employ off-site mitigation where needed to compensate for habitat lost to oil and gas development.

    The basic premise of off-site mitigation is that the impacts from oil and gas development extends beyond the immediate area of surface disturbance. Therefore in order to compensate for the reduction of habitat quality caused by the development, habitat improvements are conducted elsewhere to increase habitat values to offset values lost.

E. Vegetation

Existing stipulations provide for the reclamation of disturbed areas. Increased monitoring is required to determine if reclamation is successful.

Some general stipulations for minimization of disturbance:

1. During construction, clearing of land for facilities or structures should create curvilinear boundaries instead of straight lines and minimize disturbance of the landscape (BLM, 1982). Grading should be done in a manner which will minimize erosion and conform to the natural topography (USFS, 1977).

2. The clearing of trees and vegetation for oil and gas facilities should be limited to the minimum area required. Feather and thin edges of vegetation.

3. To the extent possible, all foliage adjacent to the site should remain undisturbed to provide maximum screening of the facility.

4. Brush or small trees cleared and not otherwise disposed of may be spread in a way to provide cover habitat for small animals, reptiles and birds. Woody materials should be randomly placed particularly in downslope fill areas to conform to adjacent vegetation patterns. It should be noted that material larger than 6" will provide breeding areas for bark beetles.

5. All timber and other vegetation material without value should be mechanically chipped and spread in a manner that will aid seedling establishment and soil stabilization.

F. Forestry

In woodland areas all exploration, development and production sites are to be regenerated (or portion thereof) as work is completed.

G. Air Quality

Mitigation measures:

1. Require a mister on the Blooie line.

2. Require an ignitor on the Blooie line.

H. Resource Use Patterns

Mitigation measures:

1. Comply with all BIA, BLM and tribal lease/permit/mineral agreement requirements concerning general agricultural and other land use issues.

2. Avoid placement of oil/gas facilities in areas of irrigated agriculture to the maximum extent possible.

3. Locate facilities on the edges of irrigated and non-irrigated agricultural lands to the maximum practicable extent to reduce direct and indirect effects on agricultural resources and operations.

4. Minimize crossings or other direct effects on agricultural irrigation facilities, including water canals, ditches, pipelines and other water conveyances to the maximum practicable extent.

5. If irrigation and other agricultural (e.g., fences, gates) facilities are damaged, repair or replace the facilities according to landowner requirements.

6. Minimize oil/gas-related construction equipment movement off specific access roads to avoid disturbance of agricultural and other lands.

7. Repair, maintain and gravel all access roads used for project related traffic.

I. Threatened and/or Endangered Species

Current stipulations as applied are adequate to protect Federal threatened or endangered species as no actions are allowed which would result in a Section 7 "jeopardy opinion". All site specific environmental documents will address protection for all known habitat of threatened and/or endangered (T/E) species on the reservation.

J. Socioeconomic

Given the positive socioeconomic effects of the project, mitigation, enhancement and protective measures are not pertinent. An effort will be made to use the Tribal work force and local materials and supplies whenever possible.

K. Archeological

The Albuquerque Area Office, BIA, policy with regard to compliance with Section 106 of the National Historic Preservation Act and the Archeological Resources Protection Act will be adhered to prior to specific oil and gas development activities. This includes Application Permit to Drill (APD), access roads, pipelines, gathering systems, re-injection wells, waterlines, compressor stations, storage tanks, and all other related activities. The third party applicants will provide for all cultural resources surveys of project areas of impact to identify cultural resources. This will include acceptable reports of these surveys. All activities necessary to protect, monitor or test identified sites will be provided by the applicant. The report review and compliance process will be completed by the Albuquerque Area Office.

All known cultural resources will be protected by providing a buffer zone, and if necessary, temporary protective fencing will be placed around a portion of identified sites. Operators who damage sites outside of designated project areas or right-of-ways, or who fail to take proper site avoidance measures as prescribed, may be subject to civil penalty assessments for site damages under the provisions of the Archeological Resources Protection Act. If any previously unidentified cultural resources are encountered during construction activities, then all work in the immediate vicinity of the find must be halted, and the Albuquerque Area Archaeologist notified.

L. Resource Related Pests

Possible solutions to the weed problem:

1. The Land Use Code must require that the land user make a conscientious effort to control weeds. A way must be achieved to enforce this provision.

2. Weed control around wells, pipeline, oilfield access routes and right-of-ways will be mandatory for gas and oil companies inside the Reservation boundary.

3. Provide education to land users in cultural and mechanical techniques that along with chemical, are part of a well rounded weed control program.

4. Improve cooperation with adjacent land users and weed control district where a joint weed problem exists.

5. Encouragement of land users to utilize the counties' chemical cost share program.

M. Other Values

The following stipulations will be employed to reduce visual impact:

1. To the maximum extent possible roads and facilities will be:

   a. Located away from populated areas, parks, scenic areas, hilltops, natural and man-made structures and prominent natural features such as distinctive rock or land forms, rivers, stream or arroyo crossings and other landmarks.

   b. Located to avoid crossing hills and ridges to avoid silhouetting unless alternative location will result in greater disturbance.

c. Facilities should be located to use natural screens of vegetation or existing topographic features.

d. For sloping terrain, a multiple level, terraced facility plan should be considered to minimize excavation and provide a facility that would blend effectively. Near travel routes, facilities should be located part way up the slopes to provide a background of topography and/or natural cover when possible. Screen these facilities from highways and other areas of public view with natural vegetation and terrain.

e. Where placement of a facility is necessary in a hilltop area, consider locations on the slope or brow of a hill to allow minimum silhouette or skylining.

f. Facilities in general should be placed strategically to make maximum use of existing topography and vegetation for screening. Utilize the edge effect for facility placement along natural vegetation breaks.

g. Facilities should be located at the base of slopes when feasible to provide a background of topography and/or natural cover.

2. Within recreation areas all equipment with engines or motors will be equipped with quiet design mufflers (hospital grade or dual dissipative) or other noise abatement equipment or housed in acoustically insulated structures.

3. On roads with high potential for vehicle accidents, it is recommended that signs be placed warning public of heavy truck traffic.

4. Color (hue) of facilities is most effective within 1,000 feet (Johnson et. al., 1970). Beyond that point, the hue becomes indistinguishable and only the value of the color can be expected to have any appreciable effect. When viewed from the shaded side, a facility structure appears a dark silhouette and generally its color is indistinguishable. Consideration should be given to coloring facilities to blend with the landscape. This is particularly significant in or near areas of high scenic value.

V. CONSULTATION AND COORDINATION

A. Personnel

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Chief, Minerals Section
Albuquerque Area Office

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APPENDIX G

BIOLOGICAL ASSESSMENT
FOR OIL AND GAS DEVELOPMENT
ON THE SOUTHERN UTE INDIAN RESERVATION

United States Department of the Interior
Bureau of Land Management
Bureau of Indian Affairs

Southern Ute Indian Tribe

Prepared by:

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San Juan Public Lands Center

August 27, 2001

INTRODUCTION

This document assesses the effects of implementing oil and gas development within the Southern Ute Indian Reservation as described in the Southern Ute Indian Tribal Oil and Gas Development Environmental Impact Statement. It is being written in accordance with Section 7 (C) of the Endangered Species Act (1973, as amended) and the Code of Federal Regulations 50 (Part 402).

A species list was received from the U.S. Fish and Wildlife Service on 6 May 1996 by the Bureau of Indian Affairs, Southern Ute Agency. This was reviewed and updated with Mr. Terry Ireland of the Grand Junction Fish and Wildlife Office in August, 2000. An updated list was received by the Public Land Center on 2 May 2001. On 25 July 2001, the yellow-billed cuckoo was listed as a candidate species because listing was warranted but precluded by higher priority listing actions (Federal Register 7/25/01).

The following species were considered for this analysis.

Endangered
- Knowlton's cactus (*Pediocactus knowltonii*)
- Mancos milkvetch (*Astragalus humillimus*)
- Black-footed ferret (*Mustela nigripis*)
- Whooping crane (*Grus americana*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)
- Colorado pikeminnow (*Ptychocheilus lucius*)
- Razorback sucker (*Xyrauchen texanus*)

Threatened
- Mesa Verde cactus (*Sclerocactus mesas-verdae*)
- Bald eagle (*Haeliaeetus leucocephalus*)
- Mexican spotted owl (*Strix occidentalis lucida*)
- Canada lynx (*Lynx canadensis*)

Candidate
- Gunnison sage grouse (*Centrocercus minimus*)
- Western boreal toad (*Bufo boreas boreas*)
- Yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

This BA accompanies the programmatic Environmental Impact Statement (EIS) for the Southern Ute Indian Tribe Oil and Gas Development Project. Because of the programmatic nature of the EIS, site-specific locations for project facilities have not been selected. Instead, development windows (20-acre parcels) have been identified to designate where well pads and other facilities are likely to be constructed. The analysis of impacts on many resources is based on the number of development windows which would be developed under each alternative and the percentage of habitat that could potentially be impacted relative to the available habitat within the Assessment Area.

The U.S. Fish and Wildlife Service (USFWS) has requested preparation of a BA because of the potential for impacts to occur on TES species as a result of the construction, production and abandonment activities which are part of the Agency and Tribal Preferred Alternative (Ireland 1997).

Although this is a programmatic EIS, formal consultation with the USFWS is requested. Individual gas development projects that follow this EIS and that have the potential to affect any TES species will require a site-specific BA and may also need to complete formal consultation with the USFWS prior to site specific approvals (Ireland 1997).

A sequential series of tasks were conducted to prepare this assessment as follows:

1. Prefield Review: All TES species that have the potential to occur in the Assessment Area, were identified by the USFWS in letters dated 6 May 1996, August 2000, and 2 May 2001 and were reviewed in this task. Habitat requirements, seasonal-use patterns, and ranges or distributions are discussed in this section. This USFWS letter is referenced in Section 8.0 of this BA.

2. Field Reconnaissance: Based on the results of the prefield review, a field reconnaissance was conducted to assess the Assessment Area for habitat suitability.

3. Analysis of Effects: Based on the information obtained and provided in this assessment, an analysis of how proposed development could impact TES species, including the effectiveness of mitigation measures, was conducted. This section also provides a general description of those project effects that could be considered to be significant impacts.

4. Determination of Impacts: Based on the analysis of effects, a determination was made on the impacts proposed development would have on TES species.

5. Documentation: A documentation record is provided that includes references that were used and contacts that were made to prepare the BA.

CONSULTATION TO DATE

A biological assessment was completed by consultants in the fall 2000 and was submitted to the U.S. Fish and Wildlife Service (FWS) in October by the Bureau of Land Management (BLM). The BLM received a letter from the FWS on 1 November 2000 stating they would be unable to complete consultation "due to insufficient and conflicting information within the BA and cover letter."

A meeting was convened on 5 and 6 February 2001 to review the project. Participants included the Bureau of Land Management, the Southern Ute Indian Tribe, and the U.S. Fish and Wildlife Service. Issues identified in the 1 November letter were discussed. A presentation was given by Matt Janowiak (BLM) regarding water depletions associated with the project. A draft biological assessment was submitted via electronic mail to the U.S. Fish and Wildlife Service on 6 July 2001 and was reviewed by Bob Leachman of the Grand Junction Office. His comments along with comments provided by the Bureau of Indian Affairs and the Durango Public Lands Center have been incorporated into this document.

CURRENT MANAGEMENT DIRECTION

Current management direction for oil and gas leasing and development is found in the following documents: Colorado Oil and Gas Leasing and Development Final Environmental Impact Statement (1991), Environmental Assessment of Oil and Gas Leasing and Development on Southern Ute Indian Reservation (1990), the Intra-Service Section 7 Consultation for Minor Depletions of 100 Acre-feet or Less From the San Juan River Basin, and the San Juan and San Miguel Resource Management Plan (1994). These documents set out a general framework for oil and gas development and provide general management direction for protection of threatened and endangered species. In practice, biological assessments are completed for individual projects under the auspices of these past programmatic framework documents.

DESCRIPTION OF ASSESSMENT AREA

The Assessment Area covers the western and central regions of the Southern Ute Indian Reservation and includes approximately 421,200 acres in LaPlata County, Colorado. The Tribe does not allow development in the eastern portion of the Reservation, as described in the Tribe's *Natural Resources Management Plan, 1990-2010* (Southern Ute Indian Tribe 1990). Although the Reservation is a patchwork of Indian and non-Indian land, the EIS addresses the potential development only upon jurisdictional lands (Tribal and allotted mineral ownership) within the Assessment Area. The project area for the EIS is thus the jurisdictional lands within the Assessment Area, as depicted on EIS Map 4 which is included in this BA.

The south-central portion of the Assessment Area has historically proven to have the most productive conventional gas reservoirs. To evaluate the impacts from the potential conventional wells, the assumption was made that the conventional wells, which would include exploration wells and new development wells, would be drilled throughout the Assessment Area rather than in small discreet pockets. This probably overestimates the extent of impact.

The coalbed methane CBM wells that would be drilled under the Proposed Action were assumed to be restricted to the area of the occurrence of the Fruitland Formation. This can be defined as within the hogback of the San Juan Basin (see Map 4 in this BA). CBM well development is not assessed to the west of the Hogback in the Assessment Area.

DESCRIPTION OF THE PROPOSED ACTION

The Southern Ute Indian Tribe (SUIT) proposes to increase exploration and development of the mineral resources on its reservation in southwestern Colorado. The Bureau of Indian Affairs (BIA) and Bureau of Land Management (BLM), as agents for the Secretary of Interior, have the responsibility for administering the leasing and development of the oil and gas resource where the mineral estate is held in trust for the Indian people. The SUIT, through the auspices of the Indian Self Determination Act, is taking an increasingly active role in the management of their mineral resources.

The EIS analyzes the impacts of oil and gas exploration and development and the resultant potential impacts of the construction of access roads and drill pads; drilling operations; and construction, operation, and maintenance of production and transportation facilities within the exterior boundaries of the Reservation. The EIS is a programmatic analysis of three alternatives under consideration and is not an analysis of a specific project. Additional NEPA documentation will be completed for individual well proposals and tiered to the EIS when APD's are filed.

The Agency and Tribal Preferred Alternative, or Proposed Action, is the reasonably foreseeable oil and gas development which might occur if both infill of coalbed methane (CBM) spacing units and enhanced coalbed methane (ECBM) recovery methods were utilized in the EIS Assessment Area. Status quo development of conventional wells and of previously undrilled CBM spacing units would also occur under the Preferred Alternative.

The Agency and Tribal Preferred Alternative allows for the optional development of one additional CBM well, or infill well, on a majority of CBM spacing units within the Assessment Area. Conventional gas well development would continue under the current spacing rules. Additionally, the Preferred Alternative may include the use of ECBM recovery methods, such as nitrogen and carbon dioxide injection, in specific areas which have not yet been identified. Injection wells that are drilled for ECBM recovery projects are not counted as infill wells in assessing the development of a unit under the applicable spacing rule. Over the twenty-year life of the project, the reasonably foreseeable development under the Preferred Alternative includes 706 new wells on Tribal mineral estate within the Assessment Area (269 conventional gas wells, 367 CBM wells, and 70 injection wells).

Development of infill wells will be mostly in the "main" area of the Ignacio Blanco Field. Gas production rates and cumulative recoveries from CBM wells vary significantly within Assessment Area. Operators have informally designated the "fairway," an area within the Assessment Area where well production is high and permeability of the coal is believed to be high. The area within 1.5 miles of the Fruitland outcrop in the Assessment Area has been designated in this EIS as the buffer zone. Any portion of the CBM development area that is not within the fairway or the buffer zone is considered part of the main area. For numerous technical reasons related to production potential, it is believed that the main area would contain the vast majority of the infill drilling and ECBM project development. It is important to note that infill is not expected to be desirable or feasible in every CBM unit.

The impacts of future CBM development on resources were assessed based on the idea of development windows. A development window is a 20-acre area within a 160 acre CBM spacing unit in which a CBM well could be drilled in the future. All the resources contained in each 20 acre development window were considered to be potentially impacted by development of that window. A well pad disturbs only approximately 3 acres of surface, but in this programmatic EIS we do not know the exact location of the CBM well within the 20 acre well window and thus where the 3 acre disturbance would occur within the window. For this reason, any resource present in a window was considered disturbed by development, even though in actuality only 3 acres would be impacted. This method tends to overestimate the impacts which were assessed.

Construction Phase

The construction phase of the proposed action includes the installation of drill pads, roads, and pipelines, the drilling and completion of wells, and the installation of production equipment, including compressors. Anticipated impacts from the construction phase for the Preferred Alternative include surface disturbances, water use, noise, and traffic. Standard operating procedures, and mitigation measures, including best management practices which are discussed below, would reduce potential impacts from construction operations.

Surface disturbance is necessary to construct drill pads, pipeline, roads, and other facilities. Each new well pad requires initially disturbing approximately 3 acres. Each new well co-located on an existing well pad requires expanding the existing pad by approximately 1 acre. Construction of 706 wells on Tribal mineral estate lands would result in the surface disturbance of approximately 2,160 acres if all new well pads were constructed. Surface disturbance in the rights of way, such as for pipelines, is reclaimed immediately after construction. Most other facilities, such as compressors, are expected to be co-located with wells or with existing facilities in order to minimize construction impacts and costs.

Well construction is projected to require approximately 29 acre-feet of fresh water per year for well drilling, cementing, fracture stimulation and associated activities. Produced (non-fresh, non-tributary formation) water can be used, and even reused, in most other well construction operations, such as for drilling mud. The fresh water would be obtained primarily from irrigation allocations. In addition, operating coalbed methane wells in the Indian Creek area will continue to intercept and produce 37 acre-feet per year of groundwater that would normally discharge to the Animas River or Basin Creek. This produced water will be pumped into deep formations or evaporation ponds, effectively removing the water from the river recharge system. Therefore, a total of 66 acre-feet per year would be depleted from the San Juan River system as a result of the proposed action. (29 a.f. of irrigation water + 37 a.f. of intercepted recharge = 66 a.f.) Please see Appendix A for a water depletion summary (Janowiak 2001).

Construction operations create noise and additional traffic, including some heavy truck traffic. However, these potential impacts are limited to the construction period, which is relatively brief (generally 1-2 months) for each location and to the immediate vicinity of the construction project. The construction period would be planned so that it does not interfere with critical life history phases (i.e. nesting, breeding) of TES species known to exist in the project area. For these reasons, these potential impacts were not considered significant.

Production Phase

In general, no direct impacts from surface disturbances are expected to occur on TES and their habitats during the production phase of the Agency and Tribal Preferred Alternative. Areas of surface disturbances from the construction phase are expected to be reduced through reclamation and revegetation in the production phase. The area of remaining surface disturbances would include 1,454 acres of Tribal mineral estate lands. In general, the area disturbed around each new well pad (3 acres) would be reduced to 2 acres in the production phase. Surface disturbances in the rights-of-way are reclaimed immediately after construction and therefore would remain undisturbed in the production phase.

Surface disturbances of vegetation types that would re-vegetate slowly (i.e., 50-100 years), such as ponderosa pine forest or woodland and piñon-juniper woodland, would be initially replaced by grasses and shrubs and would not be expected to return to the pre-disturbance habitat type during the production phase. Therefore, many of the vegetation types that support TES, such as wooded riparian vegetation and coniferous forests, if developed, are not anticipated to be replaced during oil and gas production. Riparian vegetation grows relatively quickly, although decades would be required to grow mature trees. Disturbances to wildlife resulting from the operation of machinery and vehicles (e.g., noise) are expected to occur throughout the 20-year life of this project.

Abandonment Phase

The abandonment phase would involve the reclamation and revegetation of well pads, rights-of-way, and other facilities which were not previously reclaimed in addition to the actual plugging of the wells. All equipment will be removed from the locations and the well casing will be cut off. The area of surface disturbances in the abandonment phase would decrease from the disturbance area of the production phase as reclamation proceeds. Surface disturbances of habitats such as grasslands/shrublands would revegetate relatively quickly (i.e., several growing seasons). Surface disturbances of vegetation types which grow slower, such as ponderosa pine and piñon-juniper, would be first replaced by grasses and shrubs and would not establish characteristics of woodland communities for approximately 35 to 50 years. Losses of mature forest would be long term and forest characteristics are not expected to develop for 50 to 100 years following the completion of production. Riparian vegetation grows relatively quickly, although decades would be required for the growth of mature trees.

In general, no new impacts are expected to occur on TES during the abandonment phase of the proposed project, provided that best management practices are followed to avoid contamination (e.g., sedimentation from erosion) of local streams and rivers and that abandonment activities (e.g., noise) do not disturb sensitive areas (e.g., active nest sites).

PRE-FIELD REVIEW

The Federally listed TES wildlife, fish, or plant species that have the potential to occur in the SUIT EIS Assessment Area are listed in Table 1.

The Mesa Verde cactus, black-footed ferret, Canada lynx, Gunnison sage grouse, whooping crane, yellow-billed cuckoo, and western boreal toad will not be considered further in this analysis since they are known not to occur, or are unlikely to occur in the Assessment Area. A further consideration for the black-footed ferret, was the lack of large prairie dog colonies within the

Assessment Area. The colonies are more typically small, fragmented, and scattered. The razorback sucker and Colorado pikeminnow will continue to be analyzed since water depletions affect downstream habitats where these fish are known to exist.

Table 1. Summary of Federally listed species that may occur within the Southern Ute EIS Assessment Area.

Species	Habitat	Presence
Knowlton's cactus	Pinyon juniper on tertiary alluvial deposits	Present
Mancos milkvetch	Mesa Verde Group outcrops	Possible
Mesa Verde cactus	Salt desert scrub communities in Fruitland and Mancos shale formations	Unlikely
Black-footed ferret	shortgrass to midgrass prairie to semidesert shrublands	Very unlikely
Whooping crane	mudflats around reservoirs and in agricultural areas	Migrant, possible but unlikely
Bald eagle	reservoirs and rivers	Present
Southwestern willow flycatcher	foothill and montane riparian thickets	Likely
Mexican spotted owl	steep canyons and dense forest	Possible
Yellow-billed cuckoo	wooded riparian of cottonwood and willow	Very unlikely
Canada lynx	high elevation spruce/fir forests	Not present
Gunnison sage grouse	sagebrush shrublands	Very unlikely
Western boreal toad	subalpine riparian areas	Not present
Razorback sucker	rivers	Not present
Colorado pikeminnow	rivers	Not present

Based on information from USFWS and CDOW sources, it was determined that a number of TES wildlife species and/or their habitat had the potential to occur in the Assessment Area. A field reconnaissance was conducted to inspect the habitat types present within the Assessment Area. Due to the programmatic nature of this EIS, site-specific field surveys were not conducted for certain species. These surveys would be conducted during the Preconstruction Phase when a site-specific Application for Permit to Drill (APD) or Application for Right-of-Way is filed.

STANDARD OPERATING PROCEDURES

The following measures are standard operating procedures during gas and oil development and are part of the proposed action.

- Where feasible, minimize surface disturbances by using existing well pads or minimizing well pad size.
- Access new wells using existing roadways or short spurs rather than through construction of new primary roads.
- Utilize existing rights-of-way for roads and pipelines to the greatest extent possible, to avoid fragmentation of Federally listed and rare plant and wildlife habitat.
- Reclaim and re-vegetate all areas of disturbed soil and include approved seed mixes, fertilizer, and mulch. Use native plants of the Reservation for reclamation. Monitor re-vegetated areas and conduct treatment repetitions, as necessary.
- Require noxious weed control in conjunction with all new oil and gas facilities and roads.
- Manage herbicide use under the supervision of a licensed pesticide applicator, and application, storage, and disposal procedures should meet state and Federal requirements.
- Separate topsoil and set aside for reclamation purposes.
- Prevent wildland fires whenever and wherever possible. Prevention methods include the use of spark arresters on chainsaws and mufflers on vehicles, as well as restrictions on burning.
- Avoid wetlands. If avoidance is impossible, identify unavoidable direct and indirect impacts on wetland areas during the individual well development planning stages. Develop wetland mitigation/monitoring plan and obtain necessary 404 permitting prior to initiation of construction activities.
- Avoid impacts to riparian and wetland systems to the extent possible. Minimize the number of stream crossings by roadways and pipelines. Cross streams and riparian areas at right angles, rather than parallel, by rights-of-way, including roads and pipelines, in order to minimize the area of impact on this resource.
- Protect water quality within, and downstream of, the project area from soil erosion and sedimentation by Best Management Practices, as described in the Application for Permit to Drill, that include erosion control devices and management procedures.
- Develop and implement spill prevention procedures.
- Avoid removal of mature, over-story riparian vegetation wherever possible.
- Line waste water pits to prevent contamination to ground water.

MITIGATION MEASURES

The following additional measures were developed to mitigate impacts to threatened and endangered wildlife and plant species within the project area. They are part of the proposed action.

- Conduct field surveys for Knowlton's cactus prior to all construction activities.
- Avoid individuals and populations of Knowlton's cactus which may be impacted by activities.
- Conduct surveys for Mancos milkvetch and avoid prior to well pad and rights-of-way construction activities.
- Minimize construction activities in wooded riparian habitat.
- Do not remove large cottonwood trees or other large trees within bald eagle winter range or winter concentration areas.

- Conduct annual winter roost surveys for bald eagles. Restrict well locations and rights of way to a distance of at least 0.25 miles away from active winter roosts.
- Restrict activities from 15 November to 15 March in bald eagle winter range and winter concentration areas.
- Construct well pads and rights of way at least 0.25 miles from active bald eagle nests.
- Restrict activities that could disturb nesting bald eagles within 0.5 miles of active bald eagle nests from January 1 to July 1.
- Avoid removal of large cottonwood or other large trees within the areas designated as bald eagle winter range or winter concentration areas, and areas that may provide nesting habitat.
- If development activities are required within bald eagle winter range or concentration areas, they would be restricted to working from 10:00 am to 2:00 pm (Craig 1995).
- If Mexican spotted owls are located within the Assessment Area, delineate Protected Activity Centers (PAC) around the nest or roost site by SUIT biologists and the FWS.
- Restrict development activities within a PAC, although they would be evaluated on a project-specific basis (USFWS 1995).
- Conduct Southwestern willow flycatcher surveys within suitable habitat prior to any construction activities to determine presence or absence of willow flycatchers.
- If Southwestern willow flycatchers are located during survey efforts, no surface disturbing activities would be conducted from late May through mid-July.
- Use Best Management Practices to avoid contamination of local streams and rivers to protect the razorback sucker and Colorado pikeminnow.

ANALYSIS OF EFFECTS

This section analyzes the TES that are known to occur in the Assessment Area or, based on available habitats, have the potential to occur in the Assessment Area. Information on species name, status, distribution/habitat, and also a conclusion regarding the likelihood of occurrence within the Assessment Area are provided. Also included in this section is an analysis of direct, indirect and cumulative effects that proposed gas development may have upon these species and/or their habitats. This section contains specific construction and operation practices that would help avoid or mitigate impacts on these species.

Species: **Bald eagle** *(Haliaeetus leucocephalus)*

Status: Federally Threatened

Distribution/Habitat: Bald eagles occur in Colorado primarily in the winter and are typically present from October to March. Bald eagles are considered to be uncommon to locally uncommon winter residents of the western valleys of Colorado. Wintering areas may include semideserts and grasslands, especially near prairie dog towns (Andrews and Righter 1992). Winter roost sites generally occur in sheltered areas with large trees for perching, a nearby food source, and minimal human disturbance. Bald eagles feed primarily on fish, prairie dogs, rabbits, and waterfowl. Bald eagles are considered to be a rare summer resident in restricted localities of Colorado. Although some nesting occurs in Colorado, most bald eagles migrate to northern breeding grounds and return to lower latitudes in winter. Populations have been severely impacted by shooting, habitat destruction, and pesticides.

Potential to Occur in Assessment Area: Bald eagles are known to both nest and winter in various locations throughout the Assessment Area. Winter range, including habitat designated as winter concentration areas by the CDOW, occurs along all the major drainages in the Assessment Area, as well as between the Florida and Pine rivers along northern boundary of the Reservation (see EIS Map 9 which is included in this BA). As many as 10 bald eagles may be present along the Pine River in winter (Diswood 1996). Three known active bald eagle nests occur within the Assessment Area, one is located near the Town of Allison west of the Navajo Reservoir and two are located on the Pine River north and south of the Town of Ignacio, respectively. All nests have been documented in large, mature cottonwood trees (Stroh 1998). Historic bald eagle nest sites also occur along the Animas and Pine rivers within the Assessment Area; these sites may be used by bald eagles again in the future.

Analysis of Effects: Bald eagles could be impacted both by the removal of wooded riparian vegetation as well as disturbances caused by gas development. Removal of wooded riparian vegetation primarily would occur during the construction phase (e.g., roads, drill pads, pipelines, and other facilities), rather than the operation and abandonment phases. While the removal of riparian vegetation would be minimized through avoidance as described above, nevertheless some minor fragmentation and degradation of this habitat type could occur.

Based on estimates of likely locations of wells, rights-of-way, and other facilities, direct impacts from surface disturbances to TES habitats were calculated. A maximum of 422 acres of bald eagle winter habitat would be directly impacted by construction of the Agency and Tribal Preferred Alternative without mitigation. These values represent 0.72 percent of the resource in the Assessment Area. By constructing on existing well pads, the area of disturbance can be reduced to 346 acres (0.59 percent). Furthermore, as prescribed as a first line of mitigation, this impact would be further reduced by siting well pads such that sensitive areas are avoided as much as possible.

Within the bald eagle winter concentration areas, a maximum of 77 acres would be directly impacted by the Agency and Tribal Preferred Alternative. These values represent 0.48 percent of the resource. By constructing on existing well pads, the area of disturbance can be reduced to 67 acres (0.42 percent). However, by following the prescribed mitigation it is possible to greatly reduce this direct impact by siting well pads such that sensitive areas are avoided as much as possible.

Disturbance-related impacts could be expected to occur throughout the year, especially during the production phase. Disturbance-related impacts from construction are expected to be short-term, although more severe than the operation phase. During winter months (November 15 through March 15), project activities within or directly adjacent to bald eagle winter ranges and winter concentration areas could result in the abandonment of some of these areas and may force individuals to use less optimal habitats. However, to reduce such impacts, construction would be restricted from 15 November to 15 March in bald eagle winter range and concentration areas.

Three active bald eagle nests are known to occur within the Assessment Area. Disturbance-related impacts that occur during summer months within or directly adjacent to bald eagle nesting sites could cause the disruption or abandonment of nesting activities. No activity would occur within 0.25 mile of an active nest. Seasonal restrictions during the eagle's reproductive period would be imposed within a 0.5 mile area to protect nesting birds.

Oil and gas activities could impact the eagle's prey base, including both fisheries and small mammal populations. Degradation of the water quality and quantity of local streams and rivers, and subsequently the degradation of fisheries, could adversely impact both summer and winter residents. Potential impacts on water quality could occur as a result of erosion and sedimentation, as well as from contamination from accidental spills and leaks associated with machinery fuels, lubricants, and drilling fluids. However, erosion and sedimentation would be minimized as described above by implementing best management practices, required spill prevention and remediation procedures, and containing fluids typically in small, lined and bermed areas or pits. Production water, which is highly saline, will be reinjected into formations below the Fruitland Formation and should not affect water quality or quantity, unless accidental spills occur.

Cumulative Effects: Based on the estimates of surface disturbances from existing oil and gas development within the Assessment Area, the cumulative effect of the Agency and Tribal Preferred Alternative combined with existing well pad development could maximally result in a total surface disturbance of 2,989 acres (5.1 percent of the resource) of bald eagle winter range and 719 acres (4.5 percent of the resource) of bald eagle winter concentration areas. Again, these impacts would be reduced by utilizing existing well pads where feasible and practical and by avoiding wooded riparian areas. Other cumulative effects, though difficult to quantify, could result from residential and other forms of development within wooded riparian habitats within the Assessment Area as well as from additional oil and gas and other development outside the Assessment Area.

We project that an additional 375 CBM wells will be constructed in the northern San Juan Basin, north of the Southern Ute EIS Assessment Area. This additional development is currently under study by the US Forest Service and BLM. Development of a lesser number of wells (95 wells) in the northern Basin was studied in the 1992 Forest Service/ BLM HD Mountain Gas Development EIS. The HD's EIS Assessment Area included bald eagle winter range along the Piedra and Pine rivers. The 1992 Biological Assessment for the HD's EIS concluded that 62 acres of eagle winter range would be impacted. The BA further concluded that there would be no-effect on the bald eagle. Mitigation measures approved in the HD's EIS Record of Decision are similar to those presented in this BA. The greater level of development now projected in the northern San Juan Basin has the potential to increase the density of wells in bald eagle winter range and thus to affect the species in ways similar to that described in this BA. Total avoidance of eagle winter range would not be possible if development were to proceed according to gas industry plans. The northern Basin CBM development EIS is still in scoping.

Mitigation Measures:

- Conduct surveys of nesting and roosting areas during appropriate seasons each year prior to initiation of site-specific project activities to determine if nest or roosting sites are active.
- Construct well pads and ROW's at least 0.25 miles from active bald eagle nests and active winter roosts.

- Restrict activities that could disturb nesting bald eagles within 0.5 miles of active bald eagle nests from January 1 to July 1.
- Avoid removal of large cottonwood or other large trees within the areas designated as winter range or winter concentration areas, and areas that may provide nesting habitat.
- Restrict activities within winter range or winter concentration areas during the period from November 15 to March 15.
- If development activities are required within bald eagle winter range or winter concentration areas, they would be restricted to the hours of 10:00 a.m. to 2:00 p.m. (Craig 1995).

Conclusions and Determination:

- There are nest and roost sites within or adjacent to the Assessment Area.
- Individuals are regularly sighted within or adjacent to the Assessment Area
- There is designated winter range and concentration activities within the Assessment Area.
- There are currently suitable nest or roost trees.
- Mitigations have been designed to protect active nest sites.
- Winter range and concentration activities may be affected by oil and gas construction and production activities, either by direct disturbance of nest and roost sites, or by impacting eagle prey base. Total avoidance of winter range and concentration areas is not possible.
- Standard operating procedures, and the mitigation outlined in this assessment should reduce potential impacts. Site specific project design would also incorporate project specific biological assessments and their recommendations, further reducing impacts during actual project development.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and is not likely to adversely affect</u> the bald eagle.

<u>Species</u>: **Southwestern willow flycatcher** (*Empidonax traillii extimus*)

<u>Status</u>: Federally Endangered

Distribution/Habitat: The FWS listed the southwestern willow flycatcher as endangered in February 1995. The southwestern willow flycatcher is a subspecies of one of the ten North American flycatchers in the genus Empidonax. Willow flycatchers are Neotropical migrants. The southwestern willow flycatcher arrives on breeding grounds as early as mid-May and may be present through mid-August. Migration routes and winter ranges are not well known.

The southwestern willow flycatcher breeds in riparian habitats along rivers, streams or other wetlands, where dense growths of willows (*Salix* spp.), seepwillow (*Baccharis* spp.), arrowweed (*Pulchea* spp.), buttonbrush (*Cephalanthus* spp.), or other shrubs and medium-sized trees are present, often with a scattered overstory of cottonwood (*Populus* spp.) (Tibbitts et al. 1994). Thickets or shrubs are approximately 13-23 feet in height, with dense foliage from approximately 13 feet above ground, and often a high canopy cover percentage. Nest site vegetation may be even or uneven-aged, but is usually dense and structurally homogenous (USDI 1995a). Surface water or saturated soil is virtually always present in or adjacent to nesting thickets. The nest-site community may be even-aged, or consist of diverse age classes of various plant taxa. Stream gradient may be also an important determinant in habitat suitability.

The distribution of the southwestern willow flycatchers within the state of Colorado includes areas below 8,500 feet elevation within the southwestern corner of the state extending north to Rifle, Garfield County, and east to Fort Garland, Costilla County (USFWS 1996).

Potential to Occur in Assessment Area: No comprehensive surveys have been done for the southwestern willow flycatcher within the Assessment Area, although surveys have been completed in support of individual well projects. Suitable habitat has been identified and has been mapped for the EIS. The ability to identify suitable nesting habitat for the willow flycatcher was difficult with the available vegetation data. Wooded riparian habitat has been used as a proxy and likely significantly over-represents what is actually available for nesting habitat (see EIS Map 6 which is included in this BA). Additionally, large willow stands associated with irrigation canals may provide additional suitable nesting habitat.

It is considered possible that the southwestern willow flycatcher breeds in the Assessment Area, although none have been identified. In 1995, willow flycatchers were identified near Pastorius Reservoir, which is located in the north-central region of the Assessment Area; however, these individuals were considered migratory and were not observed in the Assessment Area during the breeding season (T. Ireland, USFWS, personal communication, 1997). Other individuals have been located near Bayfield and south of the Assessment Area in New Mexico (Chris Schultz, pers. comm. 2001).

Analysis of Effects: Although suitable breeding southwestern willow flycatcher habitat does exist in the Assessment Area, no southwestern willow flycatchers have been identified and no critical habitat has been designated in the Assessment Area. Areas of suitable habitat would be surveyed in the future and a site specific BA conducted prior to the initiation of any site-specific oil and gas development projects.

The majority of the potential direct impacts on the southwestern willow flycatcher would occur from the removal of vegetation that would result from the construction phase (e.g., roads, drill pads, pipelines, and other facilities), rather than during the production and abandonment phases. Breaking up the riparian habitat would cause fragmentation and degradation of possible nesting habitat. Within the southwestern willow flycatcher's possible habitat (wooded riparian habitat), a maximum of 171 acres would be potentially impacted. This values represent 2.10 percent of the resource. By constructing on existing well pads, the area of maximum disturbance can be reduced to 165 acres (2.02 percent). However, it is the intent to greatly reduce this potential direct impact by siting well pads during project design such that sensitive areas are avoided as much as possible. The impacts to riparian vegetation would be minimized during site specific project design.

Cumulative Effects: Based on the estimates of surface disturbances from existing oil and gas development within the Assessment Area, the cumulative effect of the Agency and Tribal Preferred Alternative combined with the existing well pad development would result in potential total surface disturbance of 484 acres (5.9 percent of the resource) of wooded riparian habitat. However, this potential impact would be minimized by siting wells and roads away from flycatcher habitat during individual project design. In addition, this may be an overestimate of total acres disturbed since wooded riparian vegetation was used as a proxy for nesting habitat. Other cumulative effects, though difficult to quantify, could result from residential and other forms of development within riparian habitats within the Assessment Area, as well as from additional oil and gas and other development outside the Assessment Area.

In the northern San Juan Basin, there are similar habitat patterns as described for the Southern Ute Assessment Area. Suitable riparian areas are scattered throughout the analysis area. Suitable habitat will be mapped for the northern Basin EIS and similar mitigation as described here, including avoidance and timing limitations on activities, would apply.

Mitigation Measures:

- Conduct surveys within suitable habitat prior to any construction activities to determine presence of willow flycatchers.
- If birds are located during survey efforts, no surface disturbing activities would be conducted from 1 May through 15 August.
- Minimize disturbance to nesting habitat for the southwestern willow flycatcher.

Conclusions and Determination:

- No comprehensive surveys have been conducted for the Assessment Area. No nesting flycatchers have been observed in the Assessment Area during site specific surveys for individual well projects.
- Site specific surveys and BA's would be conducted prior to ground disturbing activities.
- A seasonal closure would be implemented to protect birds located during the survey effort.
- Riparian areas and wetlands would be avoided to the extent possible during project design. However, individuals or their nests could possibly go undetected during surveys potentially being impacted by well construction activities.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and may adversely affect</u> the Southwestern willow flycatcher.

<u>Species</u>: **Mexican spotted owl** (*Strix occidentalis lucida*)

<u>Status</u>: Federally Threatened

Distribution/Habitat: The FWS listed the Mexican spotted owl as threatened in April 1993. This spotted owl is geographically isolated from the Northern and California subspecies. It is distributed discontinuously throughout its range, with its distribution largely restricted to montane forests and canyons. It occurs in disjunct localities that correspond to isolated mountain systems and canyons.

Mixed conifer forests are commonly used throughout most of the owl's range. These forests are dominated by Douglas-fir and/or white fir, with codominant species including southwestern white pine, limber pine and ponderosa pine. The understory often contains these species as well as broad-leaved species such as Gambel oak, maples, boxelder and New Mexico locust (USDI 1995b). Mexican spotted owls typically nest and roost in closed-canopy forests or deep shady canyons; both situations provide cool micro-sites. They breed sporadically and do not nest every year. Eggs are laid in late March or, more typically, early April. The eggs usually hatch in early May (USDI 1995b).

Spotted owls appear to occupy two disparate canyon habitat types. The first is sheer, slick-rock canyons containing widely scattered patches (up to 1 ha in size) of mature Douglas-fir in or near canyon bottoms or high on the canyon walls in short, hanging canyons. The second consists of steep canyons containing exposed bedrock cliffs either close to the canyon floor or, more typically, several tiers of exposed rock at various heights on the canyon walls. Mature Douglas-fir, white fir, and ponderosa pine dominate canyon bottoms and both north- and east-facing slopes. Ponderosa pine grows on the more xeric south- and west-facing slopes, with pinyon-juniper growing on the mesa tops.

The owls nest and roost primarily in closed-canopy forests or rocky canyons. Forests used for roosting and nesting often contain mature or old-growth stands with complex structure. These forests are typically uneven-aged, multi-storied, and have a high canopy closure. Nest trees are typically large in size, where as the owls typically roost in both large and small trees. Douglas-fir is the most common species of nest tree.

In general, owls forage more in unlogged forests than in selectively logged forests. Both high-use roosting and high-use foraging sites had more big logs, higher canopy closure, and greater densities and basal areas of both trees and snags than random sites. Owls use a wider variety of forest conditions for foraging than they used for roosting (USDI 1995b).

Potential to Occur in Assessment Area: Spotted owl surveys were conducted in areas of suitable habitat within the Assessment Area. These surveys occurred prior to development of the EIS. No spotted owls were located. The Assessment Area is dominated by pinyon-juniper which is not suitable for nesting (T. Stroh, SUIT, personal communication 1997).

Analysis of Effects: No Mexican spotted owls are presently known to occur within the Assessment Area. If this owl is identified within the Assessment Area, management sites known as Protected Activity Centers (PACs) would be delineated by the SUIT biologists and USFWS around the nest site or roost site and typically would include an area of no less than 600 acres (USFWS 1994). Development activities generally would be restricted within a PAC, although they would be evaluated on a project-specific basis (USFWS 1995).

The removal of forest vegetation for construction would have a direct effect on spotted owl habitat. Clearing for rights-of-way would degrade habitat through fragmentation and create more edge. No suitable nesting habitat for the Mexican spotted owl would be affected under the Preferred Alternative since no nesting habitat is located within the Assessment Area. There is approximately

1,021 acres (6%) of suitable foraging habitat which would be affected by the surface disturbance.

Cumulative Effects: Based on the estimates of surface disturbances from existing oil and gas development within the Assessment Area, the cumulative effect of the Agency and Tribal Preferred Alternative combined with the existing well pad development is anticipated to result in a total surface disturbance of 1,021 acres (6 percent of the resource) of ponderosa pine vegetation, which is considered to be foraging habitat for the Mexican spotted owl. No nesting habitat is present within the Assessment Area, although it may be present in areas of densely, wooded coniferous forest in the vicinity of the Assessment Area. Foraging habitat has been identified within the Assessment Area. Other cumulative effects, though difficult to quantify, could result from timber harvest of coniferous forests within ponderosa forests in the Assessment Area as well as from additional oil and gas and other development outside the Reservation.

In the northern San Juan Basin EIS Assessment Area, areas of foraging habitat are present in the HD Mountains. Mexican spotted owl surveys were completed in the HD mountain area in the Ignacio Creek, Bull Creek, Turkey Creek, and Fosset Gulch drainages in 1990, 1991, 1996 and 1998. An owl was heard calling in the Fosset Gulch drainage in 1996 but no activity center was located, nor was the owl located again (Chris Schultz pers. comm 2001). No other owls were identified during the surveys.

Mitigation Measures:

- If owls are located within the Assessment Area, Protected Activity Centers (PAC) would be delineated around the nest or roost site by SUIT biologists and the FWS.
- Development activities would be restricted within a PAC, although they would be evaluated on a project-specific basis (USFWS 1995).

Conclusions and Determination:

- There is suitable foraging habitat within the Assessment Area which <u>may be impacted</u> by the proposed activities.
- There is no suitable nesting habitat within the Assessment Area.
- No owls have been located on the Southern Ute Indian Reservation.
- Mitigation measures have been designed to minimize impacts, if owls are located within the Assessment Area.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and is not likely to adversely affect</u> the Mexican spotted owl.

<u>Species</u>: **Colorado pikeminnow** (*Ptychocheilus lucius*)
Razorback sucker (*Xyrauchen texanus*)

<u>Status</u>: Federally Endangered

Potential to Occur in Assessment Area: The razorback sucker and Colorado pikeminnow are listed as endangered by the FWS. They will be analyzed together for purposes of this analysis. Neither species is known to occur within the Assessment Area. Critical habitat has been designated downstream in the San Juan River for both species.

There is a small reproducing population of Colorado pikeminnow in the San Juan River, downstream from Shiprock, New Mexico. During 1991 surveys, nine pikeminnow were captured 5 miles upstream from Shiprock.

The razorback sucker occurred historically in the lower Animas River. During a 1987 - 1990 study, suckers were observed within the San Juan River Basin in the vicinity of Lake Powell.

Analysis of Effects: Impacts to the Colorado pikeminnow and the razorback sucker have the potential to occur through water depletion and contamination of the San Juan River. As described in the Intra-Service Section 7 Consultation for Minor Water Depletions of 100 Acre-feet or Less From the San Juan River Basin (1999), the FWS concluded that "water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes". Water depletions can restrict the ability of the San Juan River to produce flow conditions necessary for the life stages of these fish.

Coalbed methane drilling and completion, as proposed, would require, in total, approximately 29 acre-feet per year of water that would typically be taken from irrigation ditches connected to the Animas, Pine, and Florida Rivers. This drilling and completion water would be recycled to a certain extent, but for the purposes of this analysis it is assumed that it would be lost from the system. In addition, existing coalbed methane wells in the Indian Creek area will continue to produce 37 acre-feet per year of water that would normally discharge to the Animas River or Basin Creek, but instead is pumped into deep formations or evaporation ponds. Therefore, a total of 66 acre-feet per year would be depleted from the San Juan River system as a result of the proposed action. Please see Appendix A for a water depletion summary (Janowiak 2001).

Surface and ground water quality have become a significant concern in the Animas, La Plata, Mancos, and San Juan drainages (USFWS 1994). Increased loading of the San Juan River and its tributaries with soil salts, elemental contaminants, and pesticides from irrigation return flows could potentially degrade water quality and harm fish within the system (USFWS 1994). Contamination to ground and surface water is unlikely as a result of this proposed action. Petroleum spills may occur but safety precautions are in place to keep these types of accidents to a minimum. In the event of a spill, procedures would be implemented to contain hazardous materials and decrease the likelihood that contaminated materials reach ground and surface water.

Potential impacts also include contamination by polynuclear (or polycyclic) aromatic hydrocarbons (PAH), which are a class of organic chemicals that are present in the environment from natural and anthropogenic sources. Relatively few (less than 50) are known to be toxic, mutagenic, teratogenic, or carcinogenic (Odell 1997). Sources of PAH production include: forest fires, agricultural burning, combustion engines, coal-fired energy generation, municipal and industrial waste discharge, stormwater run-off from streets and roads, and spills of both crude and refined petroleum and hydrocarbon products (Odell 1997). Polynuclear aromatic hydrocarbons have low water solubility and there is a low potential for mobilization via dissolution in surface or ground water. PAHs are found in sediments, aquatic biota, and the water column. PAHs in sediment are often found in concentrations 1000 or more times than in the water column (Abell 1994). They can be ingested by fish through their food or by ingesting the sediment itself. Concentrations of PAH have been found in fish but studies have been unable to draw direct correlations to anthropogenic sources (Joel Lusk, U.S. Fish and Wildlife Service, Albuquerque Field Office, pers. comm). Although no studies have unequivocally linked PAH contamination to fish disease, high incidences of tumors and other abnormalities have been documented in areas of PAH contamination (Abell 1994).

Mitigation Measures:

- Use Best Management Practices to avoid contamination of local streams and rivers.

Conclusions and Determination:

- Best management practices would be used to prevent sediment from reaching streams.
- Spill prevention measures would be implemented to contain hazardous materials and decrease the likelihood of contaminated materials reaching ground or surface water.
- Approximately 29 acre-feet per year would be used for drilling and completing wells. This water would be taken from irrigation ditches for the drilling. This water would be reused during other phases of construction.
- Approximately 37 acre-feet per year would be used during the production phase. This water would be intercepted by producing wells in the Indian Creek area from the Animas River recharge.
- The water is eventually disposed of into deep formations and would not discharge into the Animas river as it normally would. This is considered a depletion within the San Juan River system.
- The project involves minor depletions in the upper San Juan Basin. Therefore, it contributes to the cumulative effect on Colorado Pikeminnow and razorback sucker and constitutes a "may affect and likely to adversely affect" determination for these endangered fish species.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and is likely to adversely affect</u> the Colorado pikeminnow and razorback sucker.

<u>Species</u>: **Knowlton's cactus** (*Pediocactus knowltonii*)

<u>Status</u>: Federally Endangered

Potential to Occur in Assessment Area: The Knowlton's cactus occurs in piñon-juniper woodland with black sage (*Seriphidium novum*) in association with rocky alluvial soils at approximately 6,300 feet elevation. This species is one of the rarest of the genus and one of the rarest plants in the United States with collecting by hobbyists one of the factors contributing to its decline (Ecosphere 1995). The main population occurs near the New Mexico border, and other small populations are present on the Reservation. Because of possible collecting losses, specific locations of these populations are not provided in order to protect the species.

Analysis of Effects: Surface disturbing activities from gas and oil development would directly affect individual plants or populations. Within the pinon-juniper vegetation type, approximately 1,570 acres (1.15%) would be impacted through well pad and right of way development under the Preferred Alternative. Using existing well pads would reduce the disturbance to 1,318 acres (0.97%).

Cumulative Effects: Based on the estimates of surface disturbances from existing oil and gas development within the Assessment Area, the cumulative effect of the Tribal and Agency Preferred Alternative combined with the existing well pad development is anticipated to result in a total surface disturbance of 6,543 acres (4.8 percent of the resource) of piñon-juniper (medium to high density) habitat. Other cumulative effects, though difficult to quantify, could result from residential and other forms of development within piñon-juniper habitat within the Assessment Area, as well as from additional oil and gas and other development outside the Assessment Area.

Mitigation Measures:

- Conduct field surveys as part of the BA process prior to all construction activities.
- Avoid plants and populations which may be impacted by activities.
- Use existing rights-of-way when possible.

Conclusions and Determination:

- Field surveys would be conducted prior to construction activities.
- Plants and populations located during the surveys would be avoided. However, individual plants could go undetected and be impacted by well construction activities.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and is not likely to adversely affect</u> the Knowlton's cactus.

<u>Species</u>: **Mancos milkvetch** (*Astragalus humillimus*)

<u>Status</u>: Federally Endangered

Potential to Occur in Assessment Area: Mancos milkvetch is found on ledges and mesa tops in slickrock communities of the Mesa Verde Group in the Four Corners area. This species has been observed in Montezuma County, Colorado and San Juan County, New Mexico. Mancos milkvetch has not been observed in the Assessment Area, although Mesa Verde Group outcrops are present.

Analysis of Effects: Surface disturbing activities could directly affect individual plants and populations through their removal or habitat destruction. Cumulatively, residential development may occur within the Assessment Area. However, ledges and mesa tops are relatively inaccessible and the likelihood of impacts is quite low. There should be little or no cumulative effects to the Mancos milkvetch.

Mitigation Measures:

- Conduct surveys prior to well pad and rights-of-way construction activities and, unless previously surveyed by the FWS.
- Avoid individuals or populations located during pre-construction surveys.

Conclusions and Determination:

- The Mancos milkvetch has not been located within the Assessment Area.
- Some suitable habitat exists within the Assessment Area.
- Surveys would be conducted prior to all construction activities and the plant would be avoided. However, individual plants could go undetected and be impacted by well construction activities.

It is my professional determination that the oil and gas development on the Southern Ute Indian Reservation <u>may affect and is not likely to adversely affect</u> the Mancos milkvetch.

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Colorado IB-95-1

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE

INFORMATION BULLETIN TO ALL FEDERAL AND INDIAN OIL AND GAS LESSEE/OPERATORS

Prevention of Potential Bird and Bat Mortalities
Caused by Production Equipment Design

Purpose:

To encourage oil and gas operators to prevent potential and unnecessary losses of birds and bats. Colorado BLM is notifying all oil and gas operators under a federal lease of this potential mortality situation that exists with open stacks on their production equipment (dehydrators and heater treaters).

Background:

Mortality of birds and bats associated with open exhaust stacks on production equipment is of concern to the Colorado Bureau of Land Management. Within the last year, BLM has been working with several oil and gas companies as well as requiring our petroleum inspectors to conduct informal inspections of production units to determine the extent of these potential losses. At this time, our Colorado information is nonconclusive as to the extent of these bird and bat mortalities from these open exhaust stacks. A few on-site examples (14) were conducted in the Rifle and Rangely areas by removing gas well exhaust stacks. In the Rifle area, bone remains of a bluebird were found in one unit. In addition, on-site visual inspections were made of gas well facilities over the state by petroleum engineering technicians. From these inspections (approximately 200 units), no bird or bat carcasses were documented.

However, reports from different sources in New Mexico conclude that a problem does exist and is one of great concern. Different sources from BLM offices in New Mexico have reported losses of birds from being trapped inside fired units of gas wells. Cavity nesting birds such as mountain bluebirds and flickers, along with finches and shrikes were most often found in exhaust stacks. Results of volunteer surveys by industry and random sampling by BLM have shown that bird loss was occurring. Information provided by different gas companies varied greatly. Bird mortality reported varied from a small percentage of well locations to finding several birds at a single location. The information gathered did show that losses were generally occurring throughout the San Juan Basin and in Southeastern New Mexico. Equipment on a total of 2,500 wells was examined and results reported to BLM were that 252 birds and bats were found. Bird losses were more concentrated towards equipment that was fired intermittently.

Recommended Action:

Because many uncontrollable factors are contributing to the decline of several species of migratory birds, there is one factor that BLM and the oil and gas industry can control through discouraging birds and bats from entering exhaust stacks. This can be accomplished by covering the exhaust sack with a screen or other excluder devices to discourage birds and bats from entering, perching, and nesting on stacks. These preventative measures by industry would improve the environment for birds and bats.

Responsibility:

BLM is mandated to prevent unnecessary loss of wildlife including birds and bats through actions implementing resource programs. Owners of production equipment operating under a federal lease are responsible for preventing loss of birds and bats. Irresponsible parties could be in violation of the Migratory Bird Treaty Act subject to financial penalties enforced by the U.S. Fish and Wildlife Service. Under the Migratory Bird Treaty Act, any take of birds (causing death) is considered a violation of the Act and enforced by the U.S. Fish and Wildlife Service. Migratory birds protected by the Migratory Bird Treaty Act are listed in 50 C.F.R. 10.13.

Future Action:

BLM will continue to evaluate the potential mortality problem through our routine oil and gas inspection program of facilities. Any escalation of this potential problem may result in requiring operators to provide protective measures on exhaust stacks.

If you need additional information or have questions, please contact Pat Gallagher at (303) 239-3756 or contact the lc

Date: January 30, 1995 Signed: Dave Strunk,
Deputy State Director,
Resource Services

Return to NTL Page Oil and Gas Home

Colorado NTL-88-1

United States Department of the Interior
Colorado Bureau of Land Management

Notice to Lessee/Operators of Onshore Federal Oil and Gas Leases Within the Jurisdiction of the Colorado State Office

NTL-CO-88-1

Well Abandonment and Bonding Requirement Revisions

This notice is to inform lessee/operators of the Bureau of Land Management (BLM) policy that has been developed in response to the recommendations presented by the Bonding Task Force to the Washington Office.

The Task Force was set up as a result of widespread industry concern about a proposal to amend the existing fluid mineral bonding requirements that was published in the May 1, 1985, Federal Register. The rulemaking would have consolidated the existing bond types and increased the present bond amounts which had only been adjusted once in 56 years. This Task Force was mandated to review the bonding issue, solicit industry views, evaluate various alternatives, and provide the Director with recommendations. The Task Force has completed its review and submitted its final recommendations (Enclosure).

As a result of these recommendations, the BLM has instituted a phased release of bond liability. The phased release of bond liability applies only to federal wells. The Bureau of Indian Affairs is responsible for acquiring and releasing the bonds on Indian leases and it has no similar provisions for the phased bonding release. This policy applies only to single lease bonds and only to the abandonment of the last or only well on a lease. Normally, these are the $10,000 bonds for lessees, operators, or designated operators. Under the phased release, the authorized officer (AO) will be able to reduce the amount of the bond upon completion and inspection of different phases of abandonment. In Colorado, the program will consist of two phases. Phase I goes into effect after proper plugging of the leasehold's well(s) and after the site has been stabilized and seeded. Phase 2 goes into effect once reclamation is deemed complete, i.e., the site has been successfully revegetated and reclamation can be approved. Depending on the location of the site and the amount of reclamation that was required, a percentage of the bond liability can be released at Phase 1. This percentage will vary, but may go as high as 80 percent. Upon successful revegetation (Phase 2), the bond would be totally released, provided all other work necessary on the lease has been completed. The principal and surety will both be notified of our actions at each phase.

As part of the Colorado State Office review of the procedures for this process, the procedures that lessee/operators were following with regard to the permanent abandonment of each newly completed well, recompleted well, or producing well not capable of producing oil or gas in paying quantities were also examined. As a result of this examination, the procedures for permanent abandonment have been revised to incorporate phased bonding release. The entire process is as follows:

1. Notice of Intention to Abandon (NIA) (Form 3160-5, Sundry Notice) notification of proposed

plugging procedures, or confirmation of verbal plugging procedures. If plugging operations are not commenced within 30 days of approval, the operator must submit a request for approval to temporarily abandon the well, including the date when plugging operations are expected to take place.

2. Subsequent Report of Plugging (SRP) (Form 3160-5, Sundry Notice) notification within 30 days following execution of plugging, detailing procedures used for the plugging operation, including method, waiting on cement times, any tags, and any problems or abnormalities. Surface reclamation should be addressed under a separate Sundry Notice or letter.

3. Subsequent Report of Abandonment (SRA) (Form 3160-5, Sundry Notice) notification of completion of surface restoration (dirt work and reseeding). The SRA should not only detail the work that was done but also request partial bond liability release. This Sundry Notice is only required when requesting partial liability release of a single lease bond; it is optional in all other cases. Operators who do not request phased bond release should include the dirt work and reseeding information in their Final Abandonment Notice (FAN) (see item 4). The SRA is an acceptance rather than an approval action. The lease will be inspected at this time to assure that the dirt work and reseeding meet APD requirements. If there are any questions as to how the dirt work should be completed, the operator should request an inspection prior to removal of earthmoving equipment.

4. Final Abandonment Notice (FAN) (Form 3160-5, Sundry Notice) notification to the AO that restoration of the disturbed surface.area has been completed, including adequate vegetational growth, and the location is ready for inspection. Operators who do not request partial bond release should submit all surface restoration and reclamation information for this location on this notice. On Form 3160-5, check "Other" box under "Subsequent Report of" and fill in "FAN" in the blank provided. BLM approval of final abandonment must wait the length of time necessary to rehabilitate a location and access road and obtain a sufficient stand of vegetation for inspection. Depending on what part of the state your operations are in, this waiting can take from 1 to 4 years. Upon successful rehabilitation of the last well on a single bond lease, the bond may be released, provided all other work necessary on the lease has been completed.

Once the NIA has been submitted, a copy will be made and forwarded to other Surface Management Agencies (SMA), if applicable, for any revised reclamation stipulations, confirmation of water well conversion, etc. The SMA or Resource Area is responsible for approving or establishing the methods and special requirements for surface rehabilitation and determining when this rehabilitation has been satisfactorily accomplished. As such, once the FAN has been submitted, a copy will be made and forwarded to other involved SSMAs if applicable. The BLM has made a commitment that an inspection to determine if reclamation is satisfactory will be made within 60 days of receipt of a FAN, weather permitting, provided BLM is the SMA and assuming the FAN is filed when reclamation is complete. If the BLM or other SMA inspection reveals satisfactory reclamation, the FAN is approved. If the well is the last producing well on the lease and the lease is in good order, a bond release recommendation will be made to the Colorado State Office, provided all other work necessary on the lease has been completed.

If there is more than one single lease bond for that particular leasehold, all bonds will be released by the same amount. The remaining amount of the partially released bond is an "acceptable alternative" to the full bond amount as the bond would be progressively reduced to an amount commensurate with the leasehold's risk. For wells where the bonding is different for deep and shallow formations, phased releases will occur by segregation, i.e., when the last shallow well is plugged, phased bond release for the shallow bonds could occur. Bonds for the deep wells would continue to be held. The site will be inspected at each phase before partial or complete liability release can occur. The BLM has made a commitment that, allowing for weather, etc., a field inspection will be made following a lessee or operator request, for either phase, so that bond reduction or release can be completed within 60 days of the request.

Please be aware that the above procedures must be followed for all abandonments whether or not the operator requests partial bond liability release.

Operators who have already filed SRAs in the past and who wish to clear the books of those wells that have been rehabilitated may file a second SRA and/or FAN at the appropriate jurisdictional office.

Date: December 30, 1987 Approved by: Ralph Smith,
Acting State Director

Enclosure

BONDING TASK FORCE
FINAL RECOMMENDATIONS

INTRODUCTION

On May 1, 1985, the Bureau published in the Federal Register a proposal to amend the existing fluid mineral bonding requirements. The rulemaking would have consolidated the existing bond types from twelve to only four, combining b oil and gas with geothermal and seismic with drilling bonds, and would also have increased the present bond amount: been adjusted only once in 56 years.

This proposed rulemaking received a mixed response from industry. While most commentors were supportive of bor consolidation, they were strongly opposed to increasing the bond amounts. Their opposition stemmed from concerns the ability to obtain new bonds at the higher amounts, the current economic state of the oil and gas industry, and the ' health" of surety companies.

Because of these widespread concerns underlying the Bureau's bonding requirements, the Director convened a task of three State Directors (New Mexico, Chairman, California and Wyoming) and a representative from the Minerals Ma Service. The U.S. Forest Service and the Office of Surface Mining have attended ex officio. This task force was mar review the bonding issue, solicit industry views, evaluate various alternatives and provide the Director with recommen

The task force has completed this evaluation and developed their final recommendations. These recommendations a below along with other alternatives which were considered but did not merit recommendation.

FINAL RECOMMENDATION

1. Maintain present bonding requirements including present types of bonds and bond amounts but add provisions in regulations to allow for:

a) "Piggyback" on State oil/gas bonds where possible. Under this arrangement, operators who have State oil and gas bonds would, with the State's permission, satisfy the Bureau's bonding requirements through these State bonds. This is already the practice in the Bureau's locatable minerals program and it would relieve operators of the cost of 'double' bonding. Steps would be taken to coordinate actions between BLM and willing State governments.

I Concur: signed Robert Burford

b) Allow third party surety bond coverage of lessee or operator. This provision would allow a party other than the operator or lessee to provide the bond to the Bureau to cover the operator's activities. The advantage lies in the operator/lessee not needing to qualify for surety bonding but only having to find a patron to provide the bond , perhaps at a cost lower than for a surety bond for the operator/lessee.

I Concur: signed Robert Burford

c) Accept letters of credit in lieu of bonds. This regulatory change would allow the use of irrevocable letters of credit in place of surety bonds. They would be issued by a financial institution such as a bank and the Bureau would be named as the sole payee. Letters of credit would provide a sound source of funds and may be easier for some to obtain than surety bonds.

I Concur: signed Robert Burford

2. Remind field offices by instruction of the opportunity to raise bond amounts where appropriate. The Bureau currently has the authority to raise the amount of any bond when additional coverage is determined to be appropriate. The purpose of this instruction would be to emphasize this current authority and to encourage its use when necessar The field offices, however, would be cautioned to increase bonds on a selective basis and to adequately document su decisions.

I Concur: signed Robert Burford

3. Instruct field offices to release individual well bond liability as soon as possible after receiving request. Delays in releasing bond liabilities have made it difficult for some operators to acquire other bonds since surety companies look at existing bonds as outstanding financial obligations. This change would allow a staged release of bond liability, whereby the bond would be promptly reduced to a much lower amount upon completion of all abandonment/reclamation work except revegetation. A small portion of the original bond amount would be retained until the final stage (revegetation) is completed.

Concur: signed Robert Burford

4 Seek legislation to make a portion of the Reclamation fund proceeds available for oil/gas, geothermal, or mining reclamation. This fund receives a significant percentage (42 percent) of its total proceeds from oil and gas receipts. However, such proceeds are not available for reclamation work because, by statute, the purpose of the fun for the "construction and maintenance of irrigation works." This proposal would seek legislation whereby the monies credited to the fund from oil and gas leasing would be "net" the amounts needed to cover reclamation or related loss

I Concur: no signature

NO RECOMMENDATIONS ON:

1. Changes in bond amounts. Changes in the existing bond amounts are not recommended at this time due to: the current depressed oil and gas market, the uncertain impact on the ability of operators to secure new bonds, and t availability of preferable alternatives.

2. Bond consolidation (i.e., with seismic or geothermal). It is not recommended that oil/gas bonds be consolidated with seismic bonds because few firms engage in both activities and where there are both undertakings, with the same firm they are usually separate. Neither is it recommended that bonds for oil/gas and geothermal activities be consolidated due to the substantial differences between the two.

3. Action on other types of bonds (OTHER THAN oil and gas and geothermal as well as mining, as above). No other recommendations are presented for any other types of bonds because no such need was uncovered during thi evaluation because of the narrow focus of the task force's work.

4. Bond funds (i.e., "super fund" concept). The establishment of a bond fund for oil and gas reclamation would require specific legislation and impose significant administrative workloads. A bond fund could also generate controversy regarding the collection of fees and disbursement of payments. There was initial extreme opposition to any such mutual schemes by industry spokespersons.

5. Abolishment of bonds. The elimination of bonding requirements, it was felt, would impose an unacceptable risk upon the Federal Government and taxpayer. This elimination would also require legislation and would likely mee with public opposition.

6. Expanded types of bond collateral. Allowing operators to post collateral in lieu of a surety bond would be administratively burdensome as the Bureau would be required to appraise, manage, and protect any assets. Problen could also arise in converting the assets to cash to exercise attachment of the "bond".

7. Self bonding. Under this option, an operator could submit evidence of the company's financial strength and demonstrate financial responsibility in lieu of submitting a bond. This approach would impose a significant administrative workload on Government to assess credit worthiness and require specialized financial expertise. Furthermore, at least one State which currently uses this approach is considering disallowing its use because of thes very problems.

8. Priority collection on a bond. Also considered, but without recommendation, is the issue of whether the Bureau or Minerals Management Service (MMS) should have priority in collecting on an oil and gas bond if there is both a royalty loss (MMS) and a loss from improper or no reclamation (Bureau). The issue was raised because the Bureau would have to cover the actual reclamation outlay from its appropriation if there was not a sufficient share of the bond for BLM. MMS losses are unrealized gains. The task force decided that such matters may be best handled on a case by case basis. However, the MMS/BLM Steering Committee may wish to consider this item to determine whether it warrants a policy recommendation. This issue is also being considered by a special task force and recommendations are due by April 17, 1987.

www.co.blm.gov/oilandgas/ntl-88-1.htm
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Colorado NTL-88-2

Department of the Interior
Colorado Bureau of Land Management

Notice to Lessee/Operators
of Onshore Federal Oil and Gas Leases
Within the Jurisdiction of the Colorado State Office

NTL-CO-88-2

Paying Well Determinations and Venting, and Flaring
Applications on Jurisdictional Coal Bed Methane Wells

This notice is to inform lessee/operators of the Bureau of Land Management Colorado State Office's policy in regard to the processing of paying well determinations and venting and flaring applications on federal coal bed methane wells within the state of Colorado.

Production characteristics of coal bed methane gas wells are radically different than gas wells completed in conventional reservoirs. The traditional methods and procedures for doing paying well determinations cannot be applied to coal bed methane production. For those leases in or approaching extended terms on which the only production is coal bed methane, a premature nonpaying well determination may lead to loss of resources and royalties and this is clearly not in the best interest of either the lessor or the lessee.

The guidance outlined below is intended to deal with the problems associated with doing paying well determinations on coal bed methane wells.

Coal Bed Well Classification

A coal bed methane well is defined as any well predominantly completed in coal seams (usually based on electric logs, drilling time, drill cuttings, mud logs, completion reports) making measurable amounts of methane gas and generally characterized by the following parameters:

1. Reservoir performance data such as inclining gas production over time.
2. Associated high water production generally requiring artificial lift.
3. Water analysis showing relatively high bicarbonate content.
4. Gas analysis showing relative low BTU value with associated carbon dioxide.
5. Potential formation damage as a result of shutting in the well.
6. Possible detrimental effects from water encroachment as a result of shutting in the well.

Some wells may not exhibit all six of the above characteristics, but may still be classified as coal bed methane wells if conclusive evidence is provided by the operator. These classification standards do not apply to a Federal Energy Regulatory Commission category 107 determination.

Paying Well Determinations on a Leasehold Basis

Leasehold paying well determinations for wells classified as coal bed methane wells will be a two-stage process as described below:

1. Prepare an initial paying well determination.

Sufficient cost and income data are usually not available at the completion of coal bed methane to perform a typical paying well determination. An initial paying well determination can be granted for classified coal bed methane wells if it appears that a prudent operator would continue to operate the coal bed methane well in expectation of improving the well's performance. If the lease is approaching the end of its primary term and is not otherwise held by production, a positive initial paying well determination will serve to extend the lease as held by production. The operator will then be granted a period of time up to one year from the completion date of the well to continuously test the well. This initial testing period will be used to establish a baseline for monitoring the anticipated gas incline/water decline response.

The accurate measurement of water during this one-year testing period will be as important as the accurate measurement of gas for the purpose of evaluating the well's response. If requested, additional six-month extensions of the one-year testing period may be allowed. The total testing and demonstration period shall not exceed two years unless extensions of the testing periods have been granted due to an unavoidable delay situation deemed to be beyond the control of the operator, which prevents continuous operations. Any extended testing/producing period must be justified by .facts that indicate a prudent operator would continue to produce the well in anticipation of improving its performance. Any lease extended by a positive initial paying well determination will be closely monitored to ensure the continuous production of the well.

Any lease that is considered to be held by production due to a positive initial paying well determination on a coal bed methane well will be considered to be on minimum royalty, not advanced rental. A positive Initial paying production determination may result in the issuance of a first production notice.

2. Prepare a final paying well determination on a leasehold basis.

A favorable fiscal paying well determination could be made at any time the initial testing period leads the authorized officer to believe that the gas production would increase to some point within the next six months so the well would be capable of producing leasehold substances in paying quantities. A final nonpaying well determination could be made at any time the information warrants such a decision. If a nonpaying well determination is conducted for the last well that was considered to be extending on the lease, then the lessor/operator would have to be given 60 days to restore some type of paying production to prevent lease termination.

A lease considered to be held by production due to a positive initial paying well determination may also be subject to termination prior to a final paying well determination if one of the following two circumstances occur: (1) the approved period of continued production expires or (2) diligent producing operations cease without acceptable justification. Should one of these circumstances occur, such a lease would be terminated effective the date of notification of the circumstance unless the lease has another satisfactory source of paying production or diligent operations to restore paying production are commenced within 60 days after notification.

For coal bed methane wells, a final paying well determination is the same methodology used for conventional oil and gas wells in that we must determine if the well can produce sufficient quantities to overcome operating/overhead expenses which should not include capital well/facility investments. The only variance would be the high cost of disposing of produced wastes, and coal bed methane wells are anticipated to initially produce abnormally high volumes of water. This would be a severely limiting factor in the economics of a determination. To mitigate this effect, the costs of water disposal would be prorated over a period of ten years or the projected life of the well, whichever is less.

The relevant circumstances the authorized officer may use in reaching a paying well determination can include the engineer's best professional judgment as to whether and to what extent the well in question will perform, compared to the prevailing theory for coal bed methane production at the time of the determination.

Paying Well Determination on a Unit Basis

The process discussed for initial paying well determinations on a leasehold basis can be applied to coal bed methane wells drilled under the terms of a unit agreement. If such a determination is made. it would serve to hold any expiring leases in accordance with the 67 IBLA 246 Yates Petroleum Company decision dated September 24, 1982.

A coal bed methane unit well which has had initial paying well determinations will not satisfy the drilling requirements established under section 9 of the model form of the unit agreement. Drilling must continue until a discovery of unitized substances in paying quantities is made. A well which has had an initial paying well determination is not considered to be a well capable of producing unitized substances in paying quantities. To accommodate extended testing/producing requirements for establishing unit paying production, section 9 may he amended to allow for extended drilling, timeframes between the completion of one coal bed methane well and the commencement of another.

Final paying well determinations for coal bed methane unit wells are different than the final determinations as described in item 2 above for leasehold wells. Again, it is the intent of such a final determination to demonstrate that the unit well is capable of producing methane gas, a unitized substance, in paying quantities. To accomplish this, inclined methane and prorated water production rates will be used to determine if a well has the capability to produce unitized substances in sufficient quantities to repay the cost of drilling, completing, and producing operations with a reasonable profit. As long as the cash flow remains positive, there is no limit to the number of years for payout.

Venting and Flaring

Limited evidence in the field suggests that there may be a significant risk associated with shutting in a coal bed methane well even for a short time (i.e., a few days). At best, the benefits of dewatering the coal seam will be hindered, and at worst, the well could be lost. Consequently, venting and flaring issues will need to be addressed. This Is especially true during periods of market curtailment. Venting and flaring approvals will be processed as follows:

Development wells

A development well is defined as any well within one-quarter of a mile of a feasible pipeline hookup. Venting and flaring will be administratively authorized on development wells until an initial paying well determination is made. In most cases, the initial paying well determination will be made within a 30-day period following completion or recompletion of the well. For the most part, development wells will follow the existing procedures in NTL-4A. That is, after the initial 30-day period following completion or after the initial paying well determination is made, whichever occurs later, gas will be considered avoidably lost and royalty will accrue unless an NTL-4A application is approved to continue venting and flaring as it is uneconomic to capture the gas.

2. Step-out/wildcat wells

Step-out/wildcat wells are defined as new wells greater than one-quarter mile from an acceptable pipeline hookup. A with development wells, the venting and flaring will be administratively authorized until the initial paying well determination is made. Any additional venting and flaring after the initial paying well determination is made will require the approval of an NTL-4A application. Generally, the venting and flaring will be authorized as unavoidably lost under the special well test provisions, and royalties would not accrue until a final paying well determination is made.

3. Venting and flaring after the final paying well determination

After the final paying well determination is made for step-out/wildcat wells, the gas vented and flared will generally be considered as avoidably lost and royalties will accrue. It should be noted that existing guidance allows for the unavoidable short-term venting or flaring of gas without incurring royalty obligation in certain circumstances. These circumstances include temporary emergency situations (i.e., equipment failures, relief of abnormal pressures, market disruptions), routine purging, or other conditions which result in the unavoidable short-term venting or flaring of gas. This authorization is limited to 24 hours per incident and to 144 hours total for the lease during any calendar month.

If you have any questions concerning this matter, please contact Rick Ryan of this office at (303) 239-3751 or Kent Hoffman or Jim Lovato of the San Juan Resource Area Office at (970) 247-4082.

Date: September 26, 1988 Signature: Tom Walker,
Associate State Director

BRIEFING PAPER

ISSUE: Should Colorado Notice to Lessee/Operators (NTL): NTL -CO-88-2, "Paying Well Determinations and Venting and Flaring Application on Jurisdictional Coal Bed Methane Wells" apply to Indian lands as well as federal lands?

1. Background

Coal degasification activities an federal and Indian land in the state of Colorado has significantly increased during FY 1988. A large majority of the activity is located on Indian land in the San Juan Resource Area. Typically these coal degasification wells produce significant volumes of water and small amounts of methane gas at completion. As the well is continuously produced, the water production decreases and the methane gas production increases. These inclined gas production rates can take a considerable amount of time to establish. The net effect is that a coal bed methane well's peak gas production is established much later in the life of the well, unlike a conventional gas well.

This office felt that inclined production curves and extended testing requirements to establish this production history would have direct impact on existing operational policies which have been developed for conventional gas wells. In conjunction with the San Juan Resource Area, this office took the initiative to examine the following issue areas that directly impact coal bed methane operations on federal and Indian land: 1) when can a gas well be considered a coal bed methane well, 2) what production rates must be sustained by that well to extend a lease, and, 3) how much gas could be flared or vented royalty free during the extended testing/producing periods.

It was the consensus of this office and the San Juan Resource Area that a lease should not terminate at the end of its primary term if it contains a coal bed methane well that will become more prolific as the well is continually produced. This office took the lead to develop a policy concerning these issue areas and felt that a NTL for both federal and Indian lands should be issued so all coal bed methane operators would be adequately informed of this policy.

Operators soon began to realize that the unique producing aspects of coal bed methane wells would have a direct impact on their lease terms. To deal with the above issue areas, along with spacing requirements and NGPA classifications, they formed a committee entitled the Fruitland Coalbed Methane Committee. Both the Bureau of Land Management and the Southern Ute Indian Tribe were members of this committee. The San Juan Resource Area Office presented our NTL to the committee in draft form for comment. The committee, which included the representative from the Southern Ute Indian Tribe, had no objections to the issuance of the NTL as it applied to both federal and Indian land.

II. NTL Policy Issues

A. Paying well determinations. Present guidelines in the Bureau state that a paying quantities determination is a determination as to whether or not, under all relevant circumstances, a prudent operator would continue to operate a well in the manner in which such well is being operated for the purpose of making a profit and not merely to hold the lease for speculation. It is our contention that if an operator is continually testing/producing a coal bed methane in attempt to incline production rates to the point of economic feasibility, then the operator is diligently attempting to establish a viable gas resource on the lease. An initial paying well determination can be granted as long as testing/producing operations remain continuous and the authorized officer has determined that through these testing operations, the operator can reasonably expect production to incline significantly.

Extraordinary expenses should not be included in a paying well determination. Only those costs incurred on a day-to-day basis and which are expected to occur in the future should be considered. Pursuant to this existing burea policy the NTL suggests that inclined production rates and prorated water disposal costs should be used in an economic valuation. These factors are typically experienced by a coal bed methane well in the foreseeable future as t well is produced.

2. Venting/Flaring. NTL-4A states that gas vented/flared during a special test period can be considered unavoidably lost. Therefore, until a coal bed methane well is tested significantly to establish economic inclined producing rates (i.e., final paying well determination), the testing period can be considered special and therefore all

gas vented/flared can be considered unavoidably lost. However, those wells reasonably close to a pipeline hook-up and not considered to be subject to this special test provision since there is a nearby marketing outlet for the gas duri the extended testing period.

3. Limits on the amount of time an operator can spend diligently testing/producing a coal bed methane well pri to a final paying determination being conducted by the authorized officer were established (i.e., not to exceed two years). The rationale for this being that after certain point if the operator has not obtained satisfactory inclined production rates, then the operator is simply operating the well for possible lease speculation and not for the purpose of making a profit.

III. Implementation

After receiving concurrence from the Fruitland Coalbed Methane Committee, this office distributed the NTL to the Rocky Mountain Oil and Gas Association, Independent Petroleum Association. of Mountain States, Colorado Oil and Gas Conservation Commission, Southern Ute Indian Tribe, Fruitland Coal Bed Methane Committee, and the district offices. The only objection to the issuance of this NTL was received from the Souther Ute Indian Tribe. It should be noted that as a Fruitland Coal bed Methane Committee member, the Southern Ute Indian did not appear to have any objections to the NTL at that time.

IV. Conclusion

This NTL is in conformance with all existing regulations and policies. The NTL establishes a uniform policy to be applied to all coal bed methane operations in the state of Colorado. Through the issuance of this NTL, operators will understand what performance standards have been established for their coal bed methane operations. Each operator should not have to negotiate a separate agreement with the mineral management agency to determine what they must accomplish with their operations to perpetuate a lease. The NTL will be issued for federal lands. The issuance of the NTL for Indian lands will be deferred until a decision is reached by the Washington Office.

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
San Juan Resource Area Office
701 Camino Del Rio
Durango, Colorado 81301

Notice to Lessees (NTL) and Operators of Federal and Indian Oil and Gas Leases within the Ignacio-Blanco Field

NTL MDO-91-1, Change 1

April 15, 1998

This change notice is issued pursuant to the authority delegated to the Authorized Officer (AO) under 43 CFR 3161.2 and 43 CFR 3164.2 to implement oil and gas operating regulations pursuant to 43 CFR 3160 and the terms, conditions, and attached stipulations of the Federal and Indian oil and gas leases. In accordance with the regulatory guidelines referenced above, lessees and operators shall conduct operations in a manner which protects the health, safety, and welfare of the public in addition to protecting natural resources and the environment. Operations shall also be conducted in a manner which results in maximum economic recovery of the oil and gas resources with a minimum amount of waste.

Background

On July 23, 1991, the Bureau of Land Management (BLM) issued NTLMDO-91-1 (Bradenhead Testing). That notice was-issued in response to evidence of methane contamination in groundwater as documented in water quality analyses of domestic water wells. Since 1991, the BLM has aggressively implemented the terms and conditions of NTL MDO-91-1. The Colorado Oil and Gas Conservation Commission (COGCC) has also implemented and enforced similar requirements for gas wells on state and fee lands.

As a result, the extent and magnitude of gas wells exhibiting mechanical integrity problems identifiable by this process has been ascertained. Concurrent with the bradenhead testing effort, water well testing has been conducted to identify the presence of entrained methane contamination. These combined efforts have helped the BLM delineate "Critical Areas" where methane contaminated water wells exist.

Bradenhead testing has helped the BLM and the COGCC identify gas wells requiring remediation. Well remediation efforts have reduced the potential for contamination of shallow groundwater aquifers and losses of hydrocarbon resources associated with natural gas production. The overall number of gas wells

exhibiting bradenhead pressure above the established threshold of 25 psig (2 psig in the Critical areas) have been significantly reduced.

Test data suggests that a less frequent level of monitoring can be implemented while providing an effective level of control to assess potential changes in wellbore integrity. On the basis of seven years of bradenhead testing, the BLM has determined that methane contamination and loss of the hydrocarbon resource is more likely to occur at older conventional gas wells than in newer Fruitland Formation coal gas wells. This fact is a function of improved primary cementing requirements including circulation of cement through well-bore annul) from the producing horizon to the surface, thereby maximizing the potential for zonal isolation between the gas producing horizon and shallow aquifers.

II. Definitions

As used in this notice, terms are defined as follows

A. "Authorized officer" (AO) - shall mean the San Juan Resource Area Manager.

B. "Conventional Well" - A well completed in any sandstone reservoir namely the sands of the Dakota, Mesaverde, and Pictured Cliff Formations.

C. "Fruitland Formation Coal Gas Well" - A well completed in the coal seams of the Fruitland Formation.

D. "Critical Area" - Areas around domestic water wells which exhibit greater than 1 mg/L entrained methane (See attached map).

III. Requirements

This NTL modifies NTL MDO-91-1, by revising both the frequency of required bradenhead testing and adding new gas analysis requirements based on pressure, volume, and well location. Requirements are applicable only to the Ignacio-Blanco Field in Southwest Colorado and are as follows:

1) Annual bradenhead testing requirements, in accordance with NTL MDO-91-1, for all conventional gas wells and all conventional gas wells recompleted as Fruitland

Formation coal gas wells

2) Biennial bradenhead testing will now be required on Fruitland Formation Coal Gas Wells completed in the Fruitland Coal prior to 1998.

Biennial testing will be required on odd numbered years, beginning in 1999, (eg., gas wells meeting the above criteria for biennial testing will not need to be tested in 1998). Fruitland Formation Coal Gas wells drilled in 1998 and beyond will have no history of bradenhead testing. Therefore, these gas wells will be required to have an initial test conducted upon completion followed with biennial testing thereafter.

3) All gas wells having approved Notices of Intent to remediate excessive bradenhead pressure by implementing bradenhead venting and/or wellbore/well head repairs are governed by their attached Conditions of Approval which overrule items #1 and #2 above.

4) Bradenhead gas analysis is required only when gas volume is sufficient to allow a minimum of 10 purges of the collection cylinder, and when pressures exceed 2 psig in designated critical areas or 25 psig outside of designated critical areas.

In 1998, intermediate casing gas samples will be required only when specifically requested by the BLM.

IV. Conformance with NTL MDO-91-1

NTL MDO-91-1, remains in full force and effect except where modified by this NTL.

Date Area Manager, San Juan Resource Area

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www.co.blm.gov/oilandgas/
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San Juan Field Office

FAX (970) 385-1375

USDA Forest Service
San Juan-Rio Grande
NF
FAX (970) 385-1243

In Reply Refer To: BLM: 3162.5
Date: February 22, 2000

Notice to Lessees and Operators of
Oil and Gas leases within
the Ignacio-Blanco Field
Southwestern Colorado
Final
NTL-MDO-91-1, Change 2
February 22, 2000

This change notice is issued pursuant to the authority delegated to the Authorized Officer (AO) under 43 CFR 3161.2 and 43 CFR 3164.2 to implement oil and gas operating regulations pursuant to 43 CFR 3160 and the terms of the Federal and Indian oil and gas leases. In accordance with the regulatory guidelines referenced above, lessees and operators shall conduct operations in a manner which protects the health, safety, and welfare of the public in addition to protecting natural resources and the environment. Operations shall also be conducted in a manner which results in maximum economic recovery of the oil and gas resources with a minimum amount of loss.

I. BACKGROUND

On July 23, 1991, the Bureau of Land Management (BLM) issued NTL-MDO-91-1 (Bradenhead Testing). This notice was issued in response to evidence of methane contamination in groundwater as documented in water quality analyses of domestic water wells. Between 1991 and 1998, the BLM aggressively implemented the terms and conditions of NTL-MDO-91-1.

Based on nine years of data, the BLM has determined that methane contamination and loss of the hydrocarbon resource is more likely to occur at older conventional gas wells than in newer Fruitland Formation coalgas wells. This fact is a function of improved primary cementing requirements including circulation of cement through well-bore annuli from the producing horizon to the surface, thereby maximizing the potential for zonal isolation between the gas producing horizon and shallow aquifers.

NTL-MDO-91-1, Change 1 was implemented April 14, 1998. Change 1 decreased the required frequency of bradenhead testing to a biennial schedule (odd-numbered years) for Fruitland Coalgas wells with no history of aberrant bradenhead pressures.

As a result of monitoring to date, many gas wells exhibiting mechanical integrity problems identifiable by this process have been isolated and remediated or mitigated. These measures have reduced the potential for contamination of shallow groundwater aquifers and losses of hydrocarbon resources associated with natural gas production. The overall number of gas wells continuing to exhibit bradenhead pressure in excess of established thresholds has been significantly reduced. Test data suggest that similar continued monitoring can provide adequate control to assess changes.

II. DEFINITIONS

1) **Authorized Officer (AO)** shall pertain to the San Juan Field Office Manager.
2) A **conventional** gas well refers to a gas well completed in any sandstone reservoir, namely the sands of the Dakota, Mesaverde, and Pictured Cliffs horizons, or a gas well originally completed in one of these horizons and later re-completed in the Fruitland coal beds.
3) **A Fruitland CBM well** refers to a gas well originally completed in the coal seams of the Fruitland Formation.
4) **Critical Areas** were defined in 1994 as areas in which concentrations of methane equaled or exceeded 1.0 milligram per liter in groundwater drawn from domestic water well(s).

III. REQUIREMENTS

Change 2 to the Notice to Lessees-MDO-91-1 redefines the pressure threshold requirement for bradenhead sampling and analysis in the Ignacio-Blanco Field in Southwest Colorado(replacing Change 1) as follows:

1) **Annual bradenhead testing** is required for (1) **all conventional gas wells,** (2) all conventional gas wells **re-completed as Fruitland** Formation coal gas wells, (3) **all gas wells with remediation conditions of approval stipulating annual bradenhead tests.**

2) **Testing of all gas wells originally completed in the Fruitland Coal must be completed in the year drilled and in odd years** thereafter (2001,2003, 2005 etc).

3) **Samples will be required for analysis of bradenhead gas when the gas volume is sufficient to allow a minimum of 10 purges of the collection cylinder when pressures equal or exceed 5 psig in designated critical areas or 25 psig outside of designated critical areas.**

4) **Intermediate casing gas samples** will be required only when specifically requested by the authorized officer.

These requirements replace the threshold stipulated in Change 1, but do not revoke MDO-NTL-91-1 or MDO-NTL-91-1 Change 1. MDO-NTL-91-1-Change 2 amends the original requirement based upon the on-going testing and analysis efforts. These requirements will be enforced by the AO (BLM) until further notice. The BLM will continue to evaluate the effectiveness and efficiency of this program.

2/24/02

Calvin N. Joyner Date

San Juan Field Manager

SOUTHERN UTE INDIAN TRIBE

GENERAL PIPELINE RIGHT-OF-WAY STIPULATIONS

COMPANY: ____ DATE: July 25, 2002

LINE NAME: ____

LOCATION: Section(s) _____, T_______N, R_____W, N.M.P.M., La Plata County, Colorado

****

Boldface and underlined text denotes site specific stipulations.

****

1. A preliminary onsite review of the pipeline right-of-way by Tribal, BIA and archaeological representatives is required.

2. Construction will conform to the requirements as described on the Right-Of-Way Application. A copy of these stipulations shall be kept on location at all times.

3. A preliminary survey plat shall be submitted to the SUIT Energy Department at P.O. Box 737, Ignacio, Colorado 81137 at least five (5) days prior to the onsite inspection, and an "as built" survey plat shall be submitted to the Energy Department within thirty (30) days following completion of construction.

4. Surface damage compensation and/or right-of-way grant of permission assessment will be paid to the Southern Ute Indian Tribe at a rate determined by the SUIT Energy Department as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation for oil and gas facilities. All assessments shall be paid prior to construction.

5. Special and/or additional stipulations will be issued whenever conditions warrant requirements outside the General Pipeline Right-Of-Way Stipulations.

6. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted, and the following shall be notified immediately:

SUIT Energy Department - (970) 563-0140 BIA Area Archaeologist - (505) 766-3374 BIA Southern Ute Agency - (970) 563-4514

9. **An archaeology survey has identified _____ sites eligible for nomination to the National Register of Historic Places. These sites are identified by #'s as shown on the attached plats. These site boundaries, shall be fenced prior to the beginning of construction and a qualified archaeologist shall be present during all earth disturbing activities within 100 feet of this site, including the installation of the fencing.**

10. Ample notification shall be given to the Tribe at (970) 563-0140 when construction will hamper ingress and egress to Tribal lands.

10. Warning signs and reflectors indicating construction underway will be erected where applicable.

11. Construction of the pipeline shall come to a halt during inclement weather to prevent soil damage or destruction.

12. All personnel, vehicles, and construction equipment will be confined to the right-of-way.

13. Construction of new permanent access roads will not be permitted.

14. The pipeline shall be laid below the bed of any ravine, canyon or waterway it crosses.

15. Blading of pipeline routes located on gentle topography need only to have brush and surface irregularities removed and smoothed, leaving most of the underlying layer of vegetation undisturbed. Graders are recommended for clearing these routes, because blade depths can be more easily controlled.

16. **A BUREAU OF INDIAN AFFAIRS TIMBER CUTTING PERMIT, FORM 5-5331 AND LOAD TICKETS MUST BE OBTAINED PRIOR TO CUTTING TREES. THIS PERMIT CAN BE OBTAINED FROM THE TRIBAL FORESTRY (970) 563-4571.**

    a) The cleared area is to be kept to the minimum necessary for construction and maintenance.

    b) Chainsaws shall be used to cut trees. Bulldozers or other heavy equipment shall not be used to clear areas.

    c) All sound woody material, including deadwood, from piñon pine, juniper, and gambel oak, which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities.

    d) All juniper suitable for posts shall be cut into seven (7) foot lengths and all other wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to completion of construction. Load tickets must accompany every load hauled to the wood yard.

17. Surface soil material shall be stockpiled to the side of the routes where cuts and fills or other surface disturbance occur during pipeline construction. Surface soil shall not be mixed or covered with subsurface material.

18. Cuts and fills on pipelines should be made only where necessary. Cut and fill slopes should normally be no steeper than 3:1 and should be graded to blend with the adjacent terrain.

19. Rock which is brought to the surface during construction will normally be buried on site. The amount of surface rock will not be greater than the pre-disturbance condition of the site.

20. After backfilling of the ditch, final leveling will be done and the proper crown constructed to allow for settling of the trench. These trenches should be maintained in order to correct settlement and to prevent erosion.

21. All road crossings shall be compacted to avoid excessive settling.

22. Pipeline routes should be recontoured to conform to the adjacent terrain, water barred, and reseeded.

23. Frequency of water bar spacing will be dependent on the slope of the land as shown below:

percent of slope	spacing interval in feet
0 to 5	0
6 to 10	200 (only on slopes longer than 500 feet)
10 plus	50

Water bars will be started and finished in vegetation and constructed at grades of 2% or less. Water bars should be repaired as necessary.

24. Upon completion of the right-of-way, disturbed areas will be recontoured and revegetated. Unless otherwise specified, seed varieties and drilled seeding rates shall be as below. For broadcast seeding, double the rates specified.

Mix #1 North facing escarpment of Mesa Mountains and North

Arriba Western Wheatgrass	3 PLS pounds/acre
Ladak Alfalfa	1 PLS pounds/acre
Antelope Biterbrush	1 PLS pounds/acre
Luna Pubescent Wheatgrass	3 PLS pounds/acre
Delar Smal Burnet	1 PLS pounds/acre
Paloma Indian Ricegrass	2 PLS pounds/acre
Total	**11 PLS pounds/acre**

Arriba Western Wheatgrass	5 PLS pounds/acre
Lovington Blue Grama	2 PLS pounds/acre
Paloma Indian Ricegrass	3 PLS pounds/acre
Ephraim Crested Wheatgrass	2 PLS pounds/acre
Total	**12 PLS pounds/acre**

First seeding shall be done within six (6) months of completion of the right-of-way. Tribal personnel will make periodic checks of seeding success. If within one year no visible strand or only a partial stand is observed, additional seeding shall be required.

25. All existing fences removed for construction purposes will be repaired or rebuilt.

26. All existing ditches shall be rerouted or restored to pre-construction conditions.

27. The centerline of the pipeline shall be permanently staked with pipeline location stakes. The company name and telephone number shall be placed on each stake.

28. All trash or litter on the right-of-way will be disposed of at an approved landfill when construction operations have been completed.

29. No fluids (i.e., diesel, motor oil, crankcase oil, etc.) will be disposed of on the Southern Ute Indian Reservation. Discharge permits (e.g., NPDES) shall be obtained for hydrostatic water disposal.

30. Pumping stations should be kept in a neat and well maintained condition.

31. A final inspection of the right-of-way by representatives of the Southern Ute Indian Tribe and the Bureau of Indian Affairs will be done once construction has been completed.

32. ______________shall give the SUIT Energy Department (970.563.0140) at least 48 hours advance notice before construction is to begin.

33. ______________shall be responsible for upkeep and maintenance of the right-of-way on an "as needed" basis.

34. The completed pipeline ROW shall not be used as a road without written authorization by the Tribe.

35. Adequate weed control will be maintained on the right-of-way at all times during the life of the right-of-way.

SIGNED: ____ DATE: July 25, 2002

EXHIBIT "A"

LA PLATA COUNTY
PIPELINE/FACILITY NOTIFICATION FORM

Intended to comply with taxation compact between
the Southern Ute Tribe and La Plata County.

Send to: La Plata County – Tax Assessor
Craig Larson
Post Office Box 3339
Durango, Colorado 81302

1. Company Name: ____________________________________
   Contact Person Name: _______________________________
   Address: ____
   Phone Number: _____________________________________

2. Facility Name: ______________________________________

3. Legal description of location: _____ Sec. _____ Twn. ____ Range

4. Site plan (for facility) attached _____________

5. Estimated cost of pipeline or facility or both ___________________________

6. Estimated date of commencement ___________________________
   Estimated date of completion _______________________________

Position/title of person completing form ____

Name ______________________ Signature ______________________ Date _____________

SOUTHERN UTE INDIAN TRIBE

GENERAL WELL SITE CONDITIONS OF APPROVAL

COMPANY: ____ DATE: _____________________

WELL NAME: ____

LOCATION: Section _______, T______N, R_______W, N.M.P.M., La Plata County, Colorado,

________ feet from the N/S line, and _______ feet from the E/W line.

****

<u>Boldface and underlined text denotes site specific conditions.</u>

****

1. A preliminary onsite review of new gas and/or oil well pads and access roads by Tribal, BIA, BLM, and archaeological representatives is required.

2. All surface disturbance shall be confined to the 13 point surface use plan submitted with the Application for Permit to Drill (APD). All land-altering activity outside the surface use plan will require permission by the Energy Department. A copy of the APD and these conditions of approval shall be kept on location at all times.

3. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted and the following shall be notified immediately:

   Southern Ute Energy Department - (970) 563-0140
   BIA Area Archaeologist - (505) 766-3374
   BIA Southern Ute Agency - (970) 563-4514

   The operator will inform all people who are in the area that they are subject to prosecution for disturbing archaeological sites or picking up artifacts.

4. The gas and/or oil well pad shall be properly identified with a permanent readable sign, which shall include:

   Company name
   Well name
   Legal description
   Lease Number

a) The cleared area is to be kept to the minimum necessary for drilling operations.

b) Chainsaws shall be used to cut trees. Trees shall not be pushed by bulldozers or other heavy equipment.

c) All sound woody material, including deadwood, from piñon pine, juniper, and gambel oak which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities.

d) All juniper suitable for posts shall be cut into seven (7) foot lengths, and all other wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Tribal Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to the arrival of the drilling rig. Load tickets must accompany each load hauled to the wood yard.

e) Debris (slash) from forest products, which includes brush, limbs, and wood products not meeting the minimum size, will be chipped with a wood chipper and scattered around the location within seven (7) days after completion of construction. Stumps shall be stockpiled and disposed of in the reserve pit when it is being reclaimed.

f) The wood volume has been determined to be _____ cords and ______ posts.

8. The access road will be constructed on the flagline location previously approved.

9. The reserve and water pits will be lined with sufficient reinforced liner to prevent leakage.

10. The reserve and water pits shall be fenced on three sides prior to the arrival of the drilling rig. The fourth side will be fenced immediately after the rig leaves the location. The fence shall be 4-wired barbed wire with “H” braces. Wire spacing from the ground shall be 12", 12", 10" and 8", with the top wire 42" from the ground. This fence shall be maintained until the pits are reclaimed.

11. The reserve pits will be allowed nine (9) months for evaporation. The 9-month period shall begin on the spud date. Any fluids remaining after nine (9) months shall be disposed of in a manner consistent with Federal Regulations. The pits will then be filled with dirt material, leveled, and reclaimed.

12. Reserve pits with torn liners shall immediately be reclaimed.

13. Neither burn pits nor blow pits shall used for storage or disposal of fluids.

14. The reserve pit shall have a minimum of four (4) feet of freeboard at all times. Freeboard shall be measured from the top of the pit liner to the surface of the water in the reserve pit.

18. Topsoil will not be piled against trees or deposited in natural drainageways.

19. All fences and gates that are torn down or removed will be repaired or rebuilt to the original standard of construction within seven (7) days after the drilling rig leaves the location.

20. Culverts will be installed in areas where needed or required.

21. Culverts or cattle guards will not be removed unless authorized by the Tribe.

22. To prevent livestock access, the entire gas and/or oil well location may be permanently fenced with 4-wire barbed wire fence constructed with "H" braces at the corners. Line posts shall be spaced 1 rod (16.5') apart. Wire spacing from the ground shall be 12", 12", 10" and 8", with the top wire 42" from the ground. There shall be at least one livestock gate in the fence. The fence shall be completed within seven (7) days after the drilling rig leaves the location**. An alternative to fencing is to build welded pipe barriers around all well site items requiring protection from livestock. These barriers should be anchored in concrete and painted environmental green.**

23. If the gas and/or oil well site is fenced, 16-foot heavy duty cattle guard, eight (8) feet in width and with six (6) inch spacing between bars will be installed at the entrance of the well pad. The cattle guard shall be installed within seven (7) days after the drilling rig leaves the location. A livestock tight gate may be substituted for a cattle guard. The well site operator is responsible for maintenance of the cattle guard or the gate.

24. Trash will not be allowed to accumulate on the gas and/or oil well site. All materials, trash, junk, debris, etc. not required for production shall be disposed of at an approved landfill within seven (7) days after said well has been completed.

25. No trash shall be disposed of in the reserve pit.

26. Trash shall not be burned.

27. Misters on blooie lines shall be used when drilling with air or gas. Operators shall be responsible for cleaning dust off vegetation if required by the Energy Department. Contact the Energy Department at (970) 563-0140 for authorization of cleaning procedures. Additional surface damage compensation and reclamation may be required.

28. Within six (6) months upon completion of the drilling and completion operations, those areas of the wellpad not used on a daily basis, or needed for future reworking operations, will be recontoured and revegetated. Unless otherwise specified, seed varieties and drilled seeding rates shall be as below. For broadcast seeding,

Mix #1 North facing escarpment of Mesa Mountains and North

Arriba Western Wheatgrass	3 PLS pounds/acre
Ladak Alfalfa	1 PLS pounds/acre
Antelope Biterbrush	1 PLS pounds/acre
Luna Pubescent Wheatgrass	3 PLS pounds/acre
Delar Smal Burnet	1 PLS pounds/acre
Paloma Indian Ricegrass	2 PLS pounds/acre
Total	**11 PLS pounds/acre**

Mix #2 Mesa Mountains Plateau and higher elevations north of Picnic Flats area

Arriba Western Wheatgrass	3 PLS pounds/acre
Luna Pubescent Wheatgrass	3 PLS pounds/acre
Manchar Smooth Brome*	3 PLS pounds/acre
Ephraim Crested Wheatgrass	2 PLS pounds/acre
Ladak Alfalfa	1 PLS pounds/acre
Total	**12 PLS pounds/acre**

Mix #3 West of Highway 550

Arriba Western Wheatgrass	5 PLS pounds/acre
Lovington Blue Grama	2 PLS pounds/acre
Paloma Indian Ricegrass	3 PLS pounds/acre
Ephraim Crested Wheatgrass	2 PLS pounds/acre
Total	**12 PLS pounds/acre**

Tribal personnel will make periodic checks of seeding success. If within one year no visible strand or only a partial stand is observed, additional seeding shall be required.

29. No fluids (i.e., diesel, motor oil, water, etc.) will be disposed of on the Southern Ute Indian Reservation, except as otherwise specifically authorized.

30. Access roads and gas and/or oil well pads will be maintained in accordance with generally accepted standards for repair, orderliness, neatness, sanitation, and safety.

31. All personnel, vehicles, and equipment will be confined to the access roads and gas and/or oil well pads.

32. Ample notification shall be given to the Tribe at (970) 563-0140 when construction will hamper ingress and

36. Surface damage compensation will be paid to the Southern Ute Indian Tribe at a rate determined by the Southern Ute Energy Department as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation.

37. All production equipment shall be muffled.

38. All static equipment shall be painted an environmental green color within seven (7) days of completion of construction.

39. **COMPANY NAME** shall give the Southern Ute Energy Department advance notice at least 48 hours before construction is to begin.

40. Adequate weed control will be maintained on the wellpad and access road at all times during the life of the project until final reclamation of the wellsite and access road is achieved.

41. On Fruitland formation cavitation procedures, any off location vegetation that gets "dusted" by coalfines needs to be washed off with cold water within 48 hours of cavitation completion. The Operator will contact the BIA and BLM immediately so that the washing process can be monitored by them.

SIGNED: ______________________________ DATE: July 25, 2002
Petroleum Land Manager

CONCURRED: ______________________________ DATE: ____________
Realty Officer

CONCURRED: ______________________________ DATE: ____________
Superintendent

APPENDIX F
VERTEBRATE SPECIES LISTS

APPENDIX F
VERTEBRATE SPECIES LISTS

TABLE F-1: List of reptile and amphibian species expected to occur in habitat types of the Study Area. This list is not considered to be all inclusive but rather a representation of the species that may be present.

Species Name	Grassland/ Shrubland	Gambel Oak	Coniferous Forest (Ponderosa Pine/ Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
Amphibians						
Tiger salamander *Ambystoma tigrinum*						X
Woodhouse's toad *Bufo woodhousii*				X	X	X
Striped chorus frog *Pseudacris triseriata*						X
Northern leopard frog *Rana pipiens*				X	X	X
Reptiles						
Short-horned lizard *Phrynosoma douglassii*	X	X				
Eastern fence lizard *Sceloporus undulatus*	X	X				
Collared lizard *Crotaphytus collaris*	X				X	
Sagebrush lizard *Sceloporus graciosus*	X				X	

Species Name	Grassland/ Shrubland	Gambel Oak	Coniferous Forest (Ponderosa Pine/ Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
Bullsnake *Pituophis melanoleucus*	X	X	X	X	X	X
Western terrestrial garter snake *Thamnophis elegans*				X	X	X
Western rattlesnake *Crotalus viridis*	X	X	X		X	X

TABLE F-2: List of bird species expected to occur in habitat types for the Study Area. This list is not considered to be all inclusive but rather a representation of some of the more common species present.

Species Name	Grassland/ Shrubland	Gamble Oak	Coniferous Forest (Ponderosa Pine/Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
Horned lark *Eremophila alpestris*	X			X		
Western meadowlark *Sturnella neglecta*	X			X		
Killdeer *Charadrius vociferus*	X			X		X
Western bluebird *Sialia mexicana*	X	X	X			
House finch *Carpodacus mexicanus*		X	X			

Species Name	Grassland/ Shrubland	Gamble Oak	Coniferous Forest (Ponderosa Pine/Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
American goldfinch *Carduelis tristis*	X				X	
Barn swallow *Hirundo rustica*	X				X	
Green-tailed towhee *Pipilo chlorurus*		X	X			
Mountain chickadee *Parus gambeli*		X	X			
American robin *Turdus migratorius*		X	X		X	
Mourning dove *Zenaida macroura*	X		X	X	X	
Williamson's sapsucker *Sphyrapicus thyroideus*			X			
Downy woodpecker *Picoides pubescens*			X		X	
Violet-green swallow *Tachycineta thalissina*		X	X			
Northern flicker *Colaptus auratus*		X	X		X	
Stellar's jay *Cyanocitta stelleri*			X			
Scrub jay *Aphelocoma coerulescens*		X				
Black-billed magpie *Pica pica*	X	X	X	X	X	

Species Name	Grassland/ Shrubland	Gamble Oak	Coniferous Forest (Ponderosa Pine/Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
Brewer's blackbird *Euphagus cyanocephalus*				X	X	
Common nighthawk *Chordeiles minor*	X	X	X	X	X	
Belted kingfisher *Ceryle alcyon*						X
Black-chinned humming bird *Archilochus alexandri*		X	X		X	
Dusky flycatcher *Empidonax oberholseri*		X	X		X	
Western kingbird *Tyrannus verticalis*			X		X	
Common raven *Corvus corax*		X	X		X	
Warbling vireo *Vireo gilvus*					X	
Yellow warbler *Dendroica petechia*					X	
Western tanager *Piranga ludoviciana*		X	X			
Black-headed grosbeak *Pheucticus melanocephalus*		X	X		X	
Lazuli bunting *Passerina amoena*	X	X				

Species Name	Grassland/ Shrubland	Gamble Oak	Coniferous Forest (Ponderosa Pine/Piñon-Juniper)	Agricultural Land	Riparian (Shrubland and Forest)	Wetland (Marsh, Wet Meadow, and Pond)
Red-winged blackbird *Agelaius phoeniceus*					X	X
Dark-eyed junco *Junco hyemalis*			X		X	
Chipping sparrow *Spizella passerina*			X			
Mallard *Anas platyrhynchos*						X
Wild turkey *Meleagris gallopavo*		X	X			
Turkey vulture *Cathartes aura*	X	X	X		X	
American kestrel *Falco sparverius*	X	X	X	X	X	
Swainson's hawk *Buteo swainsoni*	X				X	
Red-tailed hawk *Buteo jamaicensis*	X				X	
Golden eagle *Aquila chrysaetos*	X				X	
Bald eagle *Haliaeetus leucocephalus*	X				X	
Great horned owl *Bubo virginianus*			X		X	

TABLE F-3: List of mammal species expected to occur in habitat types of the Study Area. This list is not considered to be all inclusive but rather a representation of species present.

Species Name	Grassland/ Shrubland	Gambel Oak	Coniferous Forest (Ponderosa Pine/ Piñon-Juniper)	Agricultural Land	Wetland/Riparian (Forest, Marsh, Wet Meadow)
Desert cottontail *Sylvilagus audubonii*	X	X	X		
Mountain cottontail *Sylvilagus nuttallii*	X		X		
Black-tailed jackrabbit *Lepus californicus*	X	X			
Ground squirrels *Spermophilus spp.*	X	X	X		
Abert's squirrel *Sciurus aberti*			X		
Least Chipmunk *Tamias minimus*	X	X	X		
Pocket gophers *Thomomys* spp.	X	X		X	X
Mice *Peromyscus, Reithrodontomys* spp.	X	X	X	X	X
Voles *Microtus* spp.	X			X	X
Shrews *Sorex* spp.	X	X	X	X	X
Woodrats *Neotoma* spp.	X	X	X		
Porcupine *Erethizon dorsatum*			X		

Species Name	Grassland/ Shrubland	Gambel Oak	Coniferous Forest (Ponderosa Pine/ Piñon-Juniper)	Agricultural Land	Wetland/Riparian (Forest, Marsh, Wet Meadow)
Coyote *Canis latrans*	X	X	X	X	X
Red fox *Vulpes vulpes*		X	X	X	X
Grey Fox *Urocyon cinereoargenteus*				X	X
Raccoon *Procyon lotor*				X	X
Black bear *Ursus americanus*			X		
Long-tailed weasel *Mustela frenata*	X	X	X	X	
Badger *Taxidae taxus*	X	X			
Striped skunk *Mephitis mephitis*	X	X	X	X	X
Bobcat *Lynx rufus*		X	X		
Mountain lion *Felis concolor*			X		
Mule deer *Odocoileus hemionus*		X	X	X	X
American elk *Cervus elaphus*			X	X	X
Pronghorn *Antilocapra americana*	X				

Species Name	Grassland/ Shrubland	Gambel Oak	Coniferous Forest (Ponderosa Pine/ Piñon-Juniper)	Agricultural Land	Wetland/Riparian (Forest, Marsh, Wet Meadow)
Bats *Myotis* spp.			X	X	X

Table F-4: List of fish species known to occur in the rivers of the Study Area. Native species are marked with an *.

Species Name	La Plata River	Animas River	Pine River	Piedra River	San Juan River
Rainbow trout *Oncorhynchus mykiss*	X	X	X	X	X
Brown trout *Salmo trutta*	X	X	X	X	X
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*	O				
Snake River cutthroat trout *Oncorhynchus clarki spp.*	O	X	X	X	X
Brook trout *Salvelinus fontinalis*	O	O	O	O	O
Kokanee salmon *Oncorhynchus nerka*			X	X	X
Bluehead sucker* *Catostomus discobolus*	X	X	X	X	X
Flannelmouth sucker* *Catostomus latipinnis*	X	X	X	X	X
White sucker *Catostomus commersoni*	O	X	X	X	X
Roundtail chub* *Gila robusta*	X	O	O		O

Species Name	La Plata River	Animas River	Pine River	Piedra River	San Juan River
Speckled dace* *Rhinichthys osculus*	X	X	X	X	X
Common carp *Cyprinus carpio*	O	X	X	X	X
Fathead minnow *Pimephales promelas*	X	X	X	X	X
Red shiner *Notropis lutrensis*	O	O			
Channel catfish* *Ictalurus punctatus*	O	O	X	X	X
Black bullhead* *Ameiurus melas*	O	O	X	O	O
Smallmouth bass *Micropterus dolomieui*			X		O
Largemouth bass *Micropterus salmoides*		O			O
Green sunfish *Lepomus cyanellus*	O	X	X	X	X
Bluegill *Lepomis macrochirus*			O		
Mottled sculpin* *Cottus bairdi*	X	X	X	X	X
Northern pike *Esox lucius*		O			O
Johnny darter *Etheostoma nigrum*		O			

X = Commonly found species O = Has been documented or probably occurs in very limited numbers

15 Burnett Court
DURANGO, CO 81301
(970) 247-4874
TTY (970) 385-1257

Interoffice Memorandum
USDI Bureau of Land Management
San Juan Field Office
FAX (970) 385-1375 8 March, 2001

To: Kurt Broderdorp, US Fish and Wildlife Service

cc: K. Nickell, H.M. Johnson, J. Powers, J. Pecor, K. Hoffman

From: Matt Janowiak

Re: SUIT EIS Water Depletion Summary

This technical summary was prepared as a result of the meeting on 5 February 2001 between the Southern Ute Indian Tribe, Bureau of Land Management (BLM), United States Forest Service (USFS), and the United States Fish and Wildlife Service (USFWS). The USFWS reviewed the Biological Assessment (BA) from the Southern Ute EIS, and had several questions regarding the magnitude of the water depletions associated with oil and gas development on Southern Ute Tribal Lands.

San Juan Basin Hydrology

The San Juan structural basin (not the watershed basin), is typically defined by the outcrop of the Pictured Cliffs sandstone. The 3M Study, sponsored in part by the BLM, modeled the groundwater flow in the Fruitland Formation coalbeds across the entire San Juan Basin. The Fruitland Formation was modeled because recent developments in the understanding of the coalbed methane reservoir showed that the Fruitland Formation is an aquifer, with dynamic groundwater flow. Previously, it was thought that the Fruitland Formation was a sealed reservoir, with no groundwater flow. Some workers even postulated that the water in the coalbeds was connate water, or water that was present in the original depositional environments.

The groundwater flow in the Fruitland Formation occurs in two regimes (Figures 1 and 2). There is a near-outcrop flow system where precipitation falling on the outcrop recharges the aquifers, flows basinward, looping back and eventually discharging to the rivers that cut across the outcrop. Groundwater travel time from the outcrop recharge areas to the river cuts is on the order of 1,000 to 10,000 years over distances of about 4 to 8 miles.

The second regime is a deep basin flow system that receives a small fraction of the recharge water. The deep basin flow system discharges at the western edge of the basin where the San Juan River flows across the outcrop, west of Farmington, New Mexico. The travel times from the outcrop recharge areas to the San Juan River crossing are on the order of 500,000 to 1,000,000 years and more. Groundwater in the deep basin flow system has much higher Total Dissolved Solids (TDS) concentrations, typically greater than 7,500 mg/l and often exceeding 12,000 mg/l (Figure 1). The higher TDS is caused by the very long times which the water is in contact with rock.

As noted above, the Fruitland Formation is a regional aquifer, with higher permeability than the overlying Kirtland Shale and the underlying Lewis Shale. The Pictured Cliffs Sandstone, immediately underlying the Fruitland Formation, also makes up part of the regional aquifer system along to basin rim. Deeper in the basin, the Pictured Cliffs Sandstone is a gas reservoir, with no groundwater flow.

Even though the Fruitland/Pictured Cliffs are described as an aquifer, the overall groundwater flow through these formations is quite low due to the low overall permeability and low recharge potential.

The 3M groundwater flow model has quantified the Fruitland groundwater discharge at the rivers crossing the outcrop (Table 1).

RIVER	**Fruitland Discharge (cubic ft/day)**	**Fruitland Discharge (acre-feet/year)**
La Plata	250	2.1
Animas River & Basin Creek	8,819	**73.9**
Florida River	3,650	30.6
Los Pinos (Pine) River	7,239	60.6
Piedra River & Stonesteimer Creek	3,544	29.7
San Juan River (East)	3,263	27.3
San Juan River (West)	1,890	15.8
Navajo River	248	2.1
Rio Puerco	4,587	38.4
TOTAL DISCHARGE	24,803	280.5

As shown in Figure 2, the discharge to the Florida, Pine, Animas, and Piedra Rivers comes from the near-outcrop groundwater flow system. The discharge to the San Juan and La Plata Rivers is from the deep basin flow system.

Figure 2 also illustrates the relationship between the Southern Ute Indian Reservation and the two groundwater flow regimes. Immediately evident is that a small portion of the reservation overlaps the near-outcrop flow regime that discharges to the Animas River. The recharge area on the reservation is called the Indian Creek Area, and it is the only high-elevation recharge area on the Southern Ute Indian Reservation with Fruitland Formation and Pictured Cliffs outcrops along Basin Mountain and Bridge Timber Mountain. South of Bridge Timber Mountain the elevation of the Fruitland Formation and Pictured Cliffs outcrops drops considerably. Along with this drop in elevation comes a corresponding drop in mean annual precipitation on the outcrop. As a result, the Fruitland Formation and Pictured Cliffs Sandstone provide very little recharge to the near-outcrop flow regime on the reservation.

As shown in Table 1, 73.9 acre-ft/yr discharges from the Fruitland Formation to the Animas River. Only a portion of this discharge is sourced from the recharge areas on the reservation. The remainder comes from the recharge areas east of the Animas River, north of the reservation.

Potential Coalbed Methane Depletions of Water – Basin Wide Development (Colorado and New Mexico)

Depletion to surface flows is mostly related to the near-outcrop flow regime. Recall that the deep basin flow regime is operating on 100,000 to 1,000,000 time scales, and that injection of Fruitland water into deeper zones will simply redistribute the water, without affecting the overall flows.

The majority of Fruitland water that discharges to the rivers is from the near-outcrop flow regime. The only deep basin discharge point appears to be where the San Juan River crosses the Fruitland outcrop along the western rim of the basin. At this point, about 16 acre-ft/yr are discharged.

Coalbed methane water production exceeds the recharge potential of the Fruitland and Pictured Cliffs Formations. Exactly how much excess water is produced is not known at this time. However, the water balance is negative, with vastly more water produced than recharged. Just in the Colorado portion of the San Juan Basin, produced water exceeds recharge by a factor of 4.

The 3M study characterized basin recharge to the Fruitland coalbeds. The model showed a good fit with about 280 acre-ft/yr of recharge throughout the entire basin. This model did not account for the recharge in the Pictured Cliffs Formation, which could be similar to the Fruitland recharge rates.

Pictured Cliffs contribution to streamflow at individual rivers is unknown at this time.

Potential Coalbed Methane Depletions of Water – Southern Ute Indian Reservation Development

Oil and gas development on the Southern Ute Indian Reservation only affects the near-outcrop groundwater flow system in the Indian Creek Area. By operating coalbed methane wells in the Indian Creek Area, the 37 acre-ft/yr of water that would normally discharge to the Animas River or Basin Creek are intercepted and disposed of into deep formations or evaporation ponds.

Disposal of water into deep formations takes the water out of the near-outcrop system and places this water into the deep basin flow system. In effect, the water taken from the near-outcrop flow regime is taken out of circulation for hundreds of thousands of years, and it can be considered a depletion of water within the San Juan River system.

Additional depletion of surface flow may occur by intercepting the groundwater flow in the Pictured Cliffs Sandstone. The amount of additional depletion from Pictured Cliffs groundwater interception is unknown, but a study is underway to quantify this term.

Future Work

Questions that remain unresolved are:

1. Given that the Pictured Cliffs and Fruitland Formation act as an aquifer, how much Pictured Cliffs recharge is being intercepted by the Fruitland Coalbed Methane wells? Our current understanding of recharge rates indicates that recharge in the Pictured Cliffs may be <1 to 4 times than on the Fruitland outcrop. Better quantification of Pictured Cliffs recharge potential is required.
2. In the future, as reservoir pressures decline, how much water can be lost from the rivers into the Pictured Cliffs and Fruitland Formations? As the Fruitland and Pictured Cliffs Formations are dewatered the hydraulic gradient between the river and these formations will reverse. This will change the rivers from gaining streams to losing streams as they cross the outcrop. The magnitude and timing of these changes in stream-aquifer relationships are unknown. However, it can be said that stream flow depletions by oil and gas activities on the reservation will be limited to the Animas River/BasinCreek area because the other river crossings are over 6 miles from the reservation boundary.
3. Is there a beneficial use for the produced water within the basin that regulatory agencies can agree to?

Questions 1 and 2 above are being addressed by a study funded by the Ground Water Protection Council. This study was started in October 2000 and is scheduled for completion in September 2001. Results of this study will be made available to the Fish and Wildlife Service upon completion.

Question 3 was the subject of BLM proposal to the Ground Water Protection Council. Should this project be funded, the BLM will work closely with the USFWS throughout the execution of the feasibility study for beneficial uses of the produced water.

Figure 1

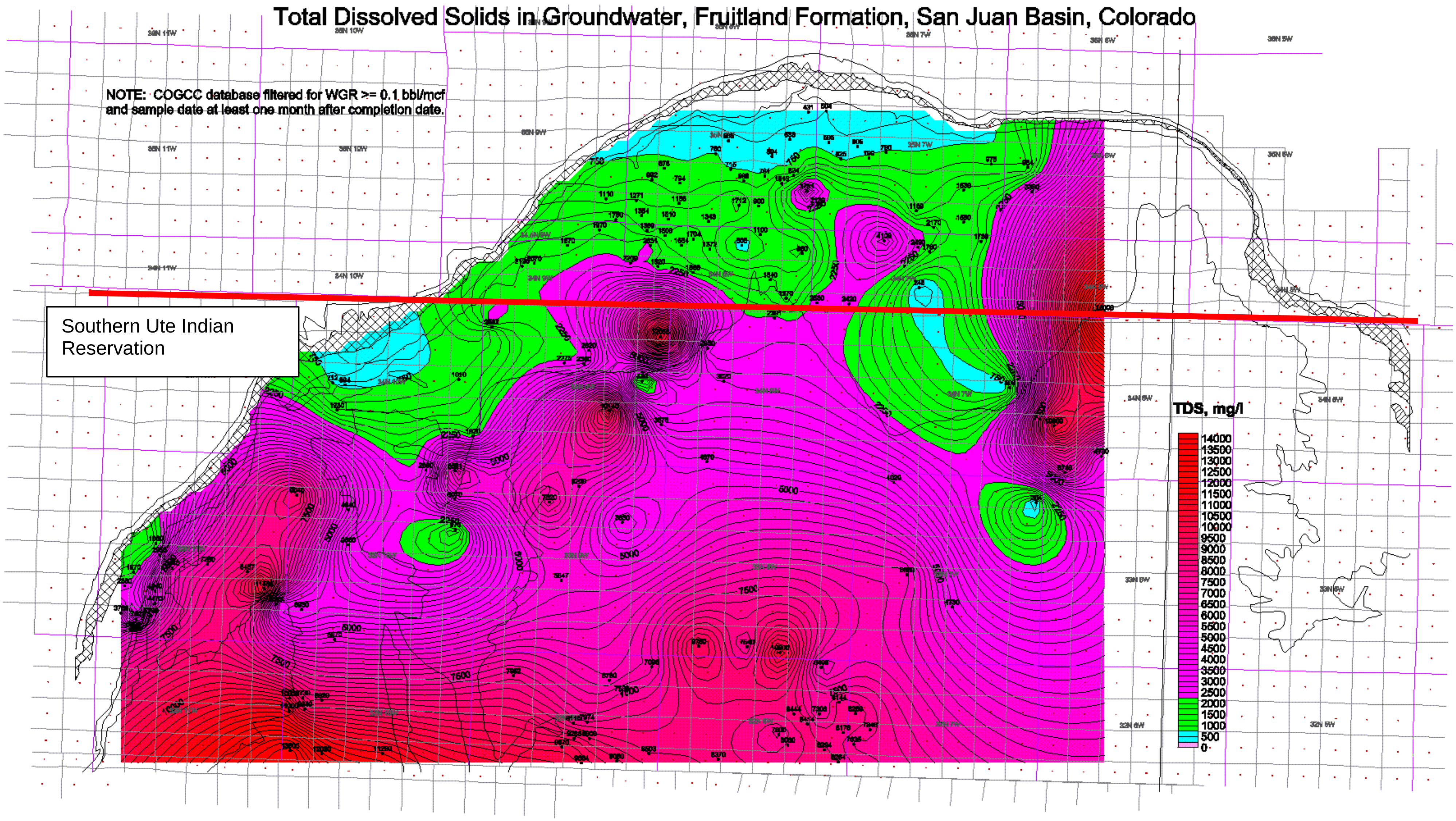
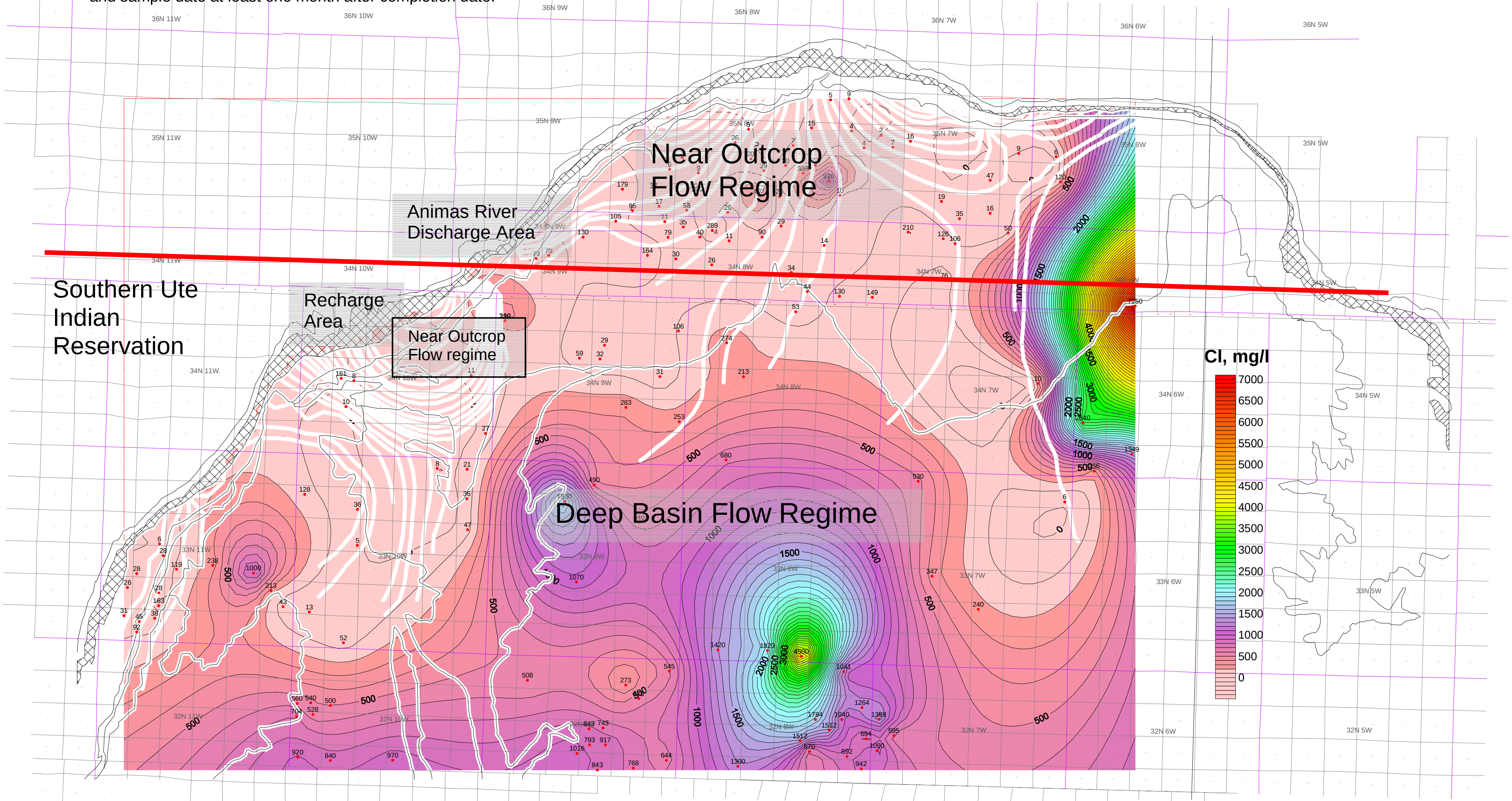

Total Dissolved Solids in Groundwater, Fruitland Formation, San Juan Basin, Colorado
NOTE: COGCC database filtered for WGR >= 0.1 bbl/mcf
and sample date at least one month after completion date.
Southern Ute Indian
Reservation
TDS, mg/l
14000
13500
13000
12500
12000
11500
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0

FIGURE 2

7500 yr Pathlines and Chloride in Groundwater, Fruitland Formation, San Juan Basin, Colorado

NOTE: COGCC database filtered for WGR >= 0.1 bbl/mcf
and sample date at least one month after completion date.



Supplement

to

Biological Assessment
For Oil and Gas Development
On the Southern Ute Reservation

United States Department of the Interior
Bureau of Land Management
Bureau of Indian Affairs

Southern Ute Indian Tribe

Prepared by

Kathleen R. Nickell, Wildlife Biologist
and
James T. Powers, Biological Scientist

San Juan Public Lands Center
March 5, 2002

The following addition information is provided to assist informal consultation between the US Fish and Wildlife Service and Bureau of Land Management regarding the biological assessment for oil and gas development on the Southern Ute Reservation.

SPECIES: Bald Eagle (*Haliaeetus leucocephalus*)

Status of nesting Bald Eagles: We reported in the Biological Assessment (August 27, 2001) that there were three active nest sites within the Study Area, one nest east of Allison and two sites along the Pine River. The following discussion updates the status of these sites and our determination of the potential for coalbed methane (CBM) development within proximity of these sites to impact Gunnison prairie dogs -- a component of the eagles diet:

Site 1- occurs in T32N, R6W, Section 14 approximately 1-2 miles S.E. of Allison and 2 mile north of Navajo Reservoir. Our review of land ownership status indicates that the entire 28 square miles (3 mile radius) surrounding this nest site is composed of private surface and private minerals. Consequently, the BLM, BIA and Tribe have no regulatory authority over development of CBM within this 28 square mile area and no authority to require operators to implement the bald eagle mitigation presented in the Biological Assessment.

For the purpose of quantifying effects to this nest site, our assessment indicates that there are 10 undeveloped drilling windows within this 28 square mile area surrounding the nest site. If each of the 10 available drilling windows were developed, we would predict a total of 31 acres of ground disturbance (3.1 acres per well site) within 3 miles proximity of the nest site. Thus the total impact would represent 2/1000 of the surrounding area (31 acres/18,100 acres = .001).

Site 2 - occurs along the Pine River approximately 1-2 miles south of State Highway 151. Our review of the status of this nest site involved interviews with Southern Ute Agency and Bureau of Reclamation biologists. The nest site was occupied as recently as 4 years ago, but has since blown off of the host cottonwood tree (Terry Stroh, U.S. Bu.Rec., pers. comm., 2001). There are no other nest sites in this vicinity. The area within a 3-mile radius of the old nest site is a combination of private and Tribal minerals (an approximate 50 - 50 mix). There are 11 undeveloped drilling windows within a 3-mile radius of the old nest site. If these 11 drill windows were developed, we estimate a total of 34 acres of ground disturbance would result. This disturbance equals approximately 2/1000 of the area within 3 mile radius of the old nest site.

Site 3 - is located along the pine river approximately half way between Ignacio and Bayfield. This site is also characterized by mixed mineral ownership and is approximately 60 percent tribal minerals, 40 percent private mineral estate. There are 15 undeveloped well windows within a 3-mile radius of this nest site. Development of these 15 well windows would impact 46 acres within a 28 square mile area. This disturbance equals approximately 2/1000 of the area within 3 miles proximity of the nest site. We assume prairie dogs could make up a portion of the eagles opportunistic diet in this location. However, we a re unsure of the dependency of bald eagle on prairie dogs. Stroh (pers. comm. 2001) and Wait (CDOW, pers. comm. 2001) indicated that we can anticipate some amount of eagle foraging of prairie dog within proximity of this nest site, but that we cannot draw inferences that the foraging habits of eagles along the Pine River mirror those of eagles studied east of Allison. Because of the minor acreage of disturbance involved we consider this level of disturbance to result in minimal to no measurable impact to the Eagle=s potential prey base in this location.

Findings: Total ground disturbing impact from gas well development within a three mile radius of the nest sites would equal:

	Site 1 -	31 of 18,100 acres
	Site 2 -	34 of 18,100 acres
	Site 3 -	46 of 18,100 acres
TOTAL		110 of 54,300 acres, or 2/1000 of the total area.

We do not expect prairie dog colonies to be located only where gas development is proposed. Under a reasonable assumption of random and widespread prairie dog colony distribution, the vast majority of prairie dog colonies would be well insulated from development. However, even if the 110 acres of ground disturbance directly impacted 110 acres of prairie dog colonies, we would consider this level of disturbance to result in minimal to no impact to the Eagle=s potential prey base within proximity of the active and abandoned sites.

Additional Mitigation: The following mitigation is added to the Biological Assessment In addition to the mitigation in the August 27, 2001 Biological Assessment:

? Survey proposed well pad and access route locations for Gunnison prairie dog. Avoid directly impacting prairie dog colonies were possible, and in light of other resource tradeoffs resulting from access road and well pad relocation.

Determination: Additional prey base analysis is presented in this Supplement. Mitigation has been designed both in the Biological Assessment and this Supplement to protect active nest sites and prey base. There is no change in the eagle=s determination:

It is my determination that oil and gas development on the Southern Ute Reservation <u>may affect and is not likely to adversely affect</u> the bald eagle.

SPECIES: Southwestern willow flycatcher (Empidonax traillii extimus)

The EIS concludes that a maximum 165 acres of wooded riparian vegetation could be impacted by proposed gas development activities. However, because mitigation calls for avoiding development in riparian areas, the expected level of impact to wooded riparian and riparian areas would be much smaller. Wooded riparian habitat is used as a surrogate for southwestern willow flycatcher habitat because the flycatcher=s habitat is not mapped.

Site-specific biological assessments are required for individual projects where, at such time, the project area is surveyed for suitable habitat and for presence of the southwestern willow flycatcher. During project design, well pads roads and other ancillary facilities will be sited away from locations that contain suitable habitat. To clarify this avoidance measure, the following mitigation is adopted:

? Avoid disturbance to suitable southwestern willow flycatcher habitat by siting facilities a minimum of 100 meters away from such habitat.

Determination: Given the mitigation policy and requirement for suitable habitat avoidance, **it is my determination that oil and gas development on the Southern Ute Reservation <u>may affect and is not likely to adversely affect</u> the southwestern willow flycatcher.**

References:

Stroh, Terry, 2001. Wildlife Biologist, US Bureau of Reclamation, Grand Junction Field Office (formerly with Bureau of Indian Affairs, Southern Ute Reservation)

Waite, Scott, 2001. Wildlife Biologist, Colorado Division of Wildlife, Durango Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES-6-RO-02-F-SJ004
MS 65412 GJ

March 20, 2002

Calvin N. Joyner, Forest Supervisor/Center Manager
Bureau of Land Management
San Juan Public Lands Center
15 Burnett Court
Durango, Colorado 81301

Dear Mr. Joyner:

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), the Fish and Wildlife Service reviewed your August 27, 2001, correspondence regarding the impacts of the Oil and Gas Development on the Southern Ute Indian Reservation Project on endangered Colorado River fishes. The project is located in numerous sections on the Southern Ute Indian Reservation in southwestern Colorado. The proposed action will cause an average annual depletion of 66 acre-feet to the San Juan River.

Reference is made to your August 27, 2001, cover letter, with attached biological assessment, requesting initiation of formal consultation for the project. Based on this consultation initiation date, the formal consultation should have been completed by us on November 25, 2001. However, following receipt of the biological assessment, we notified your staff that we disagreed with the findings in the biological assessment for the bald eagle and southwestern willow flycatcher, and it was mutually agreed that additional information was necessary. Discussions with your staff and the Colorado Division of Wildlife have therefore been ongoing regarding potential impacts to bald eagle and southwestern willow flycatcher since receipt of the biological assessment.

(*Empidonax traillii extimus*). We also concur that the project is not likely to adversely affect the Mexican spotted owl (*Strix occidentalis lucida*), *Pediocactus knowltonii* (Knowlton's cactus), and the *Astragalus humillimus* (Mancos milk-vetch). We agree there are no other federally listed species known or likely to occur within the assessment area. As water depletion is now the only adverse impact associated with the project, we are able to provide this streamlined section 7 consultation.

A Recovery Implementation Program for Endangered Fish Species in the San Juan River Basin was initiated in October 1992. The Recovery Program was intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions from the San Juan River.

On May 21, 1999, the Service issued a biological opinion determining that depletions of 100 acre-feet or less would not limit the provision of flows identified for the recovery of the Colorado pikeminnow and razorback sucker and, thus, not be likely to jeopardize the endangered fish species or result in the destruction or adverse modifications of their critical habitat.

The Bureau of Land Management should condition its approval documents to retain jurisdiction in the event that the Recovery Program is unable to implement the flows identified for recovery in a timely manner. In that case, as long as the lead Federal Agency has discretionary authority over the project, reinitiation of section 7 consultation may be required.

We appreciate the Bureau of Land Management's attention to the conservation needs of the bald eagle and southwestern willow flycatcher.

Sincerely,

Allan R. Pfister

Allan R. Pfister
Assistant Colorado Field Supervisor

cc: CDOW, Durango
FWS/ES, Lakewood
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APPENDIX H
GENERALIZED STRATIGRAPHIC COLUMN OF SOUTHERN UTE INDIAN RESERVATION

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Quaternary	Floodplain Deposits	Sand and gravel with clay, silt, and boulders; generally poorly sorted.	Up to 50 feet; in valleys of present-day streams; thinnest in the western part of the Study Area in the La Plata and Animas river valleys (Brogden and others 1979).	Originating from erosion of the La Plata Mountains (northwest of the Study Area).	Water-bearing	Water-bearing
Quaternary	Terrace deposits	Sand and gravel with clay, silt, and boulders; poorly sorted, with coarser materials well rounded.	Up to 100 feet; two large, extensive terrace deposits in the Study Area. The westernmost, between the towns of Redmesa and Breen in the La Plata River valley, is between 80 and 100 feet thick. The Florida Mesa, between the Animas and Florida rivers, is 60 feet thick.	Originating from erosion of the La Plata Mountains (northwest of the Study Area).	Water-bearing	Water-bearing
Tertiary	San Jose Formation	Interbedded arkosic sandstones, siltstones, and variegated shales (Levings and others 1990).	Overlies the Animas Formation in the northern and eastern portion of the Study Area and the Nacimiento Formation in the southwestern portion of the Study Area. About 1,000 feet thick a few miles south of Durango but is typically as much as 2,000 feet thick elsewhere within the Study Area except where eroded or downcut by the major river valleys (Aubrey 1991).	Sandstones and conglomeratic sandstone are fluvial in origin with the formation generally much sandier in the northern part of the basin than the southern suggesting a northern source.	Water-bearing	Water-bearing

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Tertiary	Nacimiento Formation	Nonresistant shale and very fine-grained sandstones. The shale is generally gray, although locally it is variegated red, white, and gray, especially near the top of the formation. The sandstone is yellow, greenish gray, or tan and quartzose and well sorted.	Uplift mainly west of the Animas River and east of the Hogback monocline; generally grades laterally into the upper part of the Animas Formation to the north; however, locally upper beds of the Nacimiento overstep steeply dripping beds of the upper part of the Animas Formation. The Nacimiento is approximately 1,450 feet thick at the Colorado-New Mexico state line and generally thins to the south (Aubrey 1991).	Variety of alluvial environment including channel, floodplain, alluvial fan, and lacustrine environments. Streamflow was from the north and east and the Nacimiento sediments are coarser in the northern part of the San Juan Basin than the southern part.	Water-bearing, gas	Not present

TABLE H-1 Generalized Stratigraphic Column of the Southern Ute Indian Reservation							
Age	**Rock Unit**		**Lithology**	**Thickness and Distribution**	**Depositional Environment**	**Use**	
						San Juan Basin	**Four Corners Platform**
Tertiary	Animas Formation	Upper part	Lower conglomeratic sequence grading into a sand and shale sequence with thin carbonaceous and coaly shales; characteristically olive, brown, or various shades of gray.	Occurs in the northern and northeastern parts of the San Juan Basin and is 1,200 feet thick at the Animas River near Durango and 2,670 feet thick near the La Plata-Archuleta county line.	Intraformation angular unconformities and conglomeratic lithologies within the upper part of the Animas as well as overstepping relations of the upper part of the Animas with underlying units suggest syntectonic deposition by alluvial fans. Source of the fans appear to be from a northern source area probably derived from the northwest San Juan and Needle mountains and from the northeast Brazos-Sangre de Cristo uplift.	Water-bearing, gas shows	Not present

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Tertiary	Ojo Alamo Sandstone	Medium to coarse-grained, crossbedded sandstone and pebbly sandstone that locally contains lenses of claystone and siltstone. The pebbles diminish in size from north to south and from west to east. The sandstone consists of lenticular bodies as much as 49 feet thick and more than 0.6 mile long that are separated by thin shale interbeds and scour surfaces.	Typically 20 to 400 feet thick in the region. The Ojo Alamo Sandstone is missing from the northern part of the San Juan Basin and is generally absent from southwestern Colorado.	Probably originally deposited in the northern areas but was later uplifted and eroded (Aubrey 1991). The Ojo Alamo deposited by sandy braided streams on a broad alluvial plain (Fassett and Hind 1971). Paleocurrent directions indicate a northern source and volcanic fragments in the Ojo Alamo also indicate a northern source in volcanic fields in the San Juan Mountains region. The base of the Ojo Alamo is generally a scour surface although locally it is gradational or interfingers with the underlying Kirtland Shale (Aubrey 1991).	Water-bearing, gas shows	Not present

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Upper Cretaceous	Animas Formation	McDer-mott Member	Very coarse breccia, volcanic conglomerates, coarse tuffaceous sandstones, shales, and thick beds of massive fine- to coarse-grained tuff with andesite cobbles and pebbles. The rocks are generally reddish brown to purple and consist of andesitic debris with lesser amounts of quartz, quartzite, and chert. Andesite boulders occur locally in the lower beds of the member and large cobbles and pebbles of andesite occur in the upper beds. The size of the andesitic boulders decrease south of McDermott Arroyo in the western part of the Reservation locally.	Variable; in general the member thins to the southeast ranging from 290 feet thick in the western part of the Study Area 15 miles south of Durango to 127 feet thick near the Colorado-New Mexico state line. Intertongues with both the underlying Upper Cretaceous Kirtland Shale and the overlying Paleocene upper part of the Animas Formation.	Probably fluvial in origin, although some conglomeratic layer that coarsen upward may have originated as mud flows. The McDermott becomes thinner and less coarse to the southeast which suggests a source to the northwest. Andesitic debris may have originated in volcanoes located in the region of the present-day La Plata Mountains.	Water-bearing, gas shows	Not present

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Upper Cretaceous	Kirtland Shale	Thick sequence of shales with some sandstones. The Kirtland is divided into three members with the upper and lower members predominately shale and the middle member predominately sandstones (called the Farmington Sandstone Member) (Aubrey 1991). Upper shale member consists of shale and interbedded lenses of nonresistant friable sandstone. The shale is similar to the shale in the lower member and the sandstone is generally light yellowish white and locally conglomeratic. The upper cable member also contains abundant intermediate volcanic fragments. The Farmington Sandstone Member is a sequence of resistant pale olive, dusky yellow, and grayish orange, fine to medium grained, and crossbedded sandstones that are separated by beds of	Regionally the Kirtland shale thins from the northwestern part of the San Juan Basin to the southeastern part where it is locally absent. Within the Study Area the thickness of the Kirtland Shale ranges from 1,065 feet on the western side of the Study Area near the Colorado-New Mexico border to 1,200 feet near Durango.	The Kirtland Shale is an alluvial deposit. Siltstone and mudstone probably represent overbank floodplain deposits and sandstone probably represents deposition in stream channels (Fassett and Hinds 1971). During most of the late Cretaceous, shorelines trended northwest-southeast and paleoslopes dipped to the northeast. A change in paleoslope from the northeast to the southwest may have occurred during the deposition of the upper member of the Kirtland Shale. Additionally the presence of volcanic fragments in the upper member indicate a source from the San Juan Mountains, the only regional volcanic source at the end of the Cretaceous, on the northern perimeter of the basin. The change in dip of the paleoslope during Kirtland deposition is the first major tectonic event of the Laramide orogeny in the region.green or	Some water near the Hogback , gas	Not present

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Upper Cretaceous	Fruitland Formation	Interbedded sandstones, siltstones, shale, carbonaceous shales, carbonaceous sandstones and siltstones, and coal (Fassett and Hinds 1971). Sandstones, which are commonly gray, brown, or olive, fine to medium grained, quartzose, well indurated, and crossbedded, are more abundant in the lower than the upper part of the formation. Sandstones and shales are discontinuous and interfinger with one another, whereas the coal is more continuous and locally traceable for several miles. The thickest coal deposit within the external boundaries of the Reservation can be found a few miles south of Durango and consists of 80 feet of thin coal beds separated by numerous thin partings (Fassett 1988; Fassett and Hinds 1971). The depositional strike of the Fruitland coals is northwest-southeast. The coals	About 500 feet thick in the northwest portion of the Study Area (Aubrey 1991; Fassett 1988).	The Fruitland Formation consists of coastal-swamp, alluvial, and lacustrine deposits that accumulated inland of the prograding and aggrading shoreline deposits of the Pictured Cliffs Sandstone (Fassett and Hinds 1971). The interfingering nature of the Fruitland and the Pictured Cliffs is due to minor local transgressions and regressions of the Cretaceous shoreline due to the sediment supply versus subsidence balance and/or minor austatic sea level changes. The Fruitland coals have been mapped into three coal zones and appear to be associated with three stalling episodes within the regression of the Pictured Cliff shoreline (Sandberg 1988). The lowermost zone contains the thickest coalbeds.	Gas, coal, water-bearing, near the Hogback	Not present are arranged en echelon and rise 1,200 feet stratigraphically from southwest to northeast.

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Upper Cretaceous	Pictured Cliffs Sandstone	Upper medium to thick bedded ledge forming sandstone and a lower thin bedded very fine-grained sandstone with interbedded shales and siltstones (Fassett and Hinds 1971). Locally stratigraphic rises occur abruptly and the Pictured Cliffs forms northwest-southeast-trending benches.	Ranges in thickness from 285 feet in the western portion of the Study Area near the Colorado-New Mexico state line to 215 feet near Durango (Aubrey 1991) and rises stratigraphically from the southwest to the northeast.	Represents the final Cretaceous regressive (R-5) shoreline within the Study Area (Fassett 1988); shoreline sandstone primarily in shallow-water, marine; benches also represent times of relative shoreline stability.	Gas, oil, water-bearing near the Hogback	Not present
Cretaceous	Lewis Shale	Thick sequences of light- to dark-gray and black shale with interbeds of fine-grained sandstone, limestone, calcareous concretions, and bentonite (Fassett and Hinds 1971). Bentonite marker beds that give distinctive responses on electric logs include the "Green Marker Horizon" near the base of the Lewis and the Huerfanito Bentonite Bed in the upper part of the Lewis (Aubrey 1991). The Lewis Shale is wedge-shaped with the wedge pointing toward the southwest.	Maximum thickness within the Study Area of approximately 2,400 feet (Fassett and Hinds 1971) conformable with and grades both laterally and vertically into the underlying Cliff House Sandstone and the overlying Pictured Cliffs Sandstone.	Represents the last Cretaceous sea (T-5 transgression and R-5 regression) in the Study Area.	Gas	Minor water near the Hogback

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Cretaceous	Mesa Verde Group	Cliff House Sandstone	Very fine to fine-grained crossbedded sandstone sequence massive or interbedded with shale and siltstones (Aubrey 1991).	About 400 feet in the Mesa Verde area to little or no sandstone present interfingers laterally and vertically with the overlying marine Lewis Shale and the underlying deltaic deposits of the upper coal member of the Menefee Formation.	Transgressive (T-5) shallow-marine sandstone that was deposited primarily in the lower to upper shoreface zone of a barrier-island beach front. Thick sandstone benches or sandstone tongues were probably deposited during time of relative shoreline stability. Shoreline deposits generally trend northwest-southeast (Aubrey 1991).	Gas, oil, under-ground water disposal	Water-bearing
Cretaceous	Mesa Verde Group	Menefee Formation	Shale, carbonaceous shale, coal, and siltstones alternating with lenticular beds of sandstone. Total Menefee coal thickness in the northern part of the basin measures approximately 10 feet, consisting of a maximum 4-foot-thick lower and a maximum 6-foot-thick upper coalbeds.	Thins to the northeast and pinches out in the eastern part of the Reservation. West of the Reservation the Menefee ranges in thickness from about 800 feet near the Colorado-New Mexico state line to about 340 feet in the northern part of the Mesa Verde area.	Relatively thick, lenticular crossbedded sandstones are probably channel sandstones deposited by meandering streams; thin sandstone beds represent crevasse-splay or levee deposits; and shale and coalbeds represent nonchannel floodplain deposits. Coal-bearing portions (lower and upper) were probably deposited on the middle or lower part of a delta plain. Coal-barren portions were probably deposited on a continental fluvial plain or on the upper to middle part of a delta plain.	Gas	Gas, coal

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Cretaceous	Mesa Verde Group	Point Lookout Sandstone	Consists of two members, the lower sandstone and shale member and the upper massive sandstone member. The sandstone and shale member is composed of interbedded yellowish-gray, fine-gained, cross-laminated sandstone and sandy dark-olive-gray, fossiliferous shale. The amount of sand in the member increases upward. The upper massive sandstone consists of thick to massive beds of light-gray to yellowish-gray, crossbedded, fine- to medium-grained sandstone.	The lower member is about 80 to 125 feet thick in the Mesa Verde area, but elsewhere in the northern part of the basin it is as thick as 250 feet. The upper massive sandstone is about 200 to 250 feet thick. The Point Lookout Sandstone rises stratigraphically from the southwest to the northeast and grades laterally as well as vertically into both the underlying Mancos Shale and overlying Menefee Formation.	Variety of coastal, shoreline environments. Benches or abrupt stratigraphic rises represent stacking of shoreline deposits when the shoreline was relatively stable. Benches in the northwestern San Juan Basin form thick sandstone bodies that continue for many miles in a northwest-southeast direction (Aubrey 1991).	Gas, oil, under-ground water disposal	Water-bearing, gas

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Cretaceous	Mancos Shale	Gray to dark-gray, gypsiferous, marine shale. A regional unconformity of Coniacian age divides the Mancos Shale into upper and lower parts (Figure 3.4-3). Many thin, platy sandstone beds interbedded with sandy shale are located at this unconformity. The 400 to 500 feet of shale directly above the unconformity has variable carbonate content. The remainder is less calcareous and in its upper part grades into the overlying Point Lookout Sandstone (Molenaar 1991).	Approximately 1,500 feet of Mancos Shale overlies the Coniacian unconformity. The Tocito Sandstone Lentil of the Mancos Shale crops out on the western side of the San Juan Basin to the west and south of the Reservation. Although the Tocito Sandstone Lentil does not crop out on the Reservation, it may occur locally in the subsurface.	Marine deposits include all the rocks between the transgressive Dakota Sandstone (T-1) and the regressive Point Lookout Sandstone (R-4) (Figure 3.4-3); not homogenous and changes in lithology within the Mancos in the Reservation reflect transgressions and regressions of the shoreline that occurred to the southwest. The Tocito was deposited during the T-3 transgression and some have interpreted thick sandstones in the Tocito to represent offshore-bar deposits.	Oil and gas	Oil and gas

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Cretaceous	Dakota Sandstone	Sand, shale, minor conglomerates, and coal. White, light- to medium-gray, and yellowish-brown conglomerate, conglomeratic sandstone, and fine- to medium-grained sandstone; grayish-green to grayish-red, generally nonbentonitic, hackly weathering mudstone, dark to medium-gray carbonaceous mudstone and siltstone and minor interbedded coal.	Thickness with the underlying Burro Canyon, undivided, ranges from 180 to 270 feet and averages 200 feet.	Deposited in response to the initial transgression (T-1) of the Upper Cretaceous epieric sea. Basal alluvial unit, Encinal Canyon Member, that is overlain by deltaic, marginal-marine, and marine rocks in different parts of the region. In general, Upper Cretaceous shorelines trended northwest-southeast and transgressed to the southwest; however, during the middle Cenomanian a large embayment, the Seboyeta Bay, formed in the northwestern New Mexico and the shoreline in the Reservation area trended north-south and transgressed to the west.	Gas, minor oil	Oil, gas, minor water

TABLE H-1
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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Lower Cretaceous	Burro Canyon Formation		Lenticular conglomerate and conglomeratic fluvial-channel sandstone bodies composed of quartzose sandstone and pebbles of colored chert, quartzite, silicified limestone, and siltstone. The conglomeratic sandstones are more numerous, less coarse, and more "blanketlike" in the upper part of the section than the lower part.		Fluvial-channel		
Jurassic	Morrison Formation	Brushy Basin Member	Light-greenish-gray to reddish-brown, smectitic mudstone; very fine-grained sandstone; and minor amounts of conglomeratic sandstone, limestone, and the aeolites anaclime and clinoptilolite.	Less than 200 feet thick across much of the Reservation but thickens to more than 300 feet in the Piedra River area.	Fluvial and lacustrine origin (Condon 1992). Playa-lake complex deposited in a basin that extended from the southern edge of the present-day San Juan Basin to the north of the present-day Uncompahgre Uplift. Zeolites originated from volcanic ash that came from a magmatic arc several hundred miles to the west (Aubrey 1991).	Gas	Gas and oil

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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Jurassic	Morrison Formation	West Canyon Member	Tan, light-gray, and yellowish-brown, fine- to medium-grained, crossbedded sandstone and light greenish-gray to dark-gray mudstone and becomes more mudstone dominated eastward into the Reservation in the subsurface.	Up to 160 feet thick, thinning to the north, on the Reservation.	Part of an alluvial complex that prograded from a source area southwest of Colorado.		
Jurassic	Morrison Formation	Recapture Member	White to light-gray, fine-grained sandstone and reddish-brown to pale-green mudstone.	About 50 to 100 feet thick.	Fluvial unit.		
Jurassic	Morrison Formation	Salt Wash Member	Light-gray, yellow, and tan, fine- to medium-grained lenticular crossbedded sandstone and greenish-gray to reddish-brown mudstone. More mudstone dominated eastward into the Reservation in the subsurface.	Averages 100 to 150 feet.	Extensive alluvial complex which was composed of sediments shed from highlands to the west.		

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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Jurassic	Junction Creek Sandstone (equivalent to the Bluff Sandstone Member of the Morrison Formation) recognized in Utah, Arizona, and New Mexico.		The formation is divided into three units. The lower most unit is equivalent with the Horse Mesa Member of the Wanakah Formation. Middle unit of the Junction Creek consists of pink to orange, fine- to medium-grained sandstone. The middle unit is thick to very thick bedded and has very large scale crossbedded cosets. The upper unit is grayish-red, fine-grained, argillaceous sandstone.	The middle unit is about 250 feet thick in McElmo Canyon and generally thins eastward in the subsurface. The thickness of the upper unit is variable; 30 feet in McElmo Canyon. The middle and upper units of the Junction Creek thin to 100 feet or less at the surface in the Piedra River area.	Eolian environments which varied from dune to interdune-playa (Condon 1992).	Under-ground water disposal	
Jurassic	Wanakah Formation	Horse Mesa Formation	Pale-red to reddish-brown, fine- to medium-grained sandstone. Coarse grains of white chert are locally abundant; alternating flat-bedded and crossbedded cosets.	Up to 40 feet thick across much of the Reservation.	Eolian dune and interdune environments.		
Jurassic	Wanakah Formation	Beclabito Member	An assemblage of interbedded reddish-orange to reddish-brown claystone, siltstone, silty sandstone, and fine-grained sandstone.	About 80 feet thick in the subsurface in the western part of the Reservation and thickens to about 100 feet in the central and eastern parts.	Deposited in marginal-marine and sabkha environments.		

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Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Jurassic	Wanakah Formation	Todilto Limestone Member	Light-gray to dark-gray, thinly laminate to massive limestone.	As thick as 120 feet in the southeastern part of the Reservation and pinches out in the subsurface west of the Reservation. The unit is about 15 feet thick in the Piedra River area.	A large, restricted marine basin.		
Jurassic	Entrada Sandstone	Slick Rock Member	White, pinkish-orange, and reddish-orange, very fine to fine-grained to locally medium-grained sandstone.	Averages 70 to 100 feet thick and up to 250 feet to the north in the Piedra River area.	Eolian dunes and interdunes that bordered the Jurassic sea.	Under-ground water disposal	
Jurassic	Entrada Sandstone	Dewey Bridge Member	Very fine-grained argillaceous sandstone and siltstone.	About 25 to 35 feet thick in the western portion of the Reservation, pinches out to the east, and is not present in the Durango and Piedra River areas.	A sabkha environment that bordered the Jurassic sea, which was present to the north and west of Colorado.		
Jurassic	Glen Canyon Group	Navajo Sandstone	All three formations are composed mainly of sandstone in Colorado and are difficult to distinguish as separate units near the eastern punchout of the group.	From its eastern punchout, west of the town of Red Mesa the group thickens abruptly westward to about 500 feet at the Colorado-Utah state line.	Eolian unit.		
Jurassic	Glen Canyon Group	Keyenta Formation			Eolian unit.		

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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Jurassic	Glen Canyon Group	Wingate Sandstone	Interbedded red to purplish-red, very fine- to coarse-grained sandstone, conglomerate, siltstone, and mudstone. Is equivalent to part of the Chinle Formation in other parts of the Four Corners region.	About 900 to 1,200 feet thick on the west side of the Reservation and is cut out in the Piedra River area by a pre-Entrada Sandstone unconformity.	Fluvial-channel, floodplain, lacustrine, and eolian sand-sheet deposits.		
Triassic	Dolores Formation		Tan, reddish-brown, orangish-red, very fine- to medium-grained sandstone. The sandstone is very thick bedded and exhibits large-scale, high-angle crossbeds.	Typically 250 feet thick in southwestern Colorado but ranges from 0 to 100 feet thick on the Reservation.	An eolian deposit.		
Permian	Cutler Group	De Chelley Sandstone	Interbedded reddish-brown to red siltstone, silty sandstone, and sandstone. Thin beds of limestone and siltstone-pebble conglomerate are present locally near the base in the area to the west of the Reservation.	Typically 500 to 900 feet thick.	Coastal-plain, mud-flat deposits in the southern part of the area and grades northward into fluvial deposits.		

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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Permian	Cutler Group	Organ Rock Formation	Sequence of pastel siltstone and shale with secondary amounts of gypsum, sandstone, and limestone. This sequence is distinctive in being pale red in contrast to the reddish-brown color of other parts of the Cutler above and below.	Ranges in thickness from 150 to 350 feet.	Tidal-flat and sabkha conditions.		
Permian	Cutler Group	Cedar Mesa Sandstone	Reddish-brown to dark-brown silty sandstone and siltstones and minor gray limestone. Thin beds of sandstone and siltstone are interbedded and outcrops consist of a series of slopes and ledges.	Averages between 350 and 800 feet.	Alternating beds of marginal-marine mud-flat and fluvial sediments that were deposited near sea levels.		
Pennsyl-vanian	Rico Formation		Conglomeratic sandstone and arkose interbedded with greenish-, reddish-, and brownish-gray shale and sandy fossiliferous limestone.	Averages about 200 feet.	A unit that was transitional between the underlying marine Hermosa Group and the overlying continental Cutler Group.		

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Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Pennsyl-vanian	Hermosa Group	Honaker Trail Formation	Light-gray to dark-gray, finely crystalline limestone and dolomite, micaceous siltstone, and arkosic sandstone. The percentage of limestone increases at the base of the unit and toward the center of the basin, and the formation includes more clastic rocks in the upper part of the unit and along the north basin margin.	Between 800 and 1,200 feet thick across much of the Reservation, although it thins abruptly to the east.	Open marine basin. The ancestral Uncompahgre highland that bounded the north side of the Paradox Basin was apparently increasingly active during deposition of the Honaker trail sediments as indicated by greater amounts of arkosic clastic rocks in the unit along the paleomountain front. The lobate distribution of these clastic rocks suggests deposition in fan deltas along the northeast margin of the Paradox Basin.		

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Pennsyl-vanian	Hermosa Group	Paradox Formation	Complex sedimentary rock unit in southwest Colorado. Divided into cyclic units (Baars and others 1967) (in ascending order), Alkali Gulch, Barker Creek, Akah, Desert Creek, and Ismay. These units are bounded by black shale beds; correlation from the evaporite facies to the shelf-carbonate facies is made possible by recognition of the shale marker beds.	Limiting recognition of the Paradox Formation to only the areas where salt or anhydrite occurs would place the eastern extent of the Paradox roughly halfway across the Reservation. However, rocks equivalent to the evaporite facies may be recognized in the eastern part of the Reservation and in areas to the south of the Reservation by correlation of shale marker and carbonate beds. Thickness of the Paradox Formation varies between 400 and 1,800 feet thick.	The sediments of the Paradox Formation and equivalent rocks were deposited in a subsiding elongate trough that was oriented northwest-southeast and bounded by uplifts. (The Paradox Basin underwent periodic episodes of rising and falling sea level making the cyclic deposits.)		Gas and oil

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Mississippian	Leadville Limestone	Yellowish-brown and light to dark-gray, finely to coarsely crystalline, fossiliferous dolomite and limestone. Dolomite is more common than limestone in the lower, thin- to medium-bedded part of the unit, and limestone is the dominant lithology of the upper, more massively bedded part. The top of the Leadville, which was deeply eroded into karst topography before deposition of the overlying sediment, has joint and cavern fillings of reddish siltstone and mudstone. This residual material filtered downward after lithification of the Leadville and was not a primary deposition feature.	Thickness ranges from nearly 0 feet on the east side of the Reservation to about 250 feet on the west side.	The Leadville limestone of southwest Colorado and adjacent areas was formed during two transgressive episodes int he Mississippian. The sediment of the lower dolomitic part were deposited under shallow-water tidal-flat conditions and that those of the upper part were deposited in diverse marine environments, which ranged from low-energy stable-shelf conditions to high-energy shoals (Condon 1992).		

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Devonian	Ouray Limestone		Dark-brown to light-gray, dense, argillaceous limestone with local green clay partings. The basal bed of the Ouray is a tan dolomite in many places. A green clay bed as thick as 15 feet commonly occurs at the top. Abundant brachiopods, gastropods, crinoids, and toraminiferans.	Generally thickens from a punchout near the east side of the Reservation to 100 feet near the Utah-Colorado state line.	The marine fauna and widespread extent of the Ouray indicate deposition in a shallow sea on a cratonic shelf between the Cordilleran miogeocline to the east and the North American craton to the west. The sediments of the Ouray were deposited during the last major transgression of the Late Devonian sea.		
Devonian	Elbert Formation	Upper Member	Poorly exposed, thinly bedded, brownish-gray, sandy dolomite, and sandstone; green to red shale; and minor anhydrite.	The Upper Member ranges from 150 to 250 feet in thickness in areas to the west of the Reservation and thins eastward to about 25 feet in the Piedra River area. The unit is not recognized east of Chromo, Colorado.	The presence of salt casts, stromatolites, and fish remains suggests that sediments of the Upper Member were deposited in the shallow-water tidal-flat environment. Sediments of the Upper Member of the Elbert Formation were deposited in the gradually deepening waters of a Late Dovonian marine transgression.		

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit		Lithology	Thickness and Distribution	Depositional Environment	Use	
						San Juan Basin	Four Corners Platform
Devonian	Elbert Formation	McCrack-en Sandstone Member	Gray to brown sandstone, brown and gray dolomite, and greenish-gray shale. The dominant lithology is very fine- to coarse-grained sandstone. The lithology changes areally depending on the lithology of the source. The sandstone is thin to thick bedding with small- to medium-scale crossbeds. The sandstone is highly silicified and weathers to ledgy cliffs. Although the McCracken and Ignacio Quartzite are somewhat different mineralogically, they look similar in outcrops, leading to misidentifications and miscorrelations (Condon 1992).	Ranges from 0 to 140 feet in the subsurface. Baars (1966) reported that the McCracken is best developed on the flanks of Paleozoic fault blocks but is absent over the tops of several blocks. The McCracken Sandstone appears to be absent in most of the San Juan Basin; however, distribution is poorly constrained on the Reservation due to lack of deep drilling.	The McCracken is composed of shallow-marine, nearshore sediment that were deposited during a eustatic sea-level rise in the Late Devonian. Authors have interpreted the McCracken and other Elbert sandstones as shallow-shelf assemblages of barrier bar, wave break-point bar, and blanket sand deposits (Condon 1992). Lack of cobbles or boulders near the Paleozoic fault blocks has led Baars and See (1968) to the conclusion that the faults were not active during deposition of the McCracken.		

TABLE H-1
Generalized Stratigraphic Column of the Southern Ute Indian Reservation

Age	Rock Unit	Lithology	Thickness and Distribution	Depositional Environment	Use	
					San Juan Basin	Four Corners Platform
Cambrian	Ignacio Quartzite	White, reddish-brown, and light-brown conglomerate; feldspathic and quartzose very coarse to fine grained sandstone; purple to green, burrowed, micaceous mudstone and siltstone; and minor dolomite. The sandstone commonly contains angular clasts of potassium feldspar. Upper part of the Ignacio, which consists of fine grained clastic rocks and dolomite.	Averages 150 feet in the northwest part of the Reservation and thins to about 30 feet in the Piedra River Canyon about 20 miles west of Pagosa Springs. In some places, such as north of Durango, the Ignacio is absent due to onlap onto Proterozoic rocks. The Ignacio is not recognized on the east side of the Reservation but thickens markedly to the west and northwest. Selectively eroded or preserved on northwest-trending horsts and grabens.	In streams and on alluvial fans. The conglomerate in the formation was apparently derived from nearby uplifted Proterozoic fault blocks and, in some cases, consists of angular boulders that were not transported far. There is a shallow-shelf assemblage of material that was deposited by the eastward transgressing sea of the Cordilleran miogeocline.		
Precambrian	Precambrian Rocks	Gneiss, schist, amphibolites, granite, gabbro, and metaconglomerate.	The distribution of these different rock types beneath the Reservation is unknown.			

Descriptions from Aubrey 1991 and Condon 1992.

APPENDIX I
FORMATION AND PRODUCTION OF COALBED METHANE

FORMATION OF COALBED METHANE

Coalbed methane (CBM) is formed during coalification, or the formation of coal. The process of coalification encompasses physical and chemical changes that occur in coal, beginning shortly after deposition, continuing throughout the burial history. During coalification, natural gases are generated from organic matter through biogenic (peat), early thermogenic (subbituminous to bituminous), and late thermogenic (bituminous-anthracite) processes. Although methane is the major gas component in coalbed gases, water, carbon dioxide, wet gases (ethane, propane, butane, etc.), nitrogen, and liquid hydrocarbons are also generated. In general, gases produced from lower rank coals (peat; vitrinite reflectance values less than 0.5 percent) are biogenic. Biogenic methane is produced at relatively low temperatures through the metabolic activity of bacteria. Primary biogenic methane generated during early coalification (peatification) is probably not retained by the coal in large quantities, suggesting that most of the biogenic gases found in coalbeds are actually secondary biogenic gases related to meteoric recharge and basin hydrodynamics. In contrast, gases produced from higher rank coals are predominantly thermogenic. Early thermogenic gases are formed before and during the main stage of liquid hydrocarbon generation (often referred to as the oil window). Once the threshold of thermogenic methane generation is attained, between vitrinite reflectance values of 0.8 and 1.0 percent, significant quantities of methane can be generated from coalbeds. Carbon dioxide is also released from the coal structure during coalification and/or is generated through the metabolic activity of bacteria during primary or secondary bacterial gas generation. Wet gases are generated from hydrogen-rich coals during coalification, and Scott (1994) reports that ethane is sorbed on some Fruitland coals, typically in the southern portion of the San Juan Basin. Nitrogen is also released during coalification from bacterial metabolism and/or occurs during thermal maturation of the coal. Dry thermogenic gases are formed by late thermogenic processes and/or by cracking heavier hydrocarbons formed from hydrogen-rich coals (Scott 1994).

Gases in the Fruitland Formation are mainly thermogenic in origin. The regional distribution of the coalbed gases suggests that coal rank is not the only factor controlling the chemical composition of the gas. There is significant difference in the coalbed gas composition between the overpressured (artesian hydraulically confined) and underpressured (non-flowing hydraulically confined) parts of the Fruitland Formation in the basin. The overpressured coalbed gases, located in the north-central part of the San Juan Basin and within the Study Area, are chemically drier (contain little or no ethane, propane, etc.) than the underpressured coalbed gases. High concentrations of carbon dioxide are associated with the overpressured coalbed gases. Nitrogen content of the Fruitland coalbed gases is generally low and does not appear to vary with the hydrogeologic regime of the formation. The gas composition correlates better with the pressure regime in the Fruitland Formation than with coal rank, suggesting that basin hydrology is a major factor controlling coalbed gas composition (Scott 1994).

COALBED METHANE PRODUCTION

The nature of the gas within the coalbed and the process used to release the gas is unique to CBM production. A coal seam is a dual porosity medium that consists of a solid matrix containing micropores and a natural fracture system known as cleats. Prior to production of a reservoir, water saturates the cleat system. This water may or may not contain free or dissolved gas but generally no free gas exists within the cleat system. The methane, rather, is adsorbed on the surface of the coal in the walls of the micropores (Ely et al. 1988). When the water from the cleat system is produced, the reservoir pressure within the coal bed decreases and the sorption capacity (the ability of the coal to retain gas) of the coal also decreases. As a result, the methane and other gases (primarily carbon dioxide, but ethane and propane also may be present) desorb and subsequently migrate from the micropore walls into the cleat system. The desorbed gas will migrate through the cleat system to lower pressures (Scott 1994).

Since water must be produced to lower the pressure and subsequently release the methane, large quantities of "produced" water are typically associated with CBM production. Fruitland CBM wells can produce more than 1,000 barrels of water per day (BWPD), although they average much less. For example, in 1998, Ignacio Blanco Fruitland wells averaged 64 barrels of water per day (Dwight's 2000). Water production also will typically decrease over the life of a well, while gas production will typically increase to a peak over a period of years and then decline similar to the way production from a conventional well declines.

As discussed in Section 3.5.1, the Fruitland coalbeds were initially under overpressured conditions in the central basin extending to within 2 miles of the northern portion of the outcrop (Ayers 1988). The artesian (or flowing) hydraulically confined condition of the aquifer is referred to as an overpressured reservoir. The overpressured nature is beneficial for well development because operators can use the higher pressure to complete the well naturally rather than introduce into the formation other materials such as fracture stimulation fluids, which have a tendency to cause formation damage and reduce reservoir permeability.

The confined nature of the Fruitland water provides the drive mechanism to bring the water to and into the well bore. For example, a confined aquifer is considered to be artesian when the water flows to the surface. During initial Fruitland CBM development, most of the CBM wells were artesian or overpressured, and the formation pressure and surface pumps were and are used to reduce the total pressure of the coals. Depleting the pressure, by pumping the water as discussed above, allows the methane to desorb from the coal. This drive mechanism is not very effective since less than 50 percent of the gas-in-place will be produced. There is a practical and economic limit to the extent to which reservoir pressure can be reduced. Studies have found that the methane desorption from the coal is achieved by reducing the partial pressure of the methane rather than merely the total pressure of the formation; thus, enhanced recovery production techniques are being evaluated for the Fruitland and other CBM fields (Puri and Yee 1990).

The Fruitland Formation water is predominately sodium bicarbonate (see Section 3.5.1 for a description of the groundwater associated with the Fruitland Formation). The produced water is typically disposed, or reinjected, into a deeper formation because of its high total dissolved solids (TDS) concentrations. Within the Study Area approximately 30 disposal wells are permitted for injecting produced water into deeper formations, typically the Entrada or Bluff (Junction Creek) sandstones. The formations used for water disposal must meet the following criteria:

- The aquifer does not currently serve as a source of drinking water.

- The aquifer currently cannot and will not in the future serve as a source of drinking water because it is:

    - mineral, hydrocarbon, or geothermal energy producing or can be demonstrated to contain minerals or hydrocarbons that, considering their quantity and location, are expected to be commercially producible;

    - situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical; or

    - contaminated to an extent that it would be economically or technologically impractical to render the water fit for human consumption.

- The TDS content of the groundwater is more that 3,000 milligrams per liter (mg/L) but less than 10,000 mg/L, and it is not reasonably expected to supply a public water system.

Played-out conventional wells (wells that are no longer economical to produce) also can be converted and permitted for disposal if properly completed. Within the boundaries of the Reservation, the Environmental Protection Agency (EPA) has permitting authority over the produced water disposal wells for the underground injection control (UIC) program. On fee land, EPA's permitting and regulation of disposal wells is duplicated by the Colorado Oil and Gas Conservation Commission (Zimpler et al. 1988; Southern Ute Indian Tribe Environmental Programs and Energy Resources 1996).

APPENDIX J
SOIL CHARACTERISTICS OF THE SUIT STUDY AREA

APPENDIX J
SOIL CHARACTERISTICS OF THE STUDY AREA

SOIL LEGEND

Map Unit[1]	BIA Symbol	Map Unit Name	Texture	Slope (%)	Erosion Potential		Soil pH	Shrink-Swell Potential	Risk of Corrosion		Prime Farmland
					Water	Wind			Uncoated Steel	Concrete	
1	T2-B	Agua Fria loam	loam, clay loam, very stony to very cobbly loam	1 to 3	slight	slight	7.4-8.4	low to moderate	high	low	yes
4	T4-B	Arboles silty clay loam	silty clay loam, silty clay	0 to 3	moderate	moderate	6.6-8.4	high	high	low	_
5	E0-CD T4-C	Arboles clay	clay, silty clay	3 to 12	moderate	moderate	6.6-8.4	high	moderate	low	yes
6	C5F C5-F	Archuleta loam	loam, clay loam	12 to 65	moderate	very slight	6.1-7.8	moderate	moderate	low	-
7	XC5-F	Archuleta-Sanchez complex	clay loam, stony sandy clay loam	12 to 65	moderate	very slight	6.1-7.8	low to moderate	high	low	-
8	S0-CD	Baca Variant loam	loam, silty clay loam	3 to 12	moderate	slight	6.6-8.4	low to high	high	low	yes
9	BD	Badland			high to severe	high to severe	-	-	-	-	-
10	A6-B	Bayfield silty clay loam	silty clay loam, silty clay	1 to 3	high	slight	6.6-8.4	moderate to high	high	low	yes
11	A6-B3	Bayfield clay loam, gullied	silty clay loam, silty clay	1 to 3	high; subject to severe gully erosion	slight	6.6-8.4	moderate to high	high	low	-
12	A6W-B	Bayfield silty clay loam, seeped	silty clay loam, silty clay	1 to 3	slight	slight	6.6-8.4	moderate to high	high	low	yes

SOIL LEGEND

13	V4-CD	Big Blue clay loam	clay loam, silty clay	0 to 6	slight	slight	7.9-8.4	moderate to high	high	low	-
14	E8-CD	Bodot clay	clay, clay loam	3 to 10	high	moderate	7.4-9.0	high	high	moderate	-
16	A5-B	Buckle loam	loam, clay loam	1 to 6	moderate	very slight	7.9-8.4	low to moderate	high	low	yes
17	H4-E	Chris very stony loam	very stony loam, gravelly clay loam	9 to 25	moderate	none	5.6-6.5	low to moderate	moderate	moderate	-
19	V5-CD	Clayburn loam	loam, clay loam	3 to 12	slight	slight	6.1-7.3	low to moderate	moderate	low	yes
21	M3-D	Coni loam	loam, clay loam	4 to 25	moderate	slight	6.1-7.3	low to moderate	moderate	low	-
22	C0-B	Corta loam	loam, clay, silty clay	1 to 3	moderate	slight	6.1-7.8	low to high	moderate	low	yes
23	CO-C	Corta loam	loam, clay, silty clay	3 to 8	moderate	slight	6.1-7.8	low to high	moderate	low	yes
24	XM9E	Dulce-Travessila-Rock outcrop complex	sandy loam	6 to 50	moderate	high	6.6-8.4	low	moderate	low	-
25	R6A-C	Durango cobbly loam	cobbly loam, clay loam	3 to 20	slight	none	6.6-9.0	low to high	high	low	-
26	R8-B	Falfa clay loam	clay loam, silty clay	1 to 3	moderate	moderate	6.6-8.4	moderate to high	high	low	yes
27	R8-CD	Falfa clay loam	clay loam, silty clay	3 to 8	moderate	moderate	6.6-8.4	moderate to high	high	low	yes
28	A2W-A	Fluvaquents	sand to very gravelly sand	0 to 3	slight, frequently flooded	high	6.6-7.8	low	moderate	low	-
31	R5-EF	Goldvale very stony fine sandy loam	very stony fine sandy loam, strong sandy clay	15 to 65	slight	none	6.1-7.3	low to moderate	moderate	moderate	-
32	RCL	Haploborolls-Rubble Land complex	very cobbly loam, very stony clay loam	10 to 60	moderate	none	6.1-7.8	low	moderate	low	-
33	T1-B	Harlan cobbly loam	cobbly loam, clay loam	1 to 3	slight	none	6.6-8.4	low to moderate	moderate	low	-
34	T1-D	Harlan cobbly loam, most	cobbly loam, clay loam	3 to 15	moderate	none	6.6-8.4	low to moderate	high	low	-
36		Hayness loam	loan, clay loam, silt loam	3 to 12	moderate	slight	7.4-9.0	low	high	low	yes

SOIL LEGEND

37	C2E	Herm loam	loam, clay loam	6 to 25	slight	slight	6.1-7.8	low to high	moderate	low	-
39	V2-CD	Hesperus loam	loam, clay loam	3 to 12	slight	slight	6.1-7.8	low	moderate	low	yes
41	MO-DE	Lazear stony loam	stony loam	6 to 25	moderate	none	7.4-9.0	low	high	low	-
42	XMO-F	Lazear-Rock outcrop complex	very stony loam, stony loam	12 to 65	moderate	none	7.4-9.0	low	high	low	-
43	D2-EF	Leadville very stony sandy loam	very stony sandy loam, very stony clay loam	15 to 55	slight	none	5.6-7.0	low to moderate	moderate	moderate	-
44	V0-CD	Mikim loam	loam, clay loam	3 to 12	high	slight	6.6-08.4	low	high	low	yes
45	T3-BC	Nehar stony sandy loam	stony sandy loam, stony clay loam	1 to 6	slight	nopne	6.1-7.8	low to moderate	moderate	low	-
47	A3-B	Nutrioso loam	loam, fine sandy loam to clay loam	1 to 3	moderate	very slight	6.6-7.8	low	high	low	yes
48	A7-C	Panbitchen-Dominquez varient silty clay loams	silty clay loam, silty clay	1 to 6	high	moderate	7.9-9.0	moderate	high	low to high	-
49	T6-B	Pastorius cobbly loam	cobbly loam, very cobbly clay loam	1 to 3	slight	none	6.1-7.8	low to moderate	moderate	low	-
50	A2-AB	Pescar fine sandy loam	fine sandy loam, loamy fine sand	0 to 2	slight; subject to frequent flooding	high	6.6-8.4	low	high	low	-
51	C6-E	Picante-Rock outcrop complex	clay loam, silty clay loam	10 to 45	high	moderate	7.4-8.4	moderate	high	low	-
52	D1-CD	Pinata loam	loam, clay loam, gravelly clay	1 to 12	slight	slight	6.1-7./8	low to high	moderate	low	-

SOIL LEGEND

53	D1-E	Pinata loam	loam, clay loam, very cobbly clay	12 to 40	moderate	slight	6.1-7.8	low to high	moderate	low	-
54	GP	Pits, gravel	-	-	-	-	-	-	-	-	-
55	R1-CD	Plome fine sandy loam	fine sandy loam, sandy clay loam	3 to 12	moderate	high	6.1-7.3	low to moderate	moderate	low	yes
56	M5-CD	Pulpit loam	loam, clay loam	3 to 12	moderate	slight	6.6-8.4	low to moderate	high	low	-
57	RV	Riverwash	sands, gravels, cobbles	-	-	-	-	-	-	-	-
58		Rock outcrop		15 to 90	-	-	-	-	-	-	-
59	TO-B	Sedillo gravelly loam	gravelly loam, very cobbly loam	0 to 3	slight	very slight	7.4-9.0	low	high	low	-
60	T5-B	Shalona loam	loam, clay loam, silty clay	1 to 6	slight	moderate	6.6-8.4	low to moderate	high	low	yes
62	V7-B	Sili clay loam	clay loam, silty clay loam	1 to 3	moderate	moderate	6.6-8.4	moderate to high	high	low	yes
63	V7-C	Sili clay loam	clay loam, silty clay loam	3 to 6	moderate	moderate	6.6-8.4	moderate to high	high	low	yes
64	V8-B	Simpatico loam	loam, silty clay loam, very cobbly loam	1 to 3	slight	slight	6.6-8.4	low to moderate	moderate	low	yes
65	J1-B	Sycle fine sandy loam	fine sandy loam, sandy clay loam	1 to 3	slight	very slight	7.4-9.0	low to moderate	high	low	yes
66	A0-B	Tefton loam	loam, clay loam to fine sandy loam	1 to 3	moderate	slight	7.4-8.4	low	moderate	low	yes
68	M8-F	Uinta loam	loam, gravelly sandy clay loam	15 to 60	moderate	high	6.1-7.8	low to moderate	moderate	low	-
69	VB-C	Umbarg loam	loam, clay loam	3 to 6	slight	moderate	7.4-8.4	low to moderate	high	low	yes
70	XTO-E	Ustic Torriothents-Ustollic Haplargids complex	very gravelly loam, gravelly loam, very gravelly sand loam	12 to 60	high	slight	7.4-8.4	low	moderate	low	-

SOIL LEGEND

71	XM1-E	Valto Rock outcrop complex	very stony fine sandy loam very stony sandy loam	12 to 65	slight	none	6.1-7.3	low	moderate	low	-
72	T7-B	Vernal fine sandy loam	fine sandy loam, clay loam	1 to 3	slight	slight	7.4-8.4	low to moderate	high	low	yes
73	T-7C	Vernal-Sedillo complex	fine sandy loam, gravelly loam, gravelly to cobbly loam	3 to 12	slight	slight	7.4-9.0	low to moderate	high	low	-
74	V3-CD	Vosburg fine sandy loam	fine sandy loam, sandy clay loam	3 to 8	moderate	high	6.1-8.4	low	high	low	yes
75	R^-B R0-B	Witt loam	loam, clay loam, silty clay loam	1 to 3	moderate	slight	6.6-8.4	low to moderate	high	low	yes
76	R6-CD R0-CD	Witt loam	loam, clay loam, silty clay loam	3 to 8	moderate	slight	6.6-8.4	low to moderate	high	low	-
77	R2-CD	Witt loam, eroded	loam, clay loam, silty clay loam	3 to 12	moderate	slight	6.6-8.4	low to moderate	high	low	-
78	V0-B	Yenlo-Florita sandy loams	sandy loam, sandy clay loam	1 to 6	moderate	high	6.6-7./8	low	moderate to high	low	-
80	Ms-E	Zau stony loam	stony loam, clay loam, sandy clay loam	9 to 25	moderate	slight	6.1-7.8	low to moderate	moderate	low	-
81	E6-CE	Zyme clay loam	clay loam, clay, silty clay loam	3 to 25	high	moderate	7.4-8.4	high	high	low	-
82	XE-6-E	Zyme-Rock outcrop complex	clay loam, silty clay loam	12 to 65	high	moderate	7.4-8.4	high	high	low	-

[1]Soils Map 13, Map volume

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APPENDIX K
CULTURAL RESOURCES - CULTURAL HISTORY, SENSITIVITY, MODELING, IMPACT ASSESSMENT STRATEGY

This appendix provides technical details about the cultural resources component of the EIS analyses. The appendix begins with a brief summary of regulatory requirements related to protection of cultural resources. Available cultural resource inventory data are then characterized, and the cultural history of the Southern Ute Indian Reservation (SUIR) and surrounding region is summarized to provide a context for evaluating the significance of cultural resources within the project area. This summary is based on previous overviews, the compiled inventory data, and the prior local experience of the staff of Southwestern Archaeological Services, Inc. who participated in this study (Susan Barnett, Barry Hibbets, and Doug Loebig). Methods used to model cultural resource sensitivity within the project area are discussed and projections of prehistoric, ethnohistoric, and historic resource sensitivity zones are described. The appendix concludes with a description of how these sensitivity projections were used to evaluate the potential impacts of the project and compare alternatives.

REGULATORY REQUIREMENTS

The National Environmental Policy Act (Section 101[b][4]) establishes a Federal policy of conserving the historic and cultural, as well as the natural, aspects of our national heritage as Federal agencies permit, fund, or plan and construct projects. The Council on Environmental Quality issued implementing regulations for *Protection of Environment* (40 CFR Part 1502.16[g]), stipulating that the consequences of Federal undertakings on historic and cultural resources be analyzed. In accordance with these and other Federal historic preservation regulations, cultural resources are considered in this environmental impact statement (EIS).

The Antiquities Act of 1906, the National Historic Preservation Act of 1966, as subsequently amended, and the Archaeological Resources Protection Act of 1979 are other Federal laws that protect cultural resources. In addition, the American Indian Religious Freedom Act of 1978 requires that all Federal agencies take into account the effects of their actions on traditional Native American religious and cultural values and practices. Also, the Native American Graves Protection and Repatriation Act of 1990 expressly provides for the protection of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, and gives affiliated Native American groups priority in the treatment of such human remains and artifacts.

Regulations for *Protection of Historic Properties* (36 CFR Part 800), which primarily implement Section 106 of the National Historic Preservation Act, define key regulatory requirements beyond those of the National Environmental Policy Act. These regulations define a process for consulting with State Historic Preservation Officers, the Federal Advisory Council on Historic Preservation, and other interested parties to ensure that significant historic properties are duly considered as

Federal projects are planned and implemented. The steps in the "Section 106 consultation" process involve:

1. determining the potential area of effect

2. identifying and evaluating the significance of properties that may be affected by a proposed undertaking

3. assessing the potential effects of the undertaking on historic properties (that is, properties included in or determined eligible for inclusion in the National Register)

4. consulting with the State Historic Preservation Office, the Federal Advisory Council on Historic Preservation, and other appropriate interested parties to determine ways to avoid or reduce any adverse effects

5. providing the Advisory Council a reasonable opportunity to comment on the proposed undertaking and effects on historic properties

6. proceeding with the undertaking under the terms of a memorandum of agreement or in consideration of comments from the Advisory Council

Cultural resources include prehistoric, historic, and traditional cultural sites, buildings, structures, districts, and objects, as well as associated artifacts, records, and remains related to such properties. The significance of cultural resources is determined in consideration of the criteria for listing on the National Register of Historic Places. To be eligible for listing on the National Register, a property must be important in American history, architecture, archaeology, engineering, or culture and must possess integrity of location, design, setting, materials, workmanship, feeling, and association. In addition, properties must meet at least one of four criteria:

criterion A: association with events that have made a significant contribution to the broad patterns of our history

criterion B: association with lives of persons significant in our past

criterion C: embodiment of distinctive characteristics of a type, period, or method of construction, or representation of the work of a master, or possession of high artistic values, or representation of a significant distinguishable entity whose components may lack individual distinction

criterion D: have yielded, or may be likely to yield, information important in prehistory or history (36 CFR Part 60.4)

The eligibility of resources for listing on the National Register is seldom evaluated until they are threatened. Therefore, few of the cultural resources that have been inventoried within the project area have yet to be determined.

The Council on Environmental Quality regulations (§1502.25) encourage agencies to coordinate preparation of environmental assessments with other environmental review and consultation requirements, such as those of the National Historic Preservation Act. However, the proposed oil and gas leasing and development evaluated in this EIS is programmatic and specific impact zones are not identified at this time. Therefore, no formal Section 106 consultations were undertaken at this time.

INVENTORY METHODS

This EIS generically assesses alternative strategies for leasing and development of oil and gas reserves on SUIR. Site specific impacts are not addressed at this time, but will be considered by subsequent studies that "tier" off this generic evaluation. Inventory information compiled for the EIS was based on results of prior studies, and no new field surveys were conducted for the EIS.

Only about 46 percent of the lands within the external boundary of SUIR are Indian lands. This stems from the allotment of lands to individual Utes in the 1890s, subsequent opening of the unallotted "surplus" lands to homesteading by non-Indians, and then re-establishment of a Reservation in the 1930s. The situation is complicated because the surface ownership and subsurface mineral estates are sometimes split. As a result, there are multiple jurisdictions within the external boundary of SUIR, including Southern Ute Tribal lands held in trust by the Bureau of Indian Affairs (BIA), individual Indian allotments, Federal lands managed by the Bureau of Land Management (BLM) and the San Juan National Forest, plus many private landowners.

Because of the multiple jurisdictions, no one agency has compiled and maintains comprehensive cultural resource information for SUIR. The BIA Albuquerque Area Office has extensive files (several file cabinets) of reports of surveys on Southern Ute Tribal lands, but maintains no consolidated maps to track the extent of prior surveys or locations of recorded cultural resources. The files of the BLM and San Juan National Forest are limited and primarily relate to the relatively small amounts of land under their jurisdiction within the external boundary of SUIR. The Bureau of Reclamation also has file information for those lands that would be affected by the proposed Animas-La Plata project, but this also covers only limited parts of the project area.

The Southern Ute Tribe is working toward establishing its own cultural resource management program, but very little existing data are currently available in Ignacio. Some of the Tribal departments have copies of some surveys conducted under their auspices, but their files are far from complete and not organized to facilitate access.

A search of the computerized files maintained by the Colorado Historical Society revealed substantial data regarding prior surveys and previously recorded archaeological and historical sites.

Because these files yielded the most extensive and most readily available information, these data were used as the primary basis for the EIS analyses. The computerized files were supplemented by review of historic maps and records to identify named places and cultural features such as communities, ditches, roads, railroads, cemeteries, as well as other named natural features that sometimes give an indication of associated activities (such as Sawmill, High Flume, Pump, Cemetery, and Cannibal canyons; Tunnel Hill; Bridge Timber Mountain; and Mormon Reservoir). General Land Office records, including township plats and master title plats, proved to be particularly valuable. Previously compiled cultural resource histories and overviews of southwestern Colorado also were reviewed.

CHARACTERISTICS OF THE COLORADO HISTORICAL SOCIETY DATABASE

In May 1996, the Colorado Historical Society provided computerized database information for 40 townships that encompass the external boundary of SUIR (Townships 32 North, Ranges 1 through 13 West (including 1½ West), Townships 33 North, Ranges 1½ through 13 West, and Townships 32 North, Ranges 1½ through 13 West, all of the New Mexico Base Line and Meridian). The 34 North townships are atypical because they include two distinct section numbering series—one for those areas north of SUIR and the other for those within SUIR. The sections north of SUIR are numbered conventionally, but a new series begins again at Section 1 within SUIR. The letter "U" is added to those sections that overlap with numbered sections north of the Reservation. We did not consider information for those areas in Townships 34 North that were north of the SUIR boundary.

The Colorado Historical Society provided two computerized data files. One file documenting prior surveys has 17 potential fields of information (Table 1), and the other file has 32 fields for coding data about previously recorded sites (Table 2). A unique number assigned to each survey report provides a common link between the site file (field = site.doc.id) and survey file (field = id).

The information in the Colorado Historical Society files has some limitations. The data have been compiled over a number of years by a variety of researchers, and incorporate some inconsistencies and errors. In addition, information is incomplete for many of the prior surveys and recorded sites, and some surveys and recorded sites have not been incorporated into the files at all. Unfortunately, the spatial aspects of the prior surveys and recorded sites are not available in a geographical information system format.

TABLE 1 DATA FIELDS IN COLORADO HISTORICAL SOCIETY COMPUTERIZED SURVEY FILES	
Field Name	**Type of Information**
id	unique survey number; first two letters are county code; next two letters are lead agency code; final R and NR numbers are sequential, with R (results) series indicating sites were recorded, and NR (negative results) series indicating no sites were found
name	name of the survey
procedure	indicates whether survey encompassed a "block" or linear transect, or both
county	county in which survey was conducted
lead agency	lead agency for the survey
institution	organization that performed the survey
doc.author	author of survey report
doc.name	label of report associated with the survey; usually same as NAME
method	type of survey; class I = literature review and records check; class II = sample field survey; class III = intensive field survey
completion.date	last day of survey fieldwork
acres.total	number of acres surveyed
site.count	number of sites recorded
if.count	number of isolated finds recorded
maps	U.S. Geological Survey quadrangle on which survey area is located
pmtrsq	legal location of survey, including prime meridian, township, range, section, and quarter-sections
zone.meters	universal transverse mercator (UTM) zone and easting coordinate
meters.north	UTM northing coordinate

TABLE 2 DATA FIELDS IN COLORADO HISTORICAL SOCIETY COMPUTERIZED SITE FILES	
Field Name	**Type of Information**
id	site number (in Smithsonian Institution trinomial format)
site.name	name of site

TABLE 2
DATA FIELDS IN COLORADO HISTORICAL SOCIETY COMPUTERIZED SITE FILES

Field Name	Type of Information
resource.type	type of resource, as defined for National Register of Historic Places
address	address of property
assessment	eligibility for listing on the National Register of Historic Places
assessment.date	date of National Register eligibility assessment
organization	organization that recorded the site
recording.date	date site was recorded
condition	integrity of site, including whether it has been tested, excavated, or vandalized
date	date of condition characterization
site.doc.id	identification number of report in which site is referenced
site.doc	name of report in which site is referenced
argy.site.type	type of archaeological site
argy.culture	culture represented by archaeological site
argy.feature	types of features identified on archaeological site
argy.feature.cou	numbers of each type of feature found on archaeological site
argy.artifact	types of artifacts found on archaeological site
artifact.count	counts of each type of artifact found on archaeological site
arct.site.type	type of architectural (historical) resource
arct.style	architectural style of property
arct.feature	features and unusual aspects of architectural properties
archit.architect	architect who designed architectural property
arct.integrity	condition of architectural property
arct.early.date	date of construction (or earliest construction date) of architectural property
arct.late.date	latest date architectural property could have been constructed
prime.meridian	primer meridian of legal description of site location
township	township of legal description of site location
range	range of legal description of site location
section	section of legal description of site location

TABLE 2 DATA FIELDS IN COLORADO HISTORICAL SOCIETY COMPUTERIZED SITE FILES	
Field Name	**Type of Information**
maps	U.S. Geological Survey quadrangle on which site is located
zone.meters.east	universal transverse mercator (UTM) zone and easting coordinate
meters.north	UTM northing coordinate

Prior Surveys

The survey file includes information about 1,471 previous surveys. These surveys encompassed 67,691 acres (almost 106 square miles). However, some of these surveys extended beyond the Reservation boundary, and unfortunately, the computerized information provides no way to identify what portions of such surveys are within or outside SUIR. Our review of the available information about the 21 largest surveys, each of which encompassed one-half section (320 acres) or more, suggests that seven of these largest surveys encompassed substantial areas outside the external SUIR boundary. Three of these are linear pipeline and transmission line surveys that extend well beyond SUIR and may not be representative of the local area. Together, the seven projects encompass more than 48 square miles (almost 31,000 acres).

The data field indicating the number of acres surveyed was not completed for 17 of the surveys, which also adds to the uncertainty of the extent of prior survey. Given these caveats, we estimate that something on the order of 55 to 60 square miles have been surveyed within the external boundary of SUIR, which constitutes something on the order of a 5 to 6 percent sample of the approximately 1,063 square miles within the external SUIR boundary.

The average area covered by each survey identified in the database is 46 acres. More than one thousand (or about 70 percent) of the prior surveys were quite small, covering 10 acres or less (Figure 1). Another 20 percent covered only 10 to 40 acres.

Assessment of prior surveys is complicated because the intensity of surveys varied, and the database does not identify specific measures of survey intensity, such as transect intervals walked by survey crews or the number of acres surveyed per person-day. Variations in these parameters certainly influence the number of archaeological sites identified within any area surveyed (Plog and others 1978). The computer files do indicate whether surveys were class III (total and "intensive," but without intensive being specified), or class II (sample surveys, but the sampling percentages are not identified, and it is not clear whether examined acres or sampled acres are reported).

Figure 1
Number of Acres Per Survey
(half page - paste on)

About 82 percent of the surveyed acreage is identified as class III, only about 7 percent as class II, and the remaining 11 percent as unspecified "other." A total of 1,399 sites are associated with the class III surveys for an average of about 17 sites per square mile. The 68 sites reported for the class II surveys yield a lower average of about 9 sites per square mile, suggesting that the acreage reported for at least some of the class II surveys probably is the entire area sampled, rather than just the acres that were walked within selected sample units.

The surveys also are classified as either block or linear surveys. In general, linear surveys can be expected to result in the discovery of relatively more sites than block surveys because of an "edge effect." This effect is more pronounced when the dimensions of sites are larger than the width of survey transects (Plog and others 1978). Roughly half the surveys are classified as block surveys, about a third as linear, and the other 20 percent incorporate both block and linear elements.

The database indicates the agencies for which surveys were conducted. Approximately two-thirds of the surveys were conducted under the auspices of the BIA, reflecting the Reservation status of much of the analysis area (Figure 2). However, the size of the surveys for the BIA were comparatively small and represent only about 20 percent of the surveyed acreage tabulated in the database (Figure 3). The other major Federal land managing agencies in the region—the San Juan National Forest and the BLM San Juan Resource Area—are identified as the sponsoring agencies for two to four percent of the surveys, but 10 to 13 percent of the surveyed acreage. A number of other agencies are identified as having jurisdiction for only one to six surveys. [Although the BLM Montrose District Office is identified as sponsoring 13 percent of the surveyed acreage, this was due to a single linear project, the Transcolorado Pipeline, and the vast majority of that acreage was beyond the SUIR boundary.] The sponsoring agencies are not identified for one-fourth of the surveys, which encompassed almost 40 percent of the surveyed acres.

More than 25 institutions have conducted the surveys tabulated in the database (Figure 4). A single firm—Archaeological Consultants, which was virtually the only consultant issued permits to work on Southern Ute Tribal lands for more than 15 years, conducted about 70 percent of these surveys. However, surveys by Archaeological Consultants were smaller than the average survey, and in the aggregate encompassed only about 28 percent of the surveyed acreage (Figure 5).

The annual rate of survey is depicted on Figure 6. Although archaeological research has been pursued within southwestern Colorado for more than a century, the database tabulations of surveys within SUIR date back only about 20 years. The average of about 70 surveys per year since 1975 was first exceeded in 1984. The number of surveys peaked in 1990, and undoubtedly reflects a flurry of activity related to deadlines for tax credits for oil and gas development at that time. The number of surveys conducted annually fell below the average in 1993 and continued to decrease through 1995.

The plot of the number of acres surveyed per year is much more erratic than the number of surveys (Figure 7). However, when the seven large surveys that seem to be mostly beyond the SUIR boundary are subtracted, the graph is much more similar to the number of surveys conducted annually. The average rate of survey since 1975 appears to be on the order of 1,400 to 1,500 acres annually. Therefore, the peak of activity in 1990 represents about three times the average rate, which again is consistent with the number of surveys.

Previously Recorded Sites

The survey database identifies 1,799 sites as having been recorded by 1,419 surveys for which data are available. That is an average of about 1.3 sites per survey. [Note that this average would be considerably less if the several surveys that reported many sites beyond the SUIR boundary were excluded.] The survey database indicates that 67,691 acres (almost 106 square miles) were inventoried to identify the 1,799 sites, which is an average of about 17 sites per square mile.

In a pattern consistent with the typically highly clustered nature of archaeological data, almost 80 percent of the surveys reported no sites, and only 25 surveys recorded 10 or more sites (Figure 8). Only a few of these 25 appear to have been related to oil and gas development [Cox Canyon gathering system (10 sites), Indian Creek gathering system (19 sites), Valencia Canyon gathering system (21 sites), Petty-Ray seismic lines (54 sites)].

An examination of the largest surveys provide some additional insight into the site densities (Table 3). Nine of the largest surveys have sufficient data to be classified as linear surveys encompassing an aggregate of almost 457 linear miles. These resulted in the discovery of 572 sites for an average of about 1.3 sites per linear mile. Densities ranged to more than 9 sites per linear mile, but the higher than average densities tend to be associated with short surveys, which could be subject to the considerable vagaries of small samples. Sufficient information is available for 11 of the largest surveys to classify them as primarily block surveys encompassing an aggregate of almost 33 square miles. A total of 359 sites were recorded by these 11 block surveys for an average of 11 sites per square mile. Site densities ranged almost to 60 sites per square mile but the higher than average densities again tend to be associated with the smaller surveys, although not as strongly as the linear surveys.

Approximately 24 percent of the sites tabulated in the survey database are associated with BIA surveys (Figure 9). This is more than any other agency (although missing data constitutes 28 percent of the recorded sites), and is expected given that much of the analysis area is Reservation land. The percentage of sites associated with the BIA is identical with 24 percent of the surveyed acreage associated with the BIA (see Figure 3). About 10 percent of the recorded sites are associated with San Juan National Forest surveys, which also is consistent with the 10 percent of the surveyed acreage being associated with surveys by the National Forest. All other identified agencies are associated with less than 3 percent of the recorded sites, except for the BLM Craig and Montrose districts. However, all of the sites associated with those agencies are related to two large, linear projects that are primarily beyond the SUIR boundary (MAPCO and Transcolorado pipelines, respectively).

Figure 2
Numbers of Surveys per Agency
8½ x 11

Figure 3
Acreage Surveyed per Agency
8½ x 11

Figure 4
Number of Surveys per Institution

Figure 5
Acres Surveyed per Institution
8½ x 11

Figure 6
Number of Surveys per Year

(half page - paste on)

Figure 7
Number of Acres Surveyed per Year
(half page - paste on)

TABLE 3 SITE DENSITIES RECORDED BY LARGEST SURVEYS			
Survey	**Length/Area (Miles/Acres)**	**Number of Sites**	**Site Density**
Linear Surveys			
Petty-Ray seismic lines	122	54	0.4/mile
Cox Canyon gathering system	12.2	10	0.8/mile
Indian Creek gathering system	14.3	19	1.3/mile
Valencia Canyon gathering system	15.1	21	1.4/mile
La Plata Electric/Meridian power line	7.7	11	1.4/mile
Transcolorado pipeline*	260	377	1.5/mile
Durango tie transmission line	20.2	40	2.0/mile
Animas-La Plata project Ridges Basin inlet	2.1	10	4.8/mile
Hesperus transmission line	3.2	30	9.4/mile
Totals	456.8	572	1.3/mile
Block Surveys			
isolated BLM tracts*	7,593	13	1.1/mile^2
known recoverable coal*	5,738	73	8.1/mile^2
Chimney Rock area	3,917	91	14.9/mile^2
Spring Creek area	775	24	19.8/mile^2
Bodo Canyon disposal site	640	25	25.0/mile^2
Piedra River corridor	300	12	25.6/mile^2
La Posta borrow pit	300	18	34.3/mile^2
Animas-La Plata Project Wheeler & Koshak units	806	46	36.5/mile^2
Sauls Creek timber sale	400	25	40.0/mile^2
Chimney Rock ravine #4	120	10	53.3/mile^2
Spring Creek watershed	240	22	58.7/mile^2
Totals	20,865	359	11.0/mile^2
* substantial acreage outside external SUIR boundary			

Figure 8
Number of Sites per Survey
8½ x 11

Figure 9
Number of Sites per Agency
8 ½ x 11 B&W

Figure 10
Number of Sites per Institution
8½ x 11

The number of sites recorded by each surveying institution is depicted on Figure 10. Much of the work of four of the six institutions recording the greatest number of sites lies beyond the external boundary of SUIR. Archaeological Consultants recorded about 15 percent of the sites, the highest number for work clearly within SUIR, which is proportional to that firm conducting about 15 percent of the survey (see Figure 5). About 10 percent of the sites were recorded by the University of Colorado, and much of the University's work apparently was stimulated by academic research rather than development projects.

Figure 11 depicts the annual rate of site recording. The data from this graph were derived from the sites database rather than the survey database. After eliminating the isolated finds that had been assigned Smithsonian trinomial site numbers, the sites database contains information about 1,961 sites, which is 162 more sites than identified in the survey database. [Note that 25 of these sites are not included Figure 11 because the date of recording was not identified for 21 sites, and the four sites recorded in 1996 were not plotted because the data for the current year are incomplete.] Because the survey database begins in 1975, the 521 sites recorded prior to that obviously are not in the survey database. Almost all of these sites recorded prior to 1975 appear to stem from three major projects: (1) investigations funded by the Bureau of Reclamation in conjunction with construction of Navajo Dam, (2) University of Colorado survey on SUIR, primarily within the Piedra River drainage, and (3) University of Colorado research in the Chimney Rock area. Most of these large early survey projects focused on areas east of the proposed oil and gas leasing and development areas.

The recording of sites peaks in 1986. This pattern is somewhat different that the annual number of acres surveyed, which appears to have peaked in 1990 (see Figure 7), but the general trend of increasing efforts in the late 1980s and early 1990s is consistent. An average of about 45 sites have been recorded annually during the 43 documented years.

Although the Colorado Historical Society database is not available in geographic information system format, the encoded legal descriptions provide a means to generally plot the spatial distribution of prior survey efforts and previously recorded sites (Figure 12). The data indicate that prior cultural resource studies have been concentrated between Townships 32 and 34 North and Ranges 7 to 11 West. The southern portion of this cluster coincides with much previous oil and gas development, and the northern part may be related more to the Animas-La Plata water project and a uranium tailings disposal project south of Durango. Another area of considerable survey is in Townships 34 North and Ranges 4 to 6 West, and probably relates to investigation of archaeological sites in the Chimney Rock area and other inventory work for various projects on the San Juan National Forest.

Figure 11
Number of Sites per Year
8½ x 11

Figure 12
Distribution of Surveys and Sites
8½ x 11

Comparison of the documented surveyed acreage and number of recorded sites is facilitated by Figure 13, which shows the calculated number of sites per square mile surveyed. However, these data must be interpreted cautiously because they combine the sites and surveys databases, which are known to be inconsistent. Clearly, not all surveys have been documented, and there are numerous "rounding" errors that could be substantial. The "rounding" errors stem from assigning those surveys that overlap township boundaries to only the first listed township. The impossibly high site densities (more than 100 sites per square mile) and incalculable densities in parts of the eastern segment of SUIR (around Townships 32 and 33 North, Ranges 2 to 6 West) are, at least in part, due to pre-1975 surveys related to construction of Navajo Reservoir that are not in the surveys database.

There is another block of impossibly high site densities in the western portion of SUIR. Some of these density estimates appear to be due to the "rounding" errors mentioned above. A few large linear transmission and pipeline surveys traversed these townships, and their acreages are assigned to adjacent townships, and a few other survey projects are not in the survey database.

We also note that the townships where the Chimney Rock archaeological district (T34N, R4W) and the Spring Creek archaeological district (T34N, R6W) are located have estimated site densities of only 8 to 10 sites per square mile. This seems low given the well known clustering of sites in these areas, but it is possible that the data reflect quite low site densities in forested areas beyond the clusters themselves.

Exceptionally low site densities (about 1 to 6 sites per square mile) also are noted in an area around Townships 32 and 33 North, and Ranges 8 to 10 West. A substantial amount of acreage has been intensively inventoried in this area so the results are probably not anomalies related to small samples. Instead, most of this survey appears to be related to oil and gas development and probably reflects the Southern Ute Tribal policy of working to avoid impacts to any archaeological sites. Projects are routinely modified to avoid sites, and commonly the avoided sites are not recorded, which results in few reported sites compared to the number of acres that are reported surveyed.

Summary of Computerized File Information

The Colorado Historical Society database indicates that prior to the mid 1970s, only three major archaeological surveys were pursued in the region. Because these early efforts focused primarily on the San Juan and Piedra river valleys, they provide little information directly relevant to the proposed oil and gas leasing and development area. To be sure, these studies yielded key information for reconstructing the cultural history of the region, which provides contextual information for evaluation of cultural resources within the project area.

Figure 13
Spatial Variation in Site Densities
8½ x 11

Since the mid-1970s the pace of cultural resource inventories grew until about 1990 and has declined since then. The rate of survey seemingly reflects the pace of oil and gas development to a great degree. The database indicates that almost 1,500 surveys have been completed, an average of about 70 surveys per year, encompassing an aggregate of about 5 square miles annually. However, half of this reported survey coverage appears to be outside SUIR. On average, approximately 39 to 46 sites were recorded annually (depending on whether the surveys database or sites database numbers are considered). The average block survey encountered about 11 to 17 sites per square mile (depending on whether the best documented largest surveys or the total aggregate data of the surveys database, which includes considerable acreage well beyond SUIR, are considered). The average linear survey encountered an archaeological site about every 1.3 miles.

The "modal" or typical survey would have been conducted in 1990 by Archaeological Consultants under the auspices of the BIA (probably for oil and gas development). The typical survey would have been a small, block survey encompassing only about 20 acres, and only a single archaeological site would have been found and recorded for every two such typical surveys.

More information about the archaeological sites recorded in the project area is described below in the discussion of modeling cultural resource sensitivities. The next section describes special status cultural resources within and in the vicinity of the project area.

SPECIAL STATUS CULTURAL RESOURCES

The listings of properties on the National Register of Historic Places also were reviewed for Archuleta, La Plata, and Montezuma counties. Three properties are listed in Archuleta County. One is the Cumbres-Toltec scenic railroad, which approaches the eastern boundary of SUIR no closer than about 30 miles. The Chimney Rock archaeological area is another listed property. This area is within the external boundary of SUIR but is on lands of the San Juan National Forest, approximately 10 miles east of the limits of the potential oil and gas leasing and development area. The third property is the 1913 Labo del Rio bridge on Highway 151 across the Piedra River near Arboles. This bridge, which is not on Tribal lands, is approximately a mile beyond the limits of the oil and gas leasing and development area.

Eleven La Plata County properties are listed on the National Register. Most of these are historic buildings or districts within Durango. Other properties include the Durango-Silverton narrow gauge railroad, Durango Rock Shelters archaeology site, and the Ute Mountain Ute Mancos Canyon archaeological district, which is primarily in Montezuma County. All of these are well beyond the external SUIR boundary, except for the large Mancos archaeological district, which borders the entire western boundary of SUIR. The one listed La Plata County property within the external SUIR boundary is the Zabel Canyon Indians ruins/Spring Creek archaeological district. However, the district is on lands of the San Juan National Forest outside the oil and gas leasing and development area, although it borders the leasing and development area. Ridges Basin (La Plata County), along the northern boundary of the SUIR, has been determined eligible as a National Register District, but is outside of the proposed oil and gas development area.

Twenty properties in Montezuma County are listed on the National Register, including Mesa Verde National Park, which also is a designated national historic landmark. The park boundary lies within two miles of the northwest corner of SUIR, but the developed visitor facilities are approximately 8 to 10 miles away. Other listed properties include the Lowry Ruin, which also is designated as a national historic landmark, and the Hovenweep and Yucca House national monuments, but these are more than 20 miles from SUIR. Other National Register listed archaeological and historical sites in Montezuma County are near Cortez, Dolores, Yellow Jacket, Pleasant View, Mancos, and Towaoc, and all are several miles or more from SUIR.

TRADITIONAL CULTURAL PLACES AND RESOURCES

Over the last five years regulatory review of cultural resource issues has broadened to more specifically consider places and resources having significance for traditional cultural groups. Many American Indian communities in the vicinity of the project area, including the Southern Ute, maintain aspects of their traditional life ways. However, available inventories of places and resources of traditional cultural significance are meager. In part, this reflects lack of prior inventory surveys, but information about traditional practices, particularly those related to religion, often are considered confidential and therefore not widely known. A recent study for the Animas-La Plata project consulted with 26 Tribes as well as local Hispanic and Mormon communities. The study identified a segment of the Old Ute Trail as the only specific place of traditional cultural concern among the Southern Utes and other Tribes (Northern Arizona University and SWCA 1996). However, the study concluded that traditional cultural concerns were likely to focus on (1) archaeological sites, (2) pictographs and petroglyphs, (3) resource collecting areas, (4) trails, and (5) springs and other water sources.

We worked with the Southern Ute Tribal historian, who also chairs the Southern Ute Language and Cultural Preservation Committee and serves as the Tribe's coordinator for the Native American Graves Protection and Repatriation Act consultations, to consider potential traditional cultural concerns about the proposed oil and gas development. Consultations with the Tribal historian revealed that the traditional territories of Muache and Capote Ute bands, who are the primary residents of the Southern Ute Reservation, were located mostly to the east of the Reservation and therefore Tribal members do not have ancient ties to specific places within the Reservation. (The current Reservation was primarily the traditional territory of the Weeminuche Band, which is now based on the adjacent Ute Mountain Ute Reservation.) The Tribal historian also indicated that although traditional ceremonies such as the Bear Dance and Sun Dance continue to be practiced by many Tribal members, there are no practicing shamans among the Tribe.

Discussions with the Tribal historian concluded that traditional Ute cultural concerns regarding the proposed oil and gas leasing and development focus on (1) protection of archaeological sites and especially any associated human burials, (2) minimizing disturbance of natural vegetation, and (3) more generally preserving Ute traditions and the environmental resources of the Reservation.

In historic times, the Utes relied on a variety of game animals and natural plant products (Calloway and others 1986). Although no plant products or animals apparently are required for ceremonial purposes, some Southern Utes continue to gather native plants, such as wild onions, as condiments. A variety of other plants are used by some Tribal members as herbal medicines, but there is no documentation regarding the extent of this practice. The utilized species have not been thoroughly inventoried, but include juniper, Mormon tea, lambs quarters, wild spinach, and yucca (Northern Arizona University and SWCA 1996:182).

Concern for preserving Southern Ute cultural heritage does not imply that the Southern Utes desire a life way "frozen in time." In fact, no culture remains static over time. The goal of traditional Southern Utes is to preserve elements of their culture and blend them with the new as their society continues to evolve. No direct linkage has been identified between the proposed oil and gas development and the desire to maintain the Southern Ute language and other aspects of the Southern Ute heritage. The economic benefits of the proposed development, in fact, have the potential to promote self determination and if the Tribe so chooses, funds could be directed to more proactively plan and promote preservation of Southern Ute heritage. In sum, heritage preservation issues do not appear to be significantly related to differences among the alternatives.

Other nearby Tribes, such as the Ute Mountain Ute, Navajo, Jicarilla Apache, Hopi, Acoma, Laguna, Zuni, and other puebloan groups in the northern Rio Grande drainage claim affinity to some archaeological sites located on the Southern Ute Reservation. Other places may have traditional ties for descendants of Euro-American settlers whose families have resided within and near the project area for several generations. No consultation with these groups was undertaken at this generic stage of analysis, because oil and gas development activities on SUIR over the last couple of decades have been successful in avoiding disturbance of human remains, funerary objects, sacred objects, and objects of cultural patrimony that affiliated groups might claim. Subsequent environmental review of specific oil and gas development projects will provide a context for more detailed consideration of traditional cultural issues as warranted.

SUMMARY OF CULTURAL HISTORY

Human societies have lived in southwestern Colorado, as they have throughout much of North and South America, for at least about 12,000 years. The following sections, based largely on previously compiled overviews of the cultural history of the region, briefly summarize the history of this occupation. The aboriginal prehistoric and ethnohistoric eras are described first, followed by a discussion of the historic era defined by the invasion and eventual conquest of the region by Euro-Americans.

Prehistoric and Ethnohistoric Era

The reconstruction of the cultural history of the Paleo-Indian, Archaic, and Anasazi periods is based on archaeological studies conducted within and adjacent to SUIR. Information about Navajo culture history is derived from both archaeological and historical studies. Given the difficulties in identifying the Ute Tradition in the archaeological record (see Buckles 1971; Wormington and Lister 1956), the reconstruction of Ute cultural history is largely based on historical and linguistic sources. Figure 14 depicts the phase sequences and periods of the various cultural traditions known to have inhabited SUIR and the adjacent region.

Paleo-Indian Stage

The earliest inhabitants of southwestern Colorado may have been the Paleo-Indians. Although no Paleo-Indian sites have been identified within the boundaries of SUIR, they are known to have been present within the Southwest at the termination of the Pleistocene, about 10,000 to 6,000 BC. The material remains of these Paleo-Indian cultures indicate their subsistence was oriented primarily towards the hunting of large migratory and non-migratory species of game animals.

Archaeological remains of Paleo-Indian campsites or kill sites typically contain large spear points in association with the bones of extinct Pleistocene megafauna, such as mammoth, bison, camel, and sloth. Remains of these early mobile hunting cultures have been found throughout the Southwest, but are rare (Irwin-Williams 1979:33). York (1990) discusses evidence from the nearby San Juan National Forest for Paleo-Indian occupation by at least 6,500 BC, and possibly as early as 8,000 BC. Most of the evidence, which he identifies as being related to the Plano Complex, is limited to isolated finds of large projectile points. No substantial, stratified Paleo-Indian sites have yet been identified in southwestern Colorado, and none of the recorded archaeological sites within SUIR are assigned to the Paleo-Indian period.

Archaic Stage: The Oshara Tradition

The Archaic period, dated from about 6,000 BC to AD 1, follows the extinction of the Pleistocene megafauna. Archaic era subsistence practices were more generalized than those of the Paleo-Indians,

and relied on a wider variety of resources, including wild plants, reptiles, fish, insects, and small to large mammals. Projectile points become slightly smaller, exhibiting a variety of notching attributes, and are thought to have tipped darts thrown with an atlatl (spear-throwing stick). The increased accuracy, velocity, and distance of these weapons may be an adaptation to the pursuit of smaller game animals. Food processing and storage technology also changed with the shift in the resource base. The increasing occurrence of ground stone tools throughout the Archaic era probably reflects growing reliance on the processing of native plant foods, such as Indian ricegrass and piñon nuts.

Figure 14
Cultural Stage and Phase Sequences for SUIR
8½ x 11

Irwin-Williams (1979) labeled the Archaic culture of the northern Southwest as the Oshara Tradition. She describes a series of phases (Jay, Bajada, San Jose, Armijo, En Medio, and Trujillo) for the Oshara Tradition, each reflecting gradual technological changes, demographic shifts, and decreased mobility throughout the Archaic period.

Archaic period sites have been documented throughout the Southwest. Surveys have noted a particular concentration of large and small Archaic sites in the Ridges Basin area south of Durango (Eddy and others 1984:69-70), and limited excavations have confirmed the presence of a Late Archaic occupation there (Fuller 1988). Of the 35 known Archaic sites within the project area, most (28) occurred in the La Plata River drainage on the far west side of the Reservation. The continuity in material remains of the Oshara Tradition and the Anasazi Tradition suggests a continuum from the Archaic Stage to the Formative Stage (Irwin-Williams 1973).

Formative Stage: The Anasazi Tradition

The transition to agriculture in the Southwest has traditionally been viewed as a gradual process occurring from about 2,000 to 1,000 BC (Woodbury and Zubrow 1979). However, Berry (1982) has made a strong case, given the ambiguous documentation, reporting, and dating of many early Southwestern sites, that maize agriculture was adopted much later at about AD 300. Berry also dismisses the gradual model of culture change. Instead, he proposed a rapid and punctuated transformation, arguing that the introduction of maize was immediately embraced by Late Archaic period peoples, radically altering subsistence strategies and social organization throughout the Southwest. In the Four Corners region, the Formative period of cultural development is represented by the well known Anasazi Tradition.

SUIR encompasses portions of two different branches of the Anasazi Tradition. The Upper San Juan Branch, encompassing the Pine and Piedra river drainages on the eastern side of SUIR, is typified by very early manifestations of village life. The Mesa Verde Branch is represented in the La Plata and Mancos river drainages in the western portion of SUIR, which was apparently occupied throughout the entire Anasazi sequence until regional abandonment at about AD 1300. The Anasazi remains in the Animas River drainage of the central SUIR suggest a stronger affiliation with the Mesa Verde Branch than the Upper San Juan Branch. However, like the Upper San Juan Branch, the Anasazi in the upper Animas drainage apparently abandoned the area sometime during the Pueblo I period (AD 750-950). An outlier of the Chaco Anasazi branch is represented in the Piedra River drainage by the late period Chimney Rock communities.

The Pecos classification, developed by Alfred V. Kidder (1927), outlines a series of cultural developments or periods that are common to most Puebloan traditions in the Southwest, including; Basketmaker II (BMII; AD 100 to 450), Basketmaker III (BMIII; AD 450 to 750), and the Pueblo I through V periods (AD 750-present). The Basketmaker I period is now recognized as the Late Archaic period and the term is no longer used.

Briefly, BMII reflects the initial adoption of corn agriculture in the region. Often, crude pottery is found in association with these remains as are a variety of pit house and surface architectural forms. BMIII is an elaboration of the earlier BMII period, and possibly reflects a greater reliance on agricultural products. BMIII sites are characterized by more formalized and deeper pit structures, and a coil-and-scrape ceramic tradition of gray ware, with some brown ware. The Pueblo I period (PI: AD 750-900) is marked by a switch from pit structures to above ground, contiguous *jacal* (pole and adobe construction) rooms as the primary domestic and storage facilities; and painted and neckbanded ceramics. During the PI period pit structures are believed to have assumed more of a ceremonial function ("proto-kivas"). The Pueblo II (PII: AD 900 to 1100) and Pueblo III (PIII: AD 1100-1300) periods include a transition to masonry architecture, planned town layouts, an elaboration of decorated and corrugated pottery styles, and intensive agricultural practices. The Pueblo IV period (PIV: AD 1300 to 1540) witnessed the abandonment of the Four Corners region and an aggregation of complex settlement systems in the Rio Grande Valley of northern New Mexico, the Upper Little Colorado River watershed, and the Hopi Mesas. The Pueblo V (PV) period, dating from about AD 1540 to the present, refers to the historic Puebloan Indians.

<u>Upper San Juan Branch of the Anasazi Tradition</u>

Dittert and others (1961) proposed a phase sequence of culture change for Anasazi sites in the Navajo Reservoir district that is still widely accepted today, and has subsequently been applied to the Upper San Juan area in general. The sequence includes the Los Pinos (BMII), Sambrito (BMIII), Rosa (early PI), Piedra (late PI), and Arboles (early PII) phases.

Los Pinos Phase (AD 1-400)

The Los Pinos phase heralds the beginning of sedentary life in the project area, and the advent of the Anasazi Tradition. The phase was originally defined during the archaeological survey of Navajo Reservoir (Dittert and others 1961). Subsequent excavations at the reservoir of five sites along the Pine River demonstrated that the phase is a localized expression of the regional San Juan Anasazi BMII culture (Eddy and Dickey 1961). Sedentism based on corn agriculture, permanent houses with shallow, basin-shaped floors, and large subterranean storage pits are the principal traits of the Los Pinos phase. Houses feature roundish to ovate floor plans, central firepits, and walls apparently constructed of stacked logs set with copious mud mortar ("log masonry"). Roofs were probably flat, pole and adobe affairs. Some of the Navajo Reservoir houses were ringed with an apron or pavement of river cobbles while others were not. There may be slight temporal differences between the two styles. Occasionally houses feature a small anteroom, reminiscent of later BMIII houses. Large, subterranean storage pits are found inside and outside the houses.

BMII sites usually lack pottery, but the Navajo Reservoir sites, as well as many other BMII sites throughout the San Juan country, often contain false pottery consisting of unfired clay molded in baskets and tempered with grass or juniper bark fiber. These artifacts may be attempts to replicate pottery known through trade or contact with other pottery making groups. Eddy recovered a few polished brown ware sherds from Los Pinos sites dating after AD 300. These were originally thought to be of southern (Mogollon) origin. The occurrence of brown wares in the subsequent Sambrito phase has led several researchers to contend these brown wares are locally produced and may represent some of the earliest pottery made in the San Juan Basin (Lister 1993).

Despite the importance of corn agriculture (supplemented with squash), Los Pinos populations retained many elements of the earlier Oshara life ways. Archaic style milling equipment is found in conjunction with corn grinding tools. The atlatl continued as the principal hunting tool.

The original investigators of the Los Pinos phase sites considered the lower Pine River Valley, now under Navajo Lake, to be the center of this local BMII occupation, "but later investigation put the heartland further north, near the small modern community of Bayfield and closer to a second comparable development in the environs of Durango" (Lister 1993: 47). The Durango Basketmaker sites (North Shelter, South Shelter, and Talus Slope Village) are located about 10 miles north of SUIR near the northern city limits of Durango. These sites, considered by many to be the type sites for Basketmaker culture in the northern San Juan Basin, yielded the earliest tree-ring dates in the Anasazi area, but also contain limited evidence of Ute reoccupation during the 17th century (Dean 1975).

Los Pinos sites at Navajo Reservoir range from single isolated houses to house clusters of as many as eleven structures. Sites typically were located at the edge of Pleistocene benches overlooking primary river courses adjacent to or very near floodplains or other tillable lowlands (Eddy 1972).

Sambrito Phase (AD 400-700)

The relationship between the Sambrito phase and the preceding Los Pinos phase is problematic. Eddy (1966) hypothesized a continuum of occupation, placing Sambrito beginnings at AD 400. Later researchers have questioned the validity of the phase because so few sites were found at Navajo Reservoir, and similar sites could not be identified elsewhere with certainty. Following emergency excavations at Navajo Lake in the late 1980s, the Sambrito Phase is presently considered valid (Hammack 1992), although its dating and earlier relationships remain clouded (Lister 1993:59,70-72).

The Sambrito phase is temporally equivalent to the BMIII period in adjacent areas of the San Juan Basin. During the original work at Navajo Reservoir, only seven sites with Sambrito components were encountered, and two of these were questionable. Significantly, none of these sites were recognized during survey. Five were found as buried components under later occupational debris, and the others were masked by non-cultural sediments. Four sites were on Pleistocene terraces while the other three were more dispersed. The small sample provides little basis for positing settlement patterns. Sites contain from one to seven houses, and lack any apparent intra-village patterning.

The first appearance of true pit houses and polished brown ware ceramics are the hallmark of the Sambrito phase. Larger pit houses feature ramp entryways, which along with the brown wares, led

Eddy (1966, 1972) to view the Sambrito phase as an incursion into the area by Mogollon peoples from the south. However, options other than migration should be considered because more recent studies conclude the pottery is locally made rather than being imported (Lister 1993:58). Hard fired, gray ware pottery appears late in the Sambrito phase as a trade ware from BMIII people living in the Animas Valley or regions west towards Mesa Verde and Montezuma Valley.

Rosa Phase (AD 700-850)

The Rosa phase correlates in time and is generally comparable to the early PI period throughout much of the San Juan Basin. The phase was originally defined by Hall (1944) in the Gobernador district south of Navajo Reservoir. At Navajo Reservoir, Rosa phase sites are plentiful; an estimated twentyfold population increase over the preceding phases may be conservative (Lister 1993:60).

More diversified and specialized site types are found during the Rosa phase. Pleistocene benches at or near arable land are still favored locations for permanent houses with secondary preferences in more isolated upland localities. Also, several campsites were found in now buried floodplain deposits yielding evidence of farming activity (Adams 1975; Eddy 1972:29). Large numbers of Rosa phase sites flank the courses of the Pine and Piedra rivers northward well into Colorado.

The general type of site consists of a relatively deep pit house located south of a squarish, jacal surface structure. Refuse (ash, ceramic and lithic discards, and other debris) commonly is located south of the pit house. Pit houses may be small and simple or large with many interior embellishments. Sipapus (small holes in the floor thought to symbolize the place of Puebloan emergence from the underworld) are noted in a few structures. Pit houses occur singularly or in groups of up to six or more.

The relative number of storage pits declines during this period, and the jacal surface structures are now used, in part, for storage. The presence of hearths in a few surface structures indicates some also were used as residences.

The ceramic assemblage includes both locally produced brown and gray wares, the latter occasionally displaying unobliterated coils on the necks of jars and ollas. Simple painted designs in both mineral and organic mediums are sometimes found on the interior of bowls and less frequently on jar exteriors. Other gray wares and occasional red wares from areas to the west appear as trade wares, usually after AD 750. The bow and arrow replaces the atlatl during Rosa times.

Piedra Phase (AD 850-950)

The Piedra phase, corresponding to the late PI period throughout much of the San Juan Basin, was first described by Roberts (1930) on the basis of surveys and excavations conducted in the upper Piedra Valley in the vicinity of Chimney Rock. In the Navajo Reservoir district the phase is marked by demographic shifts northward and upstream in the Piedra and San Juan valleys. Eddy (1972, 1973) views this as a response to headward river entrenchment, lowering water tables, and probably decreasing acreages of arable land. There is no significant increase in the numbers of sites from the preceding Rosa phase, but there are more village-size sites concentrated near tillable soil. For the first time since the Los Pinos phase, Pleistocene terraces lose favor as site locations to more recent and lower valley terraces. Dispersed isolated habitations are widely scattered throughout upland localities.

Pit houses continue to be used as domestic structures with changes limited to interior details. Jacal surface structures become more substantial. Cobblestone and slab foundations are used as basal wall supports, room outlines become more rectangular, and several rooms often are arranged in contiguous arcs or lines. Roberts (1930) defined three structure styles in his Upper Piedra study; two date to the Piedra phase and one to the later Arboles phase. Villages or clusters of pit houses sometimes have an oversize pit house interpreted as a community building. (Because a similar structure was found at the site of Shabik'eschee in Chaco Canyon, these are sometimes called "Shabik'eschee kivas").

Ceramics are little changed from the preceding Rosa phase. Painted designs are better executed and slightly more jars are neckbanded.

Demographic shifts resulting from hypothesized headward channel incision correspond to a period of decreased rainfall and shorter growing seasons. These factors seem to have contributed to desperate social conditions in the Upper San Juan and Piedra valleys. Villages become stockaded, 80 percent of Piedra houses in Navajo Reservoir are burned, and incinerated skeletons and group burials all evidence a deteriorating social environment. With Piedra phase settlements located farther and farther up the San Juan drainage, the Anasazi residents of the region became more and more isolated from contemporary counterparts in areas such as Chaco Canyon and Mesa Verde.

Arboles Phase (AD 950-1050)

The Arboles phase (early PII) is the terminal phase of Anasazi occupation at Navajo Reservoir. Settlements continue to be found farther up the San Juan and Piedra valleys concentrating on valley floors. Also, widely scattered settlements in highland areas such as Middle, Burnt, and Sandoval mesas appear.

Pit houses continue as the principal residential structure with a series of surface structures often arranged in 'L' or 'U' configurations located north of them. The surface structures undergo one important change; most are now constructed with horizontal sandstone slabs set in copious adobe mortar. This constitutes the first true masonry in the upper San Juan region. Shabik'eschee kivas are apparently absent in pure Arboles phase sites.

Though technologically unchanged, ceramics display more embellishment. Many service vessels are now covered with a white slip before painting, and many storage and cooking vessels are corrugated in a distinctive spiral pattern.

Stockades and other evidence of social unrest are lacking at sites with pure Arboles phase components. Although acreages of arable land are still dwindling, social tensions apparently eased.

Research in the Navajo Reservoir area indicates that most Arboles phase residents had left the district by AD 1000, with total abandonment occurring by AD 1050 (Eddy 1972:40). Large numbers of sites dating to the Piedra and Arboles phases are located north of the reservoir in the Chimney Rock-Devil Creek area, and these are considered to be remnants of Anasazi populations from the Navajo district. This area is at the upper altitudinal limit for corn agriculture. Adequate rainfall, better soil conditions, and proximity to mountain resources apparently offset the subsistence stress of the waning years of occupancy in the Navajo Reservoir area.

Chimney Rock Phase (AD 950-1125)

Sites in the vicinity of Chimney Rock near the confluence of Devil Creek and the Piedra River were in relative isolation until the late eleventh century, and residents lived conservative lifestyles. Pit houses continued as the traditional house form, a sharp contrast to developments at Mesa Verde and Chaco Canyon. In the eleventh century, a type of above ground or semi-subterranean pit house appears, featuring massive walls of sandstone rubble and adobe mortar. These were often incorporated with small storage rooms and mealing areas on their northern sides. Sites occur in upland situations and often occupy isolated hilltops, ridges, and other topographic salients (Eddy 1977). The house forms and topographic settings are not unlike developments in the Gallina highlands to the south and southeast in New Mexico.

In the late eleventh century, this isolation came to an abrupt end when Chimney Rock Pueblo was constructed at the base of Piedra Parada. Chimney Rock Pueblo is recognized as an outlier of the Chacoan system, and lies further northeast than any other known outliers. A number of great kivas were built in the immediate vicinity at about this same time or slightly earlier. By AD 1125 Chimney Rock Pueblo and the surrounding Piedra Valley were completely vacated by the Anasazi (Eddy 1977).

Mesa Verde Branch of the Anasazi Tradition

Literature concerning the Mesa Verde Branch of the Anasazi is voluminous, and only the outlines are sketched in this brief summary. BMIII cultural developments in the Mesa Verde region largely parallel those already discussed for the Upper San Juan Branch, but from the early PI period onward the cultural histories diverge. For the purposes of this discussion we have used the phase designations developed by Hayes (1964) for Wetherill Mesa, which is located 10 miles west of SUIR at Mesa Verde National Park. Those developments seem to parallel those in the western portion of SUIR. Hayes defined six phases of occupation at Wetherill Mesa: La Plata (BMIII), Piedra (PI), Ackman (early PII), Mancos (late PII), McElmo (early PIII), and Mesa Verde (late PIII). The preceding BMII period seems to be absent at Mesa Verde.

La Plata Phase (AD 450-700)

The La Plata phase is equivalent in time and comparable to the regional BMIII period. There seem to be few La Plata phase sites on Mesa Verde, although many may be overlain and masked by later cultural deposits. The phase marks the first appearance of true pit houses, the first locally made pottery, the introduction of beans, the adoption of the bow and arrow, and the domestication of turkeys. Houses occur singularly or in small clusters. Excavations near Yellow Jacket have found instances where BMIII houses were stockaded (Rohn 1975). The houses are usually only partially subterranean, and are roundish, squarish, or roughly rectangular in outline. An entry, ventilator, or antechamber usually is located on the south or southeast side. Storage was in subterranean pits both inside and outside the houses, and they were frequently lined with sandstone slabs.

At Mesa Verde and Yellow Jacket, which are both upland areas, habitation sites are typically found on or slightly below ridge lines, usually widely scattered in linear arrangements (Hayes 1964; Rohn 1977). Dolores Archaeological Project investigations north of Mesa Verde regularly encountered BMIII remains on riverine valley terraces (Kane 1981).

Piedra Phase (AD 700-900)

The Piedra phase, comparable in time and content to the regional PI period, marks the transition from permanent residence in pit houses to above ground structures (pueblos) (Eddy and others 1984). At first these above ground structures were little more than flimsy pole, brush, and adobe huts. By the beginning of the ninth century they were built as concentric rows (one to three rooms deep) forming an arc north or northwest of a pit structure. They are largely constructed of jacal, frequently employing vertical sandstone slabs as basal supports.

Ceramics include plain gray wares, decorated jars and bowls, neck banded jars and ollas. Red ware pottery appears briefly in the record and is both locally made and imported.

As in the Upper San Juan Branch, the Mesa Verde Branch also witnessed population increases and shifting centers of populations during the PI period. At Wetherill Mesa, Piedra phase sites constitute much of the site inventory on the mesa. The Dolores Valley contains vast numbers of PI sites, including components that are now inundated by McPhee Reservoir. Again, Mesa Verde reflects PI occupation in upland situations, in contrast to contemporary sites on the valley floor and canyon bottom terraces in the Dolores Valley.

Ackman Phase (AD 900-975)

The Ackman phase is equivalent in time to the early PII period and is marked by the first appearance of true kivas (Eddy and others 1984:60). These kivas commonly are characterized by a circular or flattened circular plan, have ventilators, and lack southern recesses. The first true masonry in the Mesa Verde area dates to this period, and consists of unshaped and rough shaped sandstone blocks and slabs set in adobe mortar. The lower half of the kiva walls are occasionally lined with masonry, but most masonry is found on the above ground structures. There is continued use of jacal architecture as well. The surface structures consist of linear alignments of a few rooms.

Ceramic additions include corrugation of jar exteriors and rather elaborate black-on-white decorated vessels. Red wares become less and less frequent.

Early PII period sites are found in a variety of situations in both highland and lowland localities. It is noteworthy that much of the Dolores Valley was virtually abandoned by the early tenth century (Kane 1981).

Mancos Phase (AD 975-1050)

The late PII period, or the Mancos phase, is marked by increasing uniformity in kiva construction, refinements in masonry building techniques, and slight changes in site layout. Kivas are still located south of the pueblo, but are found closer and closer to it. The kivas themselves now contain pilasters (usually six of them) to support elaborate cribbed roofs. Most kivas are partially lined with masonry, and early forms of some sort of southern recess begin to appear late in the phase.

Masonry consists of rough-shaped sandstone blocks one course in width, set in adobe mortar. The pueblos are one story, usually linear arrangements of rooms, sometimes forming an 'L' configuration. For the first time, circular towers appear (Hayes 1964).

McElmo Phase (AD 1050-1150)

The McElmo phase heralds the beginning of the Great or Classic Pueblo period, and is well known throughout the Four Corners region. Larger sites and site communities, multistory buildings, improved and often elaborate masonry are all hallmarks of the McElmo phase. Kivas are frequently fully lined with masonry, usually have a 'keyhole' southern recess, and commonly are partially or completely incorporated into roomblocks (pueblos). Masonry is now double course with well finished building blocks, strong enough to support two or more stories of architecture. Water control features, such as check dams, small reservoirs, and ditches are common features (Rohn 1977). For whatever their purpose, towers are now found in increasing numbers, often in direct association with kivas. Late in the phase, construction of many of the cliff dwellings was initiated.

Ceramics become increasingly refined but fewer vessel forms are produced. Firing pits for ceramic manufacture are now common, and are often found in large numbers (Fuller 1984; Hibbets and Harden 1982).

There is a tendency for McElmo phase sites to cluster at canyon heads, canyon rims, or permanent springs. There is little occupation of highland areas.

Mesa Verde Phase (AD 1150 to 1300)

The final Anasazi period in the Mesa Verde region is marked by the appearance of cliff dwellings, which are often quite large. Many of the earlier McElmo phase sites continue to be occupied into this period, often in dense concentrations, at sites such as Yellow Jacket. With the exception of a preference of overhangs and caves for site locations, there is little to differentiate Mesa Verde from McElmo phase sites. Ceramic arts attain their highest levels during the thirteenth century.

Deteriorating climatic conditions probably rank highest among the reasons for Anasazi abandonment of the Four Corners region by AD 1300. The arrival of Athabascan and Numic peoples may also be related to this abandonment, but the timing of these historic events remains clouded.

Navajo Tradition

The affiliation of the Navajo and Apache to northern Athabaskan speaking groups is based on linguistic data that indicate a close relationship of these Southwestern groups with Tribes of the McKenzie River Basin in Canada and the Pacific Northwest. Athabaskan speaking peoples are generally thought to be late comers to the New World as the divergence of the languages and dialects subsumed within this family is relatively minimal (Cassells 1983:187).

Many researchers (for example, Hester 1962) suggest the southern Athabaskans may have migrated from the north into the Southwest via the Great Plains. Brugge (1992:340) believes the Plains Apache (Kiowa Apache, Jicarilla Apache, and Lipan Apache) entered the Southwest via the high plains because they all had a well established Plains adaptation at the time of initial Spanish contact. However, the Southwestern Apache (Navajo, Western Apache, Chiricahua Apache, and Mescalero Apache) may have entered the Southwest from the Intermountain West because these groups evidence few Plains traits, which may be due to causes other than direct Plains culture assimilation.

Historically, the first mention of Navajos in New Mexico by the Spanish dates from AD 1626 when they were first identified as Apache del Nabaju (Hester 1962:Figure 25; Schroeder 1963:5-6, Figure 1). The Spanish initially differentiated the Athabaskans on the basis of those who cultivated crops (Cocoye) and those who were more nomadic hunting groups (Querecho). The Cocoye have been assumed to represent the "proto-Navajo." Governor Oñate mentions the placement of the Cocoye in mountains north of the Jemez pueblos in a letter dated 1598 (Schroeder 1963).

There is much archaeological evidence that indicates the Navajo were present in "Dinetah" (the Largo and Gobernador region of northwestern New Mexico) at least by the 1500s, while some evidence suggests they may have been in the region by 1350. Hancock (1992) reports numerous dates from Navajo sites in the nearby La Plata River valley from 1350 to 1675. Marshall (1985) reports dates from Navajo sites in the Blanco Canyon area at 1550 ±55 and 1590 ±55. A review by Winter and Hogan (1992:Figures 26.2 and 26.3) of 31 radiocarbon and 20 thermoluminescence samples obtained from early Navajo sites in the San Juan drainage leaves little doubt that by approximately 1500, and probably earlier, the Navajo inhabited the region. However, the attributed Navajo affiliation of these early sites has been questioned (Schaafsma 1993).

Few chronometric dates have been obtained from SUIR, but the early Navajo sites frequently encountered on SUIR have virtually identical types of artifact assemblages, features, and structural remains as the dated sites in northwestern New Mexico. There can be little doubt that portions of SUIR were inhabited, at least on a seasonal basis, by early Navajo emigrants.

Navajo cultural history has been divided into a number of phases, including: Dinetah, Gobernador, Piedra Lumbre, Cabezon, and Reservation phases. The Navajo abandoned the upper San Juan region by 1750 due to intensive conflicts with the Utes and Comanches. Accordingly, only the earlier Dinetah and Gobernador phases are reviewed here.

The Dinetah phase was initially defined by Dittert (1958) who noted a pattern in which some sites contained Dinetah Utility sherds, but lacked Gobernador Polychrome and other Puebloan trade wares. He postulated that these sites were occupied earlier (about 1550 to 1700) than the Gobernador phase sites (1700 to 1775), and that these sites lacked many other traits associated with Puebloan influence. The definition of the Dinetah phase was criticized for its reliance on negative traits (Eddy 1966:505-508; Schoenwetter and Eddy 1964:21).

However, recent work in the upper San Juan region has confirmed the presence of a "pre-Gobernador" Navajo occupation (Winter and Hogan 1992), which may reach back as far as 1350. The Dinetah Phase still remains ill defined but generally refers to sites that yield Dinetah Utility sherds (an overfired gray ware) and appear to lack Puebloan trade wares and other forms of Puebloan influence. The Dinetah phase Navajos built and used a variety of structures, including forked-stick hogans, sweatlodges, ramadas, and other log and brush structures. Subsistence appears to have been oriented around a generalized hunting and gathering economy, although some evidence suggests the cultivation of corn. There is no evidence that conclusively indicates that Navajos were engaged in pastoral activities at this early time.

The Gobernador phase (1770-1775) has historically been viewed as a time of intense interaction and acculturation between Navajos and Pueblo refugees, following the reconquest of New Mexico by the Spanish in 1692. Kidder (1920) was the first to suggest that the masonry pueblitos in the Largo-Gobernador district were built by Puebloan peoples who were hiding from the Spanish among the Navajos. Spanish documents indicate that after the 1680 Pueblo Revolt, many Puebloan populations feared armed reprisals and fled the northern Rio Grande to seek refuge among the more isolated Hopi, Zuni, and Acoma Indians, while smaller numbers moved to the north among the Navajos

(Dozier 1966; Hogan 1991). In particular, many researchers note that the Jemez, Santa Clara (Tewa), and Cochiti Puebloans fled north and lived with Navajos as refugees for a considerable time (Brugge 1983:493; Carlson 1965:57). It was probably during this period that Puebloan traits became most widely incorporated into Navajo culture.

The Gobernador phase was first defined by Kidder (1920), Keur (1944), and Carlson (1965). Material traits diagnostic of the Gobernador phase, as reviewed by Dittert and others (1961:246), include forked stick hogans; pueblitos; ramadas; fortified sites; undercut cooking pits; metate rests; slab mealing bins; cist burial; cremation (?); pictographs and petroglyphs; Dinetah Utility pottery; Gobernador Indented pottery; Puebloan tradewares; chipped artifacts; slab metate with two hand mano; oval, single groove arrow shaft smoothers; gilsonite pendants; trade stone material from the Abiquiu area; bone awls; uninterlocked, close-coiled two-rod-and-bundle basketry; wooden basketry awls; fire drill and hearth; wooden scoops; *Yei*; Twin War God deities; sheep and horses; weaving; *Olivella* shell beads; distinctive types of corn and beans; stone masonry hogans; cribbed log hogans (?); sweatlodges; wooden plows (?); notched-log ladders; digging sticks; dance paddles; macaw fetishes; metal; and glass beads.

Carlson (1965:101) noted that settlement patterns changed significantly during the Gobernador phase. Specifically, early Gobernador phase sites, as described for the Navajo Reservoir district (Eddy 1972), consist of hogan clusters with small (1 to 4 room) pueblitos. Late Gobernador phase sites are large masonry citadels located in difficult to access defensive positions. Tree-ring studies from these later, larger defensive settlements indicate construction occurred primarily from 1715 and 1750, well after the Spanish reconquered Santa Fe in 1692 and defeated the last uprising in 1696.

Traditionally, the pueblitos of the Gobernador-Largo district were thought to represent defensive sites built by the Pueblo refugees who were among the Navajos after the failed 1696 uprising against the Spanish (Kidder 1920). Increased raiding of Pueblo and Spanish settlements by the Navajos initiated the successful Roque de Madrid's campaign against the Navajos in 1709. By laying waste to the corn fields, the Spanish suppressed the Navajos and brokered a rare peace agreement that occurred between 1709 to 1760. McNitt (1972:22) observes that there is not a single reference to Navajo raids on Spanish settlements during this period, which, oddly enough is when the majority of the large defensive pueblitos were constructed. Carlson (1965) proposed that the construction of the large defensive pueblitos were a response to the initial Ute and Comanche advance, at about 1716 to 1720, because most of the Pueblo refugees had long since returned to the Rio Grande Valley by then. The large defensive pueblitos, then, were probably not built by the Puebloan refugees to defend against the Spanish, but were probably constructed by Navajos to defend against the raiding of goods, livestock, women, and children by the formidable Ute-Comanche alliance. The breakdown in the Spanish-Navajo truce after 1760 and the continual intensive raiding and warfare by the Utes forced the migration of the Navajos south and west of the San Juan River to their present homeland by approximately 1775.

Numerous Gobernador phase sites have been encountered on SUIR in the Animas, Pine, and La Plata river drainages. These sites typically have Dinetah Utility, Gobernador Polychrome, and Puebloan trade ware pottery. Forked-stick hogans can occur on these sites, but masonry pueblitos are absent.

The presence of chipped stone tools and waste debris, as well as ground stone implements, suggests resource acquisition and food processing commonly occurred on these sites.

The lack of early or late Gobernador pueblitos probably indicates two possibilities. First, SUIR may have only been used by the Gobernador phase Navajos on a seasonal basis, probably for hunting and gathering of native plant and animal resources. The other possibility is that by the early Gobernador phase, intensive raiding and warfare by the Utes and Comanches pushed Navajos further south and restricted them to the Largo-Gobernador district, where they built and finally abandoned the large defensive pueblitos by 1775.

Ute Tradition

The Utes speak a Shoshonean language, which is a branch of the larger Uto-Aztecan language family. Other Shoshonean speakers include Great Basin groups, such as the Paiutes, Goshutes, and Shoshones, as well as various Tribes in California, and also the Hopis.

Most research that has attempted to tie archaeological remains to the Utes has been inconclusive. In particular, it is impossible to distinguish Ute remains from those of the more general Great Basin "Desert Culture," at least prior to the introduction of the horse (Buckles 1971; Wormington and Lister 1956), suggesting that Ute life ways were very similar to those of Great Basin groups.

The Desert Culture is a very long-lived hunting and gathering adaptation utilizing a "wide spectrum economy" of native desert plant and animal resources, including seeds, roots, nuts, small and large mammals, fish, insects, and birds. Excavations of such sites as Danger Cave (occupied intermittently from 8300 BC to AD 1400) and other Great Basin sites (Jennings 1957, 1964) indicate that Desert Culture groups were organized into small mobile bands that pursued annual foraging rounds driven by the seasonal availability of various natural resources.

The inability to distinguish the archaeological remains of the Desert Culture from that of the Utes has led some researchers to conclude that the early, long-lived Desert Culture of the eastern Great Basin is ancestral to the historic Utes and other Numic speaking groups (Fowler and Fowler 1969:20-21; Smith 1974:15-17). While there is much disagreement regarding the fate of the horticultural Fremont groups, a northern manifestation of the "puebloid" culture dating from about AD 400-1150 (Stewart 1966), many authors believe that Shoshonean speakers expanded from the Death Valley, California region and fanned out through the Great Basin, with the Utes probably reaching the Gunnison Basin area of west-central Colorado possibly by AD 1150 (Fowler and Fowler 1969; Goss 1968; Miller 1966, 1984:102; Smith 1974). On glottochronological grounds, Lamb (1958:99) argues a strong case that the entire Numic branch originated in the southwestern portion of the Great Basin and only began diverging and migrating eastward and northward some 1,000 to 2,000 years ago.

The Numic Branch of the Uto-Aztecan language family is the most northerly branch of the family, encompassing the Great Basin from southern Idaho to southern California (Miller 1986:98). The

Southern Numic language subdivision includes the Ute, Southern Paiute, and Chemehuevi peoples. The minimal dialectical differences between these groups further ties and associates the Utes with a Great Basin origin. All dialects from these groups are mutually intelligible, suggesting a very recent divergence from one another (Miller 1986:98-99). The dialectical differences within the Ute language suggest that the divergence of the dialects it subsumes may have begun about 400 years ago (Goss 1968; Miller 1986:100).

The Ute Indians were organized into several bands at the time of historic contact. The Muache, Capote, and Weeminuche bands make up what became known as the Southern Utes. The Capote and Muache bands appear to have utilized the project area only periodically prior to confinement on the present day Reservation by the United States military. The Muache and Capote bands currently reside on SUIR centered in Ignacio, while the Weeminuche live on the Ute Mountain Ute Indian Reservation surrounding Towaoc.

The Capote band inhabited the area south of the Conejos River, east of the Rio Grande River to the Sangre de Cristo Mountains and east of the Continental Divide. The San Luis Valley was also frequented by the Capote band, who traveled as far south as the region around Chama and Tierra Amarilla, New Mexico. The Muache band lived in areas east of the Culebra and Sangre de Cristo ranges between the vicinity of Trinidad and Denver (Schroeder 1965:54). After the acquisition of the horse, the territories of the Capote and Muache bands shifted in response to warfare with other groups encroaching on their traditional ranges, particularly the Navajos, Spanish, Comanches, Cheyenne-Arapahoe alliance, and the Anglos. Schroeder (1965) cites many instances of these bands roaming well into northwestern New Mexico and southwestern Colorado. The Weeminuche band inhabited southwestern Colorado west of the Continental Divide, to the Abajo Mountains and canyon lands of eastern Utah, while the San Juan River was the southern boundary of their range.

Schroeder's (1965) intensive archival research documents that the three Southern Ute bands were in the vicinity of the project area by the 1600s, although their occupancy in the area probably occurred even earlier. The first definite Spanish reference to the Utes (Capote band) was in 1626. The reference was derived from accounts of residents of Jemez Pueblo who said they had visited the area just prior to Spanish settlement of the region in 1598, and reported the Utes lived in thatch-covered huts north of the San Juan River, beyond where the Navajos lived (Gobernador-Largo region).

During the period 1637 to 1641, the Spanish waged war on the Utes in southern Colorado, without provocation (Schroeder 1965:54), and 80 Utes were captured and enslaved in a workshop in Santa Fe. Intermittent raiding and warfare continued to the 1670s and the Spanish had forced more Utes into slavery, although during this period the Utes had begun capturing and obtaining horses. The acquisition of the horse dramatically changed the lives of the Utes and by 1670 they had become such a fearless and formidable force that the Spanish arranged their first treaty with them.

During the Pueblo Revolt period (1680-1696), the mounted Utes would organize large parties and raid the northern pueblos of the Rio Grande. The southern extent of the Capote band at this time was the San Juan River. Schroeder (1965:56-57) speculates that rather than Spanish antagonism, raids against the Hopi by the Capote band forced the Hopis to relocate to the top of the Hopi mesas, and probably out of Canyon de Chelly as well. The Hopis clearly view the Utes as their traditional enemies (Amsden 1949:128, note 7), which supports Schroeder's interpretation.

Since the 1670s, the Muache band had been building a strong alliance with their linguistic relatives, the Comanches. During this period, the incredibly strong and feared Ute-Comanche alliance, waged warfare and raiding on the Puebloans and Jicarilla Apaches with increasing frequency. Into the 1700s, the Ute-Comanche alliance roamed great distances, venturing onto the Great Plains north of the Arkansas River in Colorado. Northern New Mexico settlements, Pueblo, Navajo, and Spanish alike, suffered endless attacks and raiding by the Muache and Comanche alliance up to the late 1740s. The continual conflict with the Navajos resulted in Navajo settlement in the pueblitos of the Largo-Gobernador area for defensive purposes (Schroeder 1965:58), as discussed previously. This clearly places the Muaches in the Largo-Gobernador region by the early 1700s. Likewise, attacks on Abiquiu, Ojo Caliente, Embudo, and Quemado by the Ute-Comanche alliance had destroyed much of these Spanish settlements. Meanwhile, the Capote band had begun serious raiding east of the Continental Divide by 1736. By 1752, the Muache-Comanche alliance had broken down as the Comanches began to dominate the western plains due, in part, to the acquisition of guns from the French (Schroeder 1965:59).

By 1754, the Spanish had reached peace with the Utes and even Abiquiu was reinhabited. The Spanish needed this alliance with the Ute bands as they posed a formidable force and buffer to the Spanish against their enemies. The trade in deer skins from the Utes was also highly sought and considered important by the Spanish. Also in 1754, the Muache band formed an alliance with the Jicarilla Apache. The Spanish were very careful in cultivating their relationship with their Ute allies. Spanish trading ventures into Ute territory had to be properly authorized and the Spanish pursued and punished criminals who committed crimes against the Utes.

The Capote band formed a relationship with the Navajos after 1750, and the two groups even joined forces in 1785 to attack Gila Apaches in the San Jose River region. The relationship struck by the two groups alarmed the Spanish who imposed a ban on trading with the Utes.

In 1779, the Muache band and their Jicarilla and Spanish allies took part in a successful battle against the increasingly powerful Comanches. By 1786, the Spanish, Muache band, and Comanches negotiated a peace agreement. The Utes formed a tight relationship once again with the Spanish, and in 1804 the Muache-Jicarilla alliance joined the Spanish in a campaign against the Navajos.

The Weeminuche band was reported to be living with Navajos near the Carrizo Mountains in 1818, and they combined forces for periodic raiding excursions. In 1821, Mexico gained independence from Spain. The Mexican period featured increased contact with the Utes and the appearance of more and more trade goods with the opening of the Santa Fe Trail. Much of the contact and interaction in the San Juan and more northerly regions during the Mexican period was related to American fur trading ventures.

In 1833, Navajos were reported to be living among the Weeminuche in the vicinity of the La Plata River and Ute (Datil) Mountain. The Capote band and Navajo relationship had also improved considerably, much to the dismay of the Mexicans; "New Mexico at the end of the Mexican period was in an unhealthy position on her northern border with Muache Utes depredating south on the east side of the Sangre de Cristos and the Capotes and Navajos raiding into the Rio Arriba area" (Schroeder 1965:64).

The United States took control of the region in 1846 following the war with Mexico. During the next decade, contact with American settlers increased, and the advancing Americans forced the Utes into more isolated regions in Colorado, New Mexico and Utah.

The first treaty between the Utes and the United States was signed at Abiquiu in 1849. This document recognized the sovereignty of the United States and promised $5,000 a year in supplies to the Utes. In the following years this promise was rarely kept. The Utes evidently continued to raid settlements in New Mexico, because in 1855 the governor of New Mexico negotiated the Treaties of Abiquiu with unnamed Colorado Ute bands (Callaway and others 1986:355). This agreement stipulated that Utes were to abandon all of New Mexico except for about 2000 square miles north of the San Juan and east of the Animas Rivers, but the treaty was never ratified.

With the discovery of gold near modern day Denver and Colorado Springs in 1858, there were ever increasing incidents of violence between miners and Utes. The Baker party explored the San Juan country in 1860 and noted mineral deposits on the Animas River near present-day Silverton. By 1863 tensions became so escalated that a treaty council was convened at the Conejos Agency. The United States government intended to convince the Utes to become farmers in the Four Corners region. The Weeminuche and Muache bands did not attend, and although the Capote were present they refused to sign. The only Utes to sign the agreement were from the White River and Uncompahgre groups whose territories were located farther north. By signing, these Utes relinquished their (as well as those of Utes not in attendance) "mineral rights, all mountains settled by whites and the San Luis Valley" (Callaway and others 1986:355).

The Southern Ute bands were served by three subagencies in northern New Mexico: Muache were served at Cimarron, the Capote at Abiquiu, and the Weeminuche at Tierra Amarilla. A larger agency in Taos "continued to keep track of other miscellaneous southern Utes" (Marsh 1982:65).

With waves of destitute Americans flooding the West after the Civil War, a formalized treaty and Reservation was necessary. In 1868, the approximate western third of Colorado was designated Ute Reservation with an agency built at White River (near modern day Meeker). Soon after, the wealth of minerals in the San Juan Mountains was recognized, and Utes were soon relieved of their ownership of the San Juan Mountains under the terms of the Brunot Agreement, or San Juan Cession, of 1874, which deleted much of the central portion of the 1868 Reservation. This isolated the southern portion (approximately the present Southern Ute and Ute Mountain Ute Reservations) from the larger northern portion. Administration of the southern Ute bands was consolidated in 1876 at the Los Pinos Agency on Cochetopa Creek, a tributary of the Uncompahgre River (Delaney 1974).

In 1879, in a dispute over land use, Nathan Meeker, the agent at White River and eight others were killed by Utes. The fallout from this and the Thornburgh Battle in 1880 was the removal of the northern bands to the Uintah Reservation in Utah. Shortly after 1880, the Los Pinos Agency was moved to its present location near the budding town of Ignacio. Two years earlier all Utes living in New Mexico had been ordered to the Reservation in Colorado and the subagencies in New Mexico were closed (Jefferson and others 1972:24-33; Marsh 1982).

Attempts were also made to remove the southern bands to a Reservation north and east of Pagosa Springs and later to San Juan County, Utah. In 1895 a Ute Indian removal bill was introduced into Congress by Andrew J, Hunter of Illinois. Under his bill, the three southern Ute bands would be located on their old Reservation in the southwest corner of the state and individual allotments of land were to be distributed to Ute families under the terms of the Dawes Severalty Act of 1887. After these and some Tribal lands were allotted, the special status of the Reservation would be removed and the remainder of the Reservation would be opened to white settlement.

This proposal met with a mixed response from the Utes. Most members of the Muache and Capote bands agreed, and a total of 72,811 acres of land were allotted to 371 Utes. However, most of the more conservative Weeminuche band under Ignacio refused to participate and remained at their camp on the drier western end of the Reservation. This land was held as land-in-common for the Weeminuche and a sub-agency was established at Navajo Springs in 1897. This area subsequently became the Ute Mountain Ute Reservation (Delaney 1974; Schroeder 1965:64-72).

Historic Era

The following sections summarize the history of non-Indian, pre-Reservation activities and settlement in the project area, and also the history of Indian and non-Indian activities during the Reservation era.

Pre-Reservation Period

Prior to the establishment of the Reservation, non-Indian use of the project area was by Hispanos from the south and, to a lesser extent, Anglos from the east and north. The Hispano settlers were mostly descendants of the Spanish followers of Don Diego de Vargas who reconquered New Mexico in 1695. Many of these "Espanoles Mexicanos" included members of the Martinez and Serrano families who settled at the New Villa of Santa Cruz de la Cañada below the confluence of the Chama and Rio Grande Rivers (Swadesh 1966:29). Here they irrigated small plots, grazed sheep in the nearby hills and traded with Native American groups along the Old Spanish Trail. This route ran up the Chama River and then down the San Juan River, cutting through the southeast corner of the project area.

Also living among the Spanish were *castas*, people of ethnically mixed ancestry, and *Genizaros*, who included Utes and other American Indians who were enslaved to work as soldiers, farmers, and servants. Compared to many other Tribes in this region, the Spanish developed close ties to the Utes and over the years there was much interaction and intermarriage between these groups. By 1821 when the Mexican Republic was established, approximately 3,000 Spanish and castas and 250 Genizaros were living in the Chama drainage (Swadesh 1966:52).

In the early nineteenth century all good land along the lower Chama River had been allotted by the Spanish, and later Mexican, governments and petitions were made for lands on the upper Chama. One of these, the Tierra Amarilla Grant, awarded in 1832, included lands at the east edge of the project area and, in 1842, the enormous Conejos Grant was made to the east and north. It appears the greatest attraction of these lands was to secure them from possible petitions from outsiders. These areas had been grazed for years, but other than small sheep camps, no permanent settlements were established away from the main rivers. Later, beginning in 1844, hostilities with both the Utes and the Navajos further limited Mexican expansion and in 1846 when the United States territorial period began, many of the Hispano settlers went to live in California or the northern states of Mexico.

During the early territorial period, non-Indian settlement of what was to become SUIR was limited to small Hispano ranchers, many of whom were members of the Cofradia de Nuestro Padre Jesus Nazareno, also know as the Penitente Brotherhood. This movement, which developed during the secular period of the early nineteenth century, was especially popular in the rural areas where there was a shortage of priests (Chavez 1954:110-111). Later, partially because their practice of bodily penance was discouraged by the Catholic Church, the Penitentes sought out isolated localities such as those within the project area. This was a period of increasing hardships and hunger for the Utes and many placed their children in Hispano homes. When grown, these children tended to marry Hispanos or other Utes raised as themselves; their descendants have created a subcultural enclave within the Southern Ute Tribe (Swadesh 1966:89).

Anglo use of the study area came later and was much less intense than that of the Hispanos. As early as the 1820s, mountain men out of Saint Louis trapped the rivers of southwestern Colorado. In 1859 gold was discovered near Denver, and in 1860 was located in the San Juan Mountains. In addition, well organized cattle ranchers began to move in northwest of the study area. These included the notorious Lincoln County "Regulators" as well as groups of Mormons. Unlike the region south of the project area, there were few Hispano property owners in the north (Swadesh 1966:116-1170).

In the early 1870s the local situation began to change very quickly with an influx of highly capitalized Anglo land and livestock enterprises and the "Santa Fe ring" of lawyers and bankers. These men acquired Spanish and Mexican grant lands, usually by illegal means. Later, when the Hispano settlers discovered they were shut out from grazing on their traditional lands, animosities broke out and the "Black Hand," a Hispano guerilla group, was formed. In 1874, the Brunot agreement opened the San Juan area to mining and many Hispanos and Anglos, especially teamsters, settled near access routes to the mountains. In 1876, the Canyon Largo toll road was opened, running across the eastern portion of the project area from the confluence of the Piedra River with the San Juan to the Bloomfield-Canyon Largo area. By this time, although much of the land was controlled by Anglos, the non-native population of the project area was almost entirely Hispanos concentrated in the major river drainages in the southeast portion.

Development of mines north of Durango stimulated development of new transportation corridors. A wagon road was built in the late 1870s from Fort Lewis, west of Durango, down the La Plata River to Farmington. Then, in 1881, the completion of the Denver and Rio Grande narrow-gauge railroad line from Alamosa through Chama to Durango greatly affected the study area. Railroad facilities and small communities of Hispano laborers were founded at Arboles, Allison, Ballejo (later Tiffany), Serano, La Boca, La Boca Station, Ignacio (later Ignacio Station), Oxford, Colina (later Sloan), and Florida. Typically, these railroad towns were rowdy places with saloons and stores. Some of these communities that originally had Spanish names later were redesignated with Anglo names.

Reservation Era

Prior to the allotment of parcels to the Southern Utes, Reservation lands were supposed to be off-limits to non-Indians but some Hispanos settled on Reservation lands (such as at La Piedra near Arboles and at Hinsdale, east of the project area). These Hispanos were forcibly removed in 1883, and Anglo squatters, especially in the northwestern part of the Reservation also were removed (Swadesh 1966:124). General Land Office maps from this era indicate that many ranch buildings were built directly on the southern boundary of the Reservation. This may have allowed non-Indians to efficiently utilize Ute grazing lands without actually making improvements on the Reservation.

In 1886, in an earlier attempt to provide the Utes with farms, lands were cleared and 32 small houses were built for prominent Ute families. This work was performed by Hispanos who then moved into the houses and raised the crops because the Utes were not so inclined (Swadesh 1966:115). This relationship of Hispanos performing labor for the Reservation continued to recent times. Many Hispano families moved close to the agency, or near allotment farms to dig irrigation ditches or herd Indian livestock on the more isolated portions of the Reservation. Navajos also occasionally were hired by the Indian agent to dig ditches for the farms (Delaney 1974:53).

Of the Indian allotments, most were quarter sections located on the well-watered bottom lands of the Pine River and to a lesser extent along the Animas, Florida and La Plata rivers and on Spring Creek. Since the individuals obtaining the allotments had little experience with irrigation, it is not known what criteria were used for choosing these lands and in what order allotments were selected. By 1910 approximately one hundred Ute families were farming 6,500 acres of alfalfa and oats, as well as grazing cattle, and some sheep and horses (Jefferson and others 1972:47). Some allotments were leased to Anglo ranchers and, after 1910, the allotments of deceased Utes could be sold to non-Indians, with the agreement of the heirs.

The allotment system tended to disperse the Utes living on the Reservation although many continued to live near the agency and several smaller communities. A few of these communities had strong Hispano influences and in later years some Ute descendants were dropped from Tribal rolls due to diminished Ute relatedness (Swadesh 1966:112). During this period Ute leadership remained remarkably stable. Buckskin Charlie assumed leadership of the Southern Utes in 1880 upon the death of Ouray, who had been the principal leader of the Utes since the 1860s. Buckskin Charlie led the southern Ute bands for 56 years until his death in 1936 when his son, Antonio Buck, Sr., was installed as the last hereditary chief of the Southern Utes and then elected the first Tribal chairman under the new Tribal constitution.

Homesteading

After the 1895-96 allotment of Southern Ute lands, more than one-half million acres in "surplus" lands were opened to non-Indian homesteaders. At first, claims were filed under the Homestead Act of 1862, which enabled heads of households to file for 80 acres of land adjacent to railroad grants or 160 acres of land elsewhere (Gates 1968:394). The act also required that the lands be non-saline, non-mineral, not used for business, not withdrawn for townsite, nor reserved by the Federal government for other uses. A total of 2,070 entrymen made homestead claims within the project area under the 1862 Homestead Act (Table 4). Government lands also were available for purchase as Cash Entries for $1.25 or $2.50 per acre, and 447 parcels were acquired through cash entries. In a predictable pattern, many of the early homestead entries were claimed near the main drainages where irrigation was possible.

While the land was nominally free to homesteaders, they were required to pay filing fees, cultivate the land, build a residence, and live there for five years. If a homesteader failed to meet the legislated requirements, he could relinquish the claim and refile elsewhere. Otherwise the government would cancel the entry. Relinquishment of a claim, rather than allowing it to be canceled, is often a good indicator of the entryman's commitment to homesteading. Only about 43 percent (896 of the 2,070) of the filed homestead entries were successfully patented (Figure 15). Most of the early failures were formally relinquished suggesting those homesteaders planned to try somewhere else, but after about 1910, most failed homesteads were canceled by the government.

In many parts of the semi-arid West, 160 acres was far too little land for a viable farm or ranch. In an attempt to remedy this problem, Congress passed the Desert Land Act of 1877. Under this law, an entryman could file on as many as 320 acres, but these had to lie in a compact form, be feasible for irrigation purposes, and be irrigated following a pre-approved plan (43 CFR Part 2520.0-1). Residency was not required but extensive improvements in the form of dams, canals and storage reservoirs were. In addition, the entryman had to prove that he actually irrigated and reclaimed at least one-eighth of the acreage of his claim. A total of 387 desert land entries were made within the project area, but only 38 or about 10percent were actually patented, mostly in the river bottoms. Desert land entries were probably less successful because most individual farmers found it impractical to construct irrigation systems or to obtain water rights. At the same time, desert land entries were too small and often too dispersed for capitalists to make money selling water to them (Stathis 1979:188).

The Homestead and Desert Land acts still left much desert scrub land in the public sector. The Stock Raising Homestead Act of 1916 was passed to encourage settlement of these areas. Homesteads of up to 640 acres could be claimed under this act, but the entryman had to make improvements on the land that would aid in stock raising and represented a minimum investment of $1.25 per acre. Mineral and coal rights, watering places, and access ways were reserved by the government. A total of 353 stock raising entries were made within the study area, but only about 30 percent (109) were successfully patented, mostly in the drier uplands ignored by earlier homesteaders.

One unforeseen negative outcome of the Stock Raising Homestead Act was that it often resulted in too many livestock being enclosed within too small an area. The resulting overgrazing led to erosion of range lands in southwestern Colorado as elsewhere. As a result, the act was suspended during World War I and later replaced by the Taylor Grazing Act of 1934, which encouraged leasing of public lands in larger tracts more suitable to the realities of western grazing. Also in 1934, the Indian Reorganization Act was passed, allowing unclaimed lands on SUIR to be redesignated as Tribal lands. These were mostly the less desired lands in the south-central portion of the Reservation.

TABLE 4
SUMMARY OF HOMESTEADS, ALLOTMENTS, AND OIL, GAS, AND COAL PERMITS

Township	Homestead Act		Desert Land Act		Stock Raising Act		Subtotals			Cash Entries	Indian Allotments	Indian Fee	Gas	Coal	Totals
	Entries	Patents	Entries	Patents	Entries	Patents	Entries	Patents	Success						
34N 13W	118	45	0	0	11	5	129.00	50.00	0.39	3	0	0	31	0	163
33N 13W	192	56	20	2	20	9	232.00	67.00	0.29	1	0	0	30	0	263
34N 12W	143	69	19	2	5	5	167.00	76.00	0.46	25	16	1	10	0	219
33N 12W	140	74	31	4	3	5	174.00	83.00	0.48	47	12	7	6	3	249
32N 12w	9	0	2	0	23	4	34.00	4.00	0.12	0	0	0	14	5	53
34N 11W	145	42	59	9	26	10	230.00	61.00	0.27	33	8	0	27	0	298
33N 11W	48	21	3	3	37	7	88.00	31.00	0.35	4	0	0	54	0	146
32N 11W	70	19	13	0	32	11	115.00	30.00	0.26	0	0	0	36	1	152
34N 10W	86	30	1	0	38	9	125.00	39.00	0.31	16	12	1	7	0	161
33N 10W	105	42	13	0	19	5	137.00	47.00	0.34	4	16	0	5	0	162
32N 10w	58	18	2	0	35	3	95.00	21.00	0.22	2	0	0	10	0	107
34N 9 W	157	69	51	6	1	1	209.00	76.00	0.36	47	19	1	1	0	277
33N 9W	119	41	16	2	11	5	146.00	48.00	0.33	12	26	1	0	0	185
32N 9W	17	8	0	0	7	3	24.00	11.00	0.46	0	0	0	0	0	24
34N 8W	94	46	23	0	5	1	122.00	47.00	0.39	53	29	9	4	0	217
33N 8W	149	81	10	2	24	14	183.00	97.00	0.53	10	0	0	17	0	210
32N 8W	28	10	0	0	30	6	58.00	16.00	0.28	3	0	0	7	0	68
34N 7W	99	61	14	3	9	3	122.00	67.00	0.55	61	0	2	9	0	194
33N 7W	109	57	18	0	2	2	129.00	59.00	0.46	15	61	3	4	0	212
32N 7W	42	27	31	2	6	1	79.00	30.00	0.38	13	18	1	3	0	114
33N 6W	60	26	9	1	3	0	72.00	27.00	0.38	17	0	0	0	0	89
32N 6W	38	27	34	1	1	0	73.00	28.00	0.38	65	0	0	0	0	138
32N 5W	44	27	18	1	5	0	67.00	28.00	0.42	16	15	2	0	0	100
Totals	2,070	896	387	38	353	109	2,810.00	1,043.00	0.37	447	232	28	275	9	3,801

Figure 15
Homesteads; Indian Allotments; Oil, Gas and Coal Permits
8½ x 11

Community, Irrigation, and Transportation Developments

During the homesteading period, several small communities developed, especially in the mostly Anglo western part of the Reservation. These include Redmesa, Kline, Breen and Bondad. Surprisingly, even in the predominantly Hispano southeastern portion of the Reservation, few homesteads were successfully patented by Hispanos. By 1915 only five out of 363 homesteads had owners with Spanish surnames, and these were mostly around Tiffany. After the turn of the century, Hispanos continued to play an important, if waning, role on the Reservation. The community of La Posta included many Hispanos, and Ignacio was mostly settled by Hispanos after it was platted in 1910. Store owners and saloon keepers in Ignacio, such as Fabian Martinez, were locally important men. One point of contention was between the usually Anglo Indian agents at Ignacio and the Hispanos who performed many of the labors and services on the Reservation. Many agents resented the close relationship between the Utes and the Hispanos and attempted to replace the latter with men of their own choosing. The tendency of many Hispanos to run stills in the isolated canyons and bootleg illicit liquor to the Utes did nothing to endear them to the government men (Swadesh 1966:125).

Ignacio itself is a bit confusing as there are four separate locations with this name. First, in 1877 was the Los Pinos Agency, which later became known as the Ignacio Agency. In 1881, Ignacio Station was established two and one half miles to the south on the new Denver & Rio Grande Railroad. In 1910 the present residential center of Ignacio was established between the two and incorporated in 1913. A 1915 map indicates a location for "Ignacio City" located in Section 1, T33N, R8W, some one to two miles northwest of Ignacio. This last location may have been a proposed townsite, and it is not known if anything is presently there.

In 1902, the Secretary of the Interior permitted rights-of-way through allotted lands for irrigation ditches to serve homesteaders provided the Southern Utes consented (Jefferson and others 1972:47). Soon after, several privately-financed ditch and reservoir complexes were constructed. These included the Bent and La Plata (Pruitt) ditches on the La Plata River, the Animas Mesa Ditch on the Animas River, and the Colorado Land and Water Co., Ignacio Mesa, Thompson Eperson Extension, and Pine River Ditches on the Pine River. In addition, several other ditches were built by the Indian Service.

During the homesteading period, transportation continued to improve, with roads connecting Ignacio with both Durango and Arboles. Many smaller roads were established to access isolated homesteads and grazing areas. During this period the Denver & Rio Grande Railroad also built a line down the Animas Valley connecting Durango and Farmington, and in 1905 the Arizona & Colorado Railroad planned, but never built, a line down the La Plata Valley.

Mineral exploration expanded in the mid-1920s. Oil and gas prospecting was pursued across much of the western portion of SUIR, and coal was mined in the vicinity of the Cinder Buttes. Some placer mining also occurred within the project area along the lower Piedra River. Sawmills were established on the well-forested uplands and timber was hauled to sidings along the railroads.

SENSITIVITY MODELING

Because a complete inventory of cultural resources has not been compiled, "sensitivities" were modeled for the project area. High, moderate, and low sensitivity zones were defined for archaeological sites reflecting native occupation during the prehistoric and ethnohistoric eras, as well as for archaeological and historical sites dating from the historic era. The defined sensitivity zones were intended to reflect relative density and complexity of cultural resources. The methods used to develop these models and the results are described in the following sections.

Methods

Modeling human use of a landscape over thousands of years, and then predicting what evidence of those occupations survives is a daunting challenge. In some situations, archaeologists have been able to develop quantitative models to predict the distribution of archaeological sites, using sets of variables such as soil type, natural vegetation, elevation, aspect, slope, distance to water, and other variables (Grady 1980). However, development of such models typically requires extensive survey data to develop empirical correlations with various environmental parameters, and such models do not necessarily enhance our understanding of the those settlement patterns.

As discussed above, archaeologists have identified patterns of where different types of archaeological sites tend to be located (such as, Pleistocene terraces, valley floors, ridges, etc.), and how site locations have changed over time. More formal predictive modeling sometimes has demonstrated that such commonly held intuitive characterizations of site placement are not always good predictors of site locations (Adams 1975; Grady 1980; Hibbets and others 1979). The available data for SUIR does not provide a basis for a rigorous quantitative model, and therefore we have worked with the more intuitive prior observations of settlement patterns and cautiously used them to define sensitivity zones.

The basic unit of study for this analysis is the site. Isolated artifacts or occurrences were not considered because (1) regulatory and land managing agencies consider almost all isolated finds to be insignificant resources, (2) their inconsistent recording over the years and often seemingly fortuitous distributions skew settlement data, and (3) current Southern Ute Tribal policy stipulates that isolated finds not be recorded. Sites were classified as either architectural or non-architectural within temporal and cultural units. Characterization as architectural or non-architectural provides information about seasonal use versus permanent occupation, and architectural sites typically would require more substantial mitigation efforts if they were to be adversely affected.

Projecting site densities from the available survey data is problematic for several reasons. One problem stems from inconsistency in site survey and recording practices, which have become more intensive, especially over the last 10 to 20 years. Many smaller sites were not detected by earlier surveys. Some types of sites, such as simple artifact scatters or features, that 20 to 40 years age would have received only passing mention are now viewed as more meaningful resources and routinely designated as sites. Also, the amount of information recorded about sites has tended to increase over time, and usually less is known about sites recorded years ago than those recorded more recently. Accordingly, more recent surveys conducted throughout the region usually report higher site densities than earlier surveys.

Site visibility is another problem. Large areas in the project area where no sites have been recorded are under cultivation or are highly altered in other ways. We suspect that the absence of reported sites reflects alteration of the ground surface rather than a lack of archaeological sites.

Another major problem stems from the Southern Ute Tribal policy concerning avoidance of archaeological sites. Although this policy has resulted in commendable preservation of sites in place, those sites that are avoided by margins of some 50 to 100 feet routinely are not recorded or reported. As a result, a considerable number of acres of Tribal lands have been surveyed, but reported densities of archaeological sites are low and do not represent actual densities and patterns of site distribution. Surveys on non-Tribal lands within SUIR show higher densities that present more accurate information, but the extent of surveys in these areas is not great.

In sum, the recorded patterns of site density must be interpreted cautiously. In fact, the patterns are likely to reflect the degree of prior survey as much as any variation in the actual distribution of sites.

Predicting the potential for historic resources is somewhat easier than for prehistoric resources because so much of historic land use is documented. Exceptions include illegal activities such as squatting or prospecting on the Reservation by non-Indians, the construction of stills and other bootlegging activities, and temporary herding facilities.

Other activities are often well documented. All claimed and patented homestead locations are listed in the records of the General Land Office maintained by the BLM. Those records also list the locations and dates of Indian allotments, cash entries, oil and gas exploration permits, coal leases, mining claim patents, and ditch, reservoir, road, railroad, and pipeline rights-of-way. The General Land Office surveyed township maps are also useful because they show the as-built locations of cultural features such as roads, ditches, communities and ranches. The maps are limited in that they depict only what was built at the time the surveys were made. For most of the study area, these maps were made between 1881 and 1886. Other maps utilized for this project include historic military maps, land and water company maps, BLM surface management status maps (scale = 1:100,000), county maps (scale = 1:50,000), and USGS topographic quadrangles (scale = 1:24,000).

The following sections discuss trends in the distribution of recorded archaeological sites for each defined cultural and temporal period.

Distribution of Archaeological Site Components Within Drainages

Within the boundaries of SUIR west of the Piedra River, 967 sites have been recorded. They range in time from the early Archaic period to historic manifestations less than a century old. Those sites occupied by more than one cultural group or subgroup during different periods are considered to be multi-component. A total of 1,040 components are represented by the 967 sites within the study area (and because the temporal and cultural groupings used are actually quite gross, the actual number of occupational episodes is likely much greater than the tabulated 1,040 components).

The project area is cut by four south flowing rivers tributary to the San Juan River. The drainage basins of these rivers are not only convenient geographical divisions for evaluating settlement patterns, but often appear to reflect prehistoric cultural boundaries (Eddy and others 1984). Therefore, we tabulated site components by the four drainage units: La Plata, Animas-Florida, Pine, and West Piedra (Table 5). These basins are the same subdivisions used by Eddy and others (1984) in their analysis of southwestern Colorado prehistory, and the information compiled here augment that study with both comparable and contrasting data.

The density of recorded sites within sections (usually one square mile but some sections are irregular) is displayed on Figure 16. Several observations are evident.

First, over 60 percent of the sections in the SUIR area have no previously recorded sites in them. Many of these cluster in areas that are presently agricultural fields, some of them being farmed for over a century. Others, however, are on Tribally owned land in close proximity to areas known to have been densely settled in prehistoric times, such as the lower La Plata Valley, Mancos Canyon, and Mesa Verde. Simply stated, we do not know what archaeological sites are in those sections, but almost certainly numerous unrecorded sites are present.

Second, there is an apparent increase in site density from east to west across the project area with marked concentrations south of Durango and along the La Plata River just north of the New Mexico border. Oil and gas fields, utility corridors, and features of the proposed Animas-La Plata water project are located in these areas, and all have been subject to substantial intensive archaeological survey. Although the available survey information indicates these areas have relatively high site densities, they may not actually be substantially higher site concentrations than in surrounding areas that have not been subject to as much intensive survey.

TABLE 5
RECORDED SITE TYPES AND CULTURAL COMPONENTS WITHIN DRAINAGES

Culture Period	La Plata		Animas-Florida		Pine		West Piedra		Totals		
	NA	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**All**
Archaic	28		6		1				35		**35**
Anasazi											
BMII	1	5	9	5	4	7	1	2	15	19	**34**
BMIII-PI	58	60	35	85	22	30	25	42	140	217	**357**
PII-PIII	34	64	14	6	5	3	3	5	56	78	**134**
PIV	5		2				2		9		**9**
Unknown Anasazi	20		10	2	14	4			44	6	**50**
Subtotals	118	129	70	98	45	44	31	49	264	320	**584**
Navajo											
Dinetah			1	1					1	1	**2**
Gobernador	17	7	5	4	2	2	2	1	26	14	**40**
Unknown Navajo	8		20	5	1	1	1		30	6	**36**
Subtotals	25	7	26	10	3	3	3	1	57	21	**78**
Ute	5		2		2				9		**9**
Euro-American	23	24	7	14	6	11	2	2	38	51	**89***
Unknown	136		65		29		13	2	243	2	**245**
Totals	**335**	**160**	**176**	**122**	**86**	**58**	**49**	**54**	**646**	**394**	**1,040**

A = architectural; NA = non-architectural
* some imprecision due to vague site descriptions; some separate site designations combined, such as parts of Denver and Rio Grande Railroad grade and BIA buildings in Ignacio Agency complex

Figure 16
Density of Recorded Archaeological Sites in the Project Area
(restricted distribution)
8½ x 11

Third, areas south of Durango that have been intensively surveyed within SUIR reflect site densities in excess of 25 sites per square mile, as do areas on the lower La Plata River. Given that both of these areas are located adjacent to primary water courses, and considering the statements of Reagan (1919) and Roberts (1925) who conducted broad, extensive surveys in the region, it is reasonable to assume that the entire courses of the four principal rivers in the project area contain archaeological sites in high densities. Secondary drainage courses will probably reflect complimentary and only slightly lower densities. However, high site densities can also be expected in some upland areas beyond the river valleys. As previously discussed, evidence from Navajo Reservoir (Eddy 1972) and adjacent areas further up the San Juan River (Adams 1975) and Piedra River valleys (Eddy 1977) indicate that from the Rosa phase onward archaeological sites were commonly located in upland areas as well as in the river valleys. Wilshusen's (1995) recent work just to the south of SUIR has shown some of the highest site densities in the region (about 45 sites per square mile) are in secondary, intermittent drainage basins well away from the major rivers.

The following paragraphs briefly describe the distribution of the 1,040 recorded site components by drainage unit. The data reflect shifting centers of occupation and utilization for each of the five cultural traditions recognized in the project area.

Oshara Tradition

The majority of the records for pre-Formative sites ascribe only a generalized Archaic affiliation without further chronological precision. Therefore, finer phase or subperiod patterns for the Oshara Tradition cannot be evaluated.

A total of 35 site components are assigned to the Oshara Tradition. The majority of Oshara site components (28, or 80 percent) lie in the La Plata unit, with six components (17 percent) in the Animas-Florida unit. None are recorded in the western Piedra drainage basin that is within the study area, and only a single component has been recorded within the Pine River basin. Because the sample is so small, the near absence of Oshara components in the eastern half of the project area may not be a meaningful pattern, especially in consideration of the fact that Archaic sites are known from adjacent areas to the north in the HD Mountains (Martorano and others 1985).

Given the modest representation in the Animas-Florida unit and the dominance displayed in the La Plata unit some speculation is offered. Both drainage units lie considerably closer to high altitude alpine and subalpine environments than do their eastern counterparts. Because the Oshara Tradition reflects a broad spectrum hunting and foraging Archaic adaptation, the presence of more life zones in shorter linear distances may help account for the site distributions. Moreover, the La Plata Valley may well have served as a corridor of sorts between the low-lying San Juan River Valley and the La Plata Mountains. In its short course of 45 miles, the La Plata River traverses all life zones present on the Colorado Plateau—a virtual storehouse of resources for hunters and gatherers.

Anasazi Tradition

Site components dating to the Anasazi period account for 56 percent (584 components) of the recorded inventory within the project area. All Anasazi subperiods are represented in the survey records, but in varying frequencies from east to west. The data suggest shifting centers of population through time, a pattern common to prehistoric Puebloans across the northern Southwest. The distribution of Anasazi components among the drainage units is plotted in Figure 17.

Basketmaker II

Preceramic BMII components are present in all drainage units and account for 6 percent (34 components) of all Anasazi components. The Pine drainage unit contains the largest number, followed by the Animas-Florida and Piedra drainages. In contrast to the La Plata drainage dominance of the preceding Oshara Tradition, the La Plata unit contains the fewest BMII components. It is noteworthy that the La Plata unit lies within two miles of Mesa Verde National Park, and no BMII sites have been found within the park boundaries.

The Animas-Florida and Pine valleys are well known for their Basketmaker remains, and excavations north of Durango (Morris and Burgh 1954) and on the Pine River in New Mexico (Eddy and Dickey 1961) form the basis of definition of the BMII period in the northern San Juan Basin. So many sites have been reported (though not necessarily recorded) in the Pine River Valley that Eddy and others (1984) consider the middle and upper Pine Valley to be a core area for Los Pinos phase (BMII) culture in the upper San Juan region. Eddy and others (1984:76), citing avocational archaeologist Betty Green, note concentrations of Los Pinos remains flanking the Pine River from the site of La Boca northward to Vallecito Lake.

BMII components can be expected, quite possibly in high numbers, along the entire course of the Pine River in the project area. Modern agricultural practices and rapidly developing subdivisions and ranchettes are probably masking and destroying these sites.

Figure 17
Distribution of Anasazi Components Within Drainages

Basketmaker III/Pueblo I

Distinguishing BMIII sites from PI sites on the basis of surface indications is difficult, so they are lumped into a single category. Also, BMIII components commonly underlie later components (such as Sambrito phase sites at Navajo Reservoir). The components of these two periods are the most well represented in the inventory, constituting fully a third (34 percent, or 357 components) of all components, and almost two-thirds (61 percent) of all Anasazi components.

It is unclear whether the sudden and dramatic increase of the numbers of BMIII/PI components over earlier periods represents an immigration of population into the San Juan country, or if at least some of the increase can be accounted for by rapid growth of local populations. Regardless, BMIII/PI components are the dominant Anasazi component in all four drainage units, accounting for 84 percent of Anasazi components in the western Piedra unit, 71 percent in the Animas-Florida, and 58 percent in the Pine. Only in the La Plata unit do they constitute less than half of the Anasazi components (48 percent). The high percentage in the western Piedra unit is not surprising because Roberts (1925:39) noted that during his reconnaissance of southwestern Colorado, the Piedra Valley was the most thickly settled portion of the Upper San Juan country. "As one follows north from Arboles, there is what might be called an unbroken line of former house sites and ruins" (Roberts 1925:39), and later work by Roberts (1930) indicates that most of these appear to date to the PI period. Site locations include benches and hills flanking the Piedra River. Similar distributions have been noted of BMIII/PI remains along the Pine (Green 1953) and Animas rivers (Carlson 1963; Hibbets 1975).

Demographic shifts between drainage units may have occurred during this phase. Gooding (1980) convincingly argues that much of the middle and upper Animas Valley was abandoned by the end of the eighth century probably because of a very localized drought. Conversely, areas near the Animas show marked increases in population in the following century, notably the Piedra Valley, the Navajo Reservoir district, and Mesa Verde. The apparent sparse settlement of the La Plata unit in the preceding BMII period followed by relatively dense settlement in the BMIII/PI period demonstrates a real need for a refinement of survey methodology and site excavation and dating in order to understand prehistoric demographic changes in the sixth through ninth centuries.

Pueblo II/III

The latter half of the Anasazi sequence has also been grouped to compensate for inconsistent survey data. In the more well-known Anasazi regions, such as Chaco Canyon and Mesa Verde, the PII/PIII periods witness major increases in the numbers and types of archaeological sites present, culminating with the Great or Classic Pueblo period. In contrast, the number of site components decline sharply during the PII/III periods within the project area, with the exception of the La Plata drainage.

The PII/III periods account for 134 site components in the project area; nearly three-fourths of these concentrate in the La Plata unit with the remainder in the eastern valleys. The few PII/III components in all the eastern valleys are located in the southern sections near the New Mexico state line.

In the La Plata unit these late Anasazi components are located throughout the valley, with only slightly more clustering in the south. From what can be ascertained from the survey data, the La Plata unit PII and PIII components appear in about equal proportion, whereas in the eastern valleys Pueblo II materials seem to dominate. The La Plata unit patterns appear to mirror the contemporaneous developments on Chapin and Wetherill mesas within the nearby Mesa Verde area.

At Navajo Reservoir the early years of the Pueblo II period (Arboles phase) show an upstream movement of populations to northern parts of the San Juan and Piedra valleys, as well as areas beyond the district, such as Chimney Rock and Stollsteimer Mesa. This pattern is not evident in the data compiled for this project. No materials or components assigned to Eddy's (1977) Chimney Rock phase have been recorded in the Pine or western Piedra units. This Chacoan intrusion is apparently absent in the project area, and evidently confined to the Chimney Rock-Piedra River-Devil Creek region to the north.

Pueblo IV

The PIV period is represented by only nine components in the project area, accounting for only two percent of the prehistoric pueblo components. PIV components are present in all but the Pine unit, with most in the La Plata valley (five components). No PIV materials were found on architectural sites, which indicates Puebloan use of the project area during the fourteenth to early sixteenth centuries was ephemeral at most. In fact, the PIV ceramics that identify these components may have been carried into the region by the Ute or Navajo as trade wares.

Navajo Tradition

Navajo use and occupation of the project area is recognized in 78 site components (7.5 percent of recorded components). Navajo remains are present in all drainage units, but concentrate in the Animas and La Plata valleys (Figure 18). Only two recorded components are assigned to the early Navajo Dinetah period; both are located in the Animas-Florida drainage. The subsequent Gobernador phase accounts for more than half (51 percent) of all identified Navajo components. Gobernador remains are found in all drainage units, but concentrate in the La Plata Valley where more than half of them are located. Within the La Plata drainage, most of these Navajo components cluster near the New Mexico state line in upland areas east of the La Plata River. There is a marked decrease in Gobernador components from west to east.

Figure 18
Distribution of Navajo Components Within Drainages

The Navajo components labeled as "unknown" have not been assigned to any specific subperiod. These unassigned components are found in all drainage units, but are quite sparse towards the east. Twenty-five of the 36 unknown Navajo components cluster rather tightly in the Animas drainage, mostly west of the Animas River just north of the state line.

The Animas-Florida drainage unit has more Navajo affiliated remains than the other units, but the La Plata is a close second. The west Piedra drainage has the fewest Navajo components. More than three-fourths of all Navajo remains cluster in the Black Ridge-Long Mountain area, which forms the divide between the Animas and La Plata drainages. Gobernador remains are most common on the La Plata side, and temporally unassigned Navajo components are more common on the east.

Ute Tradition

Considering that the project area encompasses three-fourths of SUIR, it seems odd that less than one percent of the recorded site components can be assigned to Ute culture. Some 25 years ago, Buckles (1971) recognized that Ute sites often are archaeologically unrecognizable unless diagnostics such as European trade goods, wickiups, horse remains, Ute manufactured pottery, or rock art depicting historic items or events, are present, and such diagnostics are rare in the archaeological record.

In 1919 Reagan (1919:173) noted that shortly after the establishment of the Los Pinos Agency, Utes established a village atop Anasazi ruins in what is now the west edge of the town of Ignacio, "also making their graveyard on the ancient ruins...it is hard to tell what is Ute and what is ancient debris." In 1923 Roberts noted teepee poles, berms, and glass beads in and among Pueblo ruins at Stollsteimer Mesa on the Piedra River (Roberts 1925:41). As mentioned above, a seventeenth-century Ute structure with artifacts was recognized at the BMII Talus Slope Village, just north of Durango (Dean 1975).

These references indicate that sometimes Utes selected former Puebloan sites for their village or camping locales, creating a confusing archaeological record.

In the late 1970s, Jeffery T. Wharton (personal communication, 16 July 1996) directed a small excavation at a wickiup-like site south of Durango and one-half mile north of the project area. Wharton has considerable experience with both Ute and early Navajo remains throughout the Four Corners region, and concluded that this site (5 LP 353) probably was constructed by the Ute, even though the ceramics recovered from the site probably were made by Navajos. No wood was suitable for tree ring dating, but a piñon pine tree was growing within a structure at the site and yielded a pith date of 1802. The site only has been briefly described in an unpublished paper (Heikes 1979).

Schroeder (1965:169) notes that in 1859 a Navajo band under the leadership of Cayetano was living in the La Plata Valley and Capote Utes were living on the Animas River. Interaction between these groups could easily blur the archaeological record. These examples suggest that the presence of Utes often may be represented in the archaeological record in mixed deposits. How many of the inventoried sites identified as "unknown Navajo" might, in fact, be like site 5 LP 353?

Only nine sites with Ute components have been recorded within the project area. No Ute sites have been recorded in the west Piedra unit. The two Ute site components in the Pine drainage are both historic. Two other Ute components have been identified in the Animas drainage, and five in the La Plata. Although there is abundant historical documentation to place the Utes throughout the project area, the archaeological data clearly are too meager to meaningfully discuss any patterning in the distribution of Ute sites.

Unknown Aboriginal Cultural Affiliation

About one-fourth (24 percent) of the site components cannot be assigned to any cultural period. These 245 components are usually scatters of lithic debris or isolated features lacking datable objects or distinctive types of features. They are present in all drainage units and increase in numbers from east to west. In the west Piedra drainage, 15 percent of the recorded site components are of unknown affiliations, and the frequency is nearly doubled in the La Plata drainage (28 percent).

While no statistical manipulations have been attempted, there is some correlation between areas with high numbers of sites of unknown cultural affiliation with areas having high frequencies of Archaic and Navajo period sites. Detailed analyses of lithic remains at Navajo, Archaic, and unknown period sites in the La Plata Valley may clarify this matter.

Euro-American Tradition

Components dating to the historic Euroamerican occupation of the project area are present in each of the drainage units. Segments of some linear features such as railroad grades have been recorded as separate sites, and numerous individual buildings that all are part of the old Los Pinos Agency in Ignacio have been recorded as individual resources rather than as a site. After combining these, 89 historic Euro-American components were tallied, accounting for 9 percent of the total.

Somewhat more than half of the Euro-American components are located in the La Plata drainage. These are almost equally divided among architectural and non-architectural sites. The architectural sites are variously characterized as foundations, dugouts, structures, cabins, houses, shelters, homesteads, farms, or shelters. Most of these probably reflect residences associated with agricultural uses. A kiln and a sawmill are the only architectural sites identified with more specific functions. The non-architectural sites are mostly characterized as camps or trash deposits, with cairns, rock art, and a corral being more specifically identified features.

Approximately one-fourth of the Euro-American components have been identified in the Animas drainage. Two-thirds of these are classified as architectural and are characterized similarly to the residential sites identified in the La Plata drainage. More functionally specific sites include a church and a sawmill. The non-architectural sites include sites identified as railroads and a windmill, along with the more typical trash deposits and a camp.

Almost one-fifth of the Euro-American components are located in the Pine River drainage. Almost two-thirds of these are architectural and include the typical residential sites along with a commercial building and various types of BIA buildings at the Lost Pinos Agency at Ignacio. The non-architectural sites are all characterized as trash deposits, except for a single cemetery.

Only four Euro-American components are recorded in the west Piedra drainage. They include two architectural sites, labeled as an adobe and a jacal, perhaps a reflection of the intensive Hispanic influence in the occupation of this area. The non-architectural sites include a trash deposit, and the National Register listed Del Rio Bridge discussed above as a special status cultural resource.

The density of recorded Euro-American components decrease from west to east. This probably reflects levels of survey more than actual variation in the density of Euro-American use of the landscape. The majority of the recorded components seem to reflect habitations associated with agricultural. It is impossible to tell how many of these might reflect original homesteading activities, and some of these site may represent occupations on Indian allotments. Many of the non-architectural sites may very well be related to ranching and farming activities as well.

In addition to the recorded historic components, an inventory of historic localities and features was compiled from historic records and maps (see Maps CR-2 and CR-3). This inventory primarily reflects the distribution of homesteads and allotments, developed communities, transportation corridors, and irrigation systems. Historic oil and gas activity, coal mining, and cemeteries also were identified. Although few of these resources have been formally recorded, they do indicate the relative intensity of historic occupation. Physical remnants of at least some of these activities are likely to remain intact.

Summary of Site Component Distribution Patterns

The 1,040 cultural components recognized at the 967 sites present in the project area reflect human occupation spanning all cultural periods back to the Early Archaic period. No components dating to the Paleo-Indian tradition have been identified in the project area nor the remainder of SUIR, but have been documented in adjacent areas of San Juan National Forest. The distribution of site components reflect shifting centers of population through time. The Anasazi Tradition is represented by the number of components (584 cases) and accounts for 56 percent of the inventory in the project area. Smaller numbers of Navajo, Ute, Archaic, and Euro-American components are represented. Almost one-fourth of the components cannot be assigned to any cultural period.

In numbers, the La Plata drainage unit contains the largest concentration of components (495 or 48 percent), and includes ample evidence of all temporal units except the questionable appearance of early Navajo (Dinetah) remains. This is surprising because adjacent areas of the La Plata Valley in New Mexico contain numerous Dinetah phase sites (Winter and Hogan 1992). The number of components progressively decreases to the east. However, this distribution probably reflects the amount of prior survey rather than the actual distribution of archaeological and historical sites. Oil and gas exploration over the last couple of decades has concentrated in the La Plata and Animas drainage units. Subsequently, these areas have been more intensively surveyed than the rest of the project area. Also, site visibility is greater in the western units than the eastern ones where extensive modern agricultural fields have destroyed or masked surface remains. Informal interviews with local residents, ranchers, and collectors indicate that archaeological sites are no less frequent on unsurveyed private lands, than they are on Tribal and Federal lands where surveys have been concentrated.

<u>Prehistoric and Ethnohistoric Era Resource Sensitivity Zones</u>

Sensitivity of archaeological sites reflecting native occupation of the project area is based on estimates of variation in site densities. However, the available survey information has several limitations that preclude development of rigorous quantitative estimates of site density. The archaeological literature documents several instances of reported, but not recorded, site concentrations, such as along the Pine River Valley. Also, many of the surveys on SUIR have been conducted with an avoidance policy that results in avoided sites being left unrecorded. Therefore, site densities are under reported.

Virtually all researchers working in the region note correlations between site locations and river courses. However, Wilshusen's (1995) recent work just south of SUIR has documented some of the highest site densities in the region (about 45 sites per square mile) in intermittent, secondary drainages well away from the primary river courses.

Available information suggests that other factors also influence archaeological site distributions although again rigorous quantitative data are unavailable. For example, aspect seems to be an important variable because sites tend to cluster on southeast-facing slopes and be less common on northwest-facing slopes. Open habitation sites are usually found in gentle terrain with slopes of less than 10 degrees. Conversely, other types of sites, such as rock shelters, cliff dwellings, rock art, and many Navajo sites are more common in areas of considerable topographic relief. Site densities also appear to vary with natural vegetation, which responds to different elevations, soil types, and topography. Pine and oak brush vegetation zones generally have low site densities, with densities of approximately fewer than 10 sites per square mile being commonly reported (Hovarth 1981; Martorano and others 1985). Riparian and piñon-juniper-sage zones have higher than average densities, sometimes exceeding 40 sites per square mile (for example, Wilshusen 1995).

In sum, only limited areas of SUIR appear to have low densities (approximately 0 to 9 sites per square mile) of archaeological sites. These include some badlands and cliffs with extreme topographic relief (usually 50 degrees or more of slope), plus limited areas of pine and oak brush vegetation and pockets of lands altered by historic and recent development (see Figure 3.7-3). Areas projected to moderate site densities (approximately 10 to 19 sites per square mile) are broadly scattered across much of the project area. Usually these areas feature homogeneous terrain or vegetation or both, and include broad open mesas under cultivation in the eastern portion of the project area, and more scattered undulating uplands with piñon-juniper vegetation. Areas projected to have high site densities (approximately 20 or more sites per square mile) are expansive, incorporating the major river valleys as well as many more minor tributary drainages.

Future inventories within the defined sensitivity zones are likely to report varied site densities, and the sensitivity model certainly will warrant refinement as future surveys are completed. Although the sensitivity model is not rigorously quantitative, it is "professionally informed," and provides a basis for comparing the relative levels of impacts of the alternatives considered in this EIS.

Historic Era Resource Sensitivity Zones

The most ubiquitous historic resources within the project area are expected to be homestead and allotment sites. For each of the 24 townships within or partially within the project area, the location of each homesteading effort and Indian allotment was identified (3,517 in all). To characterize the potential for finding sites reflecting homesteading activities in a section, each type of activity was assigned a value:

Indian allotments	5 points
patented homesteads entries	5 points
unpatented homestead entries	1 point
patented desert land entries	5 points
unpatented desert land entries	1 point
patented stock raising homestead entries	2 points
unpatented stock raising homestead entries	1 point
cash entries	2 points

For other historic resources, the following values were assigned:

ditches	2 points
unnamed roads	5 points
named roads	10 points
railroads	20 points
ranches	5 points
cemeteries	5 points
sawmills	5 points
oil and gas locations	2 points
coal locations	2 points
communities	20 points
large settlements (Ignacio and Ignacio Agency)	40 points

The assigned values are based on prior experience with trying to identify similar historic properties on the ground. Each of these values assigned to each section (approximately one square mile) were combined to create an overall historic site sensitivity map. Cumulative values for each section in the study area ranges from 0 to 80, and these index values were used to define four sensitivity zones (see Figure 3.7-4) using the following criteria:

very low sensitivity	0-7 points
low sensitivity	8-20 points
moderate sensitivity	21-38 points
high sensitivity	39-80 points.

In general, homesteading and Indian Allotment sites, as well as water control sites, are ubiquitous along the Piedra, Pine, Florida, Animus and La Plata Rivers. These sites are also common along the smaller tributaries especially on the upper reaches of the La Plata, Florida and Pine Rivers and on Beaver Creek, all in the northern portion of the Reservation. Locations where they are less common include all areas with less surface water and higher elevations. These are the southwest corner of the Reservation; most of the region between Spring Gulch, east of the La Plata, and the Animas River; Mesa Mountain; and the Piedra Peak foothills. Curiously, the centrally-located and well-watered area between the Upper Pine River and Ignacio Creek also appears to have been almost completely ignored by homesteaders.

Oil and gas exploration sites tend to be where homesteading was not pursued, especially in the area between the lower La Plata and Animas rivers. Coal mining was centered around the Cinder Buttes, but small mines might be located in a number of canyons near exposed coal seams in the La Plata drainage. Sawmills are most likely near access roads in large stands of ponderosa pine.

Most other sites such as communities, standing structures, railroad facilities and cemeteries will be located along the narrow north-south transportation corridors of the La Plata, Animas, Pine, and Piedra rivers as well as the northwest to southeast-trending rail corridor between Durango and Arboles. However, the historic town of Arboles and the many historic resources in that area have been inundated by Navajo Reservoir.

IMPACT ASSESSMENT STRATEGY

The main purpose of EISs is to identify and address potential "significant" environmental impacts. This section discusses the criteria used to define what would be considered significant impacts on cultural resources within the context of this project, and describes the impact assessment methods used to evaluate and compare the project alternatives.

Defining Significant Impacts

Regulations implementing NEPA stipulate that defining "significant" impacts requires consideration of "context" (such as national, regional, or local), and "intensity" (40 CFR Part 1508.27). For this project, the issue of context is most easily addressed. Given the programmatic nature of the proposed oil and gas development across much of SUIR, a region encompassing approximately the western two-thirds of SUIR is deemed to be the most appropriate context for evaluation of impacts.

NEPA regulations identify one factor to be considered in evaluating intensity of impacts as "the degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources" (40 CFR Part 1508.27[8]). As indicated at the beginning of this appendix, numerous laws protect cultural resources. The principal laws that provide guidance for identifying significant impacts on National Register eligible properties and other types of cultural resources include the:

- National Historic Preservation Act
- Archaeological Resources Protection Act
- American Indian Religious Freedom Act
- Native American Graves Protection and Repatriation Act

The following sections discuss the intensity of potential impacts with respect to guidance provided by each of these laws.

National Historic Preservation Act

Regulations for *Protection of Historic Properties* (36 CFR Part 800), which primarily implement Section 106 of the National Historic Preservation Act, stipulate that Federal agencies consult with State Historic Preservation Officers, the Federal Advisory Council on Historic Preservation, and other interested parties to make one of four possible determinations of effect:

- no historic properties within the area of potential effect
- no effect
- no adverse effect
- adverse effect

These regulations further indicate that an undertaking will affect a historic property when it "may alter characteristics of the property that may qualify the property for inclusion in the National Register," which could involve "alteration to features of the property's location, setting, or use" (36 CFR Part 800[a]). An effect is defined as adverse when it may "diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects on historic properties include, but are not limited to:

(1) Physical destruction, damage, or alteration of all or part of the property;

(2) Isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register;

(3) Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;

(4) Neglect of a property resulting in its deterioration or destruction; and

(5) Transfer, lease, or sale of the property" (36 CFR Part 800.9[b]).

It is recognized that the proposed oil and gas development potentially could result in the types of adverse impacts identified as 1 and 3.

The available inventory data indicate that no cultural resources within the project area have actually been listed on the National Register, but many are undoubtedly National Register eligible. The vast majority of cultural resources previously recorded within the project area are archaeological sites. Although few of these sites have been formally evaluated, many probably have potential to yield important information and therefore are National Register eligible under criterion D (refer to the discussion of regulatory requirements at the beginning of this appendix). The regulations for *Protection of Historic Properties* specifically state that when such informational values can be substantially preserved through the conduct of appropriate research, and such research is conducted in accordance with applicable professional standards and guidelines, impacts on such sites can be considered to be <u>not</u> adverse (36 CFR Part 800.9[c][1]).

Although the compiled inventory data indicate that potentially National Register eligible properties are relatively dense within the project area, many specific oil and gas development projects would have small impact zones that could be adjusted and modified. Therefore, potential to avoid direct impacts to historic properties is high, and determinations of no properties or no effect are likely to be appropriate for many projects. While it may be impossible to completely avoid all cultural or historic properties regardless of which alternative is selected, per CFR 800.6(b)(iv), the execution of an MOU between the Agency Official and SHPO to implement mitigative data recovery studies could resolve any potential adverse effects.

Archaeological sites also are sometimes valued for characteristics other than their information potential, especially by traditional American Indian groups affiliated with those sites. A few sites in the project area have been identified as related to historic or protohistoric Ute origins, and Navajo, Apache, and Puebloan groups residing in the Four Corners region will consider many other archaeological sites as affiliated with their ancestors. Typically American Indians prefer to have archaeological sites preserved in place, but special concerns often focus on protection of sites that contain human remains. Physical destruction, damage, or excavation of human remains is usually considered to be an adverse effect under 36 CFR Part 800. Treatment of human remains, funerary objects, sacred objects, and objects of cultural patrimony also are specifically addressed by the Native American Graves Protection and Repatriation Act as discussed below.

Human remains are more commonly associated with habitation than non-habitation sites. Approximately 40 percent of the recorded archaeological sites appear to have architectural remnants indicative of habitation activities. Human burials may be present in many of these sites but could be present in other types of sites as well. Although these sites are relatively common, the potential to avoid impacts to such sites is high because of the relative flexibility of oil and gas facilities.

Some cultural resources may be significant for qualities other than their information potential (that is, National Register eligible under criteria A, B or C), and disturbance or destruction of the historic values of such sites would be considered adverse. However, these types of properties are likely to be much less common than those important for their information. Also, prior development is likely to have already altered the setting of many of these resources.

Because detailed inventory data will be compiled only for specific projects pursued after completion of this EIS, the impact assessment conducted at this programmatic phase of analysis is only a projection of the probable outcomes of subsequent formal Section 106 consultations. These consultations can be completed only after inventory and evaluation of cultural resources within the impact zones of specific projects are completed. Previous Section 106 consultations for oil and gas developments on SUIT typically have resulted in determinations of no historic properties or no effect. It is quite likely that consultations for the majority of specific oil and gas projects that may be approved for future development would result in such determinations as well. Determinations of adverse effect are expected to be warranted only rarely, if at all.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act prohibits unauthorized excavation, collection, or damage of archaeological resources on Federal and Tribal lands, as well as trafficking in such resources. Implementing regulations define archaeological resources as “any material remains of human life or activities which are at least 100 years of age, and which are of archaeological interest” [*Protection of Archaeological Resources: Uniform Regulations*, 43CFR Part 7.3(a)]. The law specifically requires notification of affected Indian Tribes if archaeological investigations proposed in a permit application would result in harm to or destruction of any location considered by Tribes to have religious or cultural importance. Resources protected by this act would be routinely considered as part of Section 106 consultations.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act reiterates First Amendment guarantees of religious freedom with specific reference to the inherent right of indigenous peoples to believe, express, and exercise their traditional religions, including but not limited to access to religious sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rites. Federal agencies are directed to evaluate their policies and procedures to determine if changes are needed to ensure that such rights and freedoms are not disrupted by agency practices. Amendments of the National Historic Preservation Act enacted in 1992 specifically stipulate that properties of traditional religious and cultural importance to an Indian Tribe may be determined to be eligible for inclusion on the National Register, so the types of resources protected by the American Indian Religious Freedom Act usually are considered in conjunction with Section 106 consultations.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act gives Native Americas ownership or control of human remains, funerary objects, sacred objects, and objects of cultural patrimony found on Federal and Tribal lands. The law provides for such remains in Federal museum collections to be inventoried and repatriated to related Native Americans or affiliated Native American groups. Implementing regulations stipulate that such remains and objects can be intentionally excavated on Federal and Tribal lands only after consultation and approval of a plan that provides control or right of possession of those remains and objects to related descendants or affiliated groups (*Native American Graves Protection and Repatriation Act Regulations*, 43 CFR Part 10.3). The regulations also define consultation procedures for inadvertent discoveries of such remains and objects on Federal and Tribal lands (Section 10.4).

Human remains and objects protected by this Act are likely to be present at some archaeological sites within the project area. Therefore these remains and objects would be considered under Section 106 consultations, and impacts to such remains and objects would be characterized as adverse effects. Prior development on SUIT has resulted in disturbance of only two or three human burials (personal communication, Bruce Harrell, Archaeologist, Albuquerque Area Office, BIA, 20 November 1996).

Criteria for Significant Impacts

Damaged or destroyed cultural resources sometimes may be partially restorable or reconstructible, but they are essentially non-renewable. Guidance provided by laws and regulations protecting cultural resources indicate that the permanent loss of significant cultural resources is considered "adverse," but this does not necessarily correlate to a "significant" impact within the context of NEPA. The laws protecting cultural resources create opportunities to consult with interested parties and usually ways to avoid or mitigate impacts are identified through these consultations. Therefore a determination of "adverse effect" for impacts to a single cultural resource, in most cases, would not warrant preparation of an EIS for a specific project if it has no potential for significant impacts on other types of resources. But how many significant cultural resources would have to be adversely effected to be considered "significant" within the context of NEPA? To address this issue the NEPA mandated analysis of the "intensity" of impacts to cultural resources considered the (1) susceptibility of resources to impacts, (2) quality of the affected resources, (3) numbers of resources affected, and (4) duration of the impacts.

In response to project scoping and compilation of an inventory of previously recorded cultural resources, the specific types of resources considered include (1) archaeological and historical sites, (2) and traditionally used cultural plants. The intensity of potential direct and indirect impacts to each type of resource are summarized on Table 6, and discussed in the following sections.

TABLE 6
SUMMARY EVALUATION OF THE INTENSITY OF POTENTIAL DIRECT AND INDIRECT IMPACTS

Type of Impact	Susceptibility to Impacts	Resource Quality	Resource Quantity	Impact Duration
Direct Impacts to Archaeological and Historical Sites				
ground disturbing construction activities	very	moderate to high	limited	permanent
Indirect Impacts to Archaeological and Historical Sites				
increased erosion	very	moderate to high	limited	permanent
land subsidence	very	moderate to high	limited	permanent
increased human presence	moderate	moderate to high	limited	permanent
degradation of air quality	moderate	moderate to high	very limited	long term
Direct Impacts to Traditionally Used Plants				
ground disturbing construction activities	moderate	unknown	limited	short to long term
Indirect Impacts to Traditionally Used Plants				
increased erosion	low	unknown	limited	short to long term
loss of native species	moderate	unknown	limited	short to long term

Archaeological and Historical Sites

The most severe potential direct impacts to archaeological and historical sites stem from ground disturbance associated with construction of new drill pads, flow lines, produced water lines, gas injection lines, central delivery point facilities, and access roads. Potential indirect impacts include (1) increases in erosion or ground subsidence that could disturb archaeological deposits; (2) increases in human presence that could result in inadvertent damage by activities such as off-road vehicular traffic, or vandalism by work crews; (3) and changes in air quality that could decrease visibility or increase the acidity of precipitation, which could degrade public interpretation potential and perhaps increase the rate of disintegration of some types of archaeological and historical properties.

Archaeological and historical sites, by their nature, tend to be very susceptible to ground disturbing activities, whether due to direct construction or indirect increases in erosion or vandalism. These sites are somewhat less susceptible to increased human presence simply because many are buried and often difficult to recognize. Susceptibility to degraded air quality is rated no more than moderate.

As discussed above, the quality of the archaeological and historical sites is gauged within the regulatory framework by determining whether or not they are eligible for listing on the National Register of Historic Places. The quality of these resources certainly can be considered on an expanded, graded scale as well. Some resources such as those developed for public interpretation in Mesa Verde National Park or at the Chimney Rock Archaeological Area managed by the San Juan National Forest would be perceived by most as of significantly higher quality than a scatter of lithic debitage. Similarly, the informational value of sites could be graded by archaeologists, and Native Americans may very well perceive the values of various types of sites differently. In general, the quality of the archaeological and historical resources of the project area can be rated as moderate to high.

Some parts of the study area are documented to have densities in excess of 40 archaeological and historical sites per square mile, which is characterized as relatively high. However, the impact models indicate that the areas of potential direct effect are relatively small, and therefore the quantity of archaeological and historical resources subject to direct impact are rated as limited.

Potential impacts of indirect impacts, related to erosion, increased human presence, and activities beyond the right-of-way could add a substantial increment to the level of direct impacts for all alternatives. However, Tribal procedures would address these issues during review of all proposed specific projects and therefore the quantity of resources that could be indirectly affected also is characterized as limited.

In addition, Alternative 3 has potential to alter air emissions because of gases vented by the compressors needed to develop injection pressures. The resources susceptible to indirect impacts of degraded air quality are much more limited than other types of archaeological and historical sites, and concerns are likely to focus primarily on the Mesa Verde National Park and Chimney Rock Archaeological Area. These impacts are addressed in the consideration of air quality issues.

The duration of impacts on archaeological and historical sites is expected to be permanent in most cases, because once destroyed, the values of those sites are lost forever. The one exception would be indirect impacts due to any degradation of air quality, which are expected to be long term. However, any impacts due to degraded visibility should end if air quality were to be restored after the life of the project.

In sum, archaeological and historical sites within the project area are very susceptible to most direct and indirect types of impacts, the resources are of relatively moderate to high quality, and most impacts would be of permanent duration. Archaeological and historical sites are relatively abundant within the project area, but because the areas of potential effects are relatively small the number of resources that could be disturbed or destroyed by oil and gas developments are expected to be a small percentage of the extant resources in the study area. Given the potential for avoiding or satisfactorily mitigating adverse impacts that might be identified during review of subsequent specific projects, the intensity of impacts on archaeological and historical sites, considered within the regional context of the project area, is not expected to be significant.

Traditionally Used Plants

Ground disturbing construction activities were identified as a source of potential direct impacts to traditionally used plants. Vegetation within construction zones is likely to be temporally eradicated, but is expected to regenerate within temporary construction zones not occupied by project facilities. Traditionally used plants would constitute only a portion of the natural vegetation disturbed by direct impacts. More indirect impacts could result from increased erosion that could alter natural vegetation, introduce non-native species, and lead to loss of native species. Again, traditionally used plant would be only a subset of this disturbed vegetation, and these impacts are expected to be relatively low to moderate.

Characterization of the current distribution and condition of traditionally used plants is hampered by lack of documentation about the extent of continuing traditional uses of plants and the species of plants exploited. However, the susceptibility of traditionally used plants to direct and indirect impacts is rated as limited, because the extent of disturbance is expected to be relatively minor.

The loss of plants within project facilities would be long term, but potentially could be recovered after the life of the project. Loss of plants in temporary construction areas would be short term. There is substantial potential to mitigate impacts that might be identified during evaluation of subsequent specific projects by modifying projects to avoid any particular sensitive species or propagating those species in other settings, although such artificial manipulation may be deemed culturally unacceptable (Northern Arizona University and SWCA 1996:182). In sum, the intensity of impacts on traditionally used plants is not expected to be significant.

Less than Significant Levels of Impact

Although the impacts to cultural resources from the proposed oil and gas development are not characterized as significant within the context of the NEPA analysis, the impacts characterized by the assessment methodology as low to moderate will need to be addressed in compliance with other cultural resource regulations. A cultural resource sensitivity model, based on results of prior inventory surveys and review of historic land use maps, defines low, moderate, and high sensitivity zones based on projections of the density and complexity of cultural resources, especially archaeological sites. Different levels of projected impacts within these sensitivity zones are indicative of the relative efforts that could be required to develop and implement impact avoidance or mitigation measures, and provide a basis for comparing the project alternatives.

Estimating Potential Impacts

The projection of the potential extent of direct impacts on prehistoric and ethnohistoric archaeological sites and historic resources is based on estimates of the number of acres to be disturbed in modeled zones of low, moderate, and high sensitivity. The geographical information system database developed for the project was used to make these calculations. The number of acres was then multiplied by estimates of site density within each zone to derive an approximation of the number of resources that might be present within those zones. Similarly, acres of disturbance were estimated for very low, low, moderate, and high historic resource sensitivity zones. The results provide another parameter for comparing the alternatives.

Analyses of erosion potential, subsidence potential, and air quality degradation undertaken by other project team specialists provide the basis for a more qualitative consideration of identified potential indirect impacts on archaeological and historical sites.

Because the extent of traditional use of plants and the exploited species have not been identified, no quantitative impact analysis was possible. However, the analysis of "context" and "intensity" as discussed above concluded that none of the project alternatives are expected to have significant impacts to these resources.

The impact models in combination with the sensitivity models indicate that the numbers of sites that could be affected is relatively limited compared to the regional resource base.

Alternative 1 is the status quo option that involves continuing conventional oil and gas development under current authorizations. If the maximum level of development is pursued under existing approvals, approximately 691 acres of additional ground disturbance is projected. If the Southern Ute Tribe's claim to methane in disputed coal lands is upheld, the impact model projects that an additional 101 acres might be disturbed by the currently authorized conventional development.

The impact model suggests that as much as about 60 percent of the ground disturbance could occur in high sensitivity zones for prehistoric and ethnohistoric sites, with the remainder in moderate and low sensitivity zones. If an average of 40 sites per square mile in high sensitivity zones is assumed, with an average of 20 sites per square mile in moderate and low sensitivity zones, it can be estimated that approximately 40 sites might be present within the impact zones of Alternative 1, which aggregate to approximately 1.2 square miles. The assumed site densities are at the upper end of the documented range of densities, and should compensate for the "edge effect" that increases the numbers of sites encountered by linear projects in contrast to block areas. The impact model indicates that only about 8 percent of ground disturbance would occur in areas rated as having high sensitivity for historical resources. There is a considerable margin of potential error for these estimates, but even if doubled or tripled, only a fraction of a percent of the high sensitivity areas and baseline cultural resources within the study region are likely to be affected. Also, because specific projects would be relatively flexible, modifications can probably be made to avoid direct impacts to most archaeological and historical sites that might be identified by pre-construction surveys.

Alternative 2, the decreased well spacing option, is projected to result in a maximum of approximately 1,300 acres of new ground disturbance on Tribal lands, plus up to an additional 726 acres if development were to proceed in the disputed coal lands. That is about two and one-half times more disturbed acreage than projected for Alternative 1. The impact model indicates that a maximum of about 80 percent of this disturbance could occur in zones rated as having high sensitivity for prehistoric and ethnohistoric sites. In contrast, a maximum of about 20 percent of the disturbance is likely within zones rated as having high sensitivity for historic resources.

If an average of 40 sites per square mile in high sensitivity zones is assumed, with an average of 20 sites per square mile in moderate and low sensitivity zones, it can be estimated that approximately 113 sites might be present within the impact zones of Alternative 2, which aggregate to approximately 3.2 square miles. Again this estimate could be subject to considerable error, but even if doubled or tripled, less than one-half percent or less of the high sensitivity zones for archaeological and historical sites within the study area would be affected. This level of development could affect two to three percent of the high sensitivity zones on the more limited Tribal lands. As with Alternative 1, there is good potential for modifying specific projects to avoid direct impacts to any archaeological and historical sites that may be identified by pre-construction surveys.

Alternative 3 combines the option of decreased spacing plus pressurization to enhance oil and gas recovery. Pressurization is projected to require 90 injections wells, half on Tribal lands and half on the disputed coal lands. These are expected to result in disturbance of approximately 3 to 4 percent more acreage than Alternative 2 (about 73 acres), or an aggregate of about 3.3 square miles. Therefore the impact model projects that Alternative 3 is likely to affect only about four more archaeological and historical sites than Alternative 2.

Although the level of potential impacts on cultural resources for all alternatives is not characterized as significant, one hundred or more archaeological and historical resources could be present within specific development project areas. Substantial efforts will be required to inventory, evaluate, and develop measures to avoid or mitigate impacts to these sites. In addition, efforts will be required to consider and address sometimes overlooked potential indirect impacts from erosion, increased human presence, and potential activities beyond project rights-of-way.

If additional oil and gas development is approved, the level of required cultural resource investigations could increase substantially, and a program to plan and coordinate these efforts may be warranted. Current inventory procedures, which result in no information being collected about narrowly avoided archaeological and historical sites, should be rethought because it creates gaps in the database of cultural resources on Tribal lands. More complete information, centralized at the Tribal headquarters, may very well enhance the effectiveness of cultural resource considerations as future oil and gas developments, and other Tribal initiatives, are planned.

Cumulative Impacts

Oil and gas developments have been pursued on SUIR for some 60 to 70 years, but other types of development have been pursued for more than a century within the project area. These developments have affected many cultural resources but the extent of loss has not been documented. Prior oil and gas development affected some archaeological and historical sites prior to the advent of current regulatory protection in the 1970s. Since the adoption of cultural resource review procedures, subsequent oil and gas developments have been routinely modified to avoid significant archaeological and historical sites, and therefore have not contributed to cumulative impacts.

To gauge how the alternatives for future oil and gas development could contribute to cumulative impacts of recent and future projects, three projects were reviewed: (1) Tiffany Enhanced Coalbed Methane Recovery Project, (2) Transcolorado Gas Pipeline Project, and (3) Animas-La Plata Project.

Survey for the Tiffany Project identified 25 archaeological and historical sites; 19 of these were considered to be significant or potentially significant (BLM 1996). The project was modified to avoid four of these sites, and to confine construction activities to previously disturbed corridors through the other 15 sites. Therefore, the project did not result in any impacts to significant archaeological and historical sites.

Survey for the Transcolorado Pipeline identified 23 archaeological and historical sites within the project corridor through SUIR; 16 were determined to be significant (Reed and others 1992). Given the difficulty of modifying the route of this large pipeline, site avoidance is not a practical option. Five sites are slated for extensive mitigative data recovery studies, and more limited investigations would be conducted at the other 11 sites, if the project were to be developed.

The Animas-La Plata Project is a water resource development proposed by the Bureau of Reclamation. The extent of impacts of the Animas-La Plata Project on cultural resources within SUIR cannot be projected with any confidence at this time, because the Southern Ute Tribe has not developed plans for use of the water that would be delivered to the Reservation. However, the potential extent of impacts is substantially greater than for the Tiffany or Transcolorado projects.

The Cultural Resources Affected Environment Section of the July, 2000, Final Supplemental EIS for the Animas-La Plata Project (A-LP FSEIS) states: "In his 1996 report on what is now referred to as Alternative 7, Chenault (1996) estimated that development activities (not including those at

Ridges Basin reservoir) would result in a 43.5 percent impact rate to cultural resources. While that study was oriented towards irrigation development, which is not an element of either Refined Alternative 4 or 6, the types of activities are similar enough that the 43.5 percent figure is still considered valid. Therefore it is estimated that Refined Alternative 4 will impact up to a total of 639 sites; Refined Alternative 6 will impact up to 864 cultural resource sites. Either Alternative will result in impacts significantly less than those estimated for Alternative 7, which was estimated to impact up to 1,600 cultural resource sites. Since many of the prehistoric sites for either Refined Alternative are habitation sites which date between the Basketmaker II to Pueblo III time periods, and others represent protohistoric Navajo and Ute sites,theyalso may be considered TCPs (and likely to contain burials); their identification and treatment are of considerable concern to many of the consulting Tribes."

The Cultural Resources Environmental Consequences Section of the A-LP FSEIS states that for Refined Alternative 4: "Ground disturbance and other activities associated with construction of structural components would disturb and/or destroy cultural resources. Due to the known significance of the area (Ridges Basin is a National Register-eligible District), the impacts to an estimated 80-90 sites is considered significant. Sites would be directly affected by construction of Ridges Basin Reservoir and its associated features. The potentially affected sites include Archaic period sites, Anasazi (Ancestral Pueblo) habitation and limited-use sites, historic Native American sites, a portion of the Old Ute Trail (also the route of the Dominguez-Escalante Expedition), and historic Euroamerican sites."

The September 25, 2000, Record of Decision for the A-LP FSEIS selected Refined Alternative 4 to implement the Colorado Ute Indian Water Rights Settlement Act of 1988.

Other developments in the region, including oil and gas development on adjacent fee lands, oil and gas development within the San Juan Basin in general, and other contemplated projects such as upgrading State Road 550, also have or will lead to the loss of archaeological and historical sites in the region. Although quantitative data to gauge the impacts of these activities have never been compiled, the BLM has organized large survey and data recovery efforts within the New Mexico portion of the San Juan Basin.

Alternative 1, which represents continued oil and gas development under currently approved leases, is likely to contribute to cumulative impacts equivalent to at least two or three Tiffany Projects. Alternatives 2 and 3 are likely to represent at least a tripling of the Alternative 1 increment. This level of impact will certainly add to cumulative impacts within the region. However, because of the potential to modify oil and gas development projects to avoid adverse impacts to archaeological and historical sites, the increment to cumulative impacts are likely to relatively moderate, especially compared to less flexible projects such as the Transcolorado Pipeline and the Animas-La Plata Water Project.

Mitigation

The standard Tribal procedures for oil and gas development includes compliance with Section 106 of the National Historic Preservation Act. This includes arranging for cultural resource surveys, evaluating discovered sites, and assessing the effects in consultation with the BIA, SHPO, and other interested parties. Most individual projects are likely to require development and implementation of measures to avoid or mitigate impacts identified along an approved route. These measures could entail archaeological monitoring of construction activities to prevent inadvertent damage to nearby archaeological and historical sites, and preconstruction archaeological data recovery studies are likely to become more necessary as the density of developments increases.

If the Southern Ute Tribal government should decide that traditional cultural concerns warrant further attention during subsequent development of specific oil and gas projects, they have the opportunity to do so because the Tribe has key rights and responsibilities in the environmental review process. The Tribe also could initiate broader studies in conjunction with the Tribal planning program, such as inventorying and mapping the distribution of traditionally used plant species.

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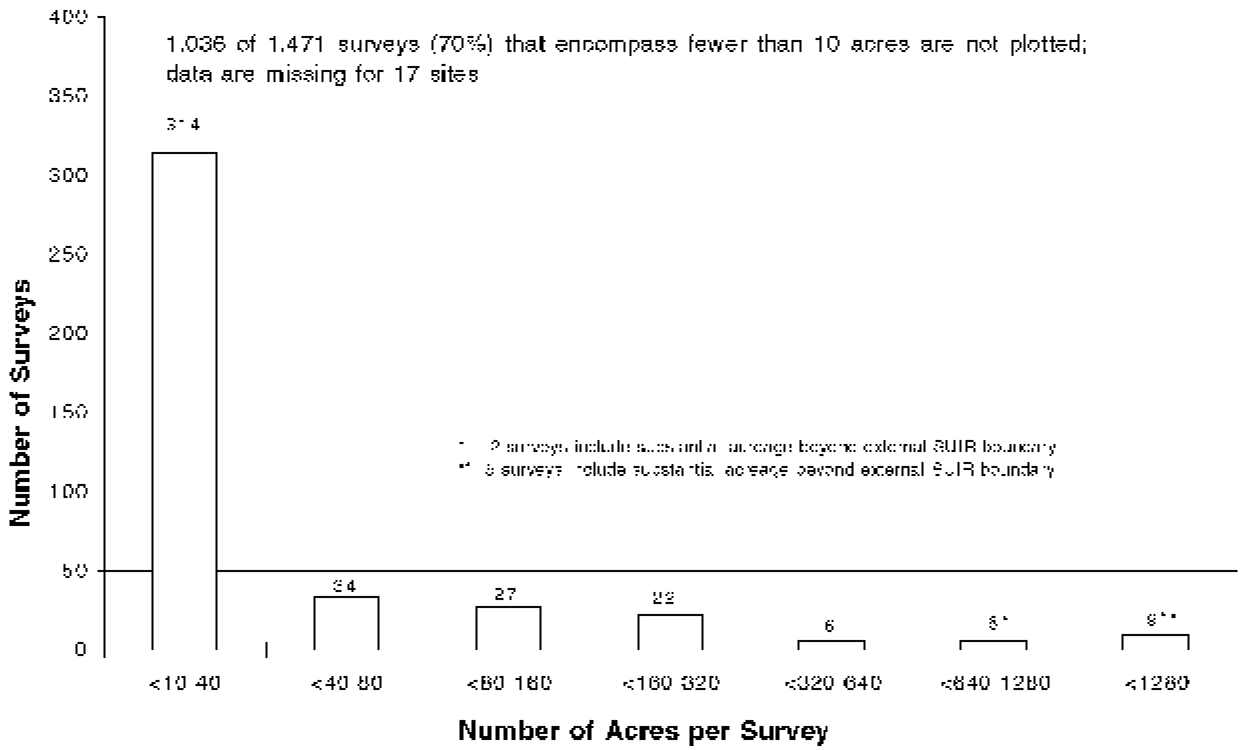
Figure 1
Number of Acres per Survey



Source: Colorado Historical Society survey database

Figure 2
Number of Surveys per Agency

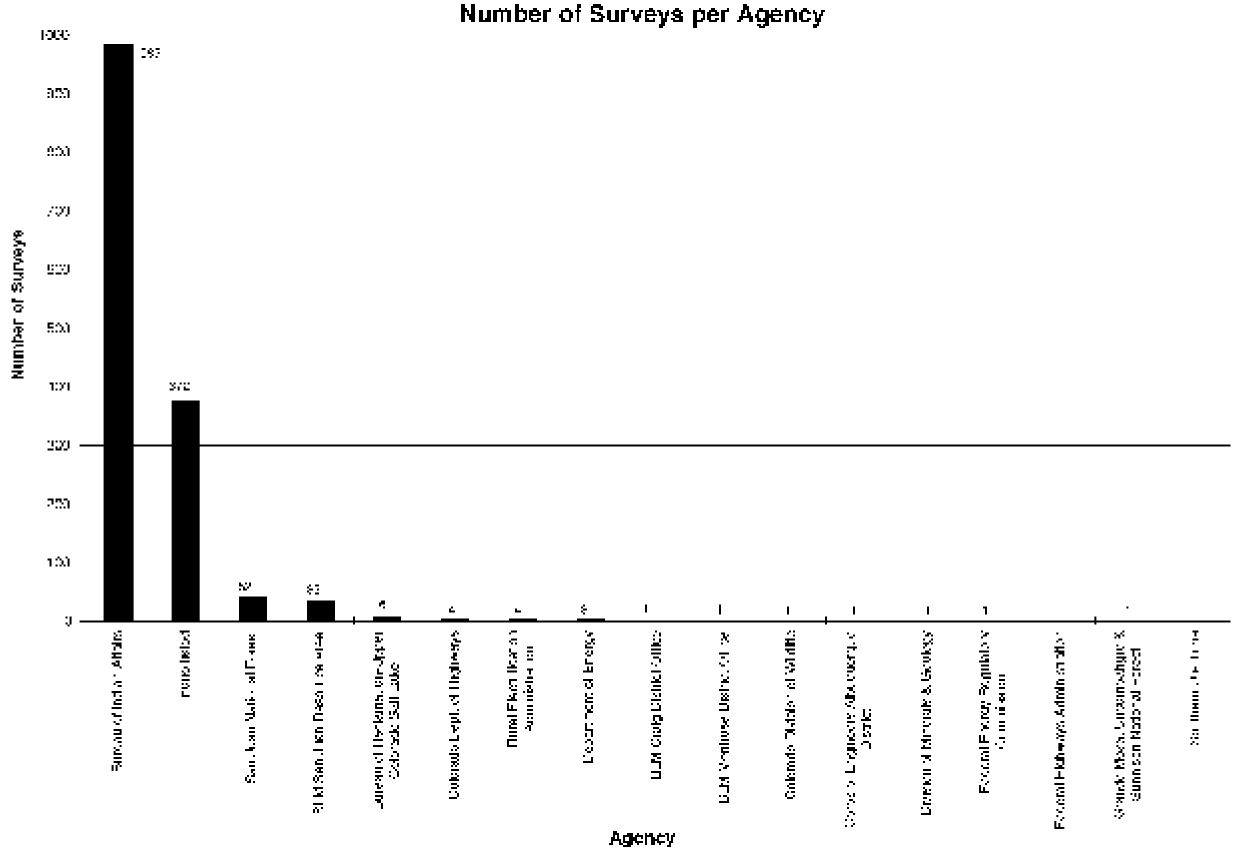


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Figure 3
Acreage Surveyed per Agency

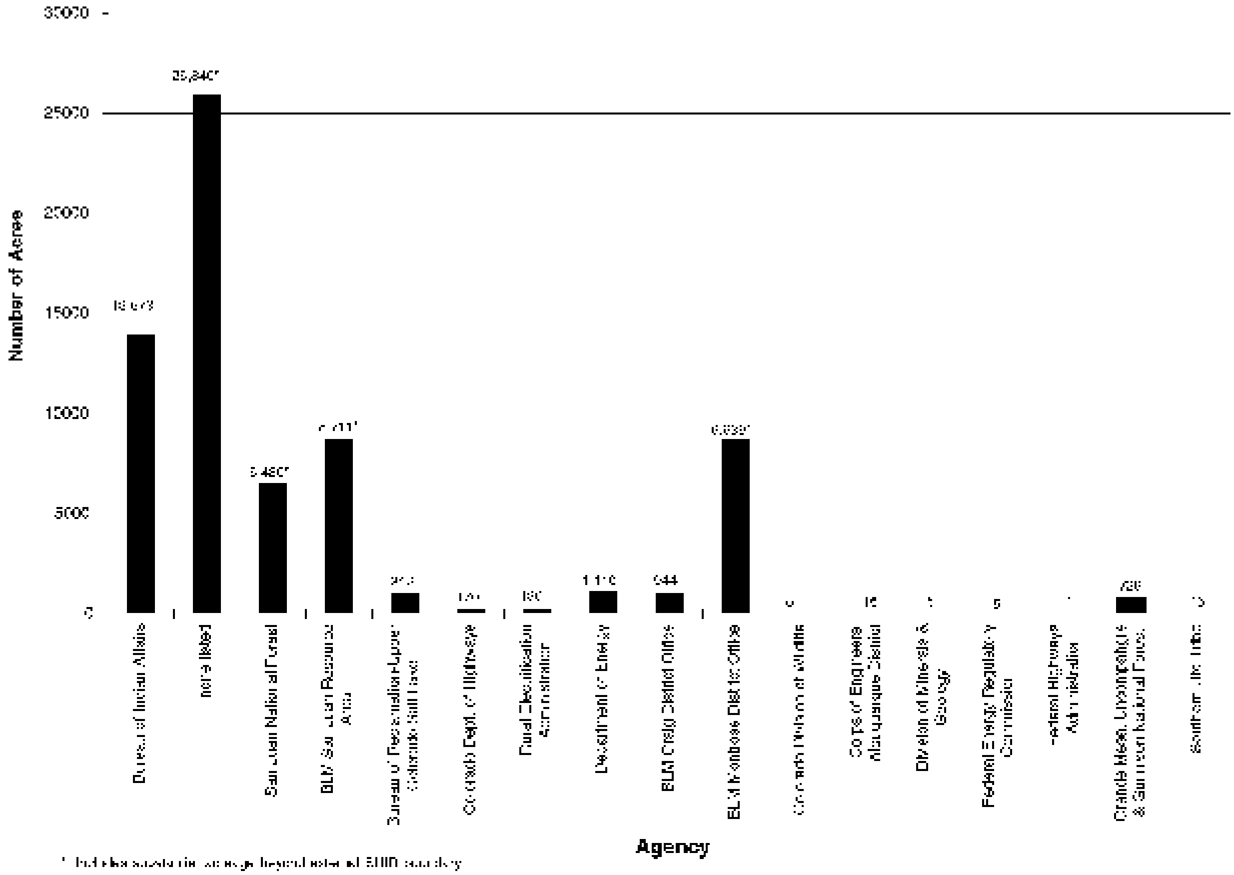

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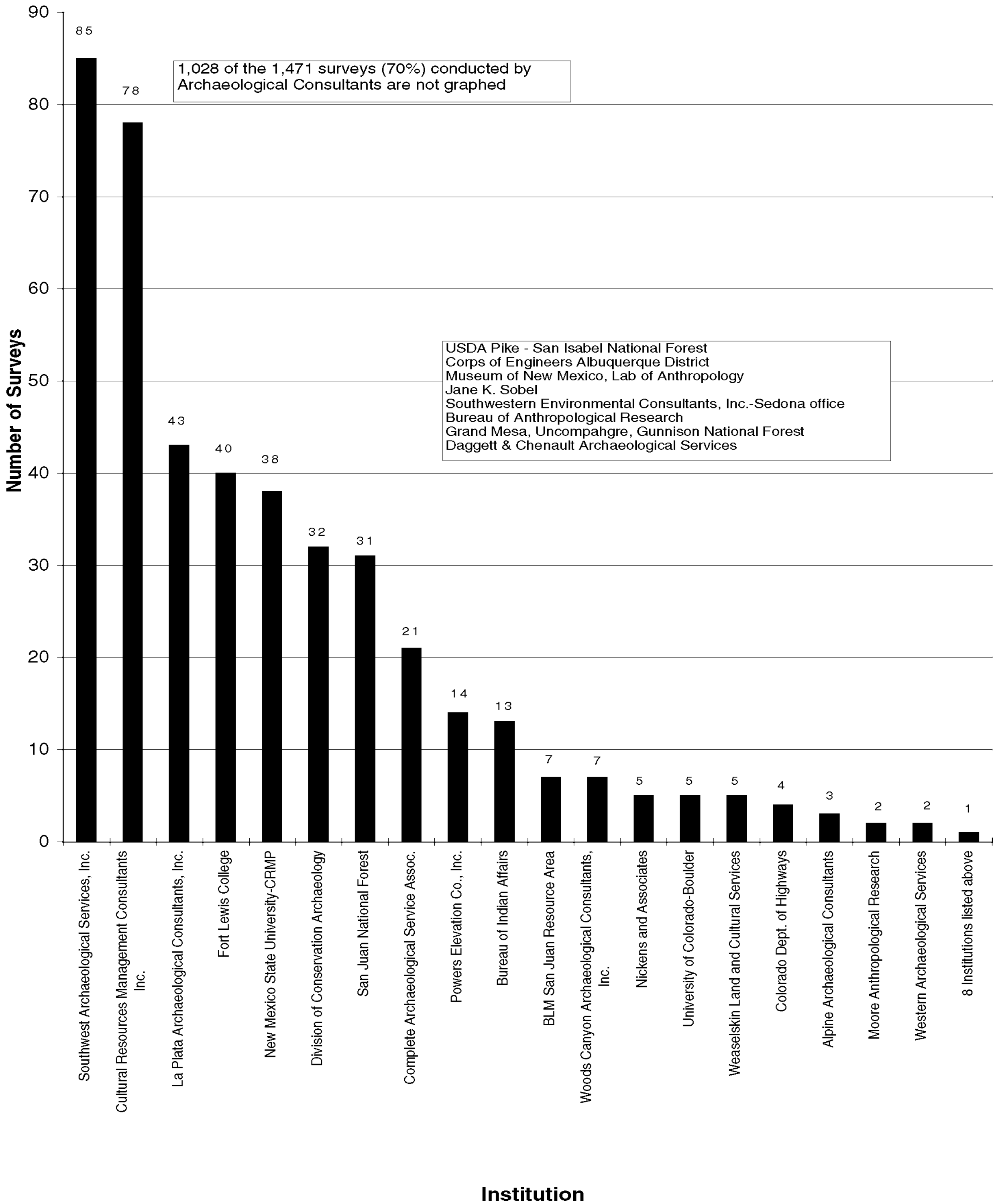
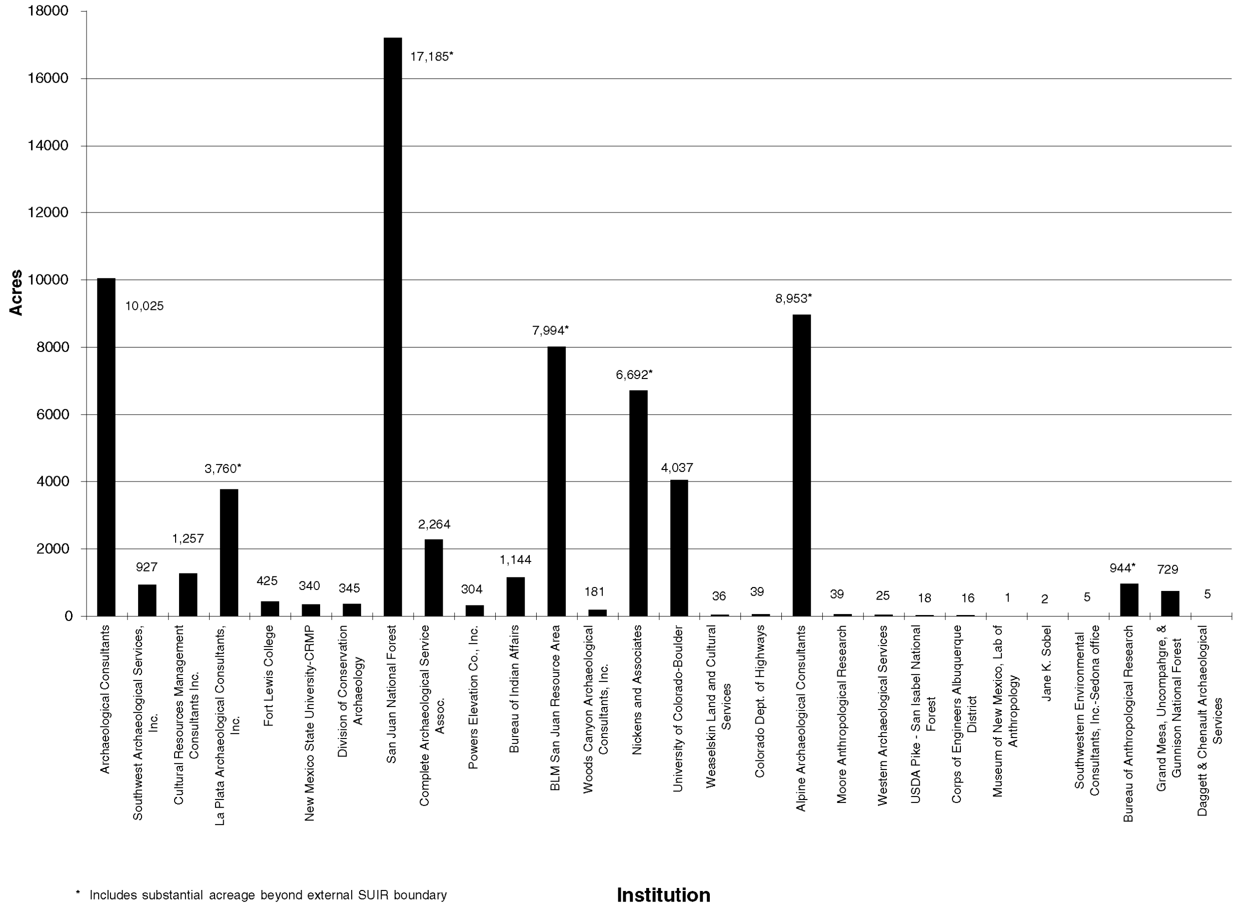
Figure 4
Number of Surveys per Institution



Source: Colorado Historical Society survey database

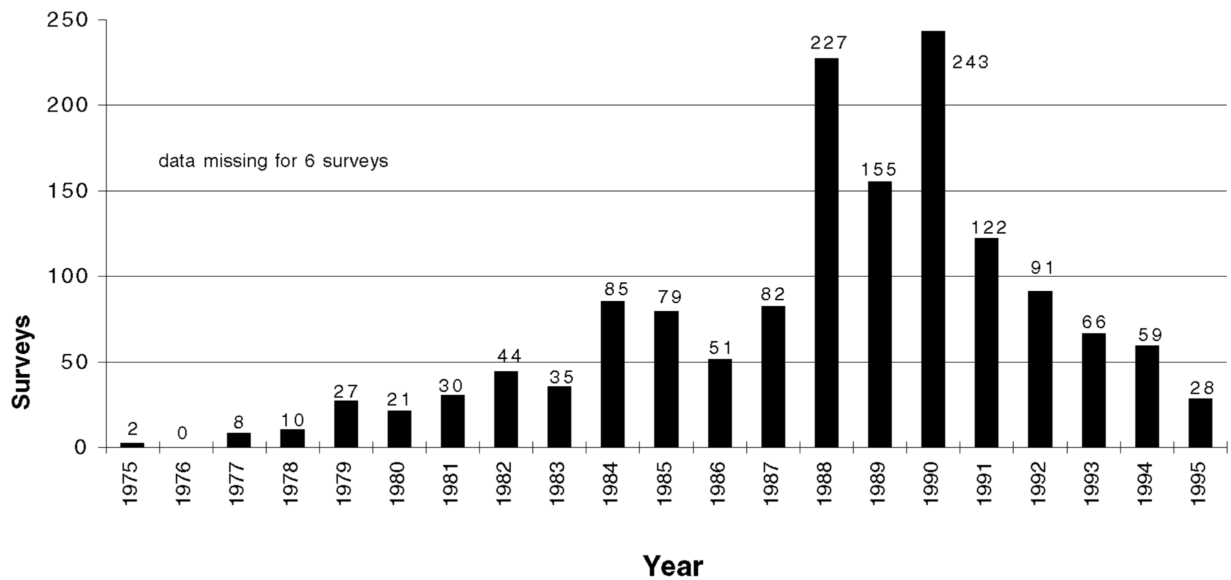
Figure 5
Acres Surveyed per Institution



* Includes substantial acreage beyond external SUIR boundary

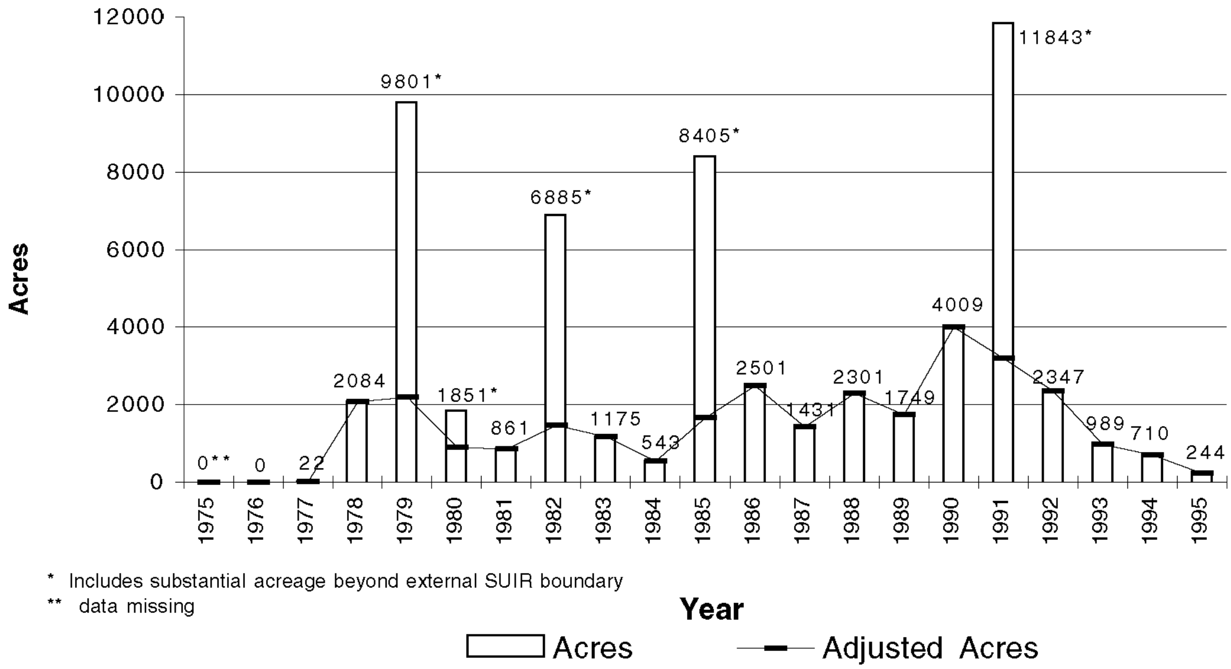
Source: Colorado Historical Society survey database

Figure 6
Number of Surveys per Year



Source: Colorado Historical Society survey database

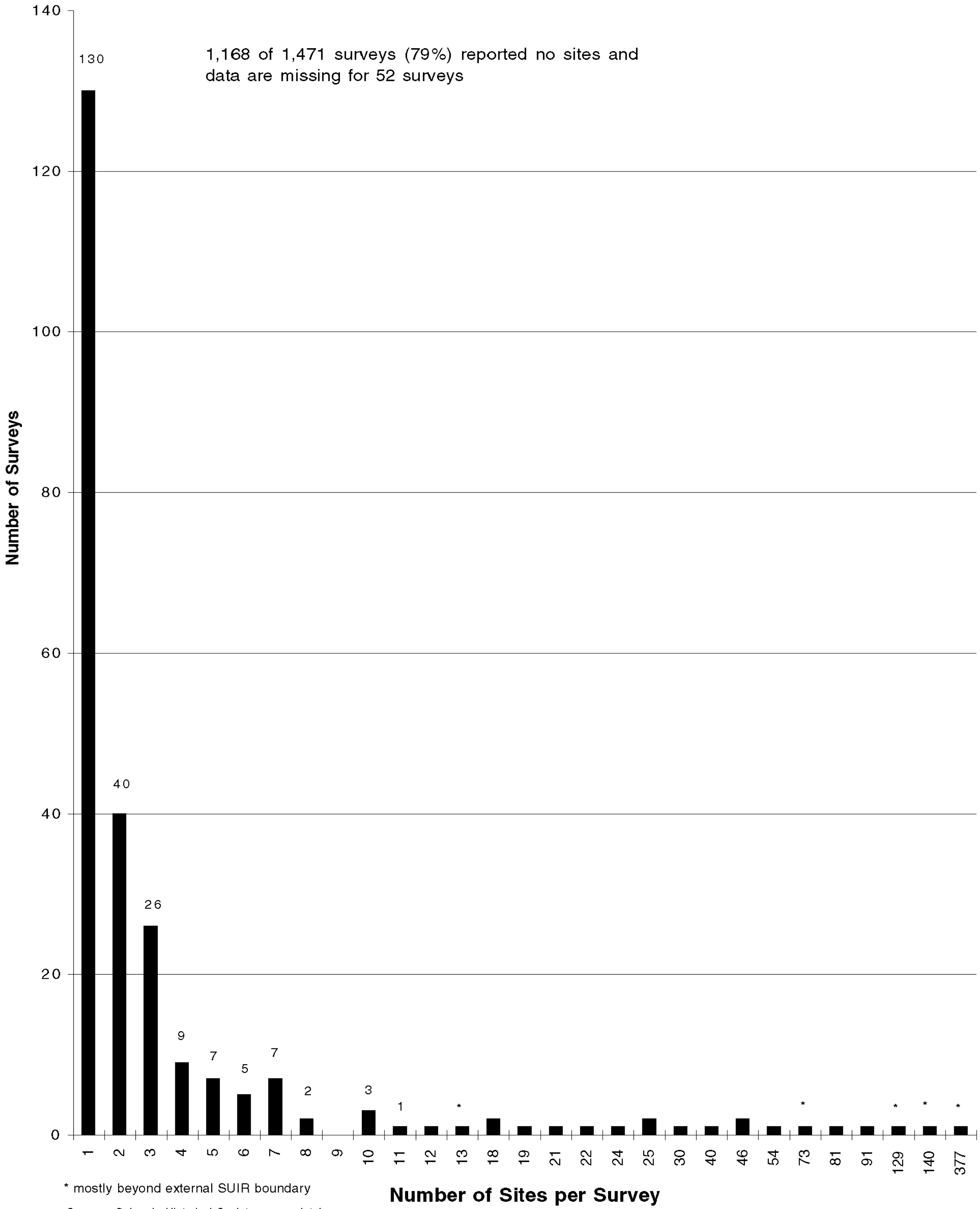
Figure 7
Number of Acres Surveyed per Year



* Includes substantial acreage beyond external SUIR boundary
** data missing

Source: Colorado Historical Society survey database

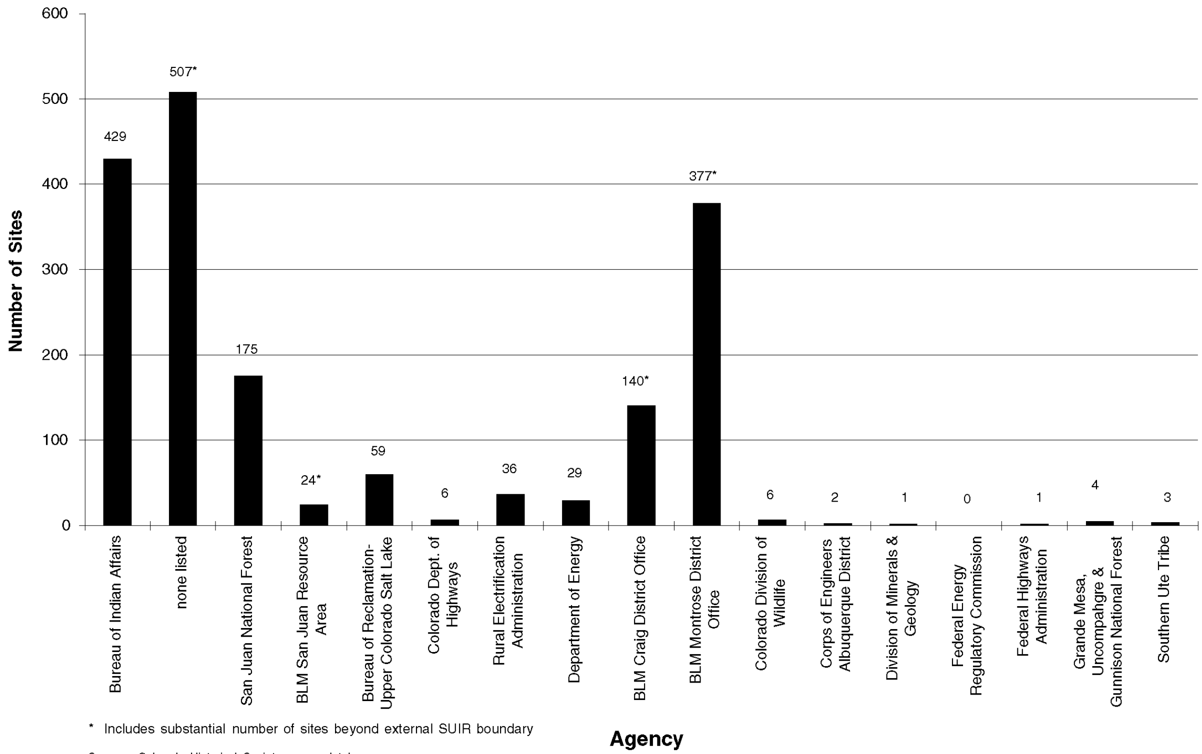
Figure 8
Number of Sites per Survey



* mostly beyond external SUIR boundary

Source: Colorado Historical Society survey database

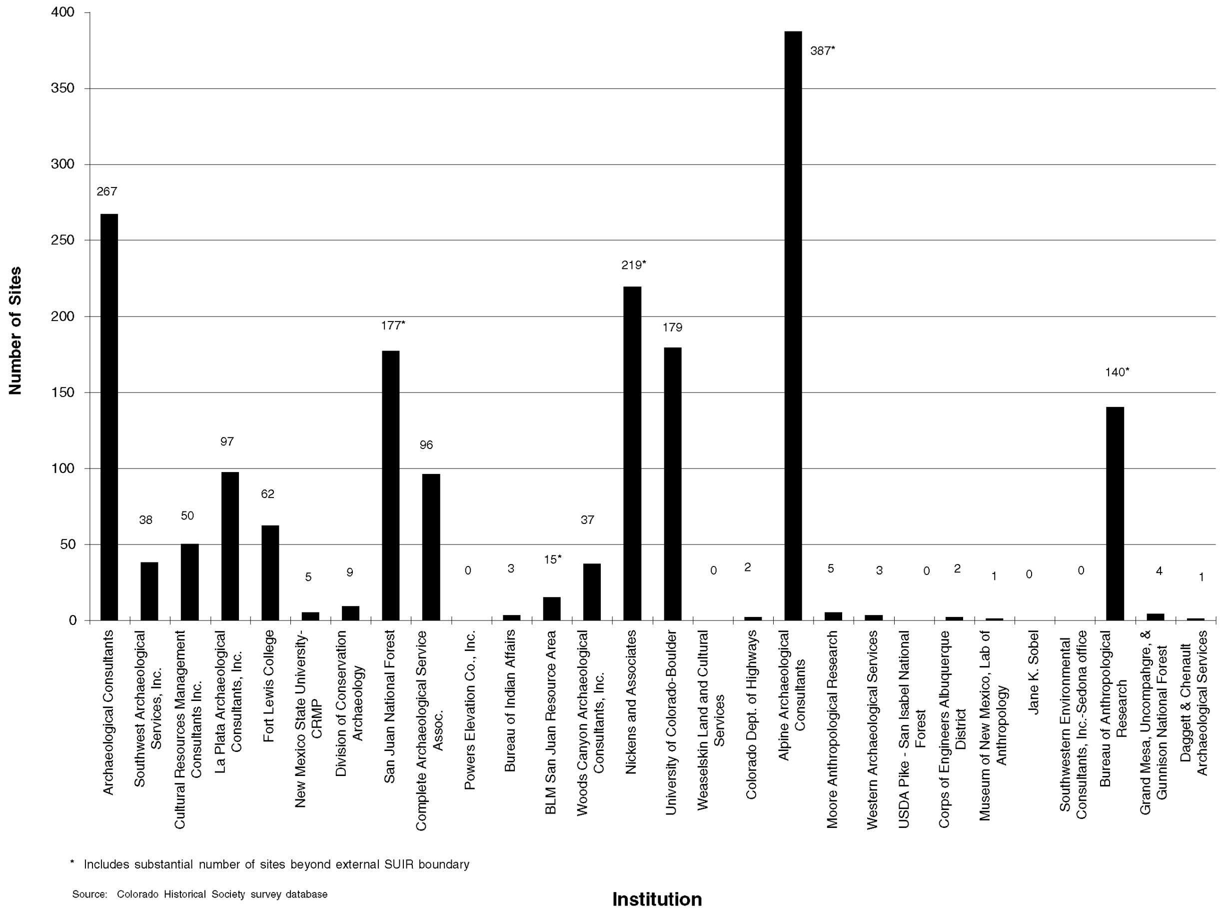
Figure 9
Number of Sites per Agency



* Includes substantial number of sites beyond external SUIR boundary

Source: Colorado Historical Society survey database

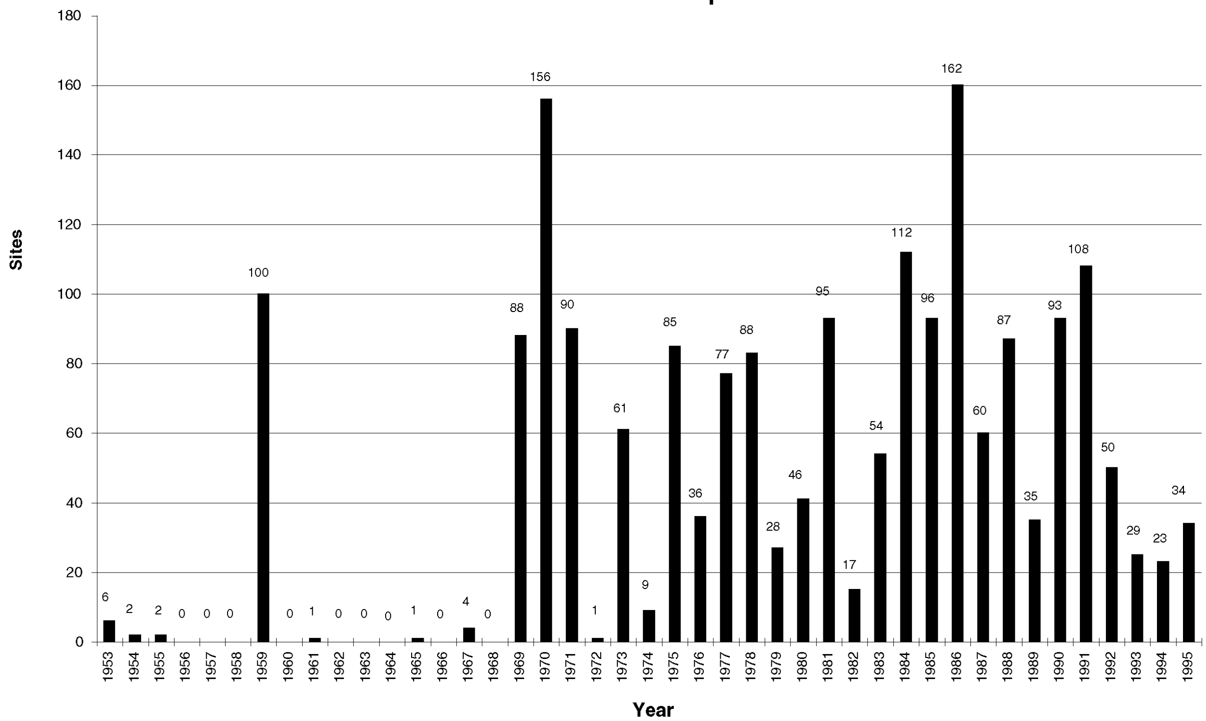
Figure 10
Number of Sites per Institution



* Includes substantial number of sites beyond external SUIR boundary

Source: Colorado Historical Society survey database

Figure 11
Number of Sites per Year



Source: Colorado Historical Society sites database

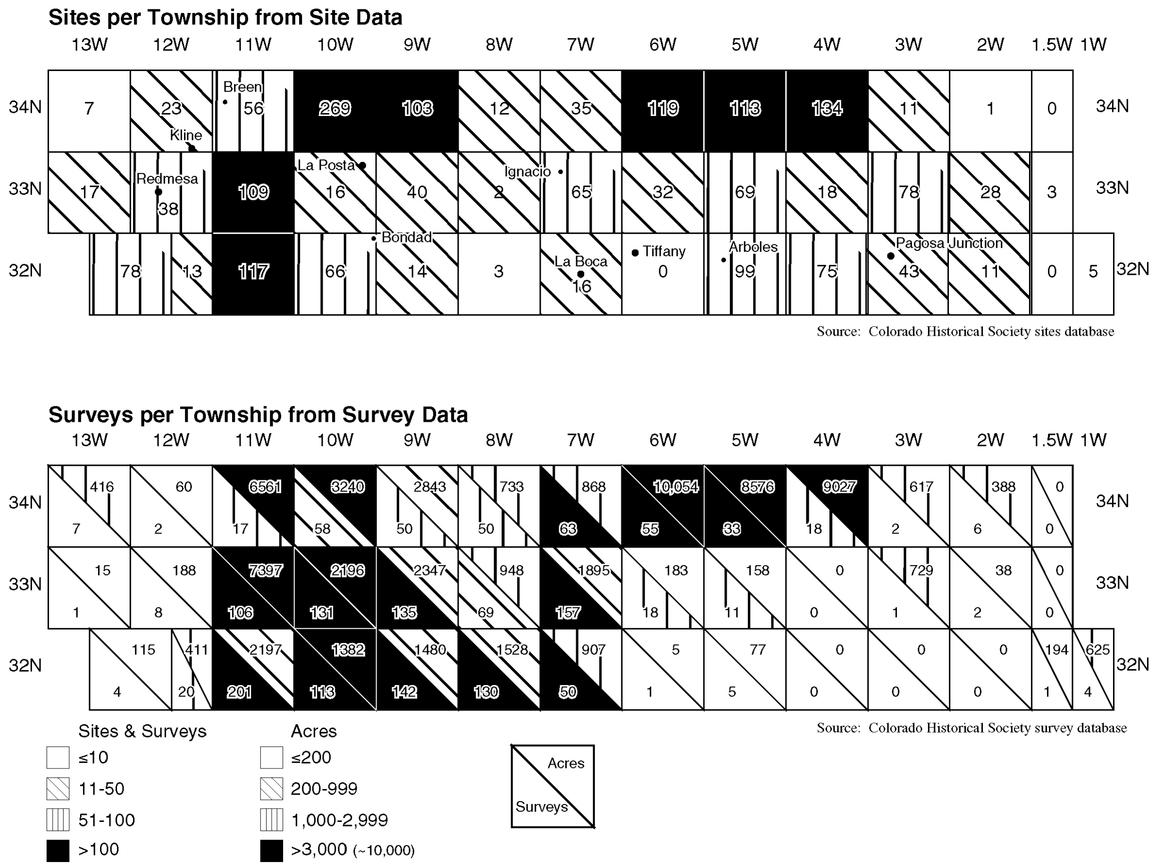


Figure 12 Distribution of Surveys and Sites

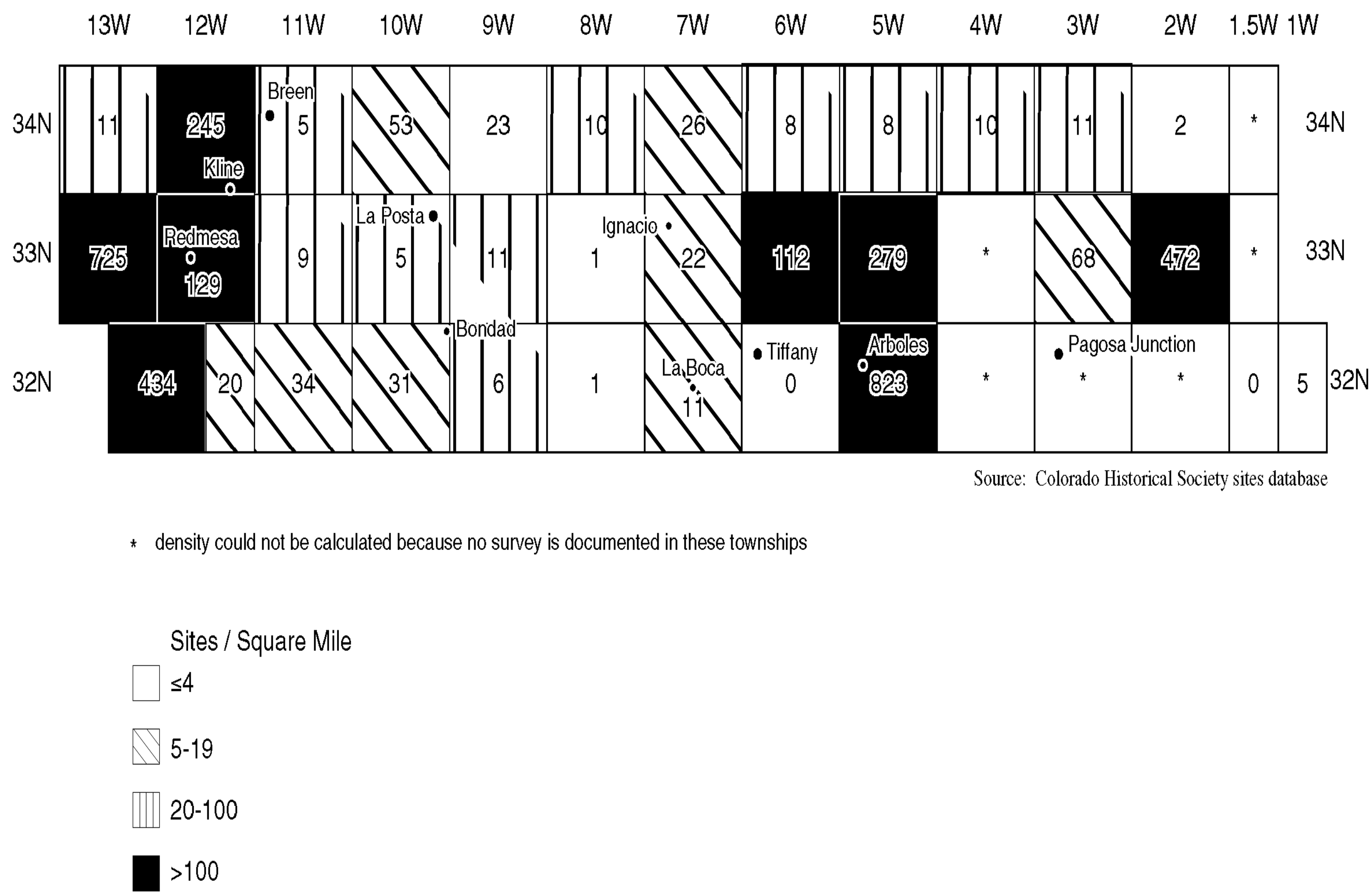
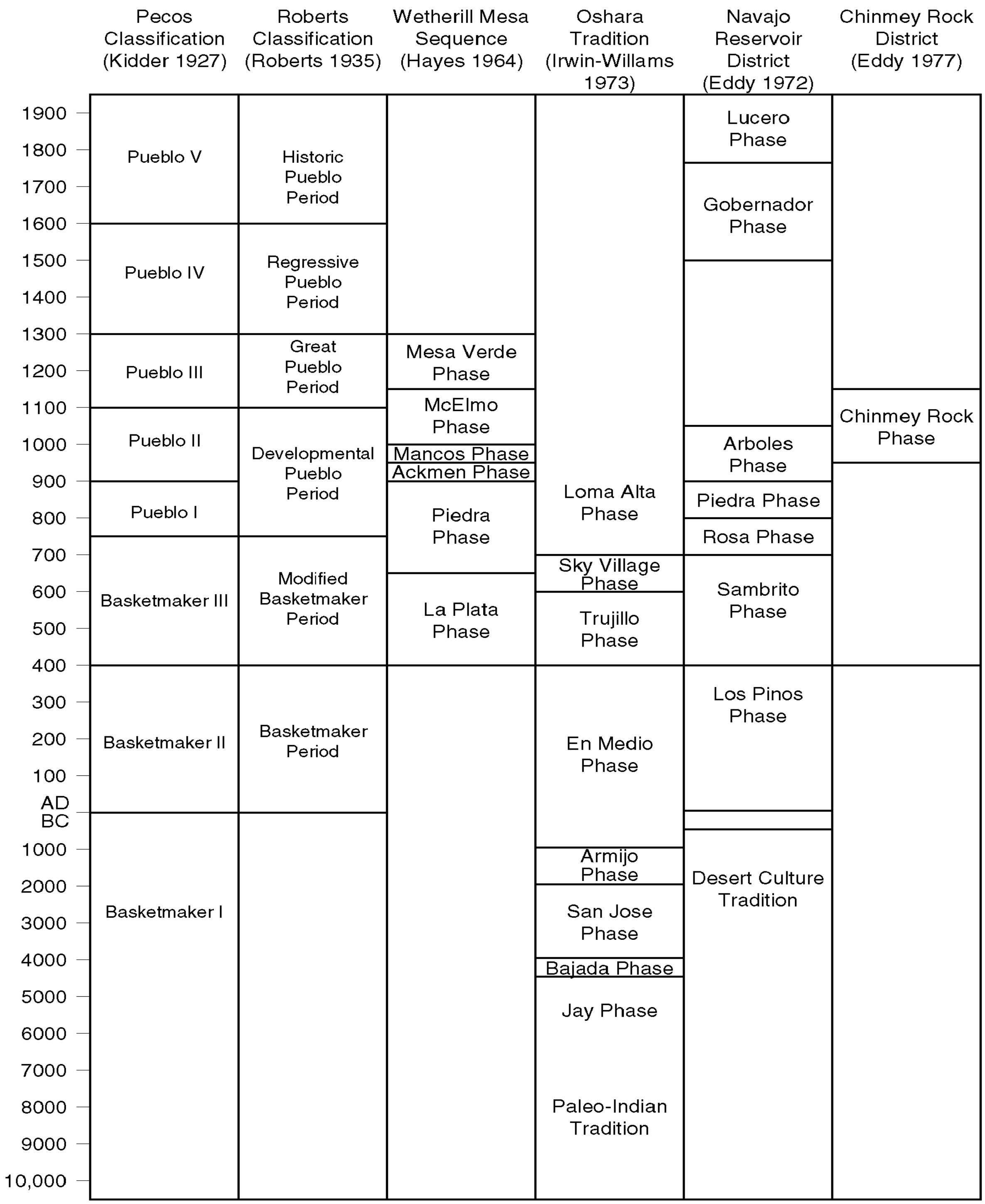
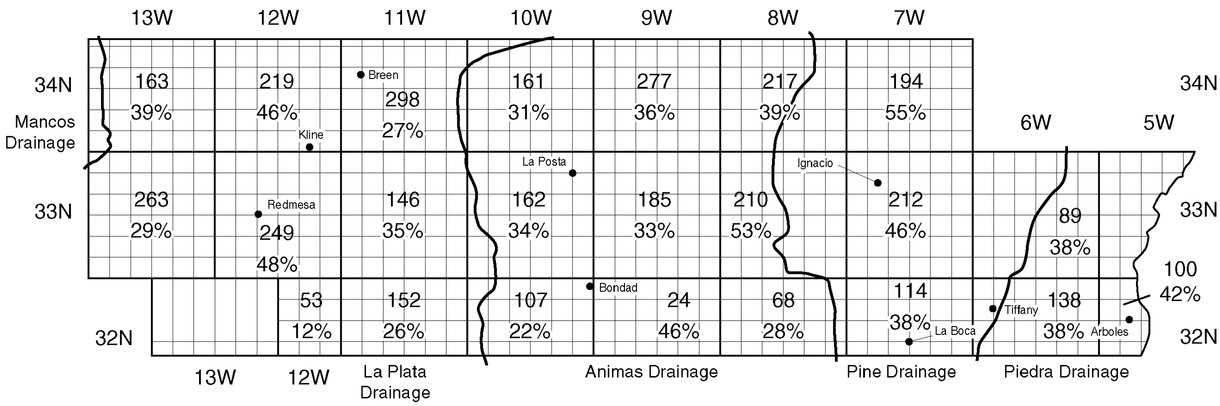


Figure 13 Spatial Variation in Site Densities

Figure 14
Cultural Stage and Phase Sequences for SUIR





number of homestead entries; Indian allotments; oil, gas, and coal permits
##% success of homesteading efforts

Figure 15 Homestead Entries; Indian Allotments; Oil, Gas, and Coal Permits

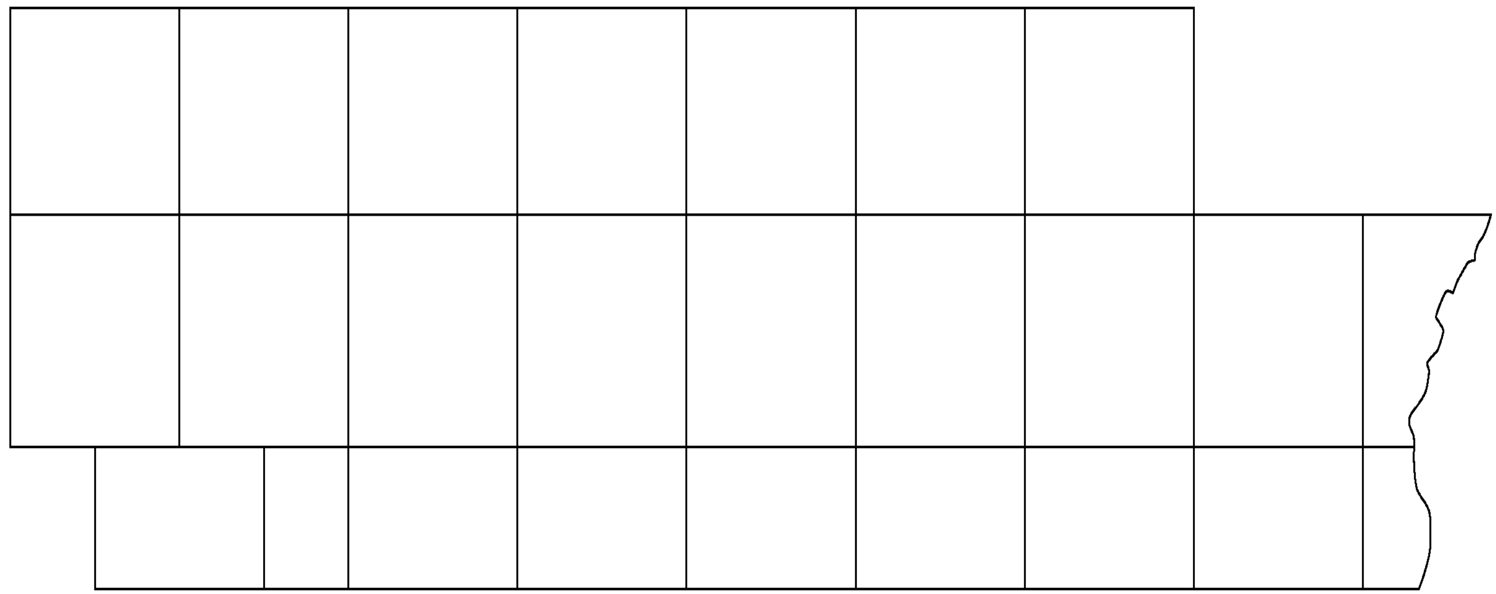


Figure 16 Density of Recorded Archaeological Sites in the Project Area

Figure 17
Distribution of Anasazi Components Within Drainages

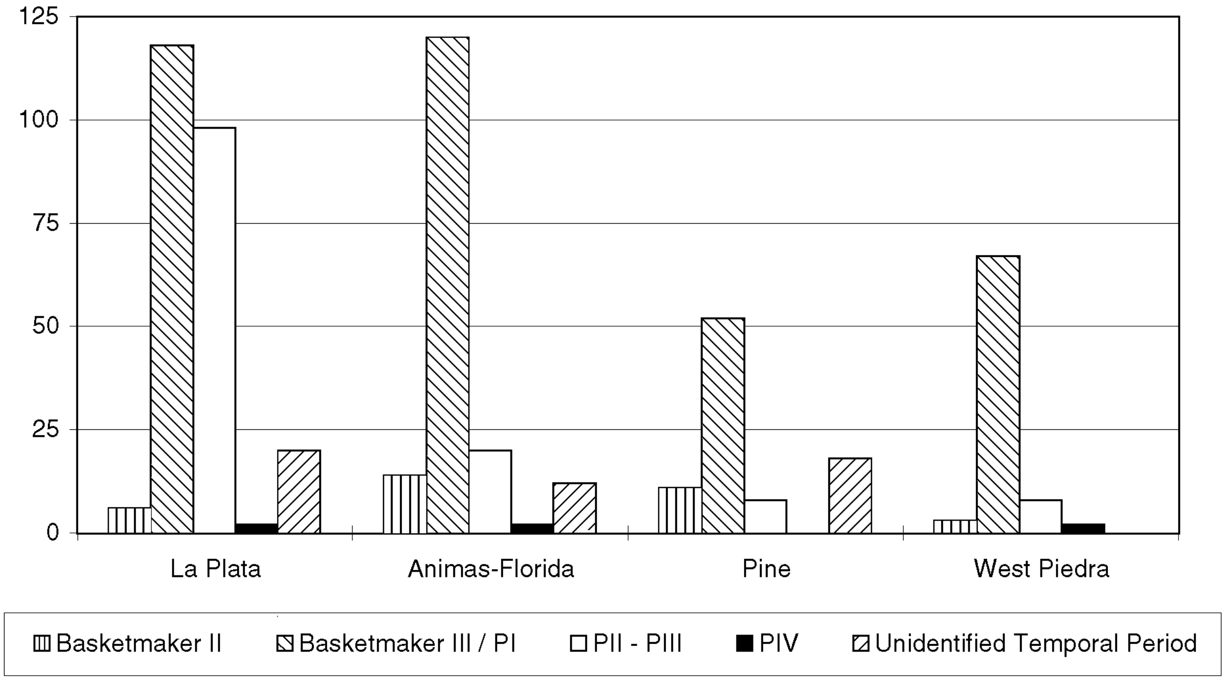
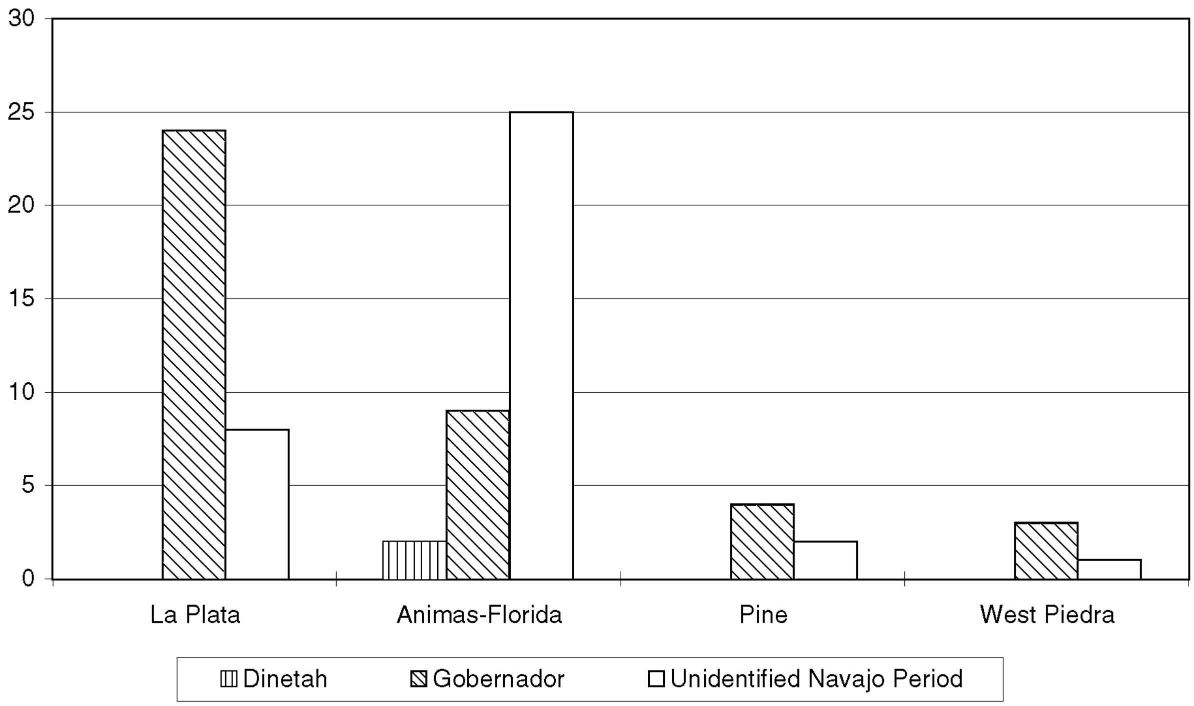


Figure 18
Distribution of Navajo Components Within Drainages



APPENDIX L
AIR QUALITY IMPACT TECHNICAL SUPPORT DOCUMENTS

The following technical support documents describe the processes used in the air quality impact assessment and provide summaries of relevant data:

Dames and Moore. 2000.* Air Quality Impact Assessment Technical Support Document (Volume I - Executive Summary, Emissions Inventory and Near-field Analysis), Oil and Gas Leasing and Development on the Southern Ute Indian Reservation, Environmental Impact Statement. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Colorado State Office, by Dames & Moore. San Diego, CA.

Earth Tech, Incorporated. 2000. Air Quality Impact Assessment Technical Support Document (Volume II - Far-field Analysis), Oil and Gas Leasing and Development on the Southern Ute Indian Reservation, Environmental Impact Statement. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Colorado State Office, by Earth Tech, Incorporated. Concord, MA.

Copies of these technical support documents are available upon request from:

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National Science and Technology Center (ST-133)
Denver Federal Center, Building 50
P.O. Box 25047
Denver, CO 80225-0047

(303) 236-6400
FAX 236-3508

scott_archer@blm.gov

* During the Public review and comment period, it was determined that the near-field cumulative carbon monoxide and nitrogen dioxide production phase impact analyses were erroneous because the Emission Parameters for Sources on Tribal Lands Included in the Cumulative Impact Analysis (Table 6-4 on Page 38 of Volume I - Emissions Inventory and Near-field Analysis of the Air Quality Impact Assessment Technical Support Document) used an incorrect unit of measure conversion factor for the emission source stack diameters. The erroneous values were not used in the near-field construction, near-field formaldehyde, nor any of the far-field modeling analyses.

Replacement Pages 38 through 40, and 49 through 55 are provided to correct those erroneous pages previously included in Dames and Moore (2000).

APPENDIX M
TIFFANY CONTINGENCY PLAN

Nitrogen Injection Project
La Plata County, Colorado
Groundwater Monitoring Program
and Contingency Plan
February 19, 1992

Objectives:

The objective of this program is twofold.

First, determine the affect that the subject project will have on methane and nitrogen content in shallow groundwater.

Second, develop a contingency plan that will address adverse impacts to groundwater that are attributed to nitrogen injection.

I. Method:

Groundwater in the area of review will be sampled on a monthly basis for methane content. If methane content' increases, then nitrogen content and methane Carbon 13 isotope analysis will also be conducted. Groundwater samples will be taken from monitoring wells which will include the two domestic water wells in the area of review, eight new groundwater monitoring wells in the study area and three out-of-area monitoring wells for control data.

The three out-of-area wells will be located at least one half mile away from the nearest nitrogen injection well and will function as control wells. These wells are included in the program so that natural variations in methane and nitrogen concentrations can be assessed. Seasonal variations in water quality are common, and these wells will provide control data for. such variations. For example, if methane concentrations increase by similar proportions in both the area-of-review wells and the out-of-area wells, then that would indicate that variations were natural rather than induced by the Nitrogen Injection Pilot Project.

Gas samples will be taken from the Fruitland Coal producing well within the Nitrogen injection pattern and from each of the four Fruitland Coal producing wells immediately surrounding the injection pattern. These gas samples will be analyzed for composition and Carbon 13 levels in the methane.

Note: **Water well owner permission** for sampling and monitoring well drilling will not be pursued until EPA has approved this program. Samples will not be taken from domestic water wells without the well owner's permission.

Monitoring Wells:

Eight monitoring wells will be drilled and completed within the area-of-review as shown in the attached map. These newly drilled monitoring wells-are denoted MI through M8 on the attached map. These wells will provide groundwater information within the injection well pattern and at the edges of the area-of-review. Well pattern is controlled by access. As shown on the map, all but three of the wells will be drilled on the section line. one well will be drilled adjacent to a new injection well and the other will be drilled adjacent to a converted injection well.

As required by the permit, the two domestic water wells within the Area-of-Review will also be monitored (see locations on the attached map).

Three groundwater monitoring wells are located at least one half mile away from nitrogen injection wells and will function as control wells (see locations on attached map). These wells are existing domestic water wells and are denoted Cl, C2 and C3.

Sampling:

A background sample will be taken from each groundwater monitoring well in the week before nitrogen injection begins.

All subsequent groundwater monitoring wells will be sampled in the first week of each month after *injection begins* and analyzed for methane and *nitrogen concentration*. Samples will be taken from each wells after two wellbore volumes have been pumped from the wells.

Sample bottles will be marked with the following information:
Monitoring Well Identifier (ie. Cl).
Sample Date and Time (ie. Mar. 31, 1992, 15:00 hours)
Samplers Name (ie. John Doe)

Samples will be taken in 40ml glass bottles. Each bottle will be completely filled, leaving no headspace. All samples will be delivered to the lab for analysis within 24 hours of sampling.

Analysis:

Methane concentration will be determined by the headspace method and will be reported as the concentration of methane in the headspace.

The headspace analysis is a two step process:

Step 1) Simultaneously inject 5m1 of helium and extract 5m1 water.

Step 2) Extract 0.1 to 1 ml of headspace vapor and analyze in gas chromatograph with detection limits less than or equal to 7 parts per million for methane and 25 parts per million of Nitrogen.

Analysis will be performed within 72 hours after the samples are taken.

Reporting:

Analysis results will be reported to the EPA by the 20th day of each month after nitrogen injection begins.

Contingency Plan:

This contingency plan will have several response actions that will vary according to the data. Following is a description of the "triggering events" and the associated response actions.

In all Response Levels, if domestic water wells are adversely affected by the nitrogen injection process, safety impacts to those domestic water well users will be assessed immediately. If safety is threatened, provide water to domestic water well users until methane concentrations are reduced to safe **levels or provide a water** treatment system to ensure safe domestic water supply to affected users.

<u>Level 1</u>

Condition for Response - Methane concentration in one or two area-of-review monitoring wells increases by at least 1000 ppm or 1O% of the methane concentration detected before injection began, whichever is greater. Methane concentrations in control wells have not changed since injection began.

Response Action - Within 24 hours of receiving the analysis data, Amoco will take four samples from the well exhibiting the increased methane concentration. Have two of the samples analyzed for headspace methane and nitrogen concentration. The other two samples will be taken in evacuated cylinders leaving a headspace and will have the methane in the headspace analyzed for the Carbon 13 isotope levels. Begin weekly sampling of monitoring wells exhibiting 10% or 1000 ppm methane concentration increase.

Level 2

Condition for Response - Methane and/or nitrogen concentrations continue to increase in two consecutive samples on two or more monitoring wells by 1000 parts per million or 10%, whichever is greater and Carbon 13 levels are identical to Fruitland Coal gas samples taken prior to the nitrogen injection. Methane concentrations in control wells unchanged since injection began.

Response Action - Stop injection into nearest nitrogen injection wells) and continue weekly sampling of monitoring wells exhibiting increasing methane and nitrogen concentrations.

Level 3

Condition for Response - All monitoring wells in study are exhibiting 1000 ppm or 10% increase, whichever is greater, in methane concentration since before injection began and immediate follow up sampling confirms increased methane and nitrogen concentration measurements. Methane concentrations in control wells are unchanged since injection began.

Response Action - Stop injection into all nitrogen injection wells and begin weekly sampling and analysis of monitoring wells. Resume monthly sampling after four weekly samples are taken.

Level 4

Condition for Response - All conditions of Level 3 are met and methane concentrations in all monitoring wells continue to increase through the first month of weekly sampling.

Response Action - PRIMARY OBJECTIVE IS TO REDUCE FRUITLAND COALBED RESERVOIR PRESSURE IMMEDIATELY. Vent all Nitrogen Injection Wells to Atmosphere. Continue to produce all Fruitland Coal wells within at least one mile of study area. Continue sampling all monitoring wells weekly until methane concentrations stop increasing, then start monthly sampling of monitoring wells until methane concentrations equal or are less then the concentrations detected before injection began.

APPENDIX N
TRAFFIC AND TRANSPORTATION

TABLE N-1 TOTAL WELL DEVELOPMENT AND SERVICE TRIPS–ALTERNATIVE 1										
	No. of Wells		***Annual Round Trips per Well by Trip Purpose***						**Total Trips**	
			Drilling	**Comp. and Test**	**Facilities Installation**	**Pipeline Inst.**	**Workover**	**Operations**		
Well Type	*Tribal Minerals*	*Disputed Coal Lands*	*336*	*45*	*31*	*75*	*6*	*365*	**Well Develop-ment**	**Well Service**
Conventional	269	0	90,384	12,105	8,339	20,041	1,614	98,185	230,668	99,799
Coal Bed	81	62	48,048	6,435	4,433	10,654	858	52,195		53,053
Injection	0	0	-	-	-	-	-	-	-	-
Total	*350*	*62*	*138,432*	*18,540*	*12,772*	*30,694*	*2,472*	*150,380*	*200,438*	*152,852*
TOTAL DAILY VEHICLE TRIPS										42
Source: Draft Alternatives Description, Leslie Ellwood, Dames & Moore, Facsimile dated 10/24/97; Tiffany EA										

TABLE N-2 COMPRESSOR INSTALLATION AND SERVICE TRIP GENERATION–ALTERNATIVE 1						
Compressor Size (measured in tons NO produced per year)	**Trips Generated**	**Compressor Installation Trips**	**New Sites**	**Service Trips per Site per Year**	**Average Annual Trips**	**Daily Vehicle Trips**
< 50 tons NO per year	0 pick-up visits per week	181	28	-	-	-
	5-7 crew cab visit per week			312	8,736	5
	0.5 multi-axle visits per year			0.5	14	0.01
50 - 100 tons NO per year	0 pick-up visits per week	181	5	-	-	-
	5-7 crew cab visit per week			312	1,560	1
	1 multi-axle visits per year			1	5	0.00
> 100 tons NO per year	2-5 pick-up visits per day	181	-	1,278	-	-
	3-8 crew cab visit per month			66	-	-
	2 multi-axle visits per year			2	-	-
Total Annual Compressor Maintenance Trips Generated on the Southern Ute Reservation					10,315	6
Total New Compressor Installation Trips					5,973	16
Total First year Trips					16,288	22
Source: Dames & Moore, Inc. and BRW, Inc.						

TABLE N-3 COMPRESSOR AND WELL ANNUAL TRIP PRODUCTION–ALTERNATIVE 1							
Year	**Compressors**		**Wells**		**Annual**	**Ann. Avg.**	**Avg. Daily**
	Service/ Maintenance	**Installation**	**Service/ Maintenance**	**Installation**			
1997	94,082	-	696,977	-	791,059	2,167	243
1998	94,082	597	696,977	10,022	801,678	2,196	272
1999	95,113	597	712,262	10,022	810,352	2,220	274
2000	96,145	597	727,547	10,022	819,026	2,244	277
2001	97,176	597	742,833	10,022	827,700	2,268	280
2002	98,208	597	758,118	10,022	836,374	2,291	282
2003	99,239	597	773,403	10,022	845,048	2,315	285
2004	100,271	597	788,688	10,022	853,722	2,339	288
2005	101,302	597	803,973	10,022	862,396	2,363	290
2006	102,334	597	819,259	10,022	871,071	2,386	293
2007	103,365	597	834,544	10,022	879,745	2,410	296
2008	104,397	-	849,829	10,022	887,821	2,432	297
2009	104,397	-	849,829	10,022	895,464	2,453	299
2010	104,397	-	849,829	10,022	903,107	2,474	301
2011	104,397	-	849,829	10,022	910,749	2,495	303
2012	104,397	-	849,829	10,022	918,392	2,516	305
2013	104,397	-	849,829	10,022	926,034	2,537	307
2014	104,397	-	849,829	10,022	933,677	2,558	309
2015	104,397	-	849,829	10,022	941,320	2,579	311
2016	104,397	-	849,829	10,022	948,962	2,600	313
2017	104,397	-	849,829	10,022	956,605	2,621	315
2018	104,397	-	849,829	-	954,226	2,614	290
2019	104,397	-	849,829	-	954,226	2,614	290
2020	104,397	-	849,829	-	954,226	2,614	290
Source: BRW, Inc.							

TABLE N-4 TOTAL WELL DEVELOPMENT AND SERVICE TRIPS–ALTERNATIVE 2										
	No. of Wells		*Annual Round Trips per Well by Trip Purpose*						Total Trips	
			Drilling	Comp. and Test	Facilities Installation	Pipeline Inst.	Workover	Drilling	Comp. and Test	
Well Type	*Tribal Minerals*	*Disputed Coal Lands*	*336*	*45*	*31*	*75*	*6*	*365*	Well Develop-ment	Well Service
Conventional	269	0	90,384	12,105	8,339	20,041	1,614	98,185	230,668	99,799
Coal Bed	367	326	232,848	31,185	21,483	51,629	4,158	252,945	594,248	257,103
Injection	0	0	-	-	-	-	-	-	-	-
Total	*636*	*326*		*43,290*	*29,822*	*71,669*	*5,772*	*351,130*	*468,013*	*356,902*
TOTAL DAILY VEHICLE TRIPS										98
Source: Draft Alternatives Description, Leslie Ellwood, D&M, Facsimile dated 10/24/97; Tiffany EA										

TABLE N-5 COMPRESSOR INSTALLATION AND SERVICE TRIP GENERATION–ALTERNATIVE 2						
Compressor Size (measured in tons NO produced per year)	Trips Generated	Compressor Installation Trips	New Sites	Service Trips per Site per Year	Average Annual Trips	Daily Vehicle Trips
< 50 tons NO per year	0 pick-up visits per week	181	11	-	-	-
	5-7 crew cab visit per week			312	3,432	2
	0.5 multi-axle visits per year			0.5	6	0.00
50 - 100 tons NO per year	0 pick-up visits per week	181	13	-	-	-
	5-7 crew cab visit per week			312	4,056	2
	1 multi-axle visits per year			1	13	0.01
> 100 tons NO per year	2-5 pick-up visits per day	181	9	1,278	11,498	6
	3-8 crew cab visit per month			66	594	0
	2 multi-axle visits per year			2	18	0.01
Total Annual Compressor Maintenance Trips Generated on the Southern Ute Reservation					19,616	11
Total New Compressor Installation Trips					5,973	16
Total First year Trips					25,589	27
Source: Dames & Moore, Inc. and BRW, Inc.						

TABLE N-6 COMPRESSOR AND WELL ANNUAL TRIP PRODUCTION–ALTERNATIVE 2							
	Compressors		Wells				
Year	Service/ Maintenance	Installation	Service/ Maintenance	Installation	Annual Trips	Ann. Avg. Daily Trips	Avg. Daily Veh. Trips
1997	94,082	-	696,977	-	791,059	2,167	243
1998	94,082	597	696,977	23,401	815,056	2,233	308
1999	96,043	597	732,667	23,401	834,863	2,287	314
2000	98,005	597	768,357	23,401	854,670	2,342	320
2001	99,966	597	804,048	23,401	874,477	2,396	326
2002	101,928	597	839,738	23,401	894,283	2,450	332
2003	103,890	597	875,428	23,401	914,090	2,504	338
2004	105,851	597	911,118	23,401	933,897	2,559	344
2005	107,813	597	946,808	23,401	953,703	2,613	350
2006	109,774	597	982,499	23,401	973,510	2,667	356
2007	111,736	597	1,018,189	23,401	993,317	2,721	362
2008	113,698	-	1,053,879	23,401	1,012,526	2,774	366
2009	113,698	-	1,053,879	23,401	1,030,371	2,823	371
2010	113,698	-	1,053,879	23,401	1,048,216	2,872	376
2011	113,698	-	1,053,879	23,401	1,066,061	2,921	381
2012	113,698	-	1,053,879	23,401	1,083,907	2,970	386
2013	113,698	-	1,053,879	23,401	1,101,752	3,018	391
2014	113,698	-	1,053,879	23,401	1,119,597	3,067	396
2015	113,698	-	1,053,879	23,401	1,137,442	3,116	400
2016	113,698	-	1,053,879	23,401	1,155,287	3,165	405
2017	113,698	-	1,053,879	23,401	1,173,132	3,214	410
2018	113,698	-	1,053,879	-	1,167,577	3,199	351
2019	113,698	-	1,053,879	-	1,167,577	3,199	351
2020	113,698	-	1,053,879	-	1,167,577	3,199	351
Source: BRW, Inc.							

TABLE N-7 TOTAL WELL DEVELOPMENT AND SERVICE TRIPS–ALTERNATIVE 3											
	No. of Wells		***Annual Round Trips per Well by Trip Purpose***						**Total Trips**		
			Drilling	**Comp. and Test**	**Facilities Installation**	**Pipeline Inst.**	**Workover**	**Ops**			
Well Type	*Tribal Minerals*	*Disputed Coal Lands*	*336*	*45*	*31*	*75*	*6*	*365*	**Well Develop-ment**	**Well Service**
Conventional	269	0	90,384	12,105	8,339	20,041	1,614	98,185	230,668	99,799
Coal Bed	367	326	232,848	31,185	21,483	51,629	4,158	252,945	594,248	257,103
Injection	70	52	40,992	5,490	3,782	9,089	732	44,530	104,615	45,262
Total	*706*	*378*		*48,780*	*33,604*	*80,758*	*6,504*	*395,660*	*527,366*	*402,164*
TOTAL DAILY VEHICLE TRIPS										110
Source: Draft Alternatives Description, Leslie Ellwood, D&M, Facsimile dated 10/24/97; Tiffany EA										

TABLE N-8 COMPRESSOR INSTALLATION AND SERVICE TRIP GENERATION ALTERNATIVE 3						
Compressor Size (measured in tons NO produced per year)	**Trips Generated**	**Compressor Installation Trips**	**New Sites**	**Service Trips per Site per Year**	**Average Annual Trips**	**Daily Vehicle Trips**
< 50 tons NO per year	0 pick-up visits per week	181	11	-	-	-
	5-7 crew cab visit per week			312	3,432	2
	0.5 multi-axle visits per year			0.5	6	0.00
50 - 100 tons NO per year	0 pick-up visits per week	181	13	-	-	-
	5-7 crew cab visit per week			312	4,056	2
	1 multi-axle visits per year			1	13	0.01
> 100 tons NO per year	2-5 pick-up visits per day	181	17	1,278	21,718	12
	3-8 crew cab visit per month			66	1,122	1
	2 multi-axle visits per year			2	34	0.02
Total Annual Compressor Maintenance Trips Generated on the Southern Ute Reservation					30,380	17
Total New Compressor Installation Trips					7,421	20
Total First year Trips					37,801	37
Source: Dames & Moore, Inc. and BRW, Inc.						

TABLE N-9
COMPRESSOR AND WELL ANNUAL TRIPS –ALTERNATIVE 3

	Compressors		Wells				
Year	Service/ Maintenance	Installation	Service/ Maintenance	Installation	Annual Trips	Ann. Avg. Daily Trips	Avg. Daily Veh. Trips
1997	94,082	-	696,977	-	791,059	2,167	243
1998	94,082	742	696,977	26,368	818,169	2,242	317
1999	97,120	742	737,193	26,368	841,315	2,305	324
2000	100,158	742	777,410	26,368	864,461	2,368	331
2001	103,196	742	817,626	26,368	887,608	2,432	338
2002	106,234	742	857,843	26,368	910,754	2,495	345
2003	109,272	742	898,059	26,368	933,900	2,559	353
2004	112,310	742	938,275	26,368	957,046	2,622	360
2005	115,348	742	978,492	26,368	980,192	2,685	367
2006	118,386	742	1,018,708	26,368	1,003,339	2,749	374
2007	121,424	742	1,058,925	26,368	1,026,485	2,812	381
2008	124,462	-	1,099,141	26,368	1,048,889	2,874	386
2009	124,462	-	1,099,141	26,368	1,068,997	2,929	392
2010	124,462	-	1,099,141	26,368	1,089,105	2,984	398
2011	124,462	-	1,099,141	26,368	1,109,213	3,039	403
2012	124,462	-	1,099,141	26,368	1,129,322	3,094	409
2013	124,462	-	1,099,141	26,368	1,149,430	3,149	414
2014	124,462	-	1,099,141	26,368	1,169,538	3,204	420
2015	124,462	-	1,099,141	26,368	1,189,646	3,259	425
2016	124,462	-	1,099,141	26,368	1,209,754	3,314	431
2017	124,462	-	1,099,141	26,368	1,229,863	3,369	436
2018	124,462	-	1,099,141	-	1,223,603	3,352	369
2019	124,462	-	1,099,141	-	1,223,603	3,352	369
2020	124,462	-	1,099,141	-	1,223,603	3,352	369

Source: BRW, Inc.

APPENDIX O
SUMMARY OF SPACING ORDERS APPLICABLE TO THE SOUTHERN UTE INDIAN RESERVATION

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7076

U.S. Department of the Interior
1849-1999

IN REPLY REFER TO

CO-934
3160

issued 5/3/00

BLM decision
from CSO

NOTICE OF DECISION AND ORDER

Well Density;
Fruitland Coal Seams;
Tribal and Individual Indian Allotted Minerals;
Southern Ute Indian Reservation

This constitutes official and formal notice of a decision and order of the Colorado State Office of the Bureau of Land Management (BLM) regarding the density of wells needed to develop Fruitland Formation coal seam gas contained in certain lands located within the exterior boundaries of the Southern Ute Indian Reservation. This decision and order affects oil and gas mineral estates owned by the United States for the benefit of the Southern Ute Indian Tribe (SUIT) or held as individual Indian allotments under the trust protection of the United States. The affected lands are more particularly described in Exhibit A, attached hereto and made a part hereof.

On April 24-25, 2000, the Colorado Oil and Gas Conservation Commission (COGCC) held a consolidated hearing to consider two applications that had been filed in Cause No. 112 (Docket No. 0004-AW-05 and Docket No. 0004-AW-06). Both applications requested that COGCC Order No. 112-61 be amended to allow an optional additional well to be drilled for the production of gas and associated hydrocarbons from the Fruitland Coal Seams for the 320 acre spacing units on all of the lands therein described, including federal, Indian and non-federal lands, rather than one well per 320 acre spacing unit allowed under the pre-existing Order No. 112-61. Docket No. 0004-AW-05 involved lands located north of the Southern Ute Indian Reservation. Docket No. 0004-AW-06 involved lands located within the exterior boundaries of the Southern Ute Indian Reservation.

BLM participated in the COGCC hearing and is issuing this order and decision in accordance with procedures set forth in the Memorandum of Understanding (Southern Ute Indian Tribe and Bureau of Land Management) and Interagency Agreement (Bureau of Indian Affairs and Bureau of Land Management) dated August 22, 1991 (Tribal MOU) and the Memorandum of

BLM to the extent they affect federal and Indian lands. With respect to tribal lands, in accordance with the Tribal MOU, the SUIT provided BLM with its consent and concurrence for this matter to be heard by the COGCC, and the BLM notified the COGCC of this agency's consent for the matter to proceed.

Based upon the testimony and evidence presented, on April 25, 2000, the COGCC found that as to the lands described in both applications, it is necessary to allow the drilling of an optional additional well per 320 acre spacing unit in order to recover coal seam gas from the Fruitland Formation. In accordance with its procedures, COGCC entered an order amending Order No. 112-61 to conform to its findings; however, as to all non-federal and non-Indian oil and gas estates, the COGCC stayed the effect of its order pending the completion of a public issues hearing to be conducted subsequently. For reasons more fully explained below, the COGCC public issues hearing does not apply to the federal and Indian lands contained in the two applications.

In order to eliminate any possible confusion regarding the effect of the COGCC's decision as it relates to Indian lands described in Docket No. 0004-AW-06, the BLM hereby orders that effective as of the date of this Notice of Decision and Order, with respect to the lands described in Exhibit A, the permissible well density for Fruitland Formation coal seam gas wells is two wells per 320 acre spacing unit. In support of this decision, the uncontroverted evidence presented at the COGCC hearing was that the drilling of one well per 320 acre drilling unit was not sufficient to recover all reserves. Additionally, the uncontroverted evidence was that the drilling of one additional well per 320 acre spacing unit would be consistent with the efficient and prudent recovery of the coal seam gas resources. Prior to the COGCC's hearing, representatives of the applicants had presented information to the BLM supporting their applications. BLM mineral staff reviewed the reservoir data and concluded, through an independent analysis of the data, that an additional well per 320 acre spacing unit is needed for recovery of the resource. The sworn testimony and evidence received at the COGCC hearing revealed nothing that contravened the previous presentations provided to the BLM, and the BLM concurs with the findings of the COGCC.

The BLM's trust responsibility to the SUIT and Indian allottees also supports entry of this order. The technical staffs of both the BLM and the SUIT have conferred, and they share the view that additional infill drilling is needed to develop the Tribe's coal seam gas resources prudently. If additional development proceeds, the SUIT will benefit not only from accelerated income, but also from a sizeable incremental increase in revenue associated with resources that would otherwise not be recovered in any foreseeable fashion.

v in

obtain permits to drill from the BLM. In reviewing any such application or group of applications, the BLM shall evaluate the environmental consequences of permitting additional drilling in conformity with the requirements of the National Environmental Policy Act ("NEPA"). In that regard it should be noted that since 1995 this agency, in conjunction with the Bureau of Indian Affairs and the Tribe, has been preparing a nearly completed Environmental Impact Statement with respect to increased density oil and gas development on Indian lands within the Reservation. Decisions to grant or deny applications for permits to drill, or to condition approval based upon necessary environmental impact mitigation measures, shall include additional evaluation under NEPA. This agency has significant legal duties associated with its Indian trust responsibility, as well as, obligations under NEPA and other federal statutes. The evaluation and balancing of those duties cannot be shifted to other agencies or to the COGCC.

The COGCC is not bound by NEPA with respect to oil and gas development on private lands. At the COGCC public issues hearing to be held in the near future regarding these applications, testimony will be taken regarding health, safety, and environmental issues associated with these applications. As recognized by the COGCC, with respect to federal and Indian lands, the BLM is the agency that must address these matters, and the COGCC has agreed to not impose development conditions upon the lessees who have obtained their interests pursuant to federal statutory authority. Because the COGCC is not bound by the same responsibilities of the BLM and has agreed to not impose conditions upon the development of federal and Indian lease operations, federal and Indian lands shall not be subject to the COGCC's determinations resulting from the public issues hearing. Nonetheless, the BLM shall carefully review and consider any conclusions the COGCC reaches under that process.

If you wish to contest this decision, you may appeal to the Interior Board of Land Appeals (See 43 CFR 3165.4 and 43 CFR Part 4). Information regarding the appeals process is attached. Please note that this decision addresses only the technical aspects of efficient drainage of reservoirs, *i.e.*, conservation of the resource and correlative rights. Therefore, any appeals of this decision must specifically address those issues. This decision does not and, indeed, could not address the environmental impacts of allowing the drilling of additional wells. The environmental impacts of drilling any additional wells will be addressed in the appropriate, site-specific environmental analysis which will be done in connection with an actual Application for Permission to Drill. Appeals of decisions on those APD's, including the environmental impacts of lesser spacing, may be addressed at that time. Information regarding the appeals process is attached.

This decision and order is entered this 3rd day of May, 2000.

Exhibit A (Lands South of the Ute Line)

T.32N., R.5W., N.M.P.M.: Sections 5-8 All, Sections 17-20 All

T.32N., R.6W., N.M.P.M.: Sections 1-4 All, Section 5 N1/2, Section 7 E1/2,Section 8 E1/2, Sections 9-16 All, Section 17 E1/2, Section 18 All, Section 23 All, Section 24 All

T.32N., R.7W., N.M.P.M.: Sections 3-6 All, Section 7 E1/2, Sections 8-11 All, Sections 13-17 All, Section 19 E1/2E1/2, Sections 20-22 All, Section 23 W1/2;W1/2E1/2

T.33N., R.7W., N.M.P.M.: Sections 1-7 All, Section 8 E1/2, Sections 9-11 All, Section 12 N1/2, Section 14 W1/2, Sections 15-23 All, Section 25 All, Section 26 W1/2, Sections 27-34 All, Section 35 W1/2, Section 36 N1/2

T.33N., R.8W., N.M.P.M. Sections 1-18 All, Section 19 N1/2, Section 20 N1/2, Sections 21-27 All, Section 35 N1/2, Section 36 All

T.33N., R.9W., N.M.P.M. Sections 1-2 All, Section 3 N1/2, Sections 4-15 All, Section 16 E1/2, Sections 17-24 All, Section 29 W1/2, Section 30 All, Section 31 N1/2, Section 32 W1/2

T.33N., R.10W., N.M.P.M. Sections 1-6 All, Section 10 All, Section 11 E1/2, Section 12 All, Section 14 W1/2, Section 15 All, Section 16 All, Section 20 E1/2, Section 21 W1/2

T.33N., R.11W., N.M.P.M. Section 1 E1/2, Section 13 N1/2, Section 14 All

T.34N., R.7W., N.M.P.M.(SUL) Sections 1-9 All, Section 10 E1/2, Sections 11-36 All

T.34N., R.8W., N.M.P.M.(SUL) Sections 1-15 All, Section 16 S1/2, Section 17 All, Section 18 All, Section 19 W1/2, Sections 20-22 All, Section 23 S1/2, Section 24 All, Sections 25-28 All, Section 29 E1/2, Sections 30-36 All

T.34N., R.9W., N.M.P.M.(SUL) Sections 1-11 All, Sections 13-35 All

T.34N., R.10W., N.M.P.M.(SUL) Section 1 All, Section 12 All, Section 13 All, Section 14 S1/2, Sections 22-36 All

O 1840-6
(July 1996)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

INFORMATION ON TAKING APPEALS TO THE BOARD OF LAND APPEALS

DO NOT APPEAL UNLESS

. This decision is adverse to you,

AND

2. You believe it is incorrect.

IF YOU APPEAL, THE FOLLOWING PROCEDURES MUST BE FOLLOWED

1. NOTICE OF APPEAL	Within 30 days file a Notice of Appeal in the office which issued this decision (see 43 CFR 4.411 and 4.413). You may state your reasons for appealing, if you desire.
2. WHERE TO FILE NOTICE OF APPEAL	BUREAU OF LAND MANAGEMENT RESOURCE SERVICES (CO-934) 2850 YOUNGFIELD STREET LAKEWOOD, COLORADO 80215
WITH COPY TO SOLICITOR	REGIONAL SOLICITOR ROCKY MOUNTAIN REGION 755 PARFET STREET, SUITE 151 LAKEWOOD, COLORADO 80215
WITH COPY TO BOARD OF LAND APPEALS	DEPARTMENT OF THE INTERIOR BOARD OF LAND APPEALS 4015 WILSON BLVD. ARLINGTON, VIRGINIA 22203
3. STATEMENT OF REASONS	Within 30 days after filing the Notice of Appeal, file a complete statement of the reasons you are appealing. This must be filed with the Interior Board of Land Appeals, at the above address (see 43 CFR 4.412 and 4.413). If you fully stated your reasons for appealing when filing the Notice of Appeal, no additional statement is necessary. Copies of your statement

5. PROOF OF SERVICE

Within 15 days after any document is served on an adverse party, file proof of that service with the Interior Board of Land Appeals. This may consist of a certified or registered mail "Return Receipt Card" signed by the adverse party (see 43 CFR 4.401(c)).

6. REQUEST FOR STAY

Except where program-specific regulations place this decision in full force and effect or provide for an automatic stay, the decision becomes effective upon the expiration of the time allowed for filing an appeal unless a petition for stay is timely filed (see 43 CFR 4.2[illegible] you wish to file a petition for a stay of the effectiveness of this decision during the time that your appeal is being reviewed by the Board, the petition for a stay must accompany your notice of appeal. A petition for a stay is required to show sufficient justification based on the standards listed below. Copies of the notice of appeal and petition for a stay must also be submitted to each party named in this decision and to the Interior Board of Land Appeals and the appropriate Office of the Solicitor (see 43 CFR 4.413) at the same time the original documents are filed with this office. If you request a stay, you have the burden of proof to demonstrate that a stay should be granted.

STANDARDS FOR OBTAINING A STAY

Except as otherwise provided by law or other pertinent regulation, a petition for a stay of a decision pending appeal shall show sufficient justification based on the following standards:

(1) The relative harm to the parties if the stay is granted or denied,

(2) The likelihood of the appellant's success on the merits,

(3) The likelihood of immediate and irreparable harm if the stay is not granted, and

(4) Whether the public interest favors granting the stay.

Unless these procedures are followed, your appeal will be subject to dismissal (see 43 CFR 4.402). Be certain that all communications a[illegible] identified by serial number of the case being appealed.

SUBPART 1821.2--OFFICE HOURS; TIME AND PLACE FOR FILING

Sec. 1821.2-1 *Office hours of State Office.* (a) State Offices and the Washington Office of the Bureau of Land Management are open to the public for the filing of documents and inspection of records during the hours specified in the paragraph on Monday through Friday of each week with the exception of those days where the office may be closed because of a national holiday or Presidential or other administrative order. The hours during which the State Offices and the Washington Office are open to the public for the filing of documents and inspection of records are from 10 a.m. to 4 p.m. standard time or daylight saving time, whichever is in effect at the city in which each office is located.

IN THE MATTER OF THE PROMULGATION AND ESTABLISHMENT OF FIELD RULES TO GOVERN OPERATIONS IN THE IGNACIO-BLANCO FIELD, LA PLATA AND ARCHULETA COUNTIES, COLORADO

Cause No. 112 Order No. 112-157

REPORT OF THE COMMISSION

This cause came on for hearing before the Commission on April 24, 2000 in the Boettcher Auditorium, Colorado History Museum, 1300 Broadway, Denver, Colorado, on April 25, 2000 in Suite 801, 1120 Lincoln Street, Denver, Colorado, on June 5 and 6, 2000 in the Exhibit Hall, La Plata County Fairgrounds, 2500 Main Avenue, Durango, Colorado and on July 10 and 11, 2000 in Suite 801, 1120 Lincoln Street, Denver, Colorado on the verified application of Amoco Pro duction Company, the Southern Ute Indian Tribe, d/b/a Red Willow Production Company, J.M. Huber Corporation, Hallwood Petroleum, Inc., SG Interests I, Ltd., Four Star Oil & Gas Company, Vastar Resources, Inc., EnerVest San Juan Operating, LLC, Pablo Operating Company, Petrogulf Corporation, Elm Ridge Resources, Maralex Resources, Inc., and Don Gosney for an order from the Commission to allow an optional additional well to be drilled for production of gas from the Fruitland Coal seams for certain 320-acre drilling and spacing units in the Ignacio-Blanco Field.

SUMMARY OF PROCEEDINGS

1. Amoco Production Company, the Southern Ute Indian Tribe, d/b/a Red Willow Production Company, J.M. Huber Corporation, Hallwood Petroleum, Inc., SG Interests I, Ltd., Four Star Oil & Gas Company, Vastar Resources, Inc., EnerVest San Juan Operating, LLC, Pablo Operating Company, Petrogulf Corporation, Elm Ridge Resources, Maralex Resources, Inc., and Don Gosney, as applicants herein, are interested parties in the subject matter of the above-referenced hearing.

2. Due notice of the time, place and purpose of the hearing has been given in all respects as required by law.

3. The Commission has jurisdiction over the subject matter embraced in said Notice, and of the parties interested therein, and jurisdiction to promulgate the hereinafter prescribed order pursuant to the Oil and Gas Conservation Act and the terms of the Memorandum of Understanding ("MOU") between the Commission and the Bureau of Land Management ("BLM").

4. On June 15, 1988, the Commission issued Order No. 112-60 which established 320-acre drilling and spacing units for the production of gas from the Fruitland coal seams, underlying certain lands in the Ignacio-Blanco Field, with the units to consist of a governmental half section and the permitted well wh

Company, Petrogulf Corporation, Elm Ridge Resources, Maralex Resources, Inc., and Don Gosney ("Applicants"), by and through their attorneys, filed with the Commission a single application requesting an order from the Commission to allow an optional additional well to be drilled for production of gas from the Fruitland coal seams for certain 320-acre drilling and spacing units in the Ignacio-Blanco Field.

6. On March 7, 2000 the Applicants by and through their attorneys, filed with the Commission a revised application to separate the lands north of the Ute Line from those south of the Ute Line, requesting an order from the Commission to allow an optional additional well to be drilled for production of gas from the Fruitland Coal seams for the 320-acre drilling and spacing units described below, with the permitted well to be located in any undrilled quar ter section no closer than 990 feet from the boundaries of the quarter section, nor closer than 130 feet to any interior quarter section line.

Township 32 North, Range 5 West, N.M.P.M. Sections 5 thru 8: All Sections 17 thru 20: All

Township 32 North, Range 6 West, N.M.P.M. Sections 1 thru 4: All Section 5: N1/2 Section 7: E1/2 Section 8: E1/2 Sections 9 thru 16: All Section 17: E1/2 Section 18: All Section 23: All Section 24: All

Township 32 North, Range 7 West, N.M.P.M. Sections 3 thru 6: All Section 7: E1/2 Sections 8 thru 11: All Sections 13 thru 17: All Section 19: E1/2 E1/2 Sections 20 thru 22: All Section 23: W1/2; W1/2 E1/2

Township 33 North, Range 7 West, N.M.P.M. Sections 1 thru 7: All Section 8: E1/2 Sections 9 thru 11: All Section 12: N1/2 Section 14: W1/2 Sections 15 thru 23: All Section 25: All Section 26: W1/2 Sections 27 thru 34: All Section 35: W1/2 Section 36: N1/2

Township 33 North, Range 8 West, N.M.P.M. Sections 1 thru 18: All Section 19: N1/2 Section 20: N1/2 Sections 21 thru 27: All Section 35: N1/2 Section 36: All

Township 33 North, Range 9 West, N.M.P.M. Sections 1 and 2: All Section 3: N1/2 Sections 4 thru 15: All Section 16: E1/2 Sections 17 thru 24: All Section 29: W1/2 Section 30: All Section 31: N1/2 Section 32: W1/2

Township 33 North, Range 10 West, N.M.P.M. Sections 1 thru 6: All Section 10: All Section 11: E1/2 Section 12: All Section 14: W1/2 Section 15: All Section 16: All Section 20: E1/2 Section 21: W1/2

Township 33 North, Range 11 West, N.M.P.M. Section 1: E1/2 Section 13: N1/2 Section 14: All

Township 34 North, Range 7 West, N.M.P.M. (S.U.L.) Sections 1 thru 9: All Section 10: E1/2 Sections 11 thru 36: All

Township 34 North, Range 8 West, N.M.P.M. (S.U.L.) Sections 1 thru 15: All Section 16: S1/2 Section 17: All Section 18: All Section 19: W1/2 Sections 20 thru 22: All Section 23: S1/2 Section 24: All Sections 25 thru 28: All Section 29: E1/2 Sections 30 thru 36: All

Commissioners verified that they had viewed the videotapes of the Local Public Forum.

8. On April 4, 2000, the Tribal Council of the Southern Ute Indian Tribe submitted a letter to the Commission in support of the application.

9. Pursuant to Rule 527., Colorado Oil and Gas Conservation Commission ("COGCC") staff convened a prehearing conference on April 12, 2000. Because La Plata County ("County") intervened in the application, under Rule 508.i.(4) a Public Issues Hearing must be held. After hearing arguments and discussion, the COGCC Hearing Officer made a preliminary ruling that the technical hearing would be bifurcated from consideration of the environmental and public health, safety and welfare issues raised by the County and the protestants to the Public Issues Hearing.

10. On April 24, 2000 the BLM submitted a letter to the Commission in support of the Application for the federal lands in accordance with the conditions of the Memorandum of Understanding between the BLM and the Commission.

BOWEN/EDWARDS/DURANGO PROTEST/INTERVENTION

11. On April 10, 2000 Bowen Gas Corporation, Edwards Energy Corporation and Durango Corporation (collectively, "Bowen") filed with the Commission a protest to the application seeking the inclusion of certain additional lands into the application. On April 14, 2000, Bowen filed with the Commission a withdrawal of their protest.

TIMOTHY BLAKE PROTEST/INTERVENTION

12. On April 10, 2000 Timothy Blake filed with the Commission a protest to the application. On April 23, 2000 Timothy Blake filed with the Commission via facsimile a request to continue the hearing for a minimum of two (2) weeks and to hold the technical hearing in Durango. Mr. Blake did not appear at the April hearing. His motion was denied.

LA PLATA COUNTY PROTEST/INTERVENTION

13. On April 10, 2000 La Plata County filed with the Commission a Statement in Protest and Intervention to the application, to raise issues relating to impacts on the environment and on public health, safety and welfare arising out of the application. The County intervenes by right pursuant to Rule 509.a.

14. On April 11, 2000 the County filed with the Commission a Motion for Expedited Discovery and a First Set of Interrogatories and Request for Production of Documents. The motion was mooted by the Applicants' agreement, stated at the Prehearing Conference, to provide the requested materials to the County.

Preconference Hearing.

18. On April 17, 2000 the Alliance filed with the Commission a Motion to Strike and Dismiss. At the hearing on April 24, 2000, the Commission denied the Motion to Strike, finding that the application contained sufficient information, and denied the Motion to Dismiss finding that the Applicants have standing to bring the application before the Commission.

19. At the hearing on April 24, 2000 the Alliance requested the Commission grant a continuance to the June hearing on the grounds that inadequate notice was given of the Prehearing Conference. The Commission denied the Motion to Continue.

20. At the April hearing the Alliance raised their concern on bifurcation of the environmental and public health, safety and welfare issues to the Public Issues Hearing. The Commission confirmed the preliminary ruling by the COGCC Hearing Officer that the technical hearing would be bifurcated from consideration of the environmental and public health, safety and welfare issues.

APPLICANTS' MOTION

21. At the April hearing the Applicants made a Motion to Dismiss the Protests of the Alliance and Timothy Blake and to determine the status of all the parties. The Applicants argued that Mr. Blake should not be granted party status for this application as the lands he has a direct interest in are located north of the Ute Line. The Commission granted the Alliance intervenor status in both the technical hearing and the Public Issues Hearing. When the Commission voted on Mr. Blake's participation, it was unclear as to which lands he was granted intervenor status on for purposes of the Public Issues Hearing.

STAFF ANALYSIS

22. At the April hearing the Director testified that based on a review of adjacent pilot projects and on the La Plata County Development Plan prepared by COGCC staff, an additional well is necessary to be drilled on the 320-acre drilling and spacing units subject to the application in order to efficiently and economically recover gas from the Fruitland coal seams. The Director also testified that independent staff analysis of the Applicants' economic analysis confirmed the Applicants' rate of return calculations.

23. The Director recommended that any order granting the application provide for the Director, at the Director's discretion, to attach drilling permit conditions to require the acquisition and reporting of initial measured bottom hole pressures. Such pressures would be obtained utilizing a bottom hole gauge after a minimum forty-eight (48) hour shut-in period following completion and prior to sales.

TECHNICAL EVIDENCE

ırd expert testimony from Gary Weitz, Landman for Amoco Production Company

26. The Commission heard expert testimony from J.W. (Bill) Hawkins, Regulatory Affairs Engineer for Amoco Production Company regarding the production and drainage of the Fruitland coal seams in the Application Area. Mr. Hawkins opined that additional wells were appropriate to prevent waste and maximize production. Mr. Hawkins further testified that the drilling of additional wells would be economic for the Applicants.

27. The Commission heard expert testimony from Vu Dinh, Principal Reservoir Engineer for Vastar Resources, Inc. on infill wells from the Fruitland coal seams reservoir regarding production, drainage and reservoir pressure. Mr. Dinh opined that additional wells would recover additional reserves, protect correlative rights and prevent waste within the Application Area.

28. Based on the technical testimony presented by the Applicants the Commission found that one well will not efficiently and economically drain the drilling and spacing units previously designated by the Commission, and that based on geological and engineering data presented at the hearing, additional wells are necessary to allow the gas to be produced at its maximum efficient rate, to prevent waste and protect correlative rights, and to efficiently an d economically recover gas from the Fruitland coal seams within the Application Area.

PUBLIC COMMENT/PARTICIPATION

29. Letters, e-mails or telephone contacts in opposition to the application were received from sixty-three (63) La Plata County residents.

30. Letters in support of the application were received from five (5) La Plata County residents.

31. Pursuant to Rule 510., La Plata County officials Mike Matheson, Joe Crain, Josh Joswick made statements regarding the need to consider potential impacts to the environment, public health, safety and welfare issues at a Public Issues Hearing in Durango that might occur if the application is granted.

32. Pursuant to Rule 510., Billy Ray Clary, a mineral owner in La Plata County, made statements regarding issues not within the scope of the application and was directed to handle those concerns at another hearing if warranted.

33. Pursuant to Rule 510., Ken Wonstolen of the Colorado Oil & Gas Association made statements regarding the increasing demand for natural and the issue of "balance" related to developing resources while protecting the environment, public health, safety and welfare.

34. Based on the facts stated in the application and the testimony and exhibits presented by the Applicants at the April Hearing, the Commission finds that the request to allow an optional additional well on the 320-acre drilling and spacing units for production of gas from the Fruitland coal seams for the lands described in Finding #6 in the Ignacio-Blanco Field should be approved. The permitted well shall be located in any undrilled quarter section, no closer than 990 feet from the boundaries of the quarter section

36. The Commission convened a Public Issues Hearing in Durango on June 5 and 6, 2000.

37. A motion was made by the Alliance to admit the videotapes from the April 4, 2000 Local Public Forum into the record. The Commission Chair granted the motion.

38. A motion was made by the Alliance to allow more time for the submission of written Rule 510. statements. The Commission Chair denied the motion.

39. A motion was made by the County to retain the court reporter and allow citizens to make verbal 510. statements after the Commission had left Durango. The Commission Chair denied the motion.

40. A motion was made by the Applicants to deny admission of the Alliance's witnesses based on failure to receive witnesses' resumes by the due date. The Commission Chair denied the motion.

41. The Commission continued the Public Issues Hearing in Denver on July 10 and 11, 2000.

42. A motion was made by the County to reallocate the allotted presentation times of the Intervenors. The Commission Chair granted the motion.

43. A motion was made by the Alliance to strike the Rule 510. written statement submitted by Scott Zimmerman. The Commission denied the motion.

STAFF ANALYSIS

44. At the June hearing the Director requested the admission of three documents into the record and testified that based on the information contained within along with the Applicants' proposed environment, public health, safety and welfare plan the environment, public health, safety and welfare were adequately protected from increased density wells. He further testified that site-specific conditions are the most appropriate to attach to each Applicati on for Permit-to-Drill. In addition, the Director reiterated the condition he recommended to the Commission at the April hearing to require periodic post-production pressure build-up data to be provided by operators.

45. At the July hearing the Director presented and discussed a memorandum to the Commission containing staff's proposed version of the Applicants' environment, public health, safety and welfare plan along with staff's proposed Rule 508.j.(3)B. Conditions. In addition, a memorandum from Debbie Baldwin to the Director was attached regarding clinker and abandoned coal mines associated with the Fruitland coal seams.

APPLICANTS EVIDENCE

48. On June 20, 2000 written supplemental testimony was submitted by David Brown regarding the Applicants' proposed environment, public health, safety and welfare plan.

49. On June 20, 2000 written supplemental testimony was submitted by Alexander McLean regarding toxicity, rights-of-way and cement integrity behind casing.

50. On June 26, 2000 written rebuttal testimony was submitted by W.C. Rusty Riese in response to Warren Holland's testimony regarding drainage by gas wells of water in the outcrop area, gas seepage, coal fires and contamination of water wells.

51. On June 26, 2000 written rebuttal testimony was submitted by Tamara Joslin outlining the differences between the Applicants' proposed plan and the County's proposed plan.

52. On June 26, 2000 written rebuttal testimony was submitted by Thomas Murphy regarding La Plata County coalbed methane outcrop evaluation.

53. On June 26, 2000 written rebuttal testimony was submitted by Daryl Erickson in response to Warren Holland's testimony regarding the Hickerson Hot Spring.

54. On June 26, 2000 written rebuttal testimony was submitted by Constance Heath regarding certain provisions in the County's proposed environment, public health, safety and welfare plan.

TIMOTHY BLAKE EVIDENCE

55. The Commission heard expert testimony from Robert Suenram, Realtor regarding the effects of wells on property values, who opined that the presence of wells along with their visual and noise impacts adversely affects real estate sales and purchases.

56. The Commission heard expert testimony from Robert McGrath, M.D. regarding pediatric safety who opined that impacts from wells on children may result in injury or death. The Applicants objected to this witness.

57. The Commission heard fact testimony from Lori Kelly who described the stress she experiences from gas well operations.

58. The Commission heard expert testimony from Deanna Surprenant, LCSW regarding the effects of stress on people where they have no control over a situation. The Applicants objected to this witness.

59. The Commission heard expert testimony from Richard Grossman, M.D. regarding the impact of gas wells on people and the environment. Dr. Grossman expressed concern about the availability of gas for future generations.

SAN JUAN CITIZENS ALLIANCE EVIDENCE

63. The Commission heard expert testimony from Dale Lehman, Economics Professor regarding the lack of data provided to the Commission to determine cost-effectiveness and economic need for additional wells. Mr. Lehman testified about guidelines for economic analysis for infill development.

64. The Commission heard expert testimony from Wilma Subra, Biologist regarding potential impacts from increased well density on the environment and disposition of oilfield waste.

65. The Commission heard fact testimony from Jane Dryer regarding the presence of combustible gas in her home and possible health effects on her child.

66. The Commission heard expert testimony from Jim Fitzgerald, Sociology Professor regarding the importance of stories told by the public who opined that the application was not sufficient to address public welfare.

LA PLATA COUNTY EVIDENCE

67. The Commission heard expert testimony from David Cox regarding the data used and results obtained in the 3M Coalbed Methane Reservoir Model he prepared. He opined that the model showed no impact from increased well density.

68. The Commission heard expert testimony from Warren Holland, Engineer and Oil and Gas Technical Advisor to the County regarding the significant adverse environmental impacts he believes may result from increased well density. He further testified as to the plan proposed by the County and opined that it would adequately address the environment, public health, safety and welfare issues.

69. The Commission heard expert testimony from Adam Keller, La Plata County Planner and Local Governmental Designee regarding the County's proposal to require operators to provide annual drilling plans to the County that could be distributed to affected surface owners.

70. On June 20, 2000 written supplemental testimony was submitted by Adam Keller clarifying the County's proposed environment, public health, safety and welfare plan.

71. On June 20, 2000 written direct testimony was submitted by Joe Crain supporting the County's proposed environment, public health, safety and welfare plan.

72. On June 20, 2000 written direct testimony was submitted by Josh Joswick supporting the County's proposed environment, public health, safety and welfare plan.

FINDINGS

75. Based on the testimony and exhibits presented at the June and July Public Issues Hearing and pursuant to Rule 508.j.(3), the Commission finds it necessary to apply conditions to the order to protect the environment from significant adverse impacts and to protect the public health, safety, and welfare, except as to those lands included in the BLM's Notice of Decision and Order dated May 3, 2000.

ORDER

NOW, THEREFORE, IT IS ORDERED, that Order Nos. 112-60, 112-61 and 112-85 are hereby amended to allow an optional additional well to be drilled for production of gas from the Fruitland Coal seams for the 320-acre drilling and spacing units described below, with the permitted well to be located in any undrilled quarter section no closer than 990 feet from the boundaries of the quarter section, nor closer than 130 feet to any interior quarter section line.

Township 32 North, Range 5 West, N.M.P.M. Sections 5 thru 8: All Sections 17 thru 20: All

Township 32 North, Range 6 West, N.M.P.M. Sections 1 thru 4: All Section 5: N1/2 Section 7: E1/2 Section 8: E1/2 Sections 9 thru 16: All Section 17: E1/2 Section 18: All Section 23: All Section 24: All

Township 32 North, Range 7 West, N.M.P.M. Sections 3 thru 6: All Section 7: E1/2 Sections 8 thru 11: All Sections 13 thru 17: All Section 19: E1/2 E1/2 Sections 20 thru 22: All Section 23: W1/2; W1/2 E1/2

Township 33 North, Range 7 West, N.M.P.M. Sections 1 thru 7: All Section 8: E1/2 Sections 9 thru 11: All Section 12: N1/2 Section 14: W1/2 Sections 15 thru 23: All Section 25: All Section 26: W1/2 Sections 27 thru 34: All Section 35: W1/2 Section 36: N1/2

Township 33 North, Range 8 West, N.M.P.M. Sections 1 thru 18: All Section 19: N1/2 Section 20: N1/2 Sections 21 thru 27: All Section 35: N1/2 Section 36: All

Township 33 North, Range 9 West, N.M.P.M. Sections 1 and 2: All Section 3: N1/2 Sections 4 thru 15: All Section 16: E1/2 Sections 17 thru 24: All Section 29: W1/2 Section 30: All Section 31: N1/2 Section 32: W1/2

Township 33 North, Range 10 West, N.M.P.M. Sections 1 thru 6: All Section 10: All Section 11: E1/2 Section 12: All Section 14: W1/2 Section 15: All Section 16: All Section 20: E1/2 Section 21: W1/2

Township 33 North, Range 11 West, N.M.P.M. Section 1: E1/2 Section 13: N1/2 Section 14: All

Township 34 North, Range 7 West, N.M.P.M. (S.U.L.) Sections 1 thru 9: All Section 10: E1/2 Sections 11 thru 36: All

IT IS FURTHER ORDERED, that the following shall be applied to additional wells where the surface location is proposed to be sited on lands subject to Commission jurisdiction, in addition to any requirements of applicable existing Commission Rules and Regulations:

Well Permit Limitations A Commission hearing shall be required before a drilling permit may be issued for a well site located within one and one-half (11/2) miles of the outcrop contact between the Fruitland and Pictured Cliffs Formations. The purpose of the hearing shall be to address potential adverse impacts to the Fruitland outcrop.

Water Well Sampling The Director shall apply appropriate drilling permit conditions to require water well sampling near proposed additional wells. The following shall be used as guidance for the Director in establishing permit conditions requiring water well sampling:

If a conventional gas well exists within one quarter (1/4) mile of a proposed additional well, then the two (2) closest water wells within a one-half (1/2) mile radius shall be sampled ("water quality testing wells"). Ideally, if possible, the water wells selected should be on opposite sides of the existing conventional gas well not exceeding a one-half (1/2) mile radius. If water wells on opposite sides of the conventional gas well cannot be identified , then the two (2) closest wells within a one-half (1/2) mile radius shall be sampled. If two (2) or more conventional wells are located within one quarter (1/4) mile of the proposed additional well, then the conventional well closest to a proposed additional well shall be used for selecting water wells for sampling.

If no conventional gas wells are located within a one quarter (1/4) mile radius of the proposed additional well, then the selected water wells shall be within one quarter (1/4) mile of the proposed additional well. In areas where two (2) or more water wells exist within one quarter (1/4) mile of the proposed additional well, then the two (2) closest water wells shall be sampled. Ideally, if possible, the water wells selected should be on opposite sides of the proposed additional well. If water wells on opposite sides of the proposed additional well cannot be identified, then the two (2) closest wells within a one quarter (1/4) mile radius shall be sampled. If two (2) water wells do not exist within a one quarter (1/4) mile radius, then the closest single water well within either a one quarter (1/4) mile radius or within a one-half (1/2) mile radius shall be selected.

If no water well is located within a one quarter (1/4) mile radius area or if access is denied, a water well within one-half (1/2) mile of the proposed additional well shall be selected. If there are no water quality testing wells meeting the foregoing criteria, then sampling shall not be required. If the BLM or the COGCC have already acquired data on a water well within one quarter (1/4) mile of the conventional well, but it is not the closest water we ll, it shall be given preference in selecting a water quality testing well. The "initial baseline testing" described in this paragraph shall include all major cations and anions, TDS, iron and manganese, nutrients (nitrates, nitrites, selenium), dissolved methane, pH, presence of bacteria and specific conductance and field hydrogen sulfide.

The initial baseline testing shall occur prior to the drilling of the proposed additional well. Within one (1) year after completion of the proposed additional well, a "post completion" test shall be performed for the same parameters above and repeated three (3) and six (6) years thereafter. If no significant changes from the baseline have been identified after the third test (the six year test), no further testing shall be required. Additional "post c ompletion" test(s) may be required if changes in water quality are identified during follow-up testing. The Director may require further water well sampling at any time in response to complaints from water well owners.

Copies of all test results described above shall be provided to the COGCC, La Plata County or Archuleta County and the landowner where the water quality testing well is located within three (3) months of collecting the samples used for the test.

Plugged and Abandoned Wells The operator shall attempt to identify all plugged and abandoned ("P&A") wells located within one quarter (1/4) mile of a proposed additional well. Any P&A well within one quarter (1/4) mile of a proposed additional well that is identified shall be assessed for risk taking into account cementing practices reported in the P&A. The operator shall notify the Director of the risk assessment of plugging procedures. The Director shall review the risk assessment and take appropriate action to pursue further investigation and remediation if warranted.

Annual Drilling Plan The Director shall survey operators as to their drilling plans for the remainder of the year 2000 and for 2001, and annually thereafter. The survey results shall be reported to the Commission for its consideration with respect to the conditions attached to this order.

Wildlife The operator shall notify the Colorado Division of Wildlife ("CDOW") of the location of any proposed additional well site and advise the Director of the date such notice was provided. If the Director receives comments from the CDOW within ten (10) days of the date notice was provided, such comments may be considered in applying Rule 508 j.(3)B. conditions.

Emergency Preparedness Plan Any operator submitting an Application for Permit-to-Drill for a proposed additional well shall file and maintain a digital Emergency Preparedness Plan ("EPP") with La Plata County or Archuleta County. The EPP shall include as-built facilities maps showing the location of wells, pipelines and other facilities, except control valve locations that which may be held confidential. The EPP shall include an emergency personnel con tact list.

Gas and Oil Regulatory Team The Director shall ensure that the La Plata County Gas and Oil Regulatory Team ("GORT") continues to meet as appropriate, but no less than quarterly. (GORT includes invited member representatives from La Plata County, BLM, Southern Ute Indian Tribe, industry operators and COGCC. Its meetings are open and typically attended by interested area residents.)

pressure build-up testing.

IT IS FURTHER ORDERED, that pursuant to Rule 508.j.(3)B. the Director shall have discretion as described in Exhibit "A" to attach additional conditions to any Applications for Permits-to-Drill additional wells where the surface well location is proposed to be sited on lands subject to Commission jurisdiction.

IT IS FURTHER ORDERED, that the Commission expressly reserves its right, after notice and hearing, to alter, amend or repeal any and/or all of the above orders.

ENTERED this day of July, 2000, as of July 11, 2000.

OIL AND GAS CONSERVATION COMMISSION OF THE STATE OF COLORADO

By Patricia C. Beaver, Secretary Dated at Suite 801 1120 Lincoln Street Denver, Colorado 80203 July 28, 2000

Exhibit "A"

RULE 508 j.(3)B CONDITIONS

The following requirements shall apply to all Applications for Permits-to-Drill additional wells subject to Order Nos. 112-156 and 112-157 where the surface well location is proposed to be sited on lands subject to COGCC jurisdiction in addition to any requirements of applicable existing COGCC rules and regulations:

1.) Prior to approving any Application for Permit-to-Drill, the Director shall conduct an onsite inspection if the surface well location is proposed to be sited within any subdivision that has been approved by La Plata County or Archuleta County or within two (2) miles of the outcrop contact between the Fruitland and Pictured Cliffs Formations.

2.) Prior to approving any Application for Permit-to-Drill, the Director shall conduct an onsite inspection if the operator and the surface owner have not entered into a surface use agreement.

3.) The purpose of the onsite inspection shall be to identify any potential public health, safety and welfare or significant adverse environmental impacts within COGCC jurisdiction regarding the proposed surface location that may not be adequately addressed by COGCC rules or orders. The onsite inspection shall not address matters of surface owner compensation, property value diminution, or any private party contractual issues between the operator and the surface owner.

4.) When the Director conducts onsite inspections under the conditions in 1.) and 2.) above, the Director shall invite the representatives of the surface owner, the operator and local governmental designee conditions if necessary to prevent or mitigate public health, safety and welfare or significant adverse environmental impacts taking into consideration cost-effectiveness and technical feasibility and relevant geologic and petroleum engineering conditions as well as prevention of waste, protection of correlative rights, and promotion of development.

6.) Examples of the types of impacts and conditions that might be applied if determined necessary by the Director in 5.) above include (this list is not prescriptive or all inclusive):

a.) visual or aesthetic impacts - moving the proposed surface well site location or access road to take advantage of natural features for screening; installing low profile artificial lift methods; constructing artificial features for screening

b.) surface impacts - moving or reducing the size, shape, or orientation of the surface well site location or access road to avoid disturbance of natural features or to enhance the success of future reclamation activities; utilizing an existing surface well site location or access road to avoid the impacts of new construction; utilizing a closed drilling fluid system instead of reserve pits to avoid impacts to sensitive areas [Note: Directional drilling f rom common surface locations is not a cost-effective or technically feasible option to mitigate surface impacts on 160-acre Fruitland coal seams well density because of the shallow (approximately 2000') target top depths, the long (average 2640') displacements and the resulting complications for artificial lift.]

c.) noise impacts - installing electric motors where practicable; locating or orienting motors or compressors to reduce noise; installing sound barriers to achieve compliance with COGCC rules; confining cavitation completion operations (excluding flaring) to the hours of 7 a.m. to 7 p.m. and notifying all area residents within one-half (1/2) mile at least seven (7) days before cavitation is commenced

d.) dust impacts - watering roads as necessary to control dust during drilling and completion operations

e.) ground water impacts - collecting and analyzing water and gas samples from existing water wells or springs; installing monitoring wells, collecting samples, and reporting water, gas and pressure data

f.) safety impacts - soil gas sampling and analysis; residential crawl space gas sampling and analysis; installing security fencing around wellheads and production equipment

g.) outcrop impacts - performing outcrop gas seep surveys; performing produced water quality analysis; periodic pressure transient testing of high water/gas ratio wells; limiting water production in wells with anomalously high water rates and water/gas ratios; funding investigative reservoir modelling under the Director's supervision

h.) wildlife impacts - limiting drilling and completion operations during certain seasonal time periods when specific site conditions warrant

Director may properly notice and set the matter for the next regularly scheduled Commission hearing to order appropriate investigative or remedia l action. Reasonable cause may include, but is not limited to, information from the 3M Mapping, Modelling and Monitoring Project.

The Director shall report in writing to the Commission no later than September 1, 2001, as to Applications for Permits-to-Drill received, onsite inspections conducted, surface use agreements reached and permit conditions applied related to proposed additional wells. The Director, after consultation with the Commission, shall notice for Commission hearing a discussion of such report no later than December 15, 2001. ??

7 (112-157)

Cause Index

Main Index

COGCC APPROVED INCREASED DENSITY APPLICATIONS
(AS OF 8/31/00)

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Vastar	SE ¼ SE ¼	14-T32N-R9W	E ½	RC	112-120
Vastar	NE ¼ SE ¼	13-T32N-R9W	E ½	RC	112-121
Cedar Ridge	SE ¼ NW ¼	5-T32N-R11W	W ½	RC	112-124
Cedar Ridge	SE ¼ SE ¼	7-T32N-R11W	E ½	RC	112-125
Red Willow	NW ¼ NW ¼	17-T32N-R11W	W ½	RC	112-130
Texaco	E ½	10-T32N-R9W	E ½	DR	112-133
Texaco	NW ¼ SW ¼	34-T33N-R9W	W ½	RC	112-134
Red Willow	various lands (Mesa Mountain)				112-136
Petrogulf	SW ¼ SW ¼	31-T33N-R9W	S ½	DR	112-137
J.M Huber	various land				112-138
Vastar	N ½	8-T32N-R9W	E ½	RC	112-139
Vastar	W ½	20-T33N-R10W	W ½	RC	112-140
Vastar	S ½	18-T3N-R10W	S ½	RC	112-141
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Red Willow	various lands				112-143
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Amoco	NE ¼	16-T34N-R8W(S)	N ½	RC	112-149
	SW ¼	35-T35N-R8W	S ½	RC	112-149
Amoco	NE ¼	9-T34N-R8W(N)	E ½	DR	112-152
Amoco	NW ¼	11-T33N-R10W	W ½	RC	112-153
Vastar	various lands			DR	112-154
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Amoco et al	various lands			DR	112-156
Amoco et al	various lands			DR	112-157

APPENDIX P

HAZARDOUS MATERIALS SUMMARY

This Hazardous Materials Summary is provided pursuant to Bureau of Land Management (BLM) Instruction Memoranda Numbers CO-97-023 and WO-93-344, which require that all National Environmental Policy Act (NEPA) documents list and describe any hazardous and/or extremely hazardous materials that would be produced, used, stored, transported, or disposed of as a result of a proposed project. The summary serves as a supplement to the FEIS for Oil and Gas Development on the Southern Ute Indian Reservation.

Materials are considered hazardous if they contain chemicals or substances listed in the Environmental Protection Agency's (EPA's) *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986.* Extremely hazardous materials are those identified in the EPA's *List of Extremely Hazardous Substances* (40 Code of Federal Regulations [CFR] 355).

Hazardous materials anticipated to be used or produced during the project may come from drilling materials, casing and plugging materials, fracturing materials, production products, fuels, geophysical survey materials, pipeline materials emissions, and miscellaneous materials. Where possible, the quantities of these products or materials have been estimated on a per-well basis. Hazardous and extremely hazardous constituents potentially occurring in these products or materials have been identified and are listed in Table P-1.

Drilling Materials

Water-based drilling fluids consisting of clays and other additives would be utilized by drilling companies for drilling each well. Drilling fluid additives potentially containing hazardous materials are listed in Table P-1. The plyacrilamides used in drilling may contain the extremely hazardous substance acrylamide. Drilling fluid additives would be transported to well locations during drilling operations in appropriate sacks and containers. Drilling fluids, cuttings, and water would be stored in reserve pits located on-site, and reserve pits would be lined as directed by the BLM to conserve water and protect near-surface aquifers. When the reserve pit is no longer required, its contents would be evaporated or solidified in place and the pit backfilled as approved by the BLM

Cementing and Plugging Materials

Well completion and abandonment operations include cementing and plugging various segments of the well bore to protect freshwater aquifers and other down-hole resources. Wells would be cased and cemented and approved by the BLM (for federal minerals), and Colorado Oil and Gas Conservation Commission (COGCC) (for state and patented minerals). Cementing and plugging materials potentially containing hazardous materials are listed in Table P-1. The extremely hazardous material acrylamide may be present in fluid loss additives. All casing and plugging materials would be transported in bulk to each well site. Small quantities may be transported and stored on-site in appropriate containers.

Fracturing Materials

Hydraulic fracturing is expected to be performed at all proposed wells to enhance gas flow rates. Fracturing fluids consist primarily of fresh water, but would contain some additives with hazardous constituents as shown in Table P-1. Fracturing materials would be transported to well locations in bulk or in manufacturer's containers. Waste fracturing fluids would be collected in above-ground tanks and/or reserve pits and evaporated, or hauled away from the location and reused at another well or disposed of at an authorized facility.

Table P-1: Hazardous and Extremely Hazardous Materials potentially utilized or produced during construction, drilling, production, and reclamation operations.

Source	Approximate Quantities Used or Produced per Well[1]	Hazardous Substances[2]	Extremely Hazardous Substances[3]	CAS No.
Drilling Materials				
Barite	16,000 lbs	Barium compounds Fine mineral fibers		— —
Bentonite	45,000 lbs	Fine mineral fibers		—
Caustic soda	750 lbs	Sodium hydroxide		1310-73-2
Glutaraldehyde	20 gal	Isopropyl alcohol		67-63-0
Lime	3,500 lbs	Calcium hydroxide		1305-62-0
Mica	600 lbs	Fine mineral fibers		—
Modified tannin	250 lbs	Ferrous sulfate Fine mineral fibers		7720-78-7 —
Phosphate esters	100 gals	Methanol		67-56-1
Polyacrylamides	100 gals	PAHs[4] Petroleum distillates POM[5]	Acrylamide	79-06-1 — 64742-47-8 —
Retarder	400 lbs	Fine mineral fibers		—
Cementing and Plugging Materials				
Anti-foamer	100 lbs	Glycol ethers		—
Calcium chloride flake	2,500 lbs	Fine mineral fibers		—
Cellophane flake	300 lbs	Fine mineral fibers		—

Cements	77,000 lbs	Aluminum oxide Fine mineral fibers		1344-2-1 —
Chemical wash	850 gals	Ammonium hydroxide Glycol ethers		1336-21-6 —
Diatomaceous earth	1,000 lbs	Fine mineral fibers		—
Extenders	17,500 lbs	Aluminum oxide Fine mineral fibers		1344-28-1 —
Fluid loss additive	900 lbs	 Fine mineral fibers Napthalene	Acrylamide	79-06-1 — 91-20-3
Friction reducer	160 lbs	Fine mineral fibers Napathalene PAHs POM		— 91-20-3 — —
Mud flash	250 lbs	Fine mineral fibers		—
Retarder	100 lbs	Fine mineral fibers		—
Salt	2,570 lbs	Fine mineral fibers		—
Silica flour	4,800 lbs	Fine mineral fibers		—
Fracturing Materials				
Biocides	6 gals	Fine mineral fibers PAHs POM		— — —
Breakers	145 lbs	Ammonium persulphate Ammonium sulphate Copper compounds Ethylene glycol Fine mineral fibers Glycol ethers		7727-54-0 7783-20-2 — 107-21-1 — —
Clay stabilizer	50 gals	Fine mineral fibers Glycol ethers Isopropyl alcohol Methanol PAHs POM		— — 67-63-0 67-56-1 — —
Crosslinkers	60 gals	Ammonium chloride Methanol Potassium hydroxide Zirconium nitrate Zirconium sulfate		12125-02-9 67-56-1 1310-58-3 13746-89-9 14644-61-2
Foaming agent	120 gals	Glycol ethers		—
Gelling agent	950 gals	Benzene Ethylbenzene Methyl tert-butyl ether Napthalene PAHs POM Sodium Hydroxide Toluene m-Xylene o-Xylene p-Xylene		71-43-2 100-41-4 1634-04-4 91-20-3 — — 1310-73-2 108-88-3 108-38-2 95-47-6 106-42-3
pH buffers	60 gals	Acetic acid Benzoid acid Fumaric acid Hydrochloric acid Sodium hydroxide		64-19-7 65-85-0 110-17-8 7647-01-0 1310-73-2
Sands	2,000,000 lbs	Fine mineral fibers		—

Solvents	50 gals	Glycol ethers		—
Surfactants	15 gals	Glycol ethers Isopropyl alcohol Methanol PAHs POM		— 67-63-0 67-56-1 — —
Production Products				
Liquid hydrocarbons	<5-45 bpd	Benzene Ethyl benzene n-Hexane PAHs POM Toluene m-Xylene o-Xylene p-Xylene		71-43-2 100-41-4 110-54-3 — — 108-88-3 108-38-3 95-47-6 106-42-3
Natural gas	0.5>5.0 mmcfd	n-Hexane PAHs POM		110-54-3 — —
Produced water/cuttings	0.5-10 bpd water and an unknown quantity of cuttings	Arsenic Barium Cadmium Chromium Lead Manganese Mercury Radium 226 Selenium Uranium Other radionuclides		7440-38-2 7440-39-3 7440-43-9 7440-47-3 7439-92-1 7439-96-5 7439-97-6 — 7782-49-2 — —
Fuels				
Diesel fuel	>36,300 gal	Benzene Cumene Ethylbenzene Methyl tert-butyl ether Napthalene PAHs POM Toluene m-Xylene o-Xylene p-Xylene		71-43-2 98-82-8 100-41-4 1634-04-4 91-20-3 — — 108-88-3 108-38-3 95-47-6 106-42-3
Gasoline	Unknown	Benzene Cumene Cyclohexane Ethylbenzene n-Hexane Methyl tert-butyl ether Napthalene PAHs POM Toluene m-Xylene o-Xylene p-Xylene	Tetraethyl lead	71-43-2 98-82-8 110-82-7 100-41-4 110-54-3 1634-04-4 91-20-3 — — 78-00-2 108-88-3 108-38-3 95-47-6 106-42-3

Natural gas	Unknown	n-Hexane PAHs POM		110-54-3 — —
Propane	Unknown	Propylene		115-07-1
Geophysical Survey Materials				
Explosives, fuses, detonators, boosters, fuels	Unknown	Aluminum Ammonium nitrate Benzene Cumene Ethylbenzene Ethylene glycol Lead compounds Methyl tert-butyl ether Napthalene Nitric acid Nitroglycerine PAHs POM Toluene m-Xylene o-Xylene p-Xylene		7429-90-5 6484-52-2 71-43-2 98-82-8 100-41-4 107-21-1 7439-92-1 1634-04-4 91-20-3 7697-37-2 55-63-0 — — 108-88-3 108-38-3 95-47-6 106-42-3
Pipeline Materials				
Coating	Unknown	Aluminum Oxide		1334-28-1
Cupric sulfate solution	Unknown	Cupric sulfate Sulfuric acid		7758-98-7 7664-93-9
Diethanolamine	Unknown	Diathanolamine		111-42-2
LP Gas	Unknown	Benzene n-Hexane Propylene		71-43-2 110-54-3 115-07-1
Molecular sieves	Unknown	Aluminum oxide		1344-28-1
Pipeline primer	Unknown	Napthalene Toluene		91-20-3 108-88-3
Potassium hydroxide solution	Unknown	Potassium hydroxide		1310-58-3
Rubber resin coatings	Unknown	Acetone Coal tar pitch Ethyl acetate Methyl ethyl ketone Toluene Xylene		67-64-1 68187-65-5 141-78-6 78-93-3 108-88-3 1330-2-07
Emissions				
Gases	127 tons[6]	Formaldehyde	 Nitrogen dioxide Ozone Sulfur dioxide Sulfur trioxide	50-00-0 10102-44-0 10028-15-6 7446-09-5 7446-11-9
Hydrocarbons	492 tons[7]	Benzene Ethylbenzene n-Hexane PAHs Toluene m-Xylene o-Xylene p-Xylene		71-43-2 100-41-4 100-54-3 — 108-88-3 108-38-3 95-47-6 106-42-3

Particulate matter	24 tons[8]	Barium		7440-39-3
		Cadmium		7440-43-9
		Copper		7440-50-8
		Fine mineral fibers		—
		Lead		7439-92-1
		Manganese		7493-96-5
		Nickel		7440-02-0
		POM		—
		Zinc		7440-66-6
Miscellaneous Materials				
Acids	Unknown	Acetic anhydride		108-24-7
		Formic acid		65-18-6
		Sodium chromate		777-11-3
		Sulfuric acid		7664-93-09
Antifreeze, heat control, and dehydration agents	300 gals	Acrolein		107-02-8
		Cupric sulfate		7758-38-7
		Ethylene glycol		107-21-1
		Freon		76-13-1
		Phosphoric acid		766-38-2
		Potassium hydroxide		1310-58-3
		Sodium hydroxide		1310-73-2
		Triethylene glycol		112-27-6
Batteries	Unknown	Cadmium		7440-43-0
		Cadmium oxide		1306-19-0
		Lead		7493-92-1
		Nickel Hydroxide		7440-02-0
		Potassium hydroxide		1310-58-3
		Sulfuric acid		7664-93-9
Biocides	Unknown	Formaldehyde		50-00-0
		Isopropyl alcohol		67-63-0
		Methanol		67-56-1
Cleaners	Unknown	Hdrochloric acid		7647-01-0
Corrosion inhibitors	Unknown	4-4' methylene dianiline		101-77-9
		Acetic acid		64-19-7
		Ammonium bisulfite		10192-30-0
		Basic zinc carbonate		3486-35-9
		Diethylamine		109-89-7
		Dodecylbenzenesulfonic acid		27176-87-0
		Ethylene glycol		107-21-1
		Isobutyl alcohol		78-83-1
		Isopropyl alcohol		67-63-0
		Methanol		67-56-1
		Napthalene		91-20-3
		Sodium nitrite		7632-00-0
		Toluene		108-88-3
		Xylene		1330-20-7
Emulsion breakers	Unknown	Acetic acid		64-19-7
		Acetone		67-64-1
		Ammnium chloride		12125-02-9
		Benzoic acid		65-85-0
		Ispropyl alcohol		67-63-0
		Methanol		67-56-1
		Napthalene		91-20-3
		Toluene		108-88-3
		Xylene		1330-20-7
		Zinc chloride		7646-85-7
Fertilizers	Unknown	Unknown		—
Herbicides	Unknown	Unknown		—

Lead-free thread compound	25 gals	Copper Zinc		7440-50-8 7440-66-6
Lubricants	Unknown	1,2,4-trimethylbenzne Barium Cadmium Copper n-Hexane Lead Manganese Nickel PAHs POM Zinc		94-63-6 7440-39-3 7440-43-9 7440-50-8 110-54-3 7439-92-1 7439-96-5 7440-02-0 — — 7440-66-6
Paraffin control	Unknown	Carbon disulfide Ethylbenzene Methanol Toluene Xylene		75-15-0 100-41-4 67-56-1 108-88-3 1330-20-7
Methanol	200 gals	Mdethanol		67-56-1
Motor oil	220 gals	Zinc compounds		—
Paints	Unknown	Aluminum Barium n-Butyl alcohol Cobalt Lead Manganese PAHs POM Sulfuric acid Toluene Triethylamine Xylene		7429-90-5 7440-39-3 71-36-3 7440-48-4 7439-92-1 7439-96-5 — — 7664-93-9 108-88-3 121-44-8 1330-20-7
Photoreceptors	Unknown	Selenium		7782-49-2
Scale inhibitors	Unknown	Acetic acid Ethylene diamine tetra Ethylene glycol Formaldehyde Hydrochloric acid Isopropyl alcohol Methanol Nitrilotriacetic acid		64-19-7 60-00-4 107-21-1 50-00-0 7647-01-0 67-63-1 67-56-1 139-13-9
Sealants	Unknown	1,1,1-trichloroethane n-Hexane PAHs POM		71-55-6 110-54-3 — —
Solvents	Unknown	1,1,1-trichloroethane Acetone t-Butyl alcohol Carbontetrachloride Isopropyl alcohol Methyl ethyl ketone Methanol PAHs POM Toluene Xylene		71-55-6 67-64-1 75-65-0 56-23-5 67-63-0 108-10-1 67-56-1 — — 108-88-3 1330-20-7
Starting fluid	Unknown	Ethyl ether		60-29-7
Surfactants	Unknown	Ethylene diamine Isopropyl alcohol Petroleum naptha		107-15-3 67-56-1 8030-30-6

lbs = pounds; gals = gallons; bpd = barrels per day; mmcfd = million cubic feet per day; Unknown = unknown quantities to be listed based on information availability.
Hazardous substances are those constituents listed under the Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, as amended.
Extremely hazardous substances are those defined in 40 CFR 355.
PAHs = polynuclear aromatic hydrocarbons.
POM = polycryclic organic matter.
Value includes NO_2 (107 tons per well) and SO^2 (20 tons per well) estimates only, as adapted from BLM (1996b).
Value includes volatile organic compound emission estimates only, as adapted from BLM (1996b).
Value includes PM_{10} emission estimates only, as adapted from BLM (1996b).