# Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development on *the Southern Ute Indian Reservation*

**Volume I:** PEA Document and Appendices A – F

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# List of Acronyms and Abbreviations

| Acronym/Abbreviation | Full Name or Phrase |
|---|---|
| AADT | Average Annual Daily Trips |
| ACEC | Areas of Critical Environmental Concern |
| AF/yr | Acre feet per year |
| AFR | Air Fuel Ratio |
| AIRFA | American Indian Religious Freedom Act |
| ALP | Animas La Plata Project |
| ANC | Acid Neutralizing Capacity |
| APCD | Air Pollution Control Division |
| APD | Application for Permit to Drill |
| AQRVs | Air Quality Related Values |
| ARPA | Archaeological Resources Protection Act |
| AUMs | Animal unit months |
| BA | Biological Assessment |
| BACT | Best available control technology |
| bbls | Barrels |
| Bcf | Billion cubic feet |
| BGEPA | Bald and Golden Eagle Protection Act |
| BIA | U.S. Bureau of Indian Affairs |
| BLM | U.S. Bureau of Land Management |
| BMPs | Best Management Practices |
| BOP | Blowout preventor |
| BOR | U.S. Bureau of Reclamation |
| CAA | Clean Air Act |
| CEQ | Council on Environmental Quality |
| CBM | Coalbed methane |
| CDOT | Colorado Department of Transportation |
| CDOW | Colorado Division of Wildlife |
| CDP | Central Delivery Point |
| CDPHE | Colorado Department of Public Health and Environment |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CIR | County Impact Report |
| CFR | Code of Federal Regulations |
| cm | Centimeter |
| CNHP | Colorado Natural Heritage Program |
| CO | Carbon Monoxide |
| COA | Conditions of Approval |
| COGCC | Colorado Oil and Gas Conservation Commission |
| CWA | Clean Water Act |
| CR | County Road |
| dBA | A-weighted decibels or decibels adjusted |
| d/b/a/ | Doing business as |
| DNA | Determination of NEPA Adequacy |
| DNR | Department of Natural Resources (SUIT) |
| DOE | Department of Energy (SUIT) |

| Acronym/Abbreviation | Full Name or Phrase |
|---|---|
| dV | Deciview |
| DWRM | Division of Wildlife Resource Management (SUIT) |
| EA | Environmental Assessment |
| EAC | Early Action Compact |
| ECBMR | Enhanced coalbed methane recovery |
| ECHO | Enforcement and Compliance Online |
| EIS | Environmental Impact Statement |
| EPD | Environmental Programs Division (SUIT) |
| ESA | Endangered Species Act |
| FCAQTF | Four Corners Air Quality Task Force |
| FEIS | Final Environmental Impact Statement |
| FLPMA | Federal Land Policy and Management Act |
| GIS | Geographic Information System |
| GORT | Gas and Oil Regulatory Team |
| g/hp-hr | Grams per horsepower hour |
| gpm | Gallons per minute |
| GPO | Government Printing Office |
| ha | Hectare |
| HAPs | Hazardous Air Pollutants |
| hp | Horsepower |
| $H_2S$ | Hydrogen sulfide |
| IHS | Indian Health Services |
| LEAD | La Plata Economic Development Action Partnership |
| LOP | Life of Project |
| LOS | Level of Service |
| LTFP | Long Term Financial Plan |
| m | Meter |
| MACT | Maximum Achievable Control Technology |
| mbbl | Thousand barrels |
| MBTA | Migratory Bird Treaty Act |
| Mcf | Thousand cubic feet |
| MEI | Maximum exposed individual |
| mg/L | Milligrams per liter |
| MLE | Most likely exposed |
| MM5 | Mesoscale model |
| MMcf | Million cubic feet |
| MMS | Minerals Management Service |
| MOU | Memorandum of Understanding |
| MW | Megawatt |
| NDIS | Natural Diversity Information System (Colorado) |
| NAAQS | National Ambient Air Quality Standards |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NPC | National Petroleum Council |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | A generic term for mono-nitrogen oxides (NO and $NO_2$) |

| Acronym/Abbreviation | Full Name or Phrase |
|---|---|
| NSCR | Non-selective catalytic reduction |
| NSPS | New Source Performance Standard |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NIIP | Navajo Indian irrigation Project |
| NMED | New Mexico Environment Department |
| NMHC | Non-methane hydrocarbon |
| $NO_x$ | Nitrogen Oxide |
| NPDES | National Pollution Discharge Elimination System |
| NPS | National Park Service |
| NRCS | Natural Resource Conservation Service |
| NRMP | SUIT Natural Resource Management Plan, 1990 - 2010 |
| NSJB | Northern San Juan Basin |
| NSPS | New Source Performance Standards |
| NSR | New Source Review |
| PAHs | Polycyclic aromatic hydrocarbons |
| PEA | Programmatic Environmental Assessment |
| PILT | Payment in Lieu of Taxes |
| PLC | Programmed logic controller |
| $PM_{2.5}$ | Particulate matter 2.5 microns in size |
| $PM_{10}$ | Particulate matter 10 microns in size |
| ppb | Parts per billion |
| ppm | Parts per million |
| PRMP | Proposed Resource Management Plan (Farmington) |
| PSD | Prevention of Significant Deterioration |
| psi | Pounds per square inch |
| RAPPS | Reasonable And Prudent Practices for Stabilization |
| RCRA | Resource Conservation and Recovery Act |
| Reservation | Southern Ute Indian Reservation |
| RFS | Reasonably Foreseeable Sources |
| RICE | Reciprocating Internal Combustion Engine |
| ROD | Record of Decision |
| ROW | Right-of-Way |
| RRF | Relative Reduction Factor |
| SCR | Selective catalytic reduction |
| SH | State Highway |
| SHPO | State Historic Preservation Office |
| SJB | San Juan Basin |
| SJRBRIP | San Juan River Basin Recovery Implementation Program |
| $SO_2$ | Sulfur Dioxide |
| Spark ignited | SI |
| Substation | Four Corners Power Plant |
| SUCAP | Southern Ute Community Action Programs |
| SUGF | Southern Ute Growth Fund |
| SUIT | Southern Ute Indian Tribe |
| SWQB | Surface Water Quality Bureau |

| Acronym/Abbreviation | Full Name or Phrase |
|---|---|
| SUSG | Sky Ute Sand and Gravel |
| SWRGAP | Southwest Regional GAP |
| tcf | Trillion cubic feet |
| TDS | Total dissolved solids |
| TERO | Tribal Rights Employment Office |
| TMDL | Total Maximum Daily Load |
| TUA | Temporary Use Area |
| UNM | University of New Mexico |
| UNM-BBER | UNM Bureau of Business/Economic Review |
| μeq/l | Microequivalents per liter |
| μg/$m^3$ | Micrograms per cubic meter |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USDI | U.S. Department of Interior |
| USEPA | U.S. Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Services |
| USGS | U.S. Geological Survey |
| UTM | Universal Transverse Mercator |
| VOC | Volatile Organic Compounds |
| WQP | Water Quality Program |
| 4M Study | *Preliminary Evaluation of the Methane Seepage Mitigation Alternatives* |
| °F | Degrees Fahrenheit |

# 1.0 PURPOSE AND NEED

## 1.1 Introduction

This programmatic environmental assessment (PEA) is being tiered to the Final Environmental Impact Statement (FEIS) Oil and Gas Development on the Southern Ute Indian Reservation (Reservation) (U.S. Department of Interior [USDI] 2002). The Southern Ute Indian Tribe (SUIT) is proposing 770 coal bed methane (CBM) 80-acre infill wells to be drilled from existing and new well sites within the Reservation over a twenty-year period. The purpose of the action is to economically extract, in an efficient and environmentally compatible manner, the recoverable oil and gas reserves known to exist in mineral estates held in trust by the United States for the benefit of the SUIT and its members through the use of 80-acre infill spacing. The need is to provide economic benefits to the SUIT and its members over the next several decades. The study area, the same as in the 2002 FEIS, encompasses approximately 421,450 acres of land, including portions of La Plata, Archuleta, and Montezuma counties (Map 1-1, Appendix A).

## 1.2 Background

The 2002 FEIS analyzed the environmental impacts of various alternatives for comprehensive development of oil and gas resources within substantial portions of the Reservation. Following public review of the 2002 FEIS, the Bureau of Land Management (BLM) and the Bureau of Indian Affairs (BIA), with the concurrence of SUIT, issued a record of decision (ROD) in 2002 selecting as the preferred alternative, Alternative 3, Enhanced Coalbed Methane Recovery (ECBM) (USDI 2002a). As summarized in the 2002 ROD, the preferred alternative analyzed the drilling or recompletion of 636 production wells (269 conventional and 367 CBM wells), using a density of two CBM wells for each 320-acre spacing unit, on Reservation lands beneficially owned by SUIT or its members under the trust supervision of the USDI. The preferred alternative also analyzed potential expansion of ECBM recovery on Tribal mineral estates through the drilling or recompletion of 70 injector wells and the injection of nitrogen, carbon dioxide, or other fluids into the Fruitland Formation. The 2002 FEIS evaluated the impacts associated with an estimated 1,306 acres of surface disturbance from new well pads, access roads, pipelines, and other mineral related facilities under the preferred alternative. As a mitigation measure under the preferred alternative, new wells were to utilize existing well pads where feasible to reduce the level of ground disturbance. In addition to evaluating impacts on Tribal lands, the 2002 FEIS analyzed the cumulative environmental impacts associated with potential non-Tribal ECBM development on adjacent lands, which had the potential to add another 67 injector wells and 519 CBM wells within the approximately 421,450-acre study area (Map 1-1, Appendix A).

Among the alternatives proposed in the 2002 FEIS, but eliminated from detailed analysis, was an alternative that addressed the infilling of Fruitland Formation production with up to four wells per 320-acre spacing unit, an effective CBM well density of one well per 80-acres. According to the 2002 FEIS, “This well density was considered, but production and reservoir characteristics, as they are currently understood, indicate [that 80-acre spacing] is not the optimum spacing for the prevention of waste and maximization of ultimate recovery.” (USDI 2002a, page 2-9). This conclusion, reached during the consideration of alternatives in the 2002 FEIS, is no longer considered valid by the BLM, BIA or SUIT due to recent technological advances and new data on the Fruitland Formation.

In 2005 and 2006, several oil and gas operators, including the SUIT doing business as (d/b/a) Red Willow Production Company, submitted applications to the Colorado Oil and Gas Commission (COGCC) for an increase in the density of Fruitland CBM wells in 320-acre spacing units from two to four wells. The purpose was to facilitate the increased and efficient recovery of CBM gas from the Fruitland coal seam within La Plata County and portions of the Reservation. Following the review of industry testimony, exhibits and technical reports, the COGCC issued orders that increased the density of wells from two to up to four wells per 320-acre spacing unit (80-acre spacing) by amending previously issued Order Nos. 112-156 and 112-157 (Order 112-156 covers areas north of the Reservation and Order 112-157 covers areas with fee lands only).

The recent orders mandate that wells not be located any closer than six hundred and sixty (660) feet from the unit boundary and that the surface location of additional wells be located on an existing well pad (with exceptions). These orders, listed below, are available on the COGCC website at http://oil-gas.state.co.us/:

- Order 112-185 (Feb. 2, 2006)
- Order 112-187 (April 7, 2006)
- Order 112-190 (Aug. 7, 2006)
- Order 112-192 (Oct. 12, 2006)
- Order 112-193 (Oct. 12, 2006)
- Order 112-194 (Nov. 21, 2006)
- Order 112-195 (Nov. 8, 2006)
- Order 112-197 (Dec. 11, 2006)

## 1.3 Oil and Gas Development History

The 2002 FEIS provides detailed information about the oil and gas development history both on the Reservation and in the San Juan Basin (SJB). The key excerpts of the development history of the Reservation and the region that frame the economic importance of the Ignacio-Blanco Field to the SUIT include:

- "The SJB has an extensive development history. In total, there are more than 26,000 wells in the entire basin, including portions of Colorado and New Mexico. The Ignacio-Blanco Field, which encompasses the Colorado portion of the basin and is almost entirely within the Reservation, contains more than 2,000 wells, of which 1,888 were actively producing at the end of the 1998 production year (USDI 2002a).
- "More than 3,000 separate completions have been made in the Ignacio-Blanco Field, with many wells having two or even three formations producing from a single well bore. As of the end of 1998, the Ignacio-Blanco Field had produced cumulatively 3.4 trillion cubic feet (tcf) of natural gas, including 1.7 tcf of gas from CBM production from the Fruitland Formation, and 115 thousand barrels (mbbl) of oil/condensate (USDI 2002a).

In summary, the oil and gas resources within the Reservation are substantial and have been the subject of extensive historical exploration and development.

## 1.4 Purpose and Need

The purpose of the activity proposed in this PEA, is to economically extract, in an efficient and environmentally compatible manner, the recoverable oil and gas reserves known to exist in mineral estates held in trust by the United States for the benefit of the SUIT and its members. Based on current technical reviews and testimony before the COGCC, the BLM and the COGCC have determined that 80-acre Fruitland Formation infill spacing in the Ignacio-Blanco Field is needed to more efficiently recover the oil and gas resources from these mineral estates (i.e., COGCC Order No. 112-190). The SUIT Department of Energy (DOE) concurs with these findings. As a result, the SUIT Tribal Council has approved 80-acre well spacing, with certain design features (mitigation requirements), within portions of the Reservation.

The BLM's trust responsibility to the SUIT and Indian allottees also supports the drilling of up to four wells per 320-acre drilling and spacing unit for production from the Fruitland coal seams in the Ignacio-Blanco Field. If additional development proceeds, the SUIT would 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 the foreseeable future. The continued development of the oil and gas resource is critical to the economic well being of the SUIT and is an integral part of the local economies. Failure to authorize production from SUIT and Indian allottee mineral estates at the same density as that permitted for offsetting (private fee lands) will ultimately result in drainage and a permanent loss of oil and gas resources currently located on Indian mineral estates.

The technical evidence that supports the need for 80-acre Fruitland infill spacing is on file with the BLM and the COGCC, and it is the basis for the aforementioned COGCC orders that allow up to four wells per 320-acre spacing unit for CBM production from the Fruitland coal seams in the Ignacio-Blanco Field.

## 1.5 Land Involved in the Analysis

The land involved in the analysis for this PEA consists of the western and central portions of the Reservation, most of which is located in the northern SJB. The study area encompasses approximately 421,450 acres of land, including portions of La Plata, Archuleta, and Montezuma counties (Map 1-1, Appendix A).

About 316,000 acres is entirely held in trust for the SUIT or its individual members by the federal government. The SUIT owns both the surface and the entire subsurface estate for 310,000 acres. Roughly 7,750 acres of trust minerals and 4,800 acres of trust surface are allotted to individual Indians who are members, or descendants of members of the SUIT (USDI 2002a). The remaining surface acreage within the exterior boundaries of the Reservation is privately owned or administered by other governmental agencies. There are about 29,000 acres of Indian-owned oil and estates underlying private or state owned surface.

Production of CBM by private operators from approximately 200,000 acres of Reservation land where the SUIT owns only the coal estate, but not the oil and gas mineral estate, does not require National Environmental Policy (NEPA) compliance. In 1999, the Supreme Court determined that in such instances, CBM belongs to the oil and gas mineral estate and not to the coal estate (Amoco Production Company v. Southern Ute Indian Tribe, 526 U.S. 865 [1999]). Development of CBM by private operators in such instances will therefore be administered by state authorities, does not require federal action, and is not subject to NEPA compliance. Working interests in CBM production owned by the SUIT, but not involving lands held in trust by the federal government, are treated as private interests and are not subject to NEPA compliance.

Analysis in this PEA addresses impacts on both the surface and the subsurface mineral estate. Federal administrative decisions related to oil and gas development will be made only for Indian land where BIA and BLM have a trust responsibility.

## 1.6 Relationship to Policies, Plans, and Programs

### 1.6.1 Tribal, BIA, and BLM

As discussed in Section 1.5 of the 2002 FEIS, the Secretary of the Interior is authorized on behalf of the federal government to administer oil and gas resources leasing on Indian land through the 1909 Mineral Leasing Act for Allotted Lands, the Indian Mineral Leasing Act of 1938, and the Indian Mineral Development Act of 1982. Lease issuance and administration are the responsibility of the BIA, which acts as the surface-management agency. Once the lease is issued, the BLM is responsible for permitting and administering operations. This includes approval of well density, underground activities, well operations, production verification, and compliance. The SUIT is integrally involved in the decision-making processes about leases and permits involving Tribal lands, which may be issued only with SUIT consent in compliance with the Indian Reorganization Act of 1934.

Tribes are viewed under federal law as quasi-sovereign nations and federal agencies coordinate with the Tribes on a “government to government” basis. Given the SUIT's quasi-sovereign status, state and local jurisdiction over the SUIT and its lands is limited. However, federal agencies have a trust responsibility to Tribes, which must be considered when federal actions potentially affect Tribal resources. As a result of the trust responsibility, the BLM's decision-making process is significantly different on Indian land from its process on public land. On Indian land, the BLM has the added responsibility of assigning considerable weight to Indian goals and interests, whereas on public land, the BLM’s actions are guided by the Federal Land Policy and Management Act (FLPMA) and the public’s best interest. Additionally, with regard to Indian lands, land use conflicts and ambiguities in federal regulations and policies are generally resolved in favor of the Indian Tribe's best interests. This is consistent with the federal government’s responsibility to protect Indian land and take such action as best serves the interests of Indian Tribes and Tribal members.

The coordinated undertaking of the SUIT, BIA, and the BLM in preparation of the 2002 FEIS and this PEA are reflective of the jurisdictional principles, laws, and practices at work on the Reservation. Appendix B of the 2002 FEIS presents a detailed discussion of the complex jurisdictional aspects of Tribal development of Reservation land and resources. The SUIT, BIA, and the BLM previously entered into a Memorandum of Understanding (MOU) on October 1, 1995, which jointly established their respective roles in the programmatic environmental review of the development of Indian oil and gas resources on the Reservation as required under the NEPA of 1969 (BLM 1995). The programmatic environmental review undertaken pursuant to the 1995 MOU resulted in issuance of the 2002 FEIS (USDI 2002a). In 2007, a new MOU was entered into among the BLM, BIA, and SUIT (BLM 2007a), which addressed preparation of this PEA.

One of the principal planning documents guiding mineral resource development on the Reservation is the SUIT Natural Resources Management Plan (NRMP), 1990-2010 (SUIT 2000). The NRMP has three general resource management goals:

- Expand the economic base of the Tribe and improve quality of life and standard of living on the Reservation through balanced development of renewable and nonrenewable resources in a culturally and environmentally appropriate manner.
- Enhance the beneficial use, productivity, and viability of Tribal natural resources while preserving and protecting important resource values for future generations through integrated multiple-use management and planning.
- Promote the protection of wild and pristine resources to preserve their unique and irreplaceable values.

In addition to these general goals, the NRMP (SUIT 2000) details specific resource management goals and objectives that are drawn from the Resources and Environment elements of the SUIT Comprehensive Plan. Included are the following goals and objectives for energy and mineral development:

- Ensure the Tribe is realizing maximum benefit from development of non-renewable resources in an environmentally sound manner.
- Evaluate avenues to obtain additional benefits from resources produced from Tribal lands.
- Monitor and interact with other governmental agencies and entities to maintain Tribal control of Tribal energy and mineral resources and preserve development opportunities.
- Identify and mitigate hazards and environmental degradation caused by energy and mineral development to protect the health, safety, and welfare of the Tribe and the Reservation's natural resources.

The proposed action considered in this PEA conforms to the NRMP.

### 1.6.2 Other Relevant Planning and Policy Documents

The planning documents of agencies other than the BIA, BLM, and SUIT have been reviewed and appropriate information has been used in the preparation of this PEA (including all those listed in the 2002 FEIS). Additionally, more recent planning documents, agreements, or guidance documents were reviewed:

- The La Plata County Impact Report (La Plata County 2002) that was prepared to identify the potential impacts to and design features for specific resources in La Plata County from anticipated CBM development.
- La Plata County MOUs with Maralex Resources, Inc, ConocoPhillips Company, Four Star Oil & Gas, Petrogulf Corporation, BP America, Red Willow Production Company, Samson Resources, Chevron, Gosney, and XTO Energy Inc.
- Farmington Proposed Resource Management Plan (PRMP) FEIS and ROD (USDI 2003a; USDI 2003b).
- Northern San Juan Basin Final Environmental Impact Statement (NSJB EIS) and ROD (USDI/U.S. Department of Agriculture [USDA] 2006 and 2007).

### 1.6.3 Relevant Planning Groups in the SJB

The Tribe, the BLM, and BIA participate actively in discussion forums along with other governmental entities and organizations who share concerns and interests associated with oil and gas exploration and development in the Four Corners Region. The states of New Mexico and Colorado have convened the Four Corners Air Quality Task Force (FCAQTF) to work on the air quality issues and challenges facing the Four Corners region. The affected states, Tribes, federal land managers, and other stakeholders in the region have come together to begin to plan control strategies for future air quality impacts from development. The concept of a Task Force has emerged that would allow for a broad and inclusive collaborative process to regional air quality planning.

The SUIT, BIA, and BLM are members of the La Plata County Gas and Oil Regulatory Team (GORT), which deals with multi-jurisdictional issues and coordinates information-sharing and facilitates planning discussions arising from oil and gas activities in the area (e.g., gas seep evaluation and mitigation options related to public health and the environment). Other members of GORT are La Plata County, COGCC, and revolving oil and gas industry representatives from the Colorado Petroleum Association.

## 1.7 Existing Rights

Indian oil and gas leases and development agreements are contracts between the Indian mineral owners and lessees which statutorily require the approval of the USDI. The lease rights typically include the right to occupy as much of the lease surface as is reasonable for the extraction of the resource, and the right to remove the resource (oil and/or gas). Limitations of these two rights may be restricted in the body of the contracts, in written stipulations incorporated as a part of the lease or development agreement, or through authorized administrative conditions imposed pursuant to federal or Tribal regulations and policies. Decisions that may be made on the basis of information contained in this PEA would not amend valid existing rights. The proposed action would not amend current leases by placing no surface occupancy stipulations on leases that do not contain these terms, or by canceling leases.

Standard lease terms allow the BLM's Authorized Officer to require reasonable measures to mitigate adverse impacts of proposed operations. New management practices and techniques may be incorporated in existing lease management terms, as long as they are compatible with the lease rights granted. If the proposed action is adopted, new management practices identified in the Agency and Tribal proposed action that do not violate existing rights would be used in managing existing leases. The new management practices would appear in the form of site specific stipulations with mitigation requirements for the BIA's issuance of rights-of-ways (ROWs) and "conditions of approval" (COA) when the BLM grants permits, or as required terms in order to obtain the SUIT consent needed for approval of site specific activities.

## 1.8 Environmental Justice

On February 11, 1994, the President of the United States issued Executive Order 12898 on Environmental Justice in Minority and Low-Income Populations. The purpose of the Order is to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of programs, policies, or activities on minority or low-income populations. In the study area for this PEA, minority populations include Native Americans and Hispanics. Low-income groups in this area also include large segments of these populations, along with low-income Caucasian populations. The construction and location of project features would not disrupt existing Southern Ute Indian, Hispanic, or other low-income communities. No disproportionate negative impact on Southern Ute Indian, Hispanic, or other low-income communities is expected. The project benefits would accrue to the Southern Ute Indian population in the area. The SUIT has allowed oil and gas operators to come onto the Reservation to develop the mineral resources for the express purpose of improving the economic and social well-being of SUIT members.

## 1.9 Authorizing Actions

This PEA has been prepared in compliance with NEPA (40 Code of Federal Regulations [CFR] 1500-1508) and is tiered to the existing 2002 FEIS and will assess whether there are any environmental impacts associated with the proposed action that will have or are likely to have a significant impact upon the human environment and warrant preparation of an Environmental Impact Statement (EIS) above and beyond those impacts previously analyzed in the 2002 FEIS.

In addition to management actions authorized by lease terms and federal regulations, management of oil and gas leasing and development activities is currently guided by the SUIT NRMP, and by standard stipulations imposed by the SUIT and the SUIT DOE in consenting to additional associated activities.

As with the 2002 FEIS, this PEA is not the final review upon which approval of all actions in the study area would be based. Site-specific environmental analyses and additional NEPA compliance (i.e., Determination of NEPA Adequacy [DNA], Environmental Assessment [EA] or EIS) would be required for all site specific actions. The scope of this additional approval process would be streamlined and facilitated by the programmatic evaluation of impacts contained in the 2002 FEIS and this PEA. These actions would begin when a lessee or operator submits an Application for Permit to Drill (APD) to the BLM. The APD and ROW application processes described below is unchanged from that described in the 2002 FEIS.

When applications are received, an on-site inspection is scheduled for agency and Tribal representatives. The private surface owner, if applicable, also would be notified. The lessee/operator would show the group where each facility would be constructed. Appropriate changes or modifications of the application are made as needed during the on-site inspection. Information would be gathered by the BLM and BIA to analyze the site specific environmental conditions of the proposed APD or ROW project area. Prior to the APD approval, the BIA would provide concurrence for cultural resources and for threatened and endangered species, per the National Historic Preservation Act (NHPA) Section 106 and Endangered Species Act (ESA) section 7 requirements. These clearances are to be performed by approved individuals with the appropriate qualifications. If any potential adverse impacts on threatened or endangered species are identified during the process, the U.S. Fish and Wildlife Service (USFWS) would be contacted and appropriate review and consultation would begin, in accordance with the ESA. Construction can begin when the BLM has completed NEPA review, the APD has been approved, and the necessary Tribal and BIA clearances and concurrence have been received. The same on-site process is used if the lessee submits a request for a ROW or a Sundry Notice that involves new surface disturbance. Sundry Notices are filed with the BLM by the well operators when they propose new construction outside the approved area of operations or reconstructing or altering existing facilities. ROWs are used to authorize roads, pipelines, compressors, and other facilities on Indian land outside the oil and gas lease boundaries and are submitted to the BIA. Applications for geophysical operations are handled in a similar manner.

## 1.10 Issues Identification and Public Involvement

### 1.10.1 Issue Identification

Because this PEA is tiering to the 2002 FEIS, the issues identified in the scoping effort implemented during the 2002 FEIS process were considered and incorporated into the PEA analysis. Issue identification is summarized in greater detail in the 2002 FEIS (USDI 2002a, Section 1.9).

In addition to considering the issues identified in the 2002 FEIS, the PEA takes into consideration the issues that were identified during the scoping process for the NSJB EIS (USDI/USDA 2006a). The location of the action evaluated in the 2002 FEIS relative to the action proposed in the PEA and the similarity in the type of development proposed, warrants\ that the NSJB EIS issues identified are also considered during the NEPA analysis in this PEA.

Similar issues identified in the scoping for the 2002 FEIS and the NSJB EIS include:

- The effects of additional CBM development on human health and safety.
- The effects of the additional CBM development on aquifers and domestic water wells in the study area.
- The effects of additional CBM development on the quantity and quality of surface water in the study area.
- The effects of additional CBM resources on the study area's geology and geologic hazards.
- The effects of the additional development of CBM resources on species of wildlife and fisheries and their habitats (particularly key species and habitats).
- The effects of the additional development of CBM resources on vegetation in the study area, including wetlands and riparian areas.
- The effects of additional CBM development on the socioeconomic environment.
- The effects of additional CBM development on transportation/roads.
- The effects of the additional development of CBM resources on the predominant land uses of agricultural and residential use.
- The effects of CBM development on air quality and visibility.
- The effects of the additional development of CBM resources on soils in and downstream or the study area.
- The effects of additional CBM development on area noise.
- The effects of additional CBM development on the study area's aesthetics.

Please note that there were three issues identified during the NSJB EIS project that do not have specific comparisons with the issues identified during the 2002 FEIS effort. The three issues were:

- Issue 13: The effects of the additional development of CBM resources on cultural resources, paleontological resources, and Native Americans.

In the NSJB EIS, concern was expressed about the potential adverse impact of additional development to cultural resources, paleontological resources, and Native Americans. In addition to the direct and indirect disturbances associated with the construction of facilities, the construction of additional roads was viewed as having the greatest potential to disturb cultural resources present in the study area. The PEA study area involves lands that have already been generally affected by pre-existing oil and gas development activity and while cultural resources and paleontological resources are serious concerns for the Tribe and the federal government, this issue is addressed during site-specific reviews.

- Issue 14: The effects of the additional development of CBM resources on recreational opportunities and the recreational experience.

Issue 14 regarding the effect of additional CBM development and recreational opportunities is not applicable to the study area included in this PEA. Therefore, there will be no NEPA analysis in this PEA regarding recreation.

- Issue 17: How will additional CBM development affect the HD Mountain's Roadless Area?

Issue 17 is applicable only to study area addressed under the NSJB EIS; therefore this issue will not be included in the NEPA analysis in this PEA.

### 1.10.2 Public Involvement

A public comment period associated with the publication of the Draft PEA was included in the EA process for this project. BIA, BLM, and SUIT believe that this opportunity for public review and comment allowed for any issues that were not addressed to be evaluated.

The Draft PEA was posted for BLM and BIA on the following website: http://ocs.fortlewis.edu/BLMPEA/. Additionally, print copies of the Draft PEA, as well as the 2002 FEIS, were made available for viewing during the comment period at the San Juan Public Lands Office, the Durango Public Library and the Ignacio Community Library. The Draft PEA was released on April 22, 2009, with a 30-day public comment period. The availability of the Draft PEA was announced in the Durango Herald on April 19 and 22, 2009, and a news release was provided to approximately 140 contacts, including newspapers, radio and television stations; environmental groups; elected officials and aids; and individual interested parties. The comment period was subsequently extended an additional two weeks with a comment receipt deadline of June 5, 2009. The comment deadline extension was announced in the Durango Herald on May 21, 2009. A news release was also distributed to the list of contacts noted previously.

A total of six comments were received: five hard copy letters and one via the BLM/BIA website. The electronic message was printed and is included with the hard copy letters in the administrative record for this project. Appendix J provides all comments received, as well as how they were addressed in the final PEA.

# 2.0 PROPOSED ACTION

## 2.1 Information Key to the Proposed Action

### 2.1.1 Study Area

The Reservation lies almost entirely within La Plata and Archuleta counties with several thousand acres also in the far eastern portion of Montezuma County in southwestern Colorado. The western and central portion of the Reservation is referred to as the study area, which is the focus of this analysis. The study area consists of approximately 421,450 acres, of which approximately 195,000 acres are Tribal surface and subsurface lands, 5,000 acres are allotted lands (owned by individual Tribal members and their heirs), and 180,000 acres are fee surface lands where the Tribe owns the entire mineral estate. Map 1-1 (Appendix A) shows the boundary of the study area.

This PEA addresses the potential development of Tribal and allotted CBM within the study area through 80-acre infill spacing. Potential cumulative impacts from CBM wells accessing fee minerals within the study area are addressed under cumulative impacts in this document (Section 4.13).

### 2.1.2 Agreements Between the SUIT, BIA and BLM, and the COGCC, La Plata County, and BLM Covering Jurisdiction Over Operations on Tribal or Federal Land

The SUIT, BIA, BLM, and COGCC have signed MOUs and Interagency Agreements, as appropriate, that outline how these government entities work together to regulate oil and gas operations within the exterior boundaries of the Reservation. These MOUs are available on the following websites: http://co.laplata.co.us/ and http://oil-gas.state.co.us. These MOUs simplify procedures for the many operators who conduct business on the Reservation and help eliminate duplication of effort by the agencies themselves. Additionally, the MOUs state that the COGCC must notify the BLM of applications pertaining to federal or Tribal minerals, and that the COGCC may not hear an application regarding Tribal lands without the express consent of the BLM. The BLM is responsible for notifying the SUIT about applications involving Tribal minerals. If the SUIT has an objection or wishes to make stipulations on approval of the application ("conditions of protest"), then the BLM must convey the details thereof to the COGCC. The COGCC must either incorporate the conditions of protest submitted by the BLM (on behalf of the BLM or the SUIT) or relinquish jurisdiction on the issue to the BLM, insofar as it relates to federal or Tribal lands.

In January 2005, the SUIT signed an MOU with La Plata County to establish a protocol for consultation between the county, the Tribe and affected land users regarding development of Tribally owned oil and gas facilities on non-Indian fee land within the exterior boundaries of the Reservation, including consideration of the performance standards of the La Plata County Oil and Gas Regulations. The La Plata County Oil and Gas Regulations require approval by the county planning department prior to construction, installation, and operation of oil and gas facilities within the unincorporated areas of the county. This approval ensures that set performance standards are met to minimize conflicts between differing land uses and users by addressing issues such as sound emissions, visual impacts, water resources, and impacts on residences, agricultural, and other commercial enterprises. The SUIT is not subject to the La Plata County Oil and Gas

Regulations, but does share a common concern for ensuring that development of oil and gas facilities is done in a manner that minimizes conflicts.

### 2.1.3 Current Development Analyzed under the Oil and Gas Development on the Southern Ute Indian Reservation 2002 FEIS

The 2002 FEIS and the corresponding ROD approved the development of 367 CBM wells, 269 conventional wells, 70 injection wells, and all required support facilities including access roads, pipelines, and other mineral related facilities on Tribal surface and/or mineral estate. The 2002 ROD approved an estimated 1,306 acres of long-term disturbance associated with the development of oil and gas resources. This acreage does not include the disturbance from the 70 approved injection wells. The 70 injector wells evaluated in the 2002 FEIS were proposed as recompletions. Recompletions involve converting existing producing wells into injection wells and would not have required additional surface disturbance. Since 2002, approximately 12 injection wells have been drilled within the study area. The proposed action evaluated in the 2002 FEIS was based on full development of all 160-acre spacing units for CBM wells. Conventional wells were evaluated on COGCC spacing units.

The 2002 ROD approved a total of 636 natural gas wells on Tribal and fee land assuming an average short-term disturbance of 2.0 acres for the well pad and 1.06 acres for the access road and pipeline ROW (3.06 acres total disturbance per well). On the Reservation, well location access roads average 0.25 mile in length. For analysis purposes in the 2002 FEIS, the average road was assumed to measure 35 feet in width and 0.25 mile in length per well with a disturbance of 1.06 acres per well. The pipeline was assumed to be located within the access road corridor and therefore would not result in new disturbance. After interim reclamation, the long-term disturbance of well pads was expected to be 2.06 acres (1.0 acre was assumed to be reclaimed). The BLM maintains informal records on the estimated amount of disturbance for approved wells. Based on this information the average short-term disturbance for wells (including pipeline and road) approved under the 2002 FEIS tends to average 2.7 acres rather than the projected 3.06 acres of short-term disturbance per well. This supports the assumption in the 2002 FEIS that the anticipated average of 3.06 acres total disturbance per well was a conservative estimation for analysis.

However, since the 2002 FEIS the BIA has permitted 40-foot wide ROWs for pipelines or pipeline/access road construction. Based on a 40-foot wide ROW, a 0.25-mile pipeline/access road corridor would result in approximately 1.2 acres of disturbance, as opposed to 1.06 acres. Therefore, this PEA will analyze surface impacts using an average of 3.2 acres per new well pad construction with interim reclamation occurring on an average of 1.0 acre per well location in order to perpetuate the conservative approach to surface disturbance estimation taken in the 2002 FEIS.

Using information from the COGCC database, Dwight's EnergyData, and BLM and BIA records, between November 1, 2002, and December 15, 2007, 56 CBM wells and 30 conventional wells have been drilled on Tribal minerals in the study area resulting in approximately 275 acres of estimated short-term disturbance and approximately 189 acres of estimated long-term disturbance. Table 2-1 provides the number of CBM and conventional wells drilled in the study area on Tribal minerals and/or surface since November 1, 2002, through December 15, 2007, and the total estimated disturbance in acres. These disturbance acreages are based on an average of 3.2 acres short-term disturbance and 2.2 acres long-term disturbance per well location. Map 2-1 (Appendix A) shows the current development that has occurred on the Reservation under the 2002 FEIS.

Based on reservoir information and advances in technology, not all 636 wells anticipated and analyzed under the 2002 FEIS are expected to be drilled. To evaluate whether 80-acre spacing of CBM wells on the Reservation could occur within the disturbance threshold of the 2002 FEIS, the disturbance from current development was added to the expected disturbance of 160-acre spaced CBM and conventional wells that are now reasonably foreseeable within the study area over the next 20 years.

**Table 2-1. The Number of CBM and Conventional Wells Drilled Since November 1, 2002, in the Study Area and the Estimated Total Long- and Short-Term Disturbance (as of December 15, 2007).**

| | Total Number of Wells | Total Short-Term Disturbance (Acres) | Total Long-Term Disturbance (Acres) |
|---|---|---|---|
| **Drilled 160-acre CBM Wells** | **56** | **179.2** | **123.2** |
| **Drilled Conventional Wells** | **30** | **96.0** | **66.0** |
| **TOTAL** | **86** | **275.2** | **189.2** |

Notes: New well pad disturbance based on an average of 3.2 acres short-term disturbance (2.00 acres for well, 1.2 acres for pipeline/road) and 2.2 acres long-term disturbance.

Of the 367 CBM wells previously approved with 160-acre spacing, approximately 234 are now reasonably anticipated to be drilled (Table 2-2) based on current knowledge of the reservoir characteristics. Of the 269 conventional wells previously approved approximately 113 are now reasonably anticipated (Table 2-3). A conservative rational assumption would be that a minimum of 20% of these wells would be co-located. The incremental surface disturbance added to the existing well pad for a proposed co-located well would be approximately 1.15 acres short-term disturbance, since this acreage would overlap onto an existing pad. This acreage is based on a conservative average disturbance as some operators, depending on equipment used, would create none or minimal (<0.2 acre) new incremental disturbance for a co-located well, while other operators would create approximately 1.14-1.16 acres of new incremental disturbance for a co-location. As a result, the incremental short-term disturbance per co-located well pad is conservatively estimated at 1.15 acres. Following construction and drilling, interim reclamation would result in an average long-term disturbance of 0.5 acres. Using an average of 3.2 acres for short-term disturbance and 2.2 acres of long-term disturbance for new well locations and an average of 1.15 acres of short-term disturbance and 0.5 acres of long-term disturbance for co-located wells, these wells would result in a total of approximately 1,242 acres of short-term disturbance (Table 2-4).

**Table 2-2. The Number of Anticipated New and Co-located 160-Acre CBM Wells in the Study Area and the Estimated Total Long- and Short-Term Disturbance in Acres.**

| | Total Number of Wells | Total Short-Term Disturbance (Acres) | Total Long-Term Disturbance (Acres) |
|---|---|---|---|
| **Anticipated 160-acre CBM Wells** | 187 | 598.4 | 411.4 |
| **Anticipated Co-located 160-acre CBM Wells** | 47 | 54.1 | 23.5 |
| **TOTAL** | **234** | **652.5** | **434.9** |

Notes: New well pad disturbance based on an average of 3.2 acres short-term disturbance (2.00 acres for well, 1.2 acres for pipeline/road) resulting in 2.2 acres long-term disturbance. Co-located well pad disturbance based on an average incremental increase of 1.15 acres short-term resulting in 0.5 acres long-term disturbance.

**Table 2-3. The Number of Anticipated New and Co-Located Conventional Wells in the Study Area and the Estimated Total Long- and Short-Term Disturbance in Acres.**

| | Total Number of Wells | Total Short-Term Disturbance (Acres) | Total Long-Term Disturbance (Acres) |
|---|---|---|---|
| **Anticipated Conventional Wells** | 90 | 288.0 | 198.0 |
| **Anticipated Co-located Conventional Wells** | 23 | 26.5 | 11.5 |
| **TOTAL** | **113** | **314.5** | **209.5** |

Notes: New well pad disturbance based on an average of 3.2 acres short-term disturbance (2.00 acres for well, 1.2 acres for pipeline/road) resulting in 2.2 acres long-term disturbance. Co-located well pad disturbance based on an average incremental increase of 1.15 acres short-term resulting in 0.5 acres long-term disturbance.

Based on the level of current and the reasonably anticipated development, a total of 433 conventional and CBM wells are expected to be drilled within the study area, as approved in 2002. The total existing and proposed estimated long-term disturbance for 160-acre spaced CBM and conventional wells (total 433) evaluated under the 2002 FEIS has been calculated to be approximately 835 acres (Table 2-4).

**Table 2-4. Short- and Long-Term Disturbance from CBM and Conventional Wells Drilled Since November 1, 2002, and the Number of Reasonably Anticipated CBM and Conventional Wells in the Study Area (as of December 15, 2007).**

| | Total Number of Wells | Total Short-Term Disturbance (Acres) | Total Long-Term Disturbance (Acres) |
|---|---|---|---|
| **Drilled 160-acre CBM Wells** | 56 | 179.2 | 123.2 |
| **Drilled Conventional Wells** | 30 | 96.0 | 66.0 |
| **Anticipated 160-acre CBM Wells** | 187 | 598.4 | 411.4 |
| **Anticipated Co-located 160-acre CBM Wells** | 47 | 54.1 | 23.5 |
| **Anticipated Conventional Wells** | 90 | 288.0 | 198.0 |
| **Anticipated Co-located Conventional Wells** | 23 | 26.5 | 11.5 |
| **TOTAL** | **433** | **1,242.2** | **834.6** |

Notes: New well pad disturbance based on 3.2 acres short-term (2.00 acres for well, 1.2 acres for pipeline/road) resulting in 2.2 acres long-term disturbance. Co-located well pad disturbance based on an average of an incremental increase of 1.15 acres short-term resulting in 0.5 acres long-term disturbance.

### 2.1.4 Well Spacing

In 2005 and 2006, several oil and gas operators submitted applications to the COGCC for an increase in the density of Fruitland Formation CBM wells in 320-acre spacing units from two to four wells. The purpose was to facilitate the recovery of CBM gas in the Fruitland Formation (Fruitland coal seam gas) within La Plata County and the Reservation. The COGCC issued orders that increased the density of wells from two to four wells per 320-acre spacing unit by amending orders previously issued in 2000 (Order Nos. 112-156 and 157). As a result, up to four Fruitland Formation CBM wells could be located on 320-acre spacing units for effective 80-acre spacing.

The orders mandate that wells not be located any closer than six hundred and sixty (660) feet from the unit boundary and that the surface location of additional wells would be located on an existing well pad where feasible.

Additionally on January 8, 2007, the SUIT Tribal Council passed Resolution No. 2007-9 approving effective 80-acre spacing for CBM wells on substantial portions of the study area.

## 2.2 Alternatives Analyzed in Detail

### 2.2.1 Alternative 1: No Action Alternative

Alternative 1 would be the continuation of current management consistent with the 2002 FEIS and ROD. APDs would continue to be authorized within the scope of the 2002 FEIS. The no action alternative would potentially entail drilling 269 conventional wells and 367

CBM wells under the 160-acre spacing unit on Tribal mineral estate. Currently, 30 conventional and 56 CBM wells have been drilled under the 2002 FEIS in the study area. Alternative 1 provides a baseline for comparison of the incremental impacts of Alternative 2, the proposed action.

### 2.2.2 Alternative 2: Proposed Action

Under Alternative 2, 80-acre spacing for CBM wells is being proposed on lands within the study area, where the Tribe owns the oil and gas minerals, including lands where the surface is owned in fee and the oil and gas mineral rights are owned by the Tribe (Map 1-1, Appendix A) contingent upon the imposition of terms and conditions required by the SUIT Tribal Council including:

1. Co-location of infill wells at existing drill pads to the maximum extent feasible.

2. Presumptive utilization of the best available air emissions control technology for new compressor installation and the presumptive upgrade of existing compressors to contemporary best available emissions control technology to the maximum extent feasible in a manner consistent with optimizing air quality on the Reservation.

### 2.2.3 Additional Anticipated Increment of Development

The total number of wells drilled would depend largely on environmental, geologic, and economic factors. A typical production life for a CBM well is approximately 25-30 years or longer, depending on economics and reservoir geology; therefore, the life of the project could be as long as 40 years if wells are drilled at slower rates.

Section 2.2 and Map 2.2 of the 2002 FEIS detailed the high potential for oil and gas resources on the Reservation (USDI 2002a). Projecting future oil and gas development can be difficult because several variables are involved including: demand for oil and gas; price increases or decreases; and new technologies. Projections are also complex due to the large number of companies operating on the Reservation and their various production techniques.

The additional anticipated increment of development could total up to 770 CBM wells on lands where the Tribe owns the oil and gas minerals. Approximately 731, or 95%, of these wells would be directionally drilled from existing well pad locations. Table 2-5 shows the potential number of 80-acre infill wells including the number of co-locations. A reasonable assumption is that approximately 5% of the 770 wells (39 wells) would not be co-located due to environmental or cultural restraints on the existing well pad sites. In these cases a new well pad location would be constructed.

The wells would be drilled as optional infill wells based on geology and reservoir qualities in areas of low recovery per well. The Fruitland Formation (range of 2,600–3,900 feet in depth) is the primary CBM producing horizon and the only horizon for which this PEA applies.

The incremental acreage added to an existing well pad for a proposed co-located well would be approximately 1.15 acres, since this acreage would overlap onto an existing pad. Following interim reclamation, the incremental estimated long-term disturbance per co-located well pad would average 0.5 acres. The disturbance for new well pads is based on an average of 3.2 acres short-term disturbance and 2.2 acres long-term disturbance per well location. Table 2-5 provides the long-term and short-term disturbance in acres for the anticipated additional incremental development.

**Table 2-5. Estimated Short- and Long-Term Disturbance in Acres Potentially Resulting from the Anticipated Additional Incremental Disturbance.**

| | Total Number of Wells | Short-Term Disturbance (Acres) | Long-Term Disturbance (Acres) |
|---|---|---|---|
| **Anticipated Co-located 80-acre Wells** | 731 | 841 | 365 |
| **Anticipated New 80-acre Wells** | 39 | 125 | 86 |
| **Total** | 770 | 966 | 451 |

Notes: Acreage estimates based on an average disturbance per well pad. Actual disturbance would vary per well. New well pad disturbance is based on 3.2 acres short-term (2.00 acres for well, 1.2 acres for pipeline/road) resulting in 2.2 acres of long-term disturbance. Co-located well pad disturbance is based on an average of an incremental increase of 1.15 acres in the short-term resulting in 0.5 acres of long-term disturbance.

The total estimated short-term disturbance for 731 co-located wells would be approximately 841 acres. After reclamation, the total amount of well pad disturbance from the co-located well sites would be an estimated 365 acres, assuming 0.5 acres of long-term disturbance per well. Co-located wells would not require construction of new access roads or pipeline ROWs.

The 39 new well pad locations are evaluated based on a total of 3.2 acres of disturbance per well (2.0 acres for the well pad and 1.2 acres for the access road and pipeline ROW) and total approximately 125 acres of new disturbance in the short-term. However, after interim reclamation total long-term disturbance for 39 new well pads would be 86 acres. The actual disturbance for new wells would vary per operator, but is not expected to exceed the average estimate of 3.2 acres per well. The total disturbance under the proposed action would be approximately 966 acres of short-term disturbance and an estimated 451 acres of long-term disturbance.

Based on reservoir information and advances in technology, not all 636 wells approved under the 2002 FEIS are expected to be drilled. Of the 367 CBM wells previously approved with 160-acre spacing, approximately 234 are reasonably anticipated to be drilled based on current knowledge of the reservoir characteristics. Of the 269 conventional wells previously approved approximately 113 are reasonably anticipated. A rational assumption would be that a minimum of 20% of these wells would be co-located. The total existing and expected long-term disturbance for 160-acre spaced CBM and conventional wells evaluated under the 2002 FEIS has been calculated to be approximately 835 acres (Table 2-4). When the anticipated incremental long-term disturbance (Table 2-5) that could occur under the proposed action (451 acres) is added to the total existing and anticipated future long-term disturbance for 160-acre spaced CBM and conventional wells evaluated under the 2002 FEIS (Table 2-4, 835 acres), it totals approximately 1,286 acres of long-term disturbance. This amount of disturbance is beneath the development threshold of 1,306 acres approved under the 2002 FEIS ROD.

All construction and oil and gas drilling and production operations would be managed within the guidelines and regulations of the BLM, BIA, and the SUIT. Typical drilling and production activities are described in Section 2.3.

## 2.3 Activities Associated with the Action Alternative

Due to the programmatic nature of this document, the exact locations and timing of activities, including drilling of wells and installation of equipment and facilities, cannot be known, although they would occur within the areas identified in Map 2-2 (Appendix A). All activities and construction related to a particular project would be evaluated in detail on a site-specific basis through the APD process, at the time each project is proposed.

The gas field within the study area is currently extensively developed. The following sections describe the phases of drilling and production of CBM wells from pre-construction, construction, to post-construction. As part of the drilling and production process, the following is also described: infrastructure and facilities, completion techniques, compression, operation, reclamation, and abandonment. The 2002 FEIS describes in detail the techniques used during the drilling and production of CBM wells; therefore, the following sections are summarized.

### 2.3.1 Pre-Construction

Upon making the decision to drill a well on a leasehold involving Tribal minerals or surface, permits from the SUIT, BIA, and BLM must be obtained by an operator prior to any ground disturbance taking place. Agreements have been signed by the SUIT, COGCC, BIA, and the BLM to simplify the process of approving actions within the exterior boundaries of the Reservation, without compromising any agency's jurisdiction. There are eight different ownership possibilities which may occur and each situation requires different processes for completion of all required documentation including NEPA, APDs, ROWs, surface leases, etc. A detailed description of these processes is included in Appendix B.

### 2.3.2 Construction Phase

Once the APD is approved well site construction can begin. To the extent practicable, the wells would be co-located on existing well pad locations thus minimizing the amount of disturbance. The following is a description of construction techniques typically used for gas development within the SUIT study area. The techniques and procedures could be applicable to all well pad and access road construction, and well drilling; however, operators may use techniques and procedures that vary slightly from those presented here. Determination of the suitability of an operator's design, construction techniques, and procedures is made by the SUIT, BIA, and BLM during the permitting process.

The first step in well pad construction involves clearing and grubbing vegetation and salvaging and stockpiling of topsoil. The typical well pad would be rectangular in shape and measure approximately 250 by 250 feet occupying approximately 1.5 acres (refer to Figure 2.6 from 2002 FEIS). The well pad would be constructed from the earthen materials present on-site and gravel brought in from off-site. Concrete would be used for setting equipment on the location. Construction would involve preparing a level area for the equipment that would drill and complete the well. Following removal of vegetation and stockpiling of viable topsoil material, the pad would be graded using standard, cut-and-fill techniques of construction using a bulldozer, grader, front-end loader, and/or backhoe. A reserve pit of sufficient size would be built based on the number of wells to be drilled from a location. A typical reserve pit is approximately 0.14 acre (120 by 40 by 10 feet deep), and is excavated adjacent to the level pad using heavy equipment. Some operators do not use a reserve pit for drill cuttings and instead bury the cuttings in a trench on location after they are dried. A closed loop system could also be implemented.

For construction of a co-located well pad, initial activities would vary from those of new well pad construction. The co-located well would be generally drilled a minimum of 90 feet from the originally wellhead on the pad. Some additional disturbance may be necessary, such as for excavating the reserve pit or slight enlargement of the existing pad to accommodate the drilling rig. A second set of dead man anchors would be set in order to secure the drilling rig. After preparation of the well pad, drilling would commence following the standard procedures discussed below. The co-located well would have an individual pump jack, flow lines, separator, and meter run. It would share the same produced water tank, produced water line (if there is not a water tank on site), and gas pipeline as the original well. During drilling of the second co-located well, the original well may be temporarily shut-in, depending on the individual operator. Operators would typically not remove any production equipment used by the original well, but commonly operators would barricade and guard the well head and production equipment during drilling of the second well.

Stockpiles for both topsoil and subsoil would generally occupy approximately 0.10 acre, but also would depend on the amount of cut-and-fill required to level each site. The placement of stockpiled material would be determined on a case-by-case basis during the on-site but would be located on the permitted area unless an additional temporary use area (TUA) is approved expressly for that purpose. Otherwise, all disturbance and stockpiling would take place within the proposed pad dimensions. It may be necessary to remove excess excavated material from a location. The SUIT and the agencies could allow transport between locations on Tribal surface lands. The need for transporting excess material would be evaluated on a case-by-case basis. In general, the stockpiled material would be graded to a stable configuration and seeded, straw mulched, and crimped following completion of the well. Backfill for the reserve pits and spoil stockpile would occupy an area adjacent to the pits. A small flare pit (20 by 20 feet) could also be constructed no less than 80 feet from the wellhead (USDI 2002a).

## ACCESS ROADS

There would be approximately 39 new roads constructed under the proposed action for those wells that would not be co-located (approximately 5%). New roads would be arterials off of main roads and would require a 20-foot wide corridor with a 16- to 18-foot wide driving surface. The 20-foot wide corridor would be a maximum surface disturbance associated with drainage ditches, back cuts, or fills. Very few well location access roads on the Reservation exceed 0.5 mile in length and average 0.25 mile in length. For analysis purposes, the average road is assumed to cause a disturbance of 20 feet in width and 0.25 mile in length (0.60 acres), per well. New road construction for new well sites would result in approximately 24 acres of disturbance. However, this number is accounted for under the total acreage figure for long-term disturbance of new wells (total 3.2 acres). Access road construction for the average road requires two days and a crew of three.

Access roads would be constructed using standard equipment and engineering techniques. Heavy equipment, such as bulldozers and road graders would clear vegetation and earthen materials from the road surface. All roads would be constructed with appropriate, adequate drainage and erosion control features/structures (e.g., cut and fill slope and drainage ditch stabilization, relief and drainage culverts, water bars, and wing ditches in accordance with Gold Book standards (USDI/USDA 2006b) as determined by the BLM through analysis of APDs. Also, depending on the road location, the BIA may assign additional site specific stipulations.

## PIPELINES

The majority of wells would be co-located and would, in most cases, be tied into an existing pipeline system. New well-tie pipeline construction consists of a buried pipe 2- to 4-inches in diameter within a 40-foot ROW. The additional anticipated incremental disturbance from pipelines would be based on approximately 39 well locations that would not be co-located. New pipeline construction for new well sites would result in approximately 48 acres of disturbance. However, this number is accounted for under the total acreage figure for disturbance of new wells (3.2 acres).

Some pipeline looping is possible in specific cases due to inadequate pipelines that were initially installed or that some 160-acre wells drilled in the area could produce greater gas volumes than predicted. This scenario coupled with increased gas volumes from 80-acre infill wells will most likely determine whether additional looping pipelines may be constructed. Since natural gas production is declining in the study area, it would seem unlikely that additional pipeline infrastructure would be needed. Currently, operators in the study area have not identified the need for increased looping or gathering pipelines. Pipeline construction, where feasible, would be contained in existing utility or road corridors.

## DRILLING OPERATIONS

Following construction of the access road and well pad, a drilling rig is transported in sections and erected on the well site. Additional equipment and materials needed for drilling operations would be trucked into the well site. Drilling is a 24-hour operation taking on average one to two weeks to drill a CBM well to the required depth. To protect the fresh water zone, surface casing is utilized. A 12¼-inch (diameter) hole is drilled to a depth of 500 to 1,000 feet, depending on the depth necessary to penetrate the fresh-water zones. Steel casing is lowered into the hole and then specially designed cement is pumped down inside the casing out the shoe (at the bottom of the pipe) and up the outer annulus of the pipe to protect aquifers above the top of the casing shoe and to secure the base of the pipe. Surface casing is set to below the depth of the nearest potable water well within 0.5 mile of the surface location. After the surface casing is set, drilling resumes. Depending on well bore conditions, additional strings of casings may be run, using the same cementing practices before the well reaches the objective depth (total depth). Following drilling and completion of the well, the reserve pit is backfilled after water has been evaporated or trucked away. The drilling pad is then contoured and seeded in interim reclamation. The reserve pit is backfilled typically within nine months per COA requirements. The reclamation of each well will be determined on a case-by-case basis per SUIT Department of Natural Resources (DNR) and BLM stipulations.

## DIRECTIONAL OR HORIZONTAL DRILLING

Directional (slant) drilling is the process of drilling a deviated well trajectory, to reach a downhole location that is not directly beneath the drill site. With technological advances from recent years, directional drilling is now economically feasible in a wide variety of basins. The majority (95%) of proposed wells would be co-located on an existing pad and would be directionally drilled. The existing pad would be expanded which could necessitate removal or reconfiguration of some surface facilities. Following expansion for the proposed location, the drilling rig would be moved onto the location (USDI 2002a). Drilling would proceed normally through the setting of the surface casing as with vertical drilling.

After setting the surface casing, directional drilling would begin with a “kick-off” (kick-off point) at which drilling would “build angle” and begin angle drilling which typically cumulates at an angle of 0-50 degrees to reach the bottom hole location and the target formation. For horizontal wells this angle could go to 90 degrees and stay there for the entire length of the horizontal leg (lateral). A pipe casing is then installed from the surface of the bore hole through the production zone and cemented in place to prevent interzonal communication between gas bearing zones and water zones. In horizontal wells the lateral could be open hole or an uncemented slotted liner could be installed. Depending on the depth to the Fruitland coal and the drilling window constraints, the bottom hole location is typically between 0-2,600 feet horizontally from the surface location. Directional drilling and completion activities may take two to four weeks, depending on the well depth and lateral extent. The drilling pad is then reclaimed to within approximately 10 feet of the drilling rig derrick anchors.

## DRILLING EQUIPMENT

The drill rig is made up of four main system components: power, hoisting, rotating and circulation. The bit is threaded onto the drill pipe and lowered through the rotary table by means of the draw work. The rotary table rotates the drill pipe and bit to bore the hole. As the hole deepens, the drill string is lengthened by adding more pipe to the upper end. Drilling fluid is circulated down the drill pipe, out jets in the bit, and then returned up the well bore between the outside of the drill pipe and the well bore. For safety measures in the event that down hole pressure exceeds the drilling mud’s hydrostatic pressure, one or more manifolds called “blowout preventers” (BOP) are mounted below the rig floor. The BOP could close off the well bore (USDI 2002a).

## WATER USE

Most of the water used during the life of a producing well is consumed during drilling operations. A small amount of water is used for dust suppression or equipment installation during other phases of development. Up to 126,000 gallons of water could be needed for activities such as mixing drilling mud and cleaning equipment. Recirculating mud systems are used to reduce the total volume of water needed. Drilling mud can be recycled to the next drilling location. Produced water from wells in the area could be used sometimes for most drilling operations except mixing cement. Operators purchase water from commercial sources and it is trucked or pumped to the well site (USDI 2002a).

## DRILLING WITH MUD

The drilling fluid, called “mud,” is a mixture of water, bentonite, caustic soda, barite, and polymers. Drilling mud cools and lubricates the bit, while lifting the well cuttings caused by the bit to the surface for examination and disposal. The mud in the well bore prevents the hole walls from sloughing off into the hole, keeps underground pressures stable, and seals the sides of the well bore through formation of a thin “mud cake”. Mud properties are carefully supervised and several measurements of the mud are made by a “mud specialist” during daily visits to the well site. The drilling mud would be mixed on location and stored in steel pits or lined earthen pits. Drill cuttings may be separated from the drilling mud and buried in a trench dug on the well location in the event that a self-contained mud system is used (closed loop) and the cuttings are extracted. The mud could be recycled to another drilling operation. If not recycled, it would remain in the pit until the water has evaporated and then is buried on location (USDI 2002a).

**DRILLING WITH AIR**

Some wells are drilled at least partially with compressed air or natural gas as the circulating fluid. Air serves some of the same purposes as drilling mud. Air drilling would be applicable only where little water is encountered in the subsurface and where the pressures of the formations to be penetrated are well known (USDI 2002a).

**DRY HOLE**

In the event formation evaluation determines a well would not be economically feasible to complete, then the well would be a dry hole and would be plugged and abandoned following the procedure described in Section 2.3.5.

### 2.3.3 Completion Operations for CBM Wells

**CEMENTING OF CASING**

Casing would be cemented with the larger drilling rig and then a smaller daylight rig would be used to complete the final phase of the well (Refer to COGCC Order 112-61). Casing would be run to the producing zone and cemented in place. Cementing methods for CBM wells would be more stringent than those associated with deeper conventional wells. To ensure isolation and protection of all zones between the surface and total depth, the BLM requires cement to be circulated from total depth to surface on the production casing, as well as on the surface casing of CBM wells. Remedial measures would be taken if cement cannot be circulated to the surface (USDI 2002a).

**STIMULATION TECHNIQUES - ACIDIZING AND HYDROFRACTURING**

If formation pressures are great enough, the well would be completed as a flowing well. Several downhole acid or fracture treatments could be necessary to enhance the formation permeability, to make the well flow. Water requirements for these treatments range from 1,800 to 3,000 barrels (bbls). At the end of the treatment, the treatment water would flow back to the surface and is captured in temporary tanks on location. This fluid would be hauled to injection wells or evaporation ponds for disposal with other produced water (USDI 2002a).

Acidizing a well would require introducing acid in the well bore across the productive interval which would cause the solution of some of the mineral materials (e.g., calcite, dolomite, etc.) around the pore space. Upon solution and removal of these minerals, porosity and permeability are enhanced (USDI 2002a).

Hydrofracturing would be conducted using fluid pumped down the well through perforations in the casing and into the formation. Pressure would be increased to the point that the formation fractures or breaks, and sand or granular material, would be added to the injection fluid to “prop open” the crack, once the pressure is released. The pressure required to fracture a given formation is generally predictable. However, some coals require very high pressures to fracture the formation (USDI 2002a).

**CAVITATION**

Cavitation is an open hole completion technique that could be used on CBM wells. In the past this completion technique was frequently used. However, currently it is not commonly used in the study area. With this completion technique, the well would be drilled to the top of the coal zone and the production casing would be set and cemented back to surface. The conventional drilling rig would be released and a modified completion rig is then brought in to complete the “cavitation” process (USDI 2002a).

An air/water mixture would be injected for one to six hours into the exposed coal interval which would fracture the coal. Ultimately pressure would be released, which causes the fractured formation to collapse thereby creating a cavity. This process is repeated over and over until desired cavity size is reached. During cavitation, pressure builds within the down hole during a shut-in (closed) interval. When pressure is released a flow of gas, fluid and coal fines moves to the surface via the blooie line. Initially pressure release results in large amounts of gas which would be controlled through a flare to burn off the excess gas. Water and coal fines would be collected in the lined reserve pit. Approximately 15 to100 barrels (bbls) of water would be used in the cavitation procedure each time shut-in occurs. Approximately 90% to 95% of coal fines would be collected in the reserve pit while the remaining 5% to 10% would be burned or lost to the atmosphere. The well would be surged and/or cleaned out intermittently on a 24-hour basis determined by the amount of coal encountered. The cavitation process typically involves 20 to 30 injections over a 10- to 15-day period and could take place day and night (USDI 2002a).

## GREEN COMPLETION

Before natural gas and CBM wells begin producing gas for sale, the well bore and surrounding reservoir would be "cleaned up" (i.e., any fluids, sand, coal particles, or drill cuttings within the well bore must be removed). The conventional method for doing this is to pump air down the well bore which would lift the waste fluids and solids out. The solid and liquid waste materials would be dumped into a pit or tank, and any gas that would be removed is flared or vented to the atmosphere. In some flareless or green completions, natural gas, rather than air, would be pumped down the well bore to clean it out.

The green completion technique would be used on some CBM wells in the study area which would eliminate flaring and testing. With the existence of a pipeline already onsite for the wells, the gas from flowback would be run through a special separator and then placed in the pipeline for gathering. This technique would reduce flaring and venting overall. The methane emissions reduction would be estimated as the total recovered from 63 wells reported during a pilot study. The study reported natural gas emissions reduction of 7,410 million cubic feet (MMcf) per year, which is 70% of the gas formerly vented to the atmosphere (U.S. Environmental Protection Agency [USEPA] 2007).

The additional equipment for green completion could include considerably more tanks, special gas-liquid-sand separator traps and portable gas dehydration. In addition to reducing methane emissions, green completions could produce an immediate revenue stream with the produced natural gas and gas liquids, less solid waste and water pollution, and a safer operating practice (USEPA 2007).

## FLARING AND TESTING

During completion and testing of CBM wells, flaring could be used to safely remove gas from the rig and work area. During the process produced gas would be ignited and burned rather than directing that gas to sales. Produced gas would be piped away from the well bore into a pit constructed on the well pad, ignited and allowed to burn. A berm would usually be constructed around the pit to aid in containing the flame and any materials that could be blown out with the gas. In a cavitation completion, as described above, a CBM well would be cycled for days or weeks between periods of pressure build up and periods of flowing. Flaring would commonly occur while the well is flowing (USDI 2002a).

**ARTIFICIAL LIFT**

Artificial-lift (pump) methods would also be used during production. These methods are explained, along with well production equipment and procedures, in Section 2.3.4 below.

### 2.3.4 Coalbed Methane Gas Production

Methane is commonly produced either from coalbeds or from nearby reservoir rock to which it has migrated. Unlike conventional wells, CBM wells usually need artificial lift (i.e., a pump) to remove formation water. A reduction in fluid pressure causes gas to be released (desorbed) from the coals. Once released it moves toward the "pressure sink," which is the well bore. It then flows preferentially to water, thereby reducing water production rates and increasing gas production rates. Once sufficient gas flow has been established, artificial lift equipment is no longer required (USDI 2002a).

**PRODUCTION FACILITIES**

Reservoirs that produce both oil and natural gas require the siting of facilities for the production, cleanup, and storage and/or transportation of the products on the well pad. If the well naturally produces only a series of pipes and valves at the well head is required to regulate the flow of product to the surface. A pump is used to lift the water to the surface if reservoir pressure is too low to lift the water to the surface (USDI 2002a).

**PRODUCED WATER**

Due to comparatively high volumes of produced water, treatment facilities are used to treat CBM production. The produced gas is transported to a well site separator, which separates the stream into individual gas and water gathering lines before transportation to the central delivery point (CDP) or treatment facility. The separate pipelines are usually contained in the same trench along the ROW. At the facility, the gas flow enters a slug catcher for additional separation. The produced water is stored in tanks before flowing to a treatment facility. Some wells have a water line laid to the disposal well piping system. These produced water lines are laid within the same trench as the pipeline and do not result in new disturbance (USDI 2002a).

**PRODUCED-WATER DISPOSAL**

Pumping jacks powered by electric motors or by gas fired internal combustion engines are used to actuate the downhole pumps used as artificial lift to remove water from a CBM well. Other methods of artificial lift include plunger lift systems. A plunger lift system is a form of intermittent gas lift that uses gas pressure buildup in the casing-tubing annulus to push a steel plunger, and the column of fluid ahead of it, up the well tubing to the surface. The plunger serves as a piston between the liquid and the gas, which minimizes liquid fallback, and as a scale and paraffin scraper.

Most wells drilled in the study area produce enough water that it must be disposed of during the well operation. The average amount of produced water for all CBM wells on the Reservation was approximately 34,648 bbls per day in 2007. A General National Pollutant Discharge and Elimination System (NPDES) permit issued by the USEPA must be authorized for produced water that is to be discharged to surface waters inside the exterior boundaries of the Reservation on Tribal lands. Produced water would be trucked or transported via pipeline to a disposal site. Most of the produced water (95%) from the Reservation is disposed of in deep injection wells (USDI 2002a).

## WATER DISPOSAL INJECTION WELLS

On the Reservation, injection disposal wells are authorized by the USEPA. BLM engineers and the SUIT have review responsibility for injection proposals to determine if there would be impacts on other minerals and groundwater; however, the USEPA has approval authority over the well and target zone. Similarly, the BIA and SUIT review the injection well for surface concerns. When water is disposed of underground, it is always introduced into a formation containing water of equal or lesser quality or into a formation that has been specifically exempted by the USEPA or COGCC (USDI 2002a). It is anticipated that additional disposal facilities would be necessary. The number of planned injection wells for produced water disposal is estimated to be less than two on Tribal lands within the study area. Approximately five injection wells are planned on non-Tribal lands within the study area (USDI 2002a).

## COMPRESSION

Compression lowers pressure at the wellhead and compresses gas to a greater pressure than pipeline pressure allowing gas to flow into a transmission line. Compression occurs at the wellhead as it enters the pipeline system, or gas can be transported by pipeline to a central compression station, prior to processing. This function is accomplished using natural gas fired engines or electric motors. Other equipment may include dehydration and amine systems for water and carbon dioxide removal.

Compression stations in the study area vary in size from approximately 1 acre to as large as 20 acres. As production declines in specific areas of the study area, compression facilities are moved to other areas to facilitate production at current levels. Producers commonly move engines or motors from one facility to another existing facility. This eliminates the need for new disturbance resulting from compression. However, additional compressor areas within the study area to optimize production may require some new disturbance. Since November 1, 2002, five compressor stations have been constructed on Tribal lands within the study area; however, many more have been permitted, but not constructed (Ed Trahan, SUIT DOE, personal communication, November 12, 2008). The total estimated long-term disturbance for these stations is approximately 21 acres. Three compressor stations have been constructed on fee lands within the study area since that time resulting in approximately 15 acres total long-term disturbance. Currently, the reasonably foreseeable development for compressor stations within the study area includes three locations on Tribal lands resulting in approximately 20.3 acres of long-term disturbance and one location on fee lands resulting in an estimated 6.8 acres of long-term disturbance.

Over the life of a natural gas well, natural reservoir pressure normally declines as reserves are produced. When the natural gas pressure at the well decreases below the line pressure in the pipeline system, wellhead compression may be needed to move the product to processing facilities. Wellhead compression uses small electric or gas-powered equipment located on the well pad. Wellhead compression does not result in new disturbance as it is located on existing well pads (USDI 2002a).

## MAINTENANCE AND WORKOVER OPERATIONS

Routine production operations occur throughout the year and require use and maintenance of access roads and well pads on a periodic, as needed basis. Maintenance of the various mechanical components used in production occurs at intervals recommended by manufacturers or as needed, based on site inspections. A pumper visits each producing well to ensure that equipment is functioning properly. Pumpers for some smaller producers may visit each well on a daily basis. For larger producers a pumper visits the well site once a week; however, such wells are generally subject to constant off-site computer based automation systems using telemetry. Solar panels are used to power the radio telemetry equipment. When a problem is identified through the system a pumper is dispatched to the location. Control and monitoring of well production by radio telemetry reduces regular site inspections of each well, as well as vehicular traffic.

Periodically, a workover on a well is required. A unit similar to a completion rig is used to conduct maintenance procedures for efficient operation. Workovers can include repairs to the well bore equipment (e.g., casing, tubing, etc.), the well head, or the production formation itself. These repairs occur during daylight hours only and are usually completed in two to five days and in some cases several weeks. Some situations may require several days to finish a workover. The frequency for this type of work cannot be accurately projected, since workovers vary well by well and depend on site specific circumstances (USDI 2002a).

## ENHANCED RECOVERY (NITROGEN AND CARBON DIOXIDE UNDERGROUND INJECTION)

The 2002 FEIS approved the use of ECBMR as a strategic recovery method for approximately half of the CBM leases within the study area. At the time, it was thought that ECBMR would be an effective and economical method to efficiently drain the Fruitland reservoir and maintain consistent production levels. Carbon dioxide and/or nitrogen are injected into the coal formation to enhance recovery. While carbon dioxide adsorption drives the methane molecules off of the coal surface, replacing them with carbon dioxide molecules, inert nitrogen reduces the effective partial pressure of methane in the coal (Brown 2002).

BP America implemented an ECBMR injection project in the Tiffany Unit in the southern Colorado portion of the SJB. The nitrogen ECBMR project consisted of 12 injection wells and 34 producing wells effectively developing the 10,000 acre unit. Nitrogen injection operations commenced on January 31, 1998, and continued intermittently until January of 2002. Injection operations were suspended at that time to evaluate the economic viability of continued nitrogen injection operations (Brown 2002).

The nitrogen ECBMR project was a technical success in terms of increasing CBM gas from the Tiffany Unit, but to expand the use of it either in the Tiffany Unit or elsewhere within the Reservation was determined not to be viable at the time for the following reasons:

- **High operating costs of the facility and infrastructure necessary to sustain nitrogen injection.** An economic evaluation completed at the time of suspension of injection operations concluded that ECBMR could not compete with an infill development program. Even though the price of natural gas was lower when the project was operating, the injection facilities have been dismantled and injection wells and pipelines have been converted to production operations since then.

- **Difficulty in initiating another project in the SJB similar in size to the Tiffany Unit.** The area where nitrogen injection would occur involves unitization of the land, which requires 80% ratification by the leaseholders. Ratification would be difficult to obtain in an area large enough for a nitrogen project similar to Tiffany. Furthermore, it was unlikely that the relatively large land area necessary for a commercially viable nitrogen injection facility could be identified with the expectation that lease holders would approve the project.

- **Substantial capital investment.** The capital investment necessary to initiate a nitrogen injection facility large enough to develop a significant area of the field under ECBMR was not an economically viable option at this time (Brown 2002).

ECBMR currently is not being implemented in the study area. However, economic conditions or technological advances could result in this process being re-initiated in the future, particularly using carbon dioxide injection.

Carbon sequestration activities are not permitted on the Reservation without consent from the SUIT Council. Currently there are three carbon dioxide pilot projects underway in the Four Corners region, including a project designed to inject 20,000 tons of carbon dioxide into Fruitland formation coalbeds near Navajo Dam. The purpose of these experimental projects is to capture carbon dioxide at fossil fuel combustion locations and to inject it underground formations where it can be permanently stored. While the potential reduction of carbon dioxide into the atmosphere has positive implications for maintaining or improving regional air quality, these projects raise serious issues regarding underground trespass and liability for unintended migration of sequestered substances (Southern Ute Indian Tribal Council 2008).

### 2.3.5 Abandonment-and-Reclamation Phase

Well plugging and abandonment requirements vary with the rock formations, subsurface water, well site, and well. In all cases, all formations bearing useable quality water, oil, gas, or geothermal resources, and/or prospectively valuable deposits of other minerals, would be protected. Generally, in a dry well, the hole below the casing would be filled with heavy drilling mud, a cement plug would be installed at bottom of the casing, the casing would be filled with heavy mud, and a cement cap would be installed on top. A pipe monument, giving the location, lease number, operator, and name of the well, would be required. In irrigated fields, the casing would be cut off and capped below the plow depth or the immediate casing.

Plugging of a depleted producing well would require a cement plug in the perforated casing in the producing zone. The cement pump jack foundations, if any, would be removed. Surface flow and injection lines would be removed. Any and all pipelines within the pad area would be removed to facilitate reclamation re-contouring. The subsurface pipeline, where it exits on the pad, would be capped and abandoned in place. Subsurface power lines would also be abandoned in place. All surface equipment would be removed.

The disturbed surface area would be restored to the requirements of the SUIT and BIA. This could involve the use of bulldozers and road graders to recontour those disturbed areas associated with the drill pad, including the access road to the particular pad. The area would be reshaped to an approximation of the original contour to create a smooth transition with adjacent undisturbed ground, minimize erosion and sedimentation, and establish vegetation. After grading, the subsoil and stockpiled topsoil would be spread, the seedbed would be prepared, and the site would be seeded with a viable seed mixture.

Following seeding, the site would be mulched and crimped with certified weed free straw. A fence could be erected to protect the site until seed germinates and vegetation becomes established, particularly in livestock-concentration areas. The installation of exclusion fences would be determined on a case-by-case basis during the agency on-site. Final abandonment would not be approved until noxious weeds were under control and vegetation groundcover is sufficient to control erosion (USDI 2002a).

## 2.4 Environmental Protection Measures

### 2.4.1 Introduction

Appropriate and prudent site-specific environmental protection measures and mitigation would be developed and made a requirement of each project during the APD approval process. This would consist of site-specific mitigation based on the findings of project specific environmental assessments, special surface stipulations from the SUIT DOE, SUIT DNR, the BIA, and BLM stipulations modifying the drilling plan (if needed) as COAs for the APD. A complete APD normally consists of a surface-use plan, drilling plan, evidence of bond coverage and other information that would be required by the SUIT, applicable regulations, and BLM Orders or Notices. A surface-use plan would contain information describing the surface uses, access, water supply, well-site layout, production facilities, waste disposal, and restoration/revegetation or reclamation associated with the site-specific well-development proposal. The drilling plan would typically include information describing the technical drilling aspects of the specific proposal, including subsurface resource protection and royalty accountability.

### 2.4.2 Management Requirements for the Implementation of the Proposed Action

The SUIT has developed standard environmental protection measures and conditions of approval that would be applied to all future development within the study area. These general conditions would be augmented with special conditions for a site specific project whenever conditions warrant. The SUIT General Well Site COAs and General Pipeline ROW Stipulations are presented in Appendix C. In addition, BLM Onshore Oil and Gas Orders and Notices to Lessees would be applied as standard operating procedures to individual projects and operators. The applicable orders and notices include:

- 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

Notice 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 ROW Stipulations
- Mitigation Measures from the Environmental Assessment of Oil and Gas Leasing and Development on the Southern Ute Indian Reservation (USDI 1990)

The SUIT has also developed management requirements for the implementation of the proposed action. These requirements would include:

- Co-location of infill wells at existing drill pads to the maximum extent feasible.
- Presumptive utilization of the best available air emissions control technology for new compressor installation and the presumptive upgrade of existing compressors to contemporary best available emissions control technology to the maximum extent feasible in a manner consistent with optimizing air quality on the Reservation.

Design features which would be implemented under the proposed action would include the specific measures that are outlined below and in Chapter 4 of the 2002 FEIS, which were referred to as mitigation measures. Additionally, the SUIT, BIA and BLM have collaborated to develop new or to modify existing measures to minimize the impacts of the proposed action. The following section provides design features which were developed for the 2002 FEIS, as well as new or modified features developed for the proposed action evaluated in this document. Each of the features is identified with the following bullet demarcation:

- 2002 FEIS design features
- ➢ New or modified design features

## AIR QUALITY

### 2002 FEIS DESIGN FEATURES

The following list of mitigation options was developed as part of the 2002 FEIS and has been revised in the PEA as outlined in Section 4.2.8.

- Roads would be surfaced or dust inhibitors would be used (e.g., surfacing materials, non-saline dust suppressants, water, etc.) as appropriate, on roads and well locations constructed on soils susceptible to wind erosion, to reduce the amount of fugitive dust generated by traffic or other activities.

- Speed limits would be enforced to the extent practicable on roads in and adjacent to the project area, to further reduce fugitive dust.

- Reduce Compression Requirements: Reducing the need for life of project (LOP) compression by limiting the need for injection compressors.

- Non-selective Catalytic Reduction: This control technology is applicable to relatively new engines and requires the installation of catalysts in the engine exhaust. The catalyst removes between 80% and 90% of the uncontrolled nitrogen oxide ($NO_x$) emissions, for an operating emission rate of 1.0 to 5.0 grams per horsepower hour (g/hp-hr). The cost effectiveness of this control technology applied to a 2,500 to 4,000 horsepower (hp) rich-burn engine ranges from $315 to $395 per ton of $NO_x$ removed.

- Lean Combustion: This technology involves the increase of the air-to-fuel ratio to lower the peak combustion temperature, thus reducing the formation of $NO_x$ (new engines and retrofit applications). The controls are between 80% and 90% efficient, for an operating emission rate of 1.5 to 4.0 g/hp-hr. The cost effectiveness of this control technology applied to a 2,500 to 4,000 hp rich-burn engine ranges from $480 to $500 per ton of $NO_x$ removed.

- Selective Catalytic Reduction: This is a post-combustion control technology that is applicable only to exhaust streams with significant oxygen content (a lean burn engine). The controls are between 80% and 90% efficient, for an operating emission rate of 1.0 to 2.5 g/hp-hr. The cost effectiveness of this control technology applied to a 2,500 to 4,000 hp rich-burn engine ranges from $700 to $890 per ton of $NO_x$ removed.

- Fuel Cell Technology: It is not feasible to connect enough fuel cells together to generate the necessary compression horsepower. About 75 fuel cells (at a capital cost of nearly $30 million) would be required to provide 20,000 hp of compression. In addition, current technology allows only two fuel cells to be connected in a series, and, as of January 1998, there were only 160 of these units operating worldwide. The cost effectiveness of this control technology ranges from $20,000 to $40,000 per ton of $NO_x$ removed.

- Natural Gas-Powered Drilling Rigs: The theoretical use of natural gas-fired engines to power drilling rigs, mud pumps, and associated equipment, rather than diesel-powered equipment, is technically feasible to reduce $PM_{10}$ (particulate matter 10 microns in size) and sulfur dioxide ($SO_2$) emissions. However, such equipment is not commercially available.

The following design features are outside the jurisdiction of the BIA's management authority:

- Withdraw or Prohibit Future Leasing: Previous NEPA document comments have suggested the BIA "withdraw or don't offer leases," apparently to eliminate natural gas development and the related air pollutant emissions. However, once the Department of the Interior Secretary has approved a valid mineral lease granted by a Tribe, the Department may impose operational condition, but may not unilaterally rescind such a lease. Similarly, under current federal mineral law, future leasing can be prohibited only in specific legal circumstances and would generally require the formal concurrence of the SUIT. The U.S. Congress could revise these laws, but the prospect of securing passage of such legislation and appropriation of funds for that specific purpose is extremely remote. In addition, elimination of natural gas leasing is inconsistent with Congressional direction [through the Clean Air Act (CAA)] for development and promotion of alternative clean fuels needed to improve air quality nationally.

- $NO_x$ Emissions "Cap and Trade": Previous NEPA document comments have suggested the BIA consider $NO_x$ emissions trading, therefore limiting $NO_x$ emissions at current levels. Existing $NO_x$ emission facilities could then either keep, trade or sell their emission allocations (essentially a property right to pollute) to other groups seeking to increase their $NO_x$ emissions. When coupled with "banking" (holding, but not using credits) and "discounting" (reduced emission credit values with each "trade"), overall

$NO_x$ emissions would decrease. Under the CAA, the U.S. Congress has already established an "allowance program" for certain $SO_2$-emitting facilities, and Congress could establish a similar $NO_x$ trading program to be implemented by the applicable air quality regulatory agencies.

- Phased (Staged) Development: Previous NEPA document comments have suggested the BIA reduce the intensity of natural gas development, such as limiting the "...number of wells or...amount of emissions until reach[ing] 0.5 deciview..." The BIA does not have the authority to require that development of existing leases be limited when specified emissions levels are reached. However, an overall air pollutant emissions "level of concern" could be established at a point where reevaluation would occur, providing timely management review and ensuring compliance with the Federal land managers' mandate to protect Air Quality Related Values (AQRVs) through participation in the applicable air quality regulatory agencies pre-construction permitting. However, this action might also require the consent of the SUIT.

**NEW OR MODIFIED DESIGN FEATURES**

- Electric Compression (including solar power): Using electric-powered compressor motors in place of the typical natural gas-fired compressor engines could eliminate direct $NO_x$ emissions from compressor station locations. Increased $NO_x$ emissions are likely to occur at the point of electrical generation, as they often burn dirtier fuels and emit more air pollutants (such as from coal-fired power plants). Using current industrial electrical rates and assuming 100% control due to elimination of 2.0 g/hp-hr $NO_x$ emissions at the compressor site, the cost effectiveness of electric compression is roughly $26,000 per ton of $NO_x$ removed. Photovoltaic (solar) electrical systems cannot provide the needed power requirements for proposed injector well and pipeline compression engines (nearly 118,000 hp).

- All new and replacement internal combustion gas field engines must meet, at minimum, recently promulgated (January 18, 2008, 73FR3568) New Source Performance Standards (NSPS) (40 CFR 60, Subpart JJJJ). Additionally, all new and replacement internal combustion gas field engines greater than or equal to 500 design-rate horsepower (or site de-rated horsepower values, as long as manufacturer de-ration values and emission factors are supplied and current demonstration compliant with appropriate emission rate requirement) must not emit more than 1 gram of $NO_x$ per horsepower-hour upon issuance of the Decision document, as opposed to being delayed under the NSPS.

- All older compression installations within the Ignacio Blanco field will be upgraded to contemporary best available emissions control technology within five years (2012). All new and replacement internal combustion gas field engines must meet, at minimum, recently promulgated (January 18, 2008, 73FR3568) NSPS (40 CFR 60, Subpart JJJJ). Additionally, all new and replacement internal combustion gas field engines greater than or equal to 500 design-rate horsepower must not emit more than 1 gram of $NO_x$ per horsepower-hour upon issuance of the Decision document, as opposed to being delayed under the NSPS.

- All prime mover diesel drilling rig engines will meet Tier 2 (or better) emission standards.[1]

[1] Drilling rig engines for new wells, not work overs or recompletion rigs.

- ➢ Refer to Appendix G the Air Quality Technical Document for more clarification on meeting air quality mitigation measures.

**Air Quality Monitoring**

- ➢ SUIT EPD, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with air quality mitigation.
- ➢ Based on the results of the annual report, SUIT EPD may require additional control measures for operators with facilities within the SUIT boundary to minimize impacts to air quality.

**BIOLOGICAL RESOURCES**

**VEGETATION**

**2002 FEIS DESIGN FEATURES**

- Avoid areas containing sensitive vegetation types, such as wooded riparian vegetation or known sites with culturally important plants, to the fullest extent possible.
- Reclaim and revegetate all disturbed areas of soil with approved, certified weed free seed mixes, fertilizer, and/or mulch.
- Separate topsoil and set aside for reclamation purposes.
- Limit construction activities to dry conditions to reduce soil compaction and rutting, as appropriate.
- Use spark arresters on chainsaws and mufflers on vehicles to prevent wildland fires.
- Burning brush, trash, scrap materials, etc. is restricted by state agency or Reservation rules.
- Apply herbicide only under the supervision of a licensed pesticide applicator, and ensure that application, storage, and disposal procedures meet state and federal requirements.
- Clean up spills of petroleum products or produced water in an appropriate manner as soon as possible to minimize damage to plant materials.
- Control erosion and sedimentation with Best Management Practices (BMPs).

**NEW OR MODIFIED DESIGN FEATURES**

- ➢ All oil and gas operators will obtain a permit from the SUIT Forestry Division prior to the removal of wood materials greater than 4 inches in diameter from well pads or pipelines.

An annual report detailing reclamation of facilities must be submitted by all oil and gas operators with facilities on Tribal lands within the SUIT boundary no later than March 1 of each year to the SUIT DOE and the BLM. The report format is outlined in Appendix E.

**WETLANDS**

**2002 FEIS Design Features**

- Avoid construction in wetlands to the fullest extent possible.
- Identify unavoidable direct and indirect impacts on wetland areas during individual project planning. Develop a wetland mitigation/monitoring plan and obtain necessary permits, prior to initiation of construction activities.
- When it is necessary to cross streams and riparian areas, design facilities to cross at right angles, rather than parallel, in order to minimize the area of impact on these resources. Use BMPs at any temporary stream crossings, and rehabilitate wetlands as soon as possible.
- Protect water quality within, and downstream of, the study area from soil erosion and sedimentation by BMPs that include erosion control devices and management procedures, retention of a vegetation buffer strip (minimum of 100 feet) between water bodies and disturbed areas, and spill prevention procedures.
- Conduct equipment fueling, maintenance, and storage operations at least 100 yards from any wetland or stream system.

**NEW OR MODIFIED DESIGN FEATURES**

➢ Whenever reasonably possible, bore under jurisdictional waters of the U.S., including drainages and wetlands to avoid and/or minimize surface impacts.

**CULTURAL SPECIES**

**2002 FEIS DESIGN FEATURES**

- Avoid disturbing areas containing culturally significant plant species (e.g., cottonwood trees along the Los Piños River).

**NEW OR MODIFIED DESIGN FEATURES**

No new or modified design features have been identified for cultural species.

**NOXIOUS WEEDS**

**2002 FEIS DESIGN FEATURES**

- Monitor invasive species populations.
- Use BMPs to minimize the introduction of invasive species.
- Require operators to control noxious weeds in disturbed areas.

- For site reclamation, use certified weed-free seed and mulch.

**NEW OR MODIFIED DESIGN FEATURES**

No new or modified design features have been identified for noxious weeds.

**WILDLIFE**

**2002 FEIS DESIGN FEATURES**

- Minimize surface disturbance by accessing new wells via spur roads off existing roadways rather than through construction of new primary roads.

- Use existing ROWs to the extent possible for new roads and pipelines.

- Minimize or avoid development in areas of critically important wildlife habitat, such as elk or deer winter concentration areas and wooded riparian vegetation.

- Conduct on-site inspections of potential development locations to ensure avoidance of wooded riparian areas to the greatest extent possible.

- Survey areas to be developed (ROWs and wells) for nesting activity or winter roost sites (e.g., eagles) prior to construction.

- Restrict new well locations and ROWs to at least 0.25 mile from a raptor nest or winter roost.

- Prohibit construction or other intrusive activities within 0.5 mile of an active raptor nest during the nesting season.

- SUIT Division of Wildlife Resources Management (DWRM) biologists shall conduct yearly nesting surveys to document known nest sites and monitor nesting success. Annual winter roost surveys would also be conducted to identify and record additional winter roost sites. These data would be used to evaluate the effectiveness of mitigation measures for wooded riparian habitat and develop additional mitigation criteria as necessary.

- Limit construction activities in elk and deer wintering habitats to appropriate times (e.g., summer months) or to any applicable seasonal restrictions, in order to reduce disturbance-related impacts on these species.

- Site major developments (e.g., well pads, heavily used roads, and processing facilities) away from migration corridors. Lightly used roads and pipelines may be placed in such areas. Tribal wildlife biologists shall be consulted directly on all major developments to develop specific mitigation to protect migration corridors.

- Minimize the number of well monitoring trips by coordinating well visits to limit traffic or by installing automated monitoring systems.

**NEW OR MODIFIED DESIGN FEATURES**

➢ Where development in unique habitats cannot be avoided, mitigation, such as habitat enhancement and restoration, shall be considered. SUIT DWRM will coordinate with the operator in the development of appropriate wildlife habitat mitigations and enhancements, and the operator will be responsible for construction of these improvements as a COA to proceed with the development activity.

- Re-vegetate disturbed areas as soon as possible. Monitor the success of re-vegetation efforts, and re-seed as needed to develop established stands of vegetation. As per requirements under the design features for vegetation resources this re-vegetation shall be noted in the annual report.

- Maintain appropriate speed limits on access roads to minimize wildlife injuries or mortalities due to vehicle-wildlife collisions.

- Heater-treaters (separators) will be screened to prevent bird mortalities.

- A migratory bird survey prior to construction during the migratory bird breeding season (March through August) will be conducted.

- All fences and cattleguards will be removed from well pads once 70% of vegetation has been established on site for all wells unless requested by landowners. Oil and gas operators will install pipe barriers or panels around wellheads, meters, valves, and other equipment to minimize impacts to wildlife and livestock.

- Bird netting will be suspended and maintained over all reserve pits, open tanks, and catchments if hydrocarbons or toxic chemicals are present in the fluids until reclamation is complete.

- All power lines will conform to the USFWS draft “Guidelines for Raptor Conservation in the Western United States”, the "Suggested Practices for Avian Protection on Power Lines, the State of the Art in 2006" (APLIC 2006), and the "Avian Protection Plan Guidelines" (APLIC 2005).

- *Recommended Buffer Zones and Seasonal Restrictions for Colorado Raptors* (Craig 2002) will be implemented, with the exception of bald eagle. Buffer zones and seasonal restrictions for bald eagle shall be determined by the SUIT DNR and are described below under State Listed Threatened and Endangered Species.

- Recommend that power lines be placed below ground, where possible.

- Pre-construction surveys will be conducted of proposed well pad and access route locations for Gunnison prairie dogs (*Cynomys gunnisoni*). Direct impacts to prairie dog colonies will be avoided where possible, and in the light of other resource tradeoffs resulting from access road and well pad relocation.

**FISHERIES**

**2002 FEIS DESIGN FEATURES**

- Protect surface waters from oil- and gas-related sedimentation and contaminant releases.

- Minimize the number of stream crossings by roadways and pipelines. Where feasible, cross streams and riparian corridors at right angles to protect additional habitat and minimize erosion.

- Maintain riparian vegetation during construction projects, along stream channels to the fullest extent possible.

**NEW OR MODIFIED DESIGN FEATURES**

- Whenever reasonably possible, bore under jurisdictional waters of the U.S. including drainages and wetlands to avoid and/or minimize impacts to fisheries.

**FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES**

**Colorado Pikeminnow and Razorback Sucker**

**2002 FEIS DESIGN FEATURES**

- Use BMPs to avoid contamination of local streams and rivers to protect the razorback sucker (*Xyrauchen texanus)*)and Colorado pikeminnow (*Ptychocheilus lucius*).

**Knowlton's Cactus**

**2002 FEIS DESIGN FEATURES**

- Conduct field surveys for Knowlton's cactus (*Pediocactus knowltonii*) prior to all construction activities.

- Avoid individuals or populations of Knowlton's cactus which may be impacted by activities.

- Use existing ROWs when possible.

**Mancos Milkvetch**

**2002 FEIS DESIGN FEATURES**

- Mancos milkvetch (*Astragalus humillimus*) may be affected by surface disturbing activities that could affect individual plants through their removal or habitat destruction.

- Conduct surveys for Mancos milkvetch prior to well pad and ROW construction activities, unless previously surveyed by the USFWS.

- Avoid individuals or populations of Mancos milkvetch located during surveys.

**Mexican Spotted Owl**

**2002 FEIS DESIGN FEATURES**

- Mexican spotted owls (*Strix occidentalis lucida*) have not been identified within the study area. If present, however, the Mexican spotted owl could be affected by removal of mature stands of conifers and by noise and human-related disturbances from project activities.

**Southwestern Willow Flycatcher**

**2002 FEIS DESIGN FEATURES**

- Conduct southwestern willow flycatcher (*Empidonax traillii extimus*) surveys within suitable habitat prior to any construction activities to determine presence or absence.

- If southwestern willow flycatchers are located during survey efforts, no surface disturbing activities will be conducted from May 1 through August 15.

- Minimize construction activities in wooded riparian habitat, or any other potential southwestern willow flycatcher nesting habitat.

**NEW OR MODIFIED DESIGN FEATURES**

- ➢ No disturbance will be allowed within 200 meters of known or discovered occupied southwestern willow flycatcher breeding habitat.
- ➢ No disturbance will be allowed within 20 meters of federally listed plant occupied habitat, and any disturbance proposed within 200 meters of listed plants occupied habitat would be analyzed in a separate site specific consultation.

**STATE LISTED THREATENED AND ENDANGERED SPECIES**

State endangered species law has no applicability to the SUIT or the SUIT's lands within the Reservation. However, there are instances when a federally listed species is de-listed but remains, or is included, as a State listed threatened or endangered species. On July 9, 2007, the USFWS issued their 'Final Rule' removing the bald eagle (*Haliaeetus leucocephalus*) in the lower 48 states from the list of endangered and threatened wildlife (USFWS 2007). Section 4(g)(1) of the ESA requires management agencies, in cooperation with the states, to implement a monitoring program for not less than five years for all species that have been recovered and de-listed. The purpose of this requirement is to develop a program that detects the failure of any de-listed species to sustain itself without the protective measures provided by the ESA. Although the bald eagle is no longer protected by the ESA, the provisions of the Bald and Golden Eagle Protection Act (BGEPA) will remain in place. The federal de-listing of the bald eagle will not affect the bald eagle's Colorado state status as "threatened".

**2002 FEIS DESIGN FEATURES**

- Den sites and resting areas could be impacted by removal and disturbance of wooded riparian habitats. Aquatic habitats and food sources could be affected by in-stream depletions and degradation of water quality through accidental spills of petroleum products and produced (saline) water as well as sedimentation from erosion of disturbed surfaces.

- Construction activities requiring stream crossings and/or work within riparian corridors would be minimized or avoided where suitable river otter habitat is present and where known dens (e.g., bank dens) are present. Disturbance-free buffer zones based on the quality and quantity of suitable habitat would be established and BIA and SUIT experts should be consulted wherever habitat impacts are suspected to occur. Also, USFWS, BIA, and BLM construction standards regarding well placement would be followed, and wastewater pits would be lined accordingly to avoid hydrocarbon contamination of streams.

## NEW OR MODIFIED DESIGN FEATURES

- Pre-construction surveys for Gunnison prairie dogs will be conducted on proposed well pad and access route locations. Direct impacts to prairie dog colonies will be avoided where possible, and in the light of other resource tradeoffs resulting from access road and well pad relocation.

- A migratory bird survey will be completed by a qualified biologist prior to construction during the migratory bird breeding season (March through August) would be conducted.

- Bird netting will be suspended and maintained over all reserve pits, open tanks, and catchments if hydrocarbons or toxic chemicals are present in the fluids until reclamation is complete.

- All fences and cattle guards will be removed from well pads once 70% of vegetation has been established on site unless requested by landowners. Oil and gas operators will install pipe barriers or panels around wellheads, meters, valves and other equipment to minimize impacts to wildlife and livestock.

<u>Bald Eagle Winter Roosting (November 15 to March 15)</u>

- For a construction project planned during the bald eagle winter roosting period and within 0.25 mile of a riparian zone with a mature cottonwood component, a pre-construction survey shall be initiated within 10 days prior to the start of construction to verify the presence or absence of bald eagle roosting activity. The surveys must be conducted by qualified biologist(s) according to protocol as set forth by the USFWS. Generally, the survey should be performed during dawn and dusk periods on two or more days immediately prior to the construction start date. The survey should be documented and results sent to the Division Head of the SUIT DWRM.

- If <u>one or no</u> bald eagles are found to be roosting within 0.25 mile of the study area during the pre-construction survey, work may proceed with no time of day restrictions.

- If <u>two or more</u> bald eagles are found to be roosting within 0.25 mile of the proposed construction site study area during the pre-construction survey, the operator will be restricted to working between 10:00AM and 2:00PM on a daily basis.

- If bald eagles continue to occupy or enter the area within 0.25 mile of the construction site between the 10:00AM and 2:00PM time window, work will stop until the bald eagles leave the area. Under no circumstances shall bald eagles be harassed in order to disperse them from the area.

<u>Bald Eagle Spring/Summer Nesting (March 16 to July 1)</u>

- For a construction project planned during the bald eagle nesting period and within 0.5 mile of suitable bald eagle nesting habitat (i.e., a riparian area with a mature cottonwood component), a pre-construction survey will be initiated within 10 days prior to the start of construction to verify the presence or absence of bald eagle nesting activity. The survey will be conducted by qualified biologist(s) according to protocol as set forth by the USFWS. Generally, the surveys should be performed during dawn and dusk periods on two or more days immediately prior to the construction start date. The survey will be documented and results sent to the Division Head of the SUIT DWRM.

- If no bald eagles are found to be nesting within 0.5 mile of the proposed construction site during the pre-construction survey, work may proceed with no restriction. If bald eagles are found to be nesting within 0.5 mile of the construction area, the construction must stop until all signs of nest use have stopped for the year.

- If an active bald eagle nest is known to exist within 0.5 mile of a proposed construction project, the construction project may not proceed until all signs of nest use have stopped for the year.

**BIOLOGICAL RESOURCES MONITORING**

- SUIT DNR, SUIT DOE, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with biological resources mitigation and may take additional, legally authorized enforcement actions to assure compliance.

## GEOLOGY, MINERALS, AND SOILS

**2002 FEIS DESIGN FEATURES**

- Monitor soil vapor concentrations at more than 150 locations along the Fruitland outcrop.

- Monitor vegetative stress using infrared aerial photography.

- Collect pressure data from 22 monitoring locations across the Fruitland outcrop.

- Measure gas flow rates from “slant” wells drilled into the Fruitland outcrop at Valencia Canyon Gap.

- Conduct additional reservoir modeling on areas near the Fruitland outcrop to predict potential for future gas seepage.

- Include COAs in APDs designed to aid the outcrop monitoring or mitigation efforts for new wells to be located near the Fruitland outcrop.

**NEW OR MODIFIED DESIGN FEATURES**

- An annual report detailing reclamation of facilities will be submitted by all oil and gas operators with facilities within the SUIT boundary no later than March 1 of each year to the SUIT DOE and the BLM. The report format is outlined in Appendix E.

- Topsoil can be imported onto Tribal lands when approved by the SUIT.

- Pits will be stepped down in areas where the reserve pit would be located in the fill portion of the well pad.

**GEOLOGY MINERALS AND SOILS MONITORING**

- SUIT DNR, SUIT DOE, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with reclamation mitigation.

- Based on the results of the annual report, the SUIT DNR may require additional design features for operators with facilities within the exterior boundary of the SUIT boundary to minimize impacts to vegetation and soils.

**WATER RESOURCES**

**GROUNDWATER**

**2002 FEIS DESIGN FEATURES**

- Monitor bradenhead pressures to identify wells that may be acting as vertical conduits.

- Monitor (frequency dependent on area) methane contamination in water wells and compare to baseline conditions to evaluate concentration trends and correlate with bradenhead testing.

- Monitor seeps and water levels near the Fruitland outcrop and develop appropriate mitigation measures.

- Cement all production casing strings from the casing shoe or total depth, whichever is shallower, to the surface by circulation methods for all wells heretofore and hereafter drilled and completed in the Fruitland coal seams of the Ignacio Blanco Field.

- Monitor additional wells (about 12) in the near Fruitland outcrop zone installed by the SUIT DOE in the year 2000.

- Within any areas of concern, the SUIT DOE and BLM may require water well monitoring as part of APD approval.

- In the event that domestic groundwater well degradation is caused by a gas well, the gas well must be remediated or other action taken as determined by the appropriate agency.

- Soil monitoring for methane and other component gases will be conducted near the Fruitland outcrop or in proximity to existing wells as specified by the SUIT and BLM in accordance with APD requirements.

- Injection well operations will continue to be monitored monthly at each injection well for cumulative injection volumes and pressures in tubing and tubing/casing annulus.

**NEW OR MODIFIED DESIGN FEATURES**

- Closed-loop systems will be required in areas of shallow groundwater and riparian areas, or other areas identified. The need for a closed-loop system will be determined on a case-by-case basis during the on-site evaluation. A closed-loop system uses a series of storage tanks that separate liquids and solids during the drilling process. The waste is trucked offsite for disposal.

- ➢ SUIT EP will test all domestic wells on the Reservation on a quarterly basis for analytes.

**SURFACE WATER**

**2002 FEIS DESIGN FEATURES**

- Meet all applicable water quality standards.
- Avoid construction activities near or through streams during high flows or wet periods.
- Minimize the time and area of disturbance for road and pipeline surface water crossings and design crossings at right angles to streams to minimize the area of disturbance.
- Require operators to map and delineate waters of the U.S., as defined at 33 CFR Part 328.3, prior to the planning of any activity at or in the vicinity of such waters.
- Require operators to avoid impacting waters of the U.S. whenever practicable.
- Require operators to obtain 404 permits from the U.S. Army Corps of Engineers (USACE), including 401 certification from the USEPA for land within the boundary of the Reservation.
- Require operators to minimize unavoidable discharges of fill material to waters of the U.S.
- Require operators to mitigate waters of the U.S. that are adversely impacted by their activities.
- Require operators to obtain appropriate permits, including those associated with Section 404 of the Clean Water Act (CWA), when crossing surface waters or waters of the U.S., as defined at 33 CFR Part 328.3.
- Implement BMPs to slow or reduce the flow of surface-water runoff across disturbed areas, including diversion of surface runoff around facilities.
- Route surface runoff from drill locations into reserve pits, if appropriate.
- Install road-grade culverts following BMPs.
- Reduce erosion impacts from roads through measures described in the standard environmental protection criteria.
- Prepare storm water management plans when a construction site involves over 5 acres of disturbance and a storm water master plan, if appropriate.
- Implement structural erosion and sediment controls such as interim or permanent water bars, detention ponds, straw bales, silt fences, earth dikes, and inlet and outlet protection.
- Implement non-structural control practices such as interim and permanent stabilization, permanent and temporary seeding and revegetation, and geotextiles.

- Install culverts as erosion prevention measures in areas of high runoff.

- Protect water bodies and drainage pathways near drill sites or roads, which are the most susceptible to erosion by developing buffers or adding erosion control measures.

- Minimize erosion at sites located in steep terrain during the construction phase by measures such as contouring, water bars, temporary ditches, and detention basins, along with minimizing the period of disturbance.

- Timely plug and abandon non-productive wells and associated flowlines and equipment.

- Develop a comprehensive surface water quality monitoring program for the three principal rivers and major tributaries that drain the study area to establish the significance of any concerns regarding surface water contamination from gas migration, or from non-point source runoff. Monitoring should focus on a limited number of conservative chemical and physical parameters that can be used to evaluate the presence or absence of impacts associated with oil and gas development in the study area.

### NEW OR MODIFIED DESIGN FEATURES

- ➢ The *Stormwater Recommendations for Oil and Gas Operations on Tribal Lands within the Southern Ute Indian Reservation* will be implemented (Appendix F).

- ➢ Operators will be required to obtain a crossing permit when pipelines cross the Los Piños River Indian Irrigation Project canal, except in instances in which such crossing is already authorized by leases or easements.

- ➢ Operators will implement the USEPA Reasonable and Prudent Practices for Stabilization (RAPPS) BMPs to eliminate or minimize adverse impacts to the environmental health of the SUIT natural resources (USEPA 2004).

### WATER RESOURCES MONITORING

- ➢ SUIT DNR, SUIT DOE, SUIT EPD, BLM and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with storm water regulations.

## LAND USE AND OWNERSHIP

### 2002 FEIS DESIGN FEATURES

- Situate project facilities, including roads, away from or at the edges of irrigated and non-irrigated agricultural land to the maximum extent practical to reduce direct and indirect effects on agricultural resources and operations.

- Minimize crossings or other direct effects on watershed restoration facilities; agricultural irrigation facilities, including water canals, ditches, and pipelines; and other water conveyance systems to the maximum extent practical or provide for their protection to allow them to operate as designed.

- If facilities (e.g., fences, gates, cattleguards) are damaged or displaced by oil and gas activities, they would be repaired or replaced by the operator, to a condition as good as or better than original.

- Restrict project-related construction equipment and vehicle movement to specific, designated access roads to minimize disturbance to potentially sensitive areas.

- Continue to require responsibility for fence, gate, and cattle guard maintenance and for noxious weed control as COAs and stipulations for APDs and ROW grants.

- Develop reclamation plans for all areas that have been disturbed during production, and specify techniques for reclamation of well pads, pipeline ROW, and roads.

- Site facilities to avoid or minimize impacts on livestock or wildlife water. If such water is impacted, measures should be taken to replace the water source in respect to both quantity and quality.

- Site roads, pipelines, and well pads away from residences and out of view from residences as much as possible.

- Work with surface owner, when possible, to pick sites for roads, pipelines, and well pads.

- Continue to paint facilities so as to minimize visual impacts.

**NEW OR MODIFIED DESIGN FEATURES**

No new or modified design features have been identified for land use ownership.

**LAND USE OWNERSHIP MONITORING**

No monitoring has been developed for land use ownership.

## TRAFFIC AND TRANSPORTATION

No design features were identified in the 2002 FEIS and no new measures or monitoring has been developed for the PEA.

## CULTURAL RESOURCES

**2002 FEIS DESIGN FEATURES**

- All subsequent specific oil and gas developments must be implemented in compliance with Section 106 of the NHPA. Regulations implementing this Act require that: (1) cultural resources be thoroughly inventoried within areas that would be potentially affected by these projects; (2) the significance of any identified resources be evaluated; and (3) measures be taken to avoid or mitigate any identified adverse effects on significant resources. This requirement must be done in consultation with the State Historic Preservation Office (SHPO), Federal Advisory Council on Historic Preservation, BIA, and other interested parties.

- Standard Tribal and BIA procedures require project developers to retain archaeological consultants to intensively survey project areas (accompanied by Tribal representatives), and prepare reports that document the survey results, assess projected impacts, and formulate recommendations about resource significance and measures to avoid or mitigate any identified adverse effects. These procedures must be completed in accordance with all applicable regulations. Standard procedures stipulate that all well site, access road, and pipeline development activities be confined within areas that have been inventoried for cultural resources.

- All work crews would be routinely informed of cultural resource protection laws and that they are subject to prosecution if they collect artifacts or disturb archaeological sites. This measure would be included in all future stipulations and COAs for oil and gas development projects.

- It is anticipated that most projects probably can be modified to avoid direct impacts on archaeological and historical sites. If avoidance is impossible, the potential is high for satisfactorily mitigating impacts through professional study to recover important data from archaeological and historical sites before they are affected by a proposed project.

- Environmental assessments of any subsequent authorized individual projects would consider impacts on archaeological sites and also provide additional opportunities for the Tribe to assess and address protection of traditionally used native species and preservation of SUIT heritage.

**NEW OR MODIFIED DESIGN FEATURES**

- ➢ If COAs or other stipulations state that a cultural resources monitor must be present during construction activities and the operator does not comply with that stipulation, the project will be shut down until such monitoring is present. Additionally, lawfully authorized penalties may be imposed for non-compliance.

- ➢ No drilling activity will be allowed within 0.25 mile of the Sun Dance and Bear Dance grounds during these annual events. Through traffic will be minimized in these areas during these events.

- ➢ A resolution was passed in 2002 restricting oil and gas development on Indian Mesa (no surface occupancy).

**CULTURAL RESOURCES MONITORING**

No monitoring has been developed for cultural resources.

**<u>VISUAL RESOURCES</u>**

**FACILITY LOCATION**

**2002 FEIS DESIGN FEATURES**

- Locate facilities at the base of slopes where feasible to provide a background of topography and/or natural cover.

- Choose sites that would provide topographic and vegetative screening for the location of well facilities.

- Locate facilities away from prominent topographic features.

- If possible, avoid locations near populated areas, parks, scenic areas, hilltops, and natural or manmade structures. For linear facilities such as access roads, avoid crossing hill crests.

- Where placement of a facility is necessary in a hilltop area, consider locations on the slopes or brow of a hill to minimize the silhouette.

**NEW OR MODIFIED DESIGN FEATURES**

No design features were identified in the 2002 FEIS and no new measures or monitoring have been developed for this PEA.

**FACILITY DESIGN**

**2002 FEIS DESIGN FEATURES**

- Paint facilities to match the surrounding vegetation/landscape.

- Use low profile tanks and other production facilities to minimize visibility.

- Design cut-and-fill slopes to achieve maximum compatibility with the surrounding natural topography.

- Align access roads to follow existing grades to minimize cuts and fills.

- Provide access roads with side drainage ditches and traverse culverts to prevent soil or road erosion.

- Design exterior lighting of project facilities to minimize visual impacts while meeting applicable safety and security objectives.

**NEW OR MODIFIED DESIGN FEATURES**

No design features were identified in the 2002 FEIS and no new measures or monitoring has been developed for the PEA.

**LANDFORM DISTURBANCE**

**2002 FEIS DESIGN FEATURES**

- Limit the clearing of trees and vegetation for the project facilities to the minimum area required. Clearing edges should be feathered and thinned, as appropriate.

**NEW OR MODIFIED DESIGN FEATURES**

➢ Panel barriers will be erected around meter houses, pump heads or other surface facilities unless an allottee or private landowner requests fencing of the location. The type and location of barriers would be determined during on a case by case basis during the onsite.

**VISUAL RESOURCES MONITORING**

No monitoring has been developed for visual resources.

## NOISE

### 2002 FEIS DESIGN FEATURES

Recommended measures that may be used to reduce noise impacts may include, but are not limited to, the following:

- Muffling: Equipment-specific noise reduction techniques may be used to reduce noise levels for each piece of equipment. Several different grades of muffling systems have been developed for gas compressor engines and pumping units ranging from standard mufflers to hospital grade mufflers and supercritical muffling systems. Muffling systems can reduce noise levels up to 15 A-weighted decibels (dBA) with hospital grade mufflers.

- Sound Barriers: Sound barriers such as walls and earthen berms are commonly used to mitigate noise. Sound barriers can be effective in reducing noise from the cooling fans associated with compressor engines. The effectiveness of a barrier depends upon factors such as the relative height of the barrier and the distance from the barrier to the source. To be effective, a barrier must block the line-of-sight path from the noise source to the receptor. Properly installed barriers reduce sound levels in a range of 15 to 20 dBA.

- Enclosures: Construction of a building to enclose the frame portion of a compressor is very effective in reducing noise levels. Reductions between 20 dBA and 30 dBA can be achieved depending upon the acoustical design of the building.

- Existing Topography: With proper siting, existing topography and vegetation can act as natural barriers to reduce noise generated by well construction and production activities. Hills, trees, and other vegetation can be effective in reducing noise levels at sensitive receptors. The effectiveness of noise level reduction is dependent on the frequency of the noise source and the orientation of the noise source in relation to the topography and vegetation. Proper siting allows the topography and vegetation to block the line-of-sight path from the noise source to the receptor. The type and thickness of the vegetation also is a factor.

- Electric motors would be installed where practicable.

- Motors or compressors would be located and/or oriented to reduce noise transmission.

### NEW OR MODIFIED DESIGN FEATURES

- ➢ Operators will comply with COGCC noise regulations for facilities located on Tribal lands, until superseded by Tribal regulation.

- ➢ Electrification will be utilized to reduce situations where noise conflicts are identified. The need for electrification will be determined on a case-by-case basis during the on-site evaluation.

- ➢ SUIT DNR, SUIT DOE, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with noise mitigation measures and may require additional mitigation measures for operators and take additional, legally authorized enforcement actions to assure compliance.

## HEALTH AND SAFETY

### 2002 FEIS DESIGN FEATURES

No design features were identified in the 2002 FEIS.

### NEW OR MODIFIED DESIGN FEATURES

- Companies with oil and gas facilities on the Reservation will provide sanitary facilities at locations such that a person would not have to travel by vehicle any longer than 10 minutes from a given location to reach a sanitary facility.

- In the event that personnel are not able to reach a sanitary facility and must relieve themselves onsite, they are expected to have access to a shovel and bury any toilet paper and human waste sufficiently beneath the surface of the ground.

## HEALTH AND SAFETY MONITORING

- SUIT DNR, SUIT DOE, SUIT EPD, USEPA, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance and spill prevention measures.

# 3.0 AFFECTED ENVIRONMENT

## 3.1 Introduction

Chapter 3 summarizes the physical, biological, social, and economic environments of the affected study area, in accordance with NEPA regulations. The affected environment for individual resources was delineated based on the area of potential direct, indirect, and cumulative environmental impacts that could result from the proposed action. For most resources, the analysis is focused on the study area. However, other resources such as air quality and socioeconomics are addressed in a larger regional context.

Baseline information summarized in this chapter was obtained by reviewing existing documentation, published and unpublished, and consulting with individuals and agencies. Geographic Information System (GIS) data were provided by the SUIT, COGCC, La Plata County, U.S. Geological Survey (USGS), and other private and public sources.

The following critical elements of the human environment (BLM Manual Handbook 1790-1, Appendix 5) are not present in the study area and therefore are not discussed in the descriptions of the affected environment: wild horses, Wilderness Areas, Wild and Scenic Rivers, and Areas of Critical Environmental Concern (ACEC).

## 3.2 Air Quality and Climate

### 3.2.1 Introduction

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is strongly affected by local topography. In the mountainous western U.S., topography is particularly important in channeling pollutants along valleys, creating up slope and down slope circulations which entrain airborne pollutants, and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak (2002 FEIS). This section discusses the topography, climate, and air quality within the study area.

### 3.2.2 Topography

The Reservation is located in the northern portion of the SJB and the eastern area of the Colorado Plateau in southwestern Colorado. The Colorado Plateau is a vast physiographic province extending throughout western Colorado, northwestern New Mexico, most of northern Arizona, and southern and eastern Utah. This physiographic province is characterized by generally flat-lying sedimentary deposits divided by faults and monoclines that form cliffs and individual plateaus. Steep-sided mesas and buttes capped by erosion-resistant rock layers are common.

The topography of the Reservation varies from moderately steep to steep mountains, canyons, and mesas in the north-central and south-central portions, to rolling hills and gently sloping river valleys in the eastern and western regions. Elevations range from about 6,000 to 9,000 feet.

### 3.2.3 Air Quality Analysis Area

The area of analysis for this air quality study includes the Reservation as well as the Four Corners region which includes southwestern Colorado, northern New Mexico, and eastern Arizona and Utah (hereafter referred to as the air quality analysis area). The air quality analysis area is shown in Map 3-1 (Appendix A). Far field modeling and ozone impacts utilized a 2005 mesoscale model (MM5) for the air quality analysis area. Refer to Appendix G for a detailed discussion of the air quality modeling and the analysis area.

### 3.2.4 Climate and Meteorology

Temperature and precipitation data from Ignacio, Colorado, are considered to be representative of climatic conditions within the air quality analysis area. However, because elevation, slope and aspect affect precipitation and temperatures, the complex terrain of La Plata County, Colorado, creates considerable climatic variability. The Reservation was classified into six climatic zones (BLM 1996):

- Zone 1 - semi-desert grasslands at elevations below 6,000 feet; average annual precipitation less than 12 inches;
- Zone 2 - sagebrush savanna at elevations from 6,000 to 6,300 feet; average annual precipitation 12 to 13 inches;
- Zone 3 - piñon-juniper woodland at elevations from 6,000 to 7,200 feet; average annual precipitation 13 to 17 inches;
- Zone 4 - piñon-juniper/mountain browse at elevations from 6,100 to 8,400 feet; average annual precipitation 14 to 20 inches;
- Zone 5 - ponderosa pine at elevations from 6,500 to 8,800 feet; average precipitation 16 to 23 inches; and
- Zone 6 - fir-spruce/aspen at elevations from 6,600 to 9,000 feet; average precipitation 18 to 27 inches.

Annual precipitation measurements at Ignacio during the period from 1961 through 1990 averaged 14.4 inches. From 1993 through 1996, precipitation was well distributed throughout the year, with the months from April to June receiving the lowest average amounts (0.5 to 0.9 inches) and August the highest levels (1.7 inches). December and January were the coldest months, with average lows of about 10 degrees Fahrenheit (°F) and highs of about 40°F. The warmest months were July and August with average minimum and maximum temperatures of 50°F and 85°F, respectively. Based on 30-year climate data (National Oceanic and Atmospheric Administration 1992), the norm minimum temperature (about 6°F) occurs in January and the normal maximum temperature (88 °F) occurs in July.

A wind rose is a graphical figure that shows wind speed and direction that are typically distributed at a particular location and shows the frequency of winds blowing from particular directions. Preprocessed meteorological data used for the air quality modeling analysis were obtained from the State of New Mexico web site (NMED 2008). These data were processed by the New Mexico Environment Department (NMED) Air Quality Bureau to produce a wind rose at Bloomfield, New Mexico. The distribution of wind values at Bloomfield, New Mexico is shown in Figure 3-1. Note that the direction associated with any bar in this figure is the direction from which the wind blows. From the standpoint of dispersal of airborne pollutants, better dilution and dispersion would be expected to occur along ridges and high elevation areas than in protected valley locations.

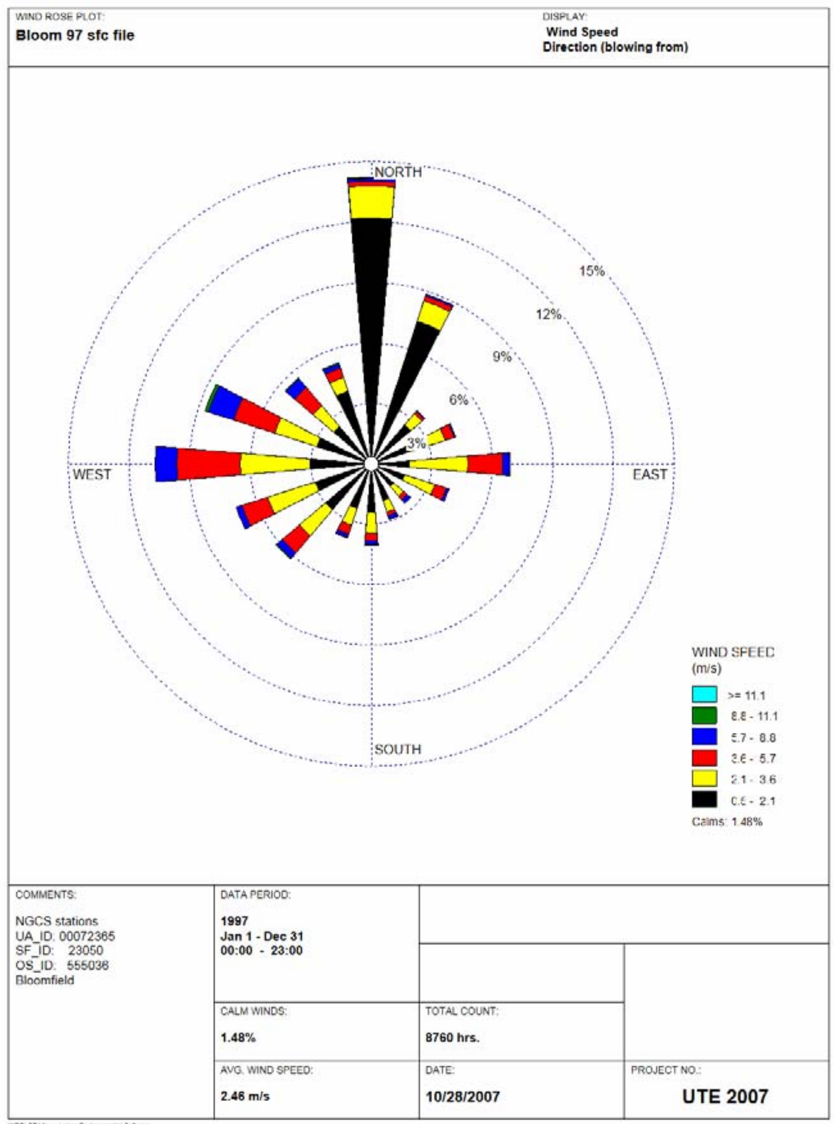



**Figure 3-1. Wind Rose at Bloomfield, New Mexico**

### 3.2.5 Regulatory Framework

The USEPA establishes and revises the National Ambient Air Quality Standards (NAAQS) as necessary to protect public health and welfare and sets absolute upper limits for specific air pollutant concentrations at all locations where the public has access. Under the CAA, USEPA is required to periodically technically review and revise ambient standards based on the most current health effects data. Pollutants addressed include carbon monoxide (CO), nitrogen oxides ($NO_x$, a generic term for mono-nitrogen oxides produced during combustion; includes nitric oxide [NO] and nitrogen dioxide [$NO_2$]), ozone, particulate matter 10 microns in size ($PM_{10}$), particulate matter 2.5 microns in size

($PM_{2.5}$) and sulfur dioxide ($SO_2$). USEPA recently revised the ozone NAAQS (Federal Register 2008a).

States and Indian tribes have the ability to establish more stringent ambient air quality standards. At the present time, the SUIT has not promulgated any additional ambient air quality standards that are applicable on the Reservation. The State of Colorado has established and implemented a Colorado 3-hour $SO_2$ ambient air quality standard that is applicable within the State of Colorado, but not within the boundaries of the Reservation.

Table 3-1 presents a summary of applicable ambient air quality standards and Prevention of Significant Deterioration (PSD) increment concentrations.

**Table 3-1. Applicable Ambient Air Quality Standards and PSD Increment Values**

| **Pollutant** | **Averaging Time** | **National Ambient Air Quality Standards (ppm) ($\mu g/m^3$)** | **Colorado Ambient Air Quality Standards ($\mu g/m^3$) [A]** | **PSD Class I Increment ($\mu g/m^3$)** | **PSD Class II Increment ($\mu g/m^3$)** |
|---|---|---|---|---|---|
| CO | 1-hour | 9 (40,000) [B] | 40,000 | N/A | N/A |
| | 8-hour | 35 (10,000) [B] | 10,000 | N/A | N/A |
| $NO_2$ | Annual | 0.053 (100) | 100 | 2.5 | 25 |
| Ozone | 1-hour | 0.12 (235) [B] | 235 | N/A | N/A |
| | 8-hour (1997 std) | .080 [C] | .080 | N/A | N/A |
| | 8-hour (2008 std) | 0.075 [D] | | N/A | N/A |
| $PM_{10}$ | 24-hour | 150 [E] ($ug/m^3$) | 150 | 8 | 30 |
| | Annual | 50 ($ug/m^3$) | 50 | 4 | 17 |
| $PM_{2.5}$ | 24-hour | 65 [F] ($ug/m^3$) | 65 | N/A | N/A |
| | 24-hour | 35 ($ug/m^3$) | 35 | N/A | N/A |
| | Annual | 15 ($ug/m^3$) | 15 | N/A | N/A |
| $SO_2$ | 3-hour (Secondary) | 0.50 (1,300) [B] | 700 [B] | 25 | 512 |
| | 24-hour | 0.14 (365) [B] | 365 [B] | 5 | 91 |
| | Annual | 0.03 (80) | 80 | 2 | 20 |

Source: USEPA 2008
N/A = not applicable
$\mu g/m^3$ = micrograms per cubic meter
ppm = parts per million
[A] Not applicable within the Reservation
[B] Not to be exceeded more than once per year.

[C] i)To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 (parts per million (ppm).
ii) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as USEPA undertakes rule making to address the transition from the 1997 ozone standard to the 2008 ozone standard.

[D] i)The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.
ii) As of June 15, 2005, USEPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

[E] Not to be exceeded more than once per year on average over 3 years.

[F] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).

Given the Reservation's current attainment status, future development projects which have the potential to emit more than 250 tons per year of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tons per year) would be required to submit a pre-construction PSD permit application (including a regulatory PSD increment consumption analysis) under the federal new source review (NSR) permitting regulations. Development projects subject to PSD regulations must also demonstrate the use of best available control technology (BACT) and show that the combined impacts of all applicable sources would not exceed the PSD increments for $NO_2$, $PM_{10}$ or $SO_2$. The permit applicant must also demonstrate that cumulative impacts from all existing and proposed sources would comply with the applicable ambient air quality standards throughout the operational lifetime of the permit applicant's project.

The Colorado Department of Public Health and Environment (CDPHE)-Air Pollution Control Division (APCD), SUIT, or USEPA may conduct a regulatory PSD increment consumption analysis in order to demonstrate that applicable PSD increments have not been exceeded by all major or minor increment consuming emission sources. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agencies (with USEPA oversight).

In 1999 the CDPHE-APCD conducted a detailed review of $NO_2$ PSD increment consumption in southwest Colorado and concluded that Class I increment values "are probably not violated" at Mesa Verde National Park or the Weminuche Wilderness Area, but that preliminary results "suggest that there is one isolated hot spot in La Plata County where there is an apparent Class II PSD increment violation." The CDPHE-APCD worked closely with the emission source operator to better understand the specific situation and that action resolved the source-specific PSD Class II increment situation (CDPHE-APCD 1999).

On August 7, 1977, Congress designated mandatory federal Class I Areas, which included those existing wilderness areas greater than 5,000 acres in size and national parks greater than 6,000 acres in size. All other locations in the country where ambient air quality is within the NAAQS (including attainment and unclassified areas) are designated as PSD Class II Areas with less stringent requirements. In addition, sources subject to PSD permit review procedures for PSD Class I Areas are required to analyze Air Quality Related Values (AQRVs) including degradation of visibility, deposition of acidic compounds in mountain lakes, and effects on sensitive flora and fauna within the PSD Class I Areas.

Most of the air quality analysis area is designated as a PSD Class II Area. The two closest PSD Class I Areas are Mesa Verde National Park and the Weminuche Wilderness Area, which are protected by more stringent $NO_2$, $PM_{10}$, and $SO_2$ PSD Class I Area increment thresholds as shown in Table 3-1. AQRV impacts were also evaluated at Bandelier National Monument (New Mexico), Canyonlands National Park (Utah), La Garita Wilderness Area (Colorado), Petrified Forest National Park (Arizona), and San Pedro Park (New Mexico).

This PEA analysis compares potential air quality impacts from the proposed action to applicable ambient air quality standards, PSD increments, and AQRVs, but it does not represent a regulatory air quality permit analysis. Comparisons to the PSD Class I and II increments are intended to evaluate a "threshold of concern" for potentially significant adverse impacts, but do not represent a regulatory PSD increment consumption analysis.

**NEW SOURCE REVIEW AND OPERATING PERMITS**

The CAA requires emission sources to obtain permits.  Depending on the attainment status, source type, and emission levels, different types of permits are required (e.g., operating and pre-construction). Currently, within the SUIT boundaries, new sources in excess of 250 tons per year (or 100 tons per year for specific listed sources) are required to obtain a PSD permit prior to construction. Because the SUIT does not have an approved permitting program, PSD permits are issued by USEPA. In addition, sources in excess of 100 tons per year are required to obtain a Title V operating permit. Because neither USEPA nor the SUIT has a minor source pre-construction permitting program, sources that do not require PSD pre-construction permits or Title V operating permits do not require air permits.

Currently, a minor source permitting program is being developed by the SUIT Environmental Programs Division (EPD) Air Quality Program for recommendation to the SUIT and State of Colorado Environmental Commission.  Once the minor source permitting program is recommended by the Tribe, the SUIT and State of Colorado Environmental Commission will decide, after a public review and comment process, whether to adopt the program for the Reservation.  If the Tribe's recommended program is not adopted, it is possible that USEPA's proposed minor source NSR program could be finalized and would be administered on the Reservation either by USEPA or by the Tribe under a delegation from USEPA.

### 3.2.6 Air Quality Regulations that are Applicable to the SUIT Infill Project

**NSPS FOR NATURAL GAS FIRED RICE**

On January 18, 2008, USEPA promulgated a New Source Performance Standard (NSPS) for spark ignited engines (Federal Register 2008b).  This regulation established minimum emission standards for new, modified, and reconstructed stationary natural gas fired (and other fuels) engines. The following subsections present an overview of the new regulation. As a result of the regulation, emissions from applicable engines (especially engines less than 300 horsepower) will be substantially lower than in the past.

**Engines Less Than 25 Horsepower**

Stationary non-emergency spark ignited (SI) natural gas engines less than 25 horsepower must meet the emission limits indicated in Table 3-2.

**Table 3-2. $NO_x$, HC, NMHC and CO Emission Standards for Stationary SI Engines 25 hp Manufactured After July 1, 2008.**

| Engine Class | Emission Standards in g/hp-hr | | |
|---|---|---|---|
| | HC+NOx | NMHC+NOx | CO |
| I 100 cc< Displacement<225 cc | 12.0 | 11.0 | 455 |
| I-A Displacement <66 cc | 37 | - | |
| I-B 66 cc< Displacement 100 cc | 30 | 27.6 | |
| II Displacement >225 cc | 9.0 | 8.4 | |

**Engines Greater Than 25 Horsepower but Less Than 100 Horsepower**

Stationary non-emergency spark ignited (SI) natural gas engines greater than 25 horsepower but less than 100 horsepower manufactured after July 1, 2008 must limit exhaust emissions of $NO_x$ to 2.8 g/hp-hour and CO to 4.8 g/hp-hour.

**Engines Greater Than or Equal to 100 Horsepower but Less Than 500 Horsepower**

Stationary natural gas engines greater than or equal to 100 horsepower and less than 500 horsepower manufactured after July 1, 2008 must limit exhaust emissions of $NO_x$ to 2.0 g/hp- hour, emissions of CO to 4.0 g/hp-hour and emissions of NMHC to 1.0 g/hp-hour.

More stringent emission standards take effect 3 years later, i.e., for stationary natural gas engines greater than or equal to 100 horsepower and less than 500 horsepower manufactured after January 1, 2011. These engines must comply with a $NO_x$ standard of 1.0 g/hp-hour, a CO standard of 2.0 g/hp-hour, and a NMHC standard of 0.7 g/hp-hour.

**Engines Greater Than or Equal to 500 Horsepower**

Stationary natural gas engines greater than 500 horsepower manufactured after July 1, 2007 must limit exhaust emissions of $NO_x$ to 2.0 g/hp-hour, emissions of CO to 4.0 g/ hp-hour and emissions of NMHC to 1.0 g/ hp-hour.

Stationary natural gas fired engines with a maximum engine power greater than or equal to 500 horsepower that are manufactured after July 1, 2010 must limit exhaust emissions of $NO_x$ to 1.0 g/hp-hour, emissions of CO to 2.0 g/HP-hour and emissions of NMHC to 0.7 g/hp-hour.

## NSPS FOR COMPRESSION IGNITION ENGINES

There is a similar emission standard for diesel engines used on drilling rigs[2] and the NSPS emission standards for these engines are summarized in Table 3-3. Because the life expectancy of a drilling rig engine is 5-10 years[3], there is constant replacement of older engines with new low emission engines.

[2] 40 CFR, Part 60, Subpart IIII
[3] WRAP Oil and Gas 2002/2005 and 2018 Area Source Emission Inventory Improvements 2007

**Table 3-3. Tier 2, 3, and 4 Emission Standards for Large (> 300 hp) Diesel Engines**

| | 300 to 600 hp | 600 to 750 hp | > 750 hp | Gen Sets 750 to 1250 hp | Gen sets greater than> 1200 hp |
|---|---|---|---|---|---|
| **AP-42** | 14.1[a] | 10.9 [b] | 10.9 [b] | 10.9 [b] | 10.9 [b] |
| **Tier 1** | 6.9 | 6.9 | 6.9 | 6.9 | 6.9 |
| **Tier 2** | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| **Tier 3** | 3 | 3 | | | |
| **Tier 4 Transitional** | 0.3 | 0.3 | 2.6 | 0.5 | 0.5 |
| **Tier 4 Final** | 0.3 | 0.3 | 2.6 | 0.5 | 0.5 |

[a] Ap-42 Table 3.3-1
[b] Ap-42 Table 3.4-1
Shading = NMHC + $NO_x$

### 3.2.7 Existing Air Quality

**CRITERIA POLLUTANTS**

Continuous air quality measurements are made at seven locations within the air quality analysis area. The SUIT operates two monitoring stations, one located outside Ignacio, Colorado and one in Bondad, Colorado. The NMED operates one monitoring station near the Four Corners Power Plant (Substation), one near Bloomfield, New Mexico and one near Navajo Lake, New Mexico. Additionally, the National Park Service (NPS) operates an ozone monitor at Mesa Verde National Park and the Forest Service operates a monitoring station north of Durango, Colorado. These monitoring sites are shown on Map 3-2 (Appendix A).

**$NO_2$ MONITORING DATA**

Figure 3-2 presents a summary of annual average $NO_2$ measurements from the Substation, Bloomfield, Navajo Lake, Ignacio and Bondad monitors from 2000 to 2008. The USEPA NAAQS for $NO_2$ is currently an annual average concentration of 0.053 ppm. As indicated by Figure 3-1, the monitored concentrations are well below the USEPA ambient air quality health standard (40 CFR Part 50).

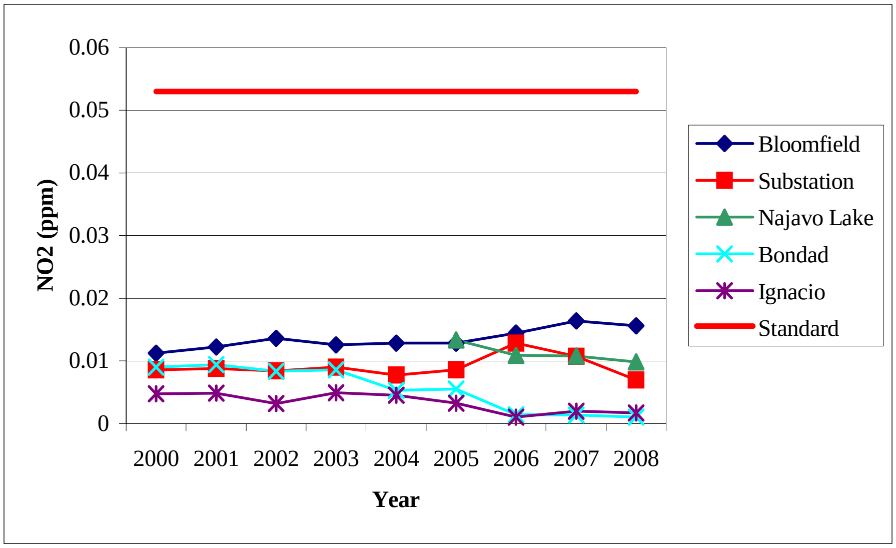



**Figure 3-2. Annual Average $NO_2$ Concentrations**

## $SO_2$ MONITORING DATA

The only $SO_2$ monitoring data in the Four Corners region are at the Substation and Bloomfield monitors operated by NMED. Both of these stations are likely influenced by nearby large $SO_2$ sources and therefore cannot be considered background monitors. Figure 3-3 presents the annual average, maximum 24-hour, and maximum 3-hour average concentrations from these two monitors from 2000 to 2008. As indicated by this figure, measured concentrations are well below applicable primary and secondary air quality standards (40 CFR Part 50).

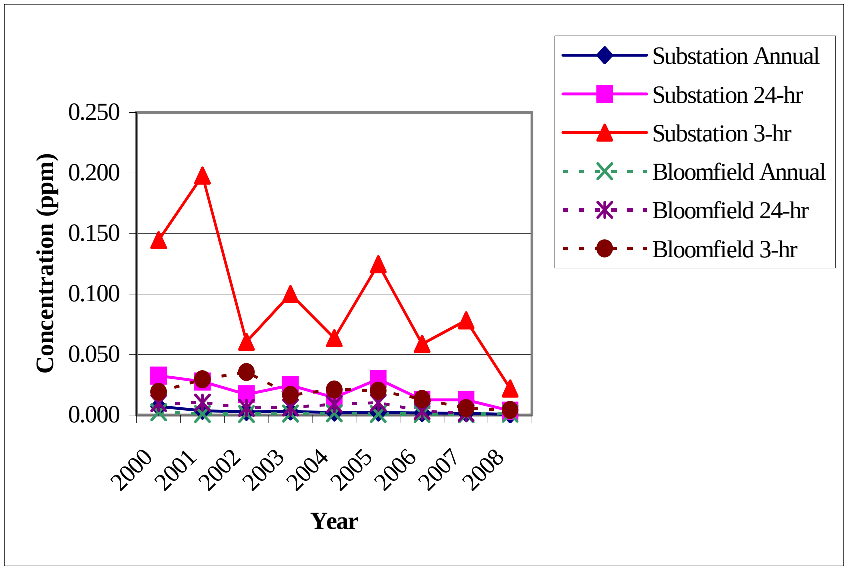



**Figure 3-3. Measured Maximum $SO_2$ Concentrations**

## $PM_{10}$ MONITORING DATA

Figure 3-4 presents the maximum 24-hour $PM_{10}$ measured at the SUIT Bondad and Ignacio monitoring sites in micrograms per cubic meter ($\mu g/m^3$). It should be noted that the standard is based on the second highest measured concentration. Figure 3-5 presents the annual average concentration measured at these two monitoring sites. As indicated by these data, measured concentrations are well below the applicable standards.

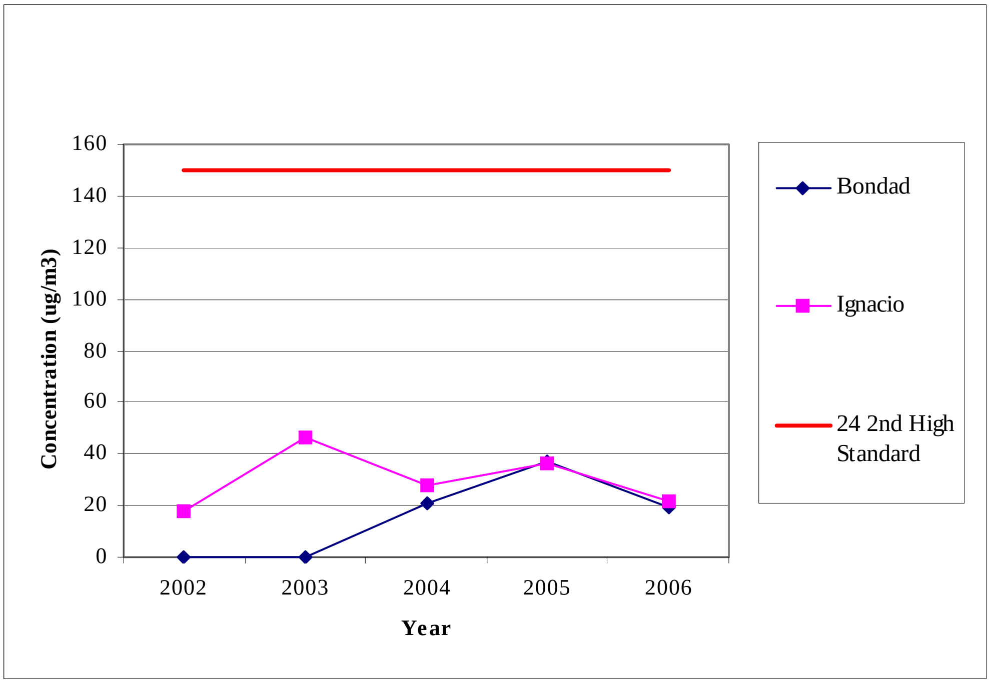



**Figure 3-4. Comparison of Maximum Measured $PM_{10}$ Concentrations to the 150 $\mu g/m^3$ Second Highest NAAQS**

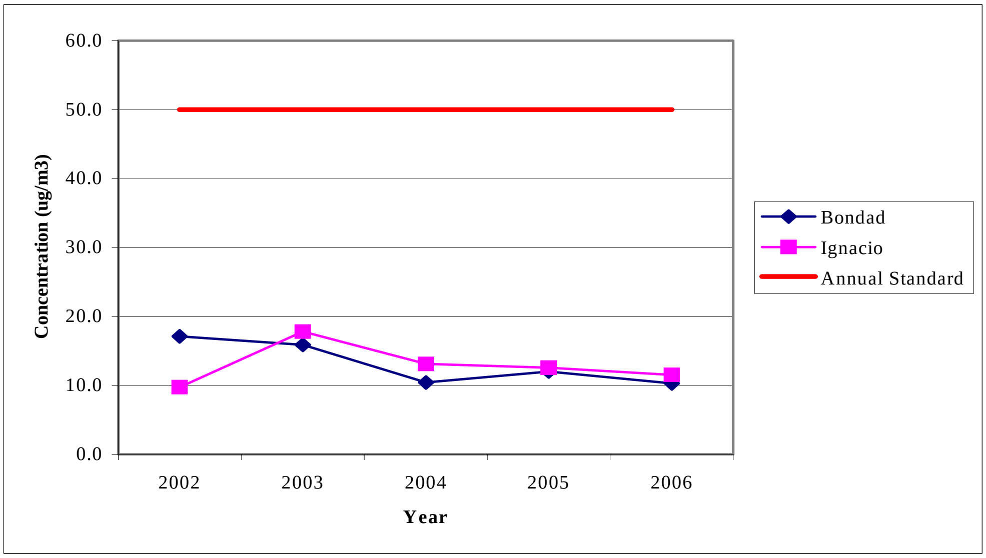



**Figure 3-5. Comparison of Annual Average $PM_{10}$ Concentrations to the 50 $\mu g/m^3$ NAAQS**

## $PM_{2.5}$ MONITORING DATA

$PM_{2.5}$ (particulate matter 2.5 microns in size) particulate sampling is conducted at the Navajo Lake site by NMED (http://air.state.nm.us/stationStatus.php?stationNo=81). This monitoring has been conducted from July 2005 to the present. Figure 3-6 presents a plot of the annual average and maximum 24-hour concentrations. It should be noted that the short-term standard is expressed as the 3-year average of the 98th percentile (approximately the 7th highest value). As indicated in Figure 3-6, measured concentrations are well below the $PM_{2.5}$ standards.

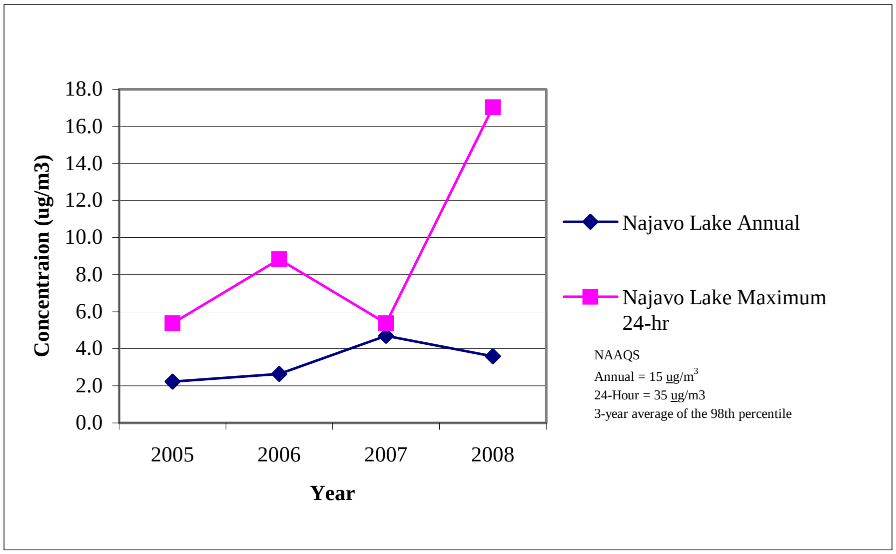



**Figure 3-6. Measured PM $_{2.5}$ Concentrations at the Navajo Lake Monitor**

## CO MONITORING DATA

CO concentrations are measured at the SUIT Ignacio monitoring station and a summary of these data are presented in Figure 3-7. The CDPHE has previously assumed that 1 hour and 8 hour background CO levels are approximately 2,286 μg/m$^3$ compared to 1 hour and 8 hour ambient standards of 40,000 μg/m$^3$ and 10,000 μg/m$^3$ respectively (USDI/USDA 2006a).

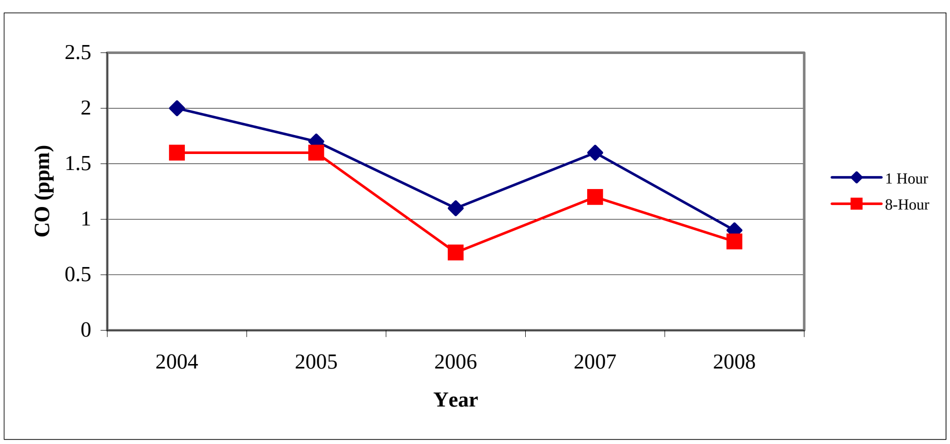



**Figure 3-7. Second Highest CO Concentrations Measured in the Four Corners Area**

## OZONE MONITORING DATA

Figure 3-8 presents a plot of the fourth-highest 8-hour annual ozone concentration measured at all six monitoring stations from 2000 through 2008. Compliance with the ozone standard is determined by comparison of the 3-year average of the fourth-highest 8-hour concentration with the 0.075 parts per billion (ppb) standard (Table 3-4).

Figure 3-8 presents a plot of the fourth-highest annual ozone concentration measured at all monitoring stations over the period 2000 through 2008. Several important trends are apparent in this figure. First, the fourth-highest measured ozone concentrations have not increased over this period. During 2000 through 2004 the concentrations recorded at the Bondad and Ignacio ozone monitors are inconsistent with the other monitors.

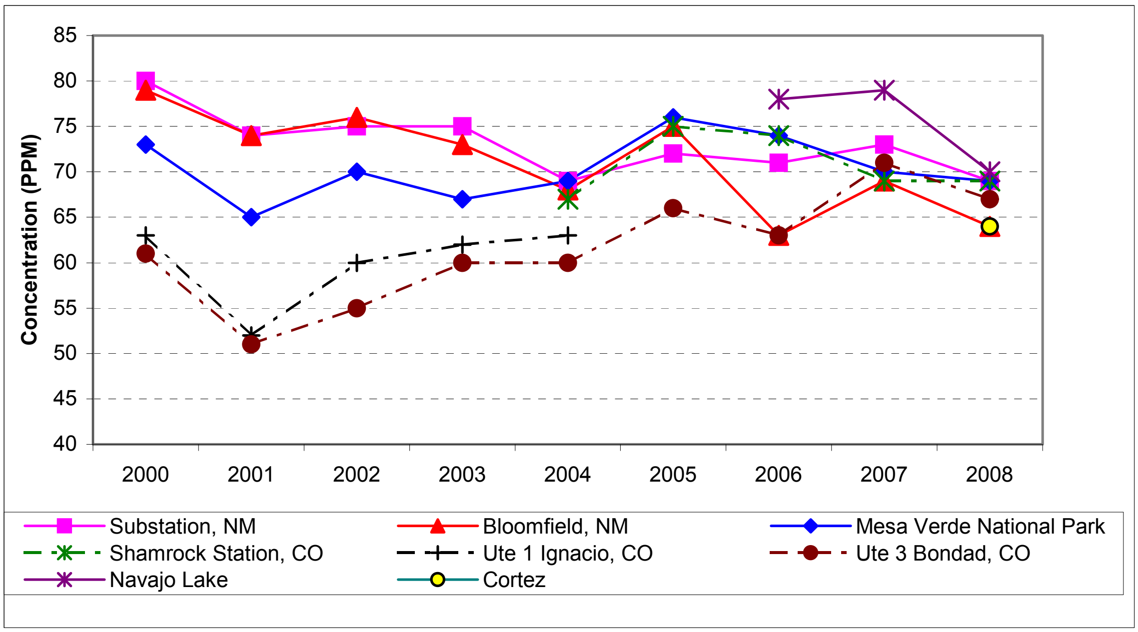



**Figure 3-8. 8-hour Ozone: Annual Fourth-Daily Maximum Concentrations Values in the Four Corners Area**

**Table 3-4. Ozone Design Values for the Four Corners Region**

| Years | | Ozone Design Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Mesa Verde | Substation | Bloomfield | Navajo Lake | Shamrock | Bondad | Ignacio |
| 2000 | 2002 | 74 | | 77 | | | | |
| 2001 | 2003 | 68 | | 75 | | | 56 | |
| 2002 | 2004 | 70 | 73 | 73 | | 72 | 60 | |
| 2003 | 2005 | 70 | 72 | 73 | | 73 | 64 | 65 |
| 2004 | 2006 | 72 | 71 | 69 | | 71 | 65 | 66 |
| 2005 | 2007 | 73 | 73 | 70 | | 70 | 67 | 67 |
| 2006 | 2008 | 71 | 71 | 66 | 75 | 70 | 67 | 67 |

Notes:
a) Only 2006-2008 can be used to define an area nonattainment.
b) An NAAQS exceedance occurs at 76 ppb.

As noted in Figure 3-8 and Table 3-4 the calculated design values at Mesa Verde, Substation, and Shamrock are relatively constant. The Bloomfield design value indicates some variability (66 ppb to 75 ppb) and this change is likely related to increases in $NO_2$ concentrations.

While elevated ozone concentrations have been recorded at the Navajo Lake monitor, (although the NAAQS has not been exceeded), several important conclusions can be reached.

At the other monitors over the period of 2000 to 2008 ozone concentrations have not increased. There are only three years of data at the Navajo Lake monitor. Based on the relationship between the peak measured ozone concentrations at the Navajo Lake monitor and the other monitors, there is no evidence that ozone concentrations are increasing at this monitor.

A large portion of the elevated concentrations occurred during April and October and such occurrences require additional study to better understand these episodes.

## AIR QUALITY RESOURCE VALUE MONITORING

### Visual Range

Figure 3-9 presents the calculated visual range at Mesa Verde National Park for the 20% best, 20% middle and 20% worst days (http://vista.cira.colostate.edu/improve/ 2008). As indicated in Figure 3-9, there has been little change in the best, middle or worst days over the period from 1989 through 2004. During 2002 and 2003, visibility on the worst 20% of the days increased and then decreased in 2004 to previous levels.

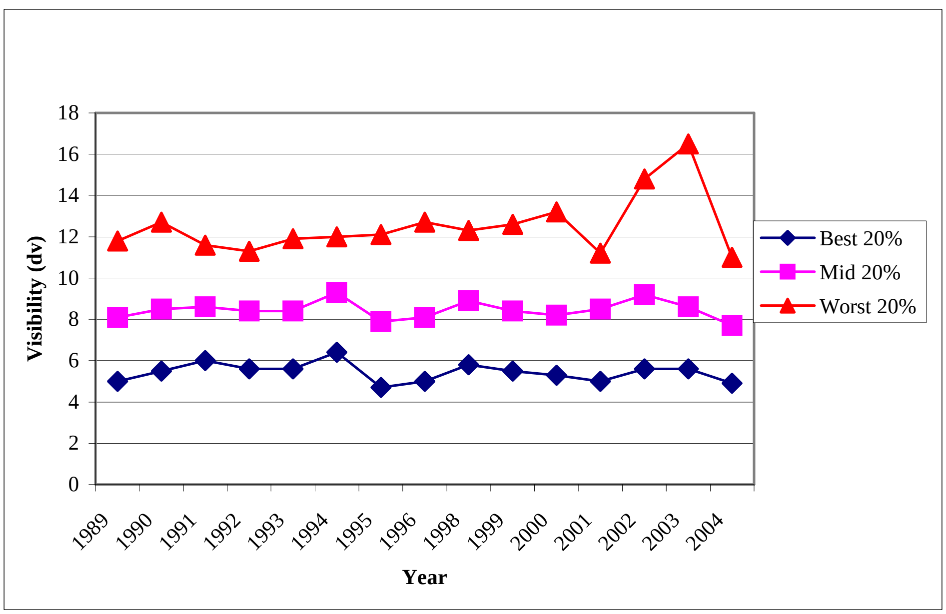



**Figure 3-9. Measured Visual Range at Mesa Verde National Park**

Figure 3-10 presents calculated visual range at Weminuche Wilderness Area for the 20% best, 20% middle and 20% worst days (http://vista.cira.colostate.edu/improve/2008). Figure 3-10 indicates there has been little change in the best, average, or worst days over the period 1988 through 2004.

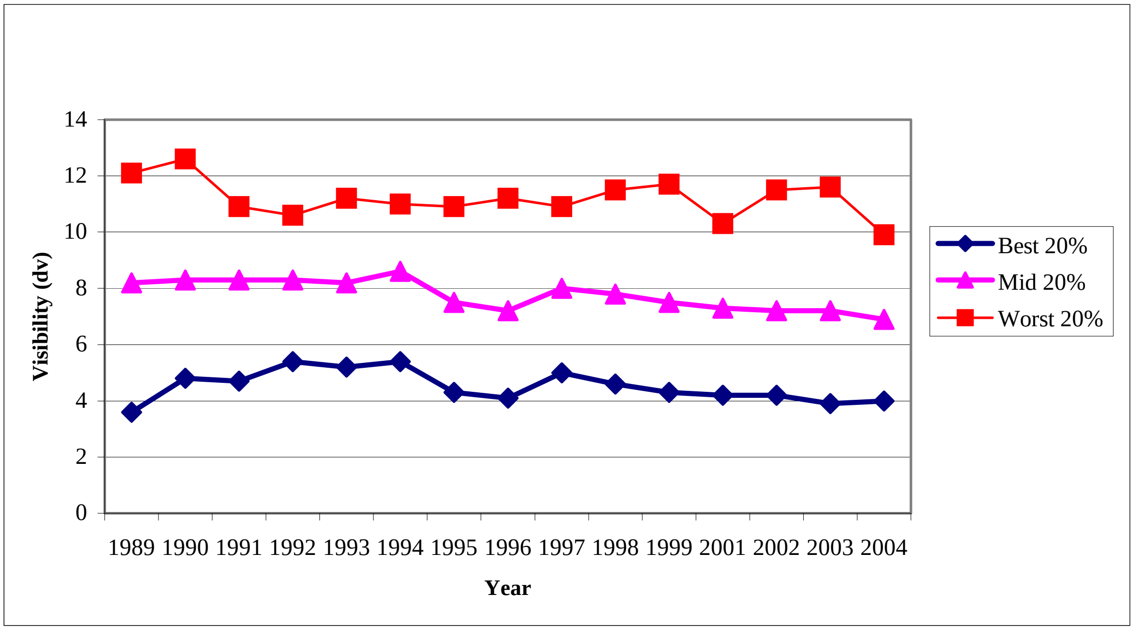



**Figure 3-10. Measured Visual Range at Weminuche Wilderness Area**

Figure 3-11 presents the visual range at the San Pedro Class I Area. The period of record is 2001 to present and data are available through 2004. As indicated in this figure there has been relatively little change in visibility over this period. The exception is that in 2003 there was a reduction in visibility for the 20% worst days.

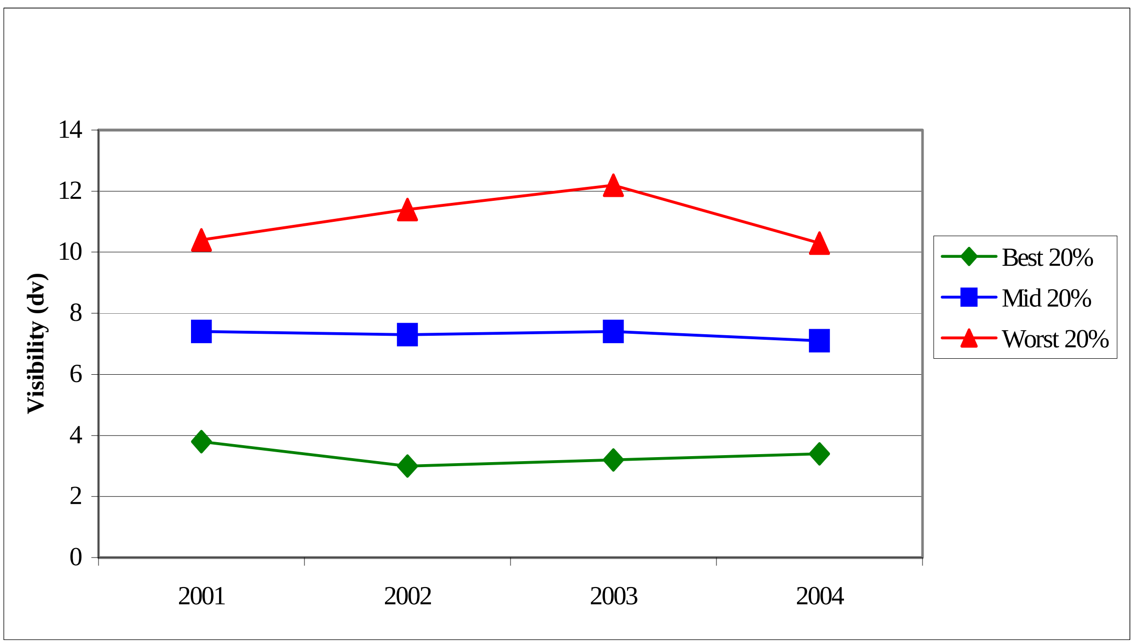



**Figure 3-11. Measured Visual Range at the San Pedro Class I Area**

## DEPOSITION

Figure 3-12 presents total sulfur deposition at Mesa Verde over the period 1997 through 2007[4]. Figure 3-13 presents total nitrogen deposition over the same period at Mesa Verde.

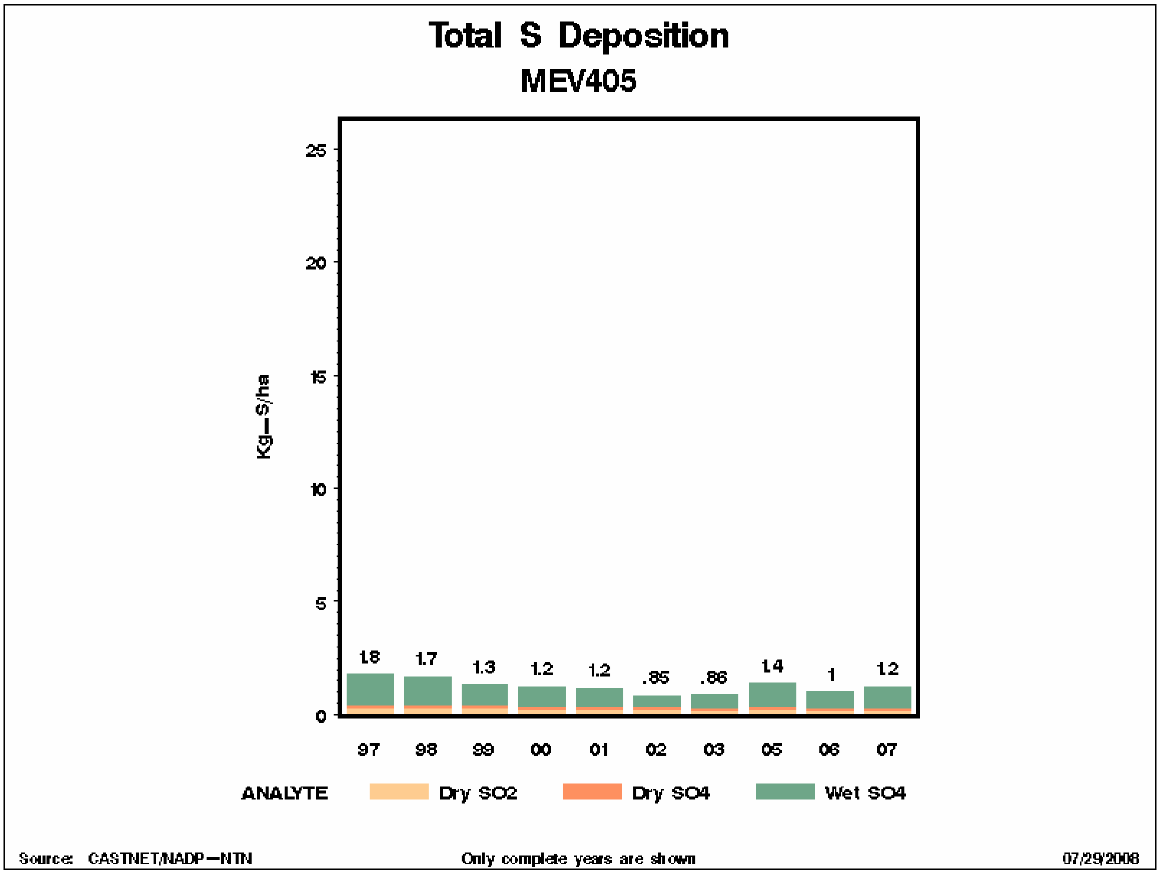



**Figure 3-12. Sulfur Deposition at Mesa Verde**

[4] CASTNET website http://www.epa.gov/castnet/

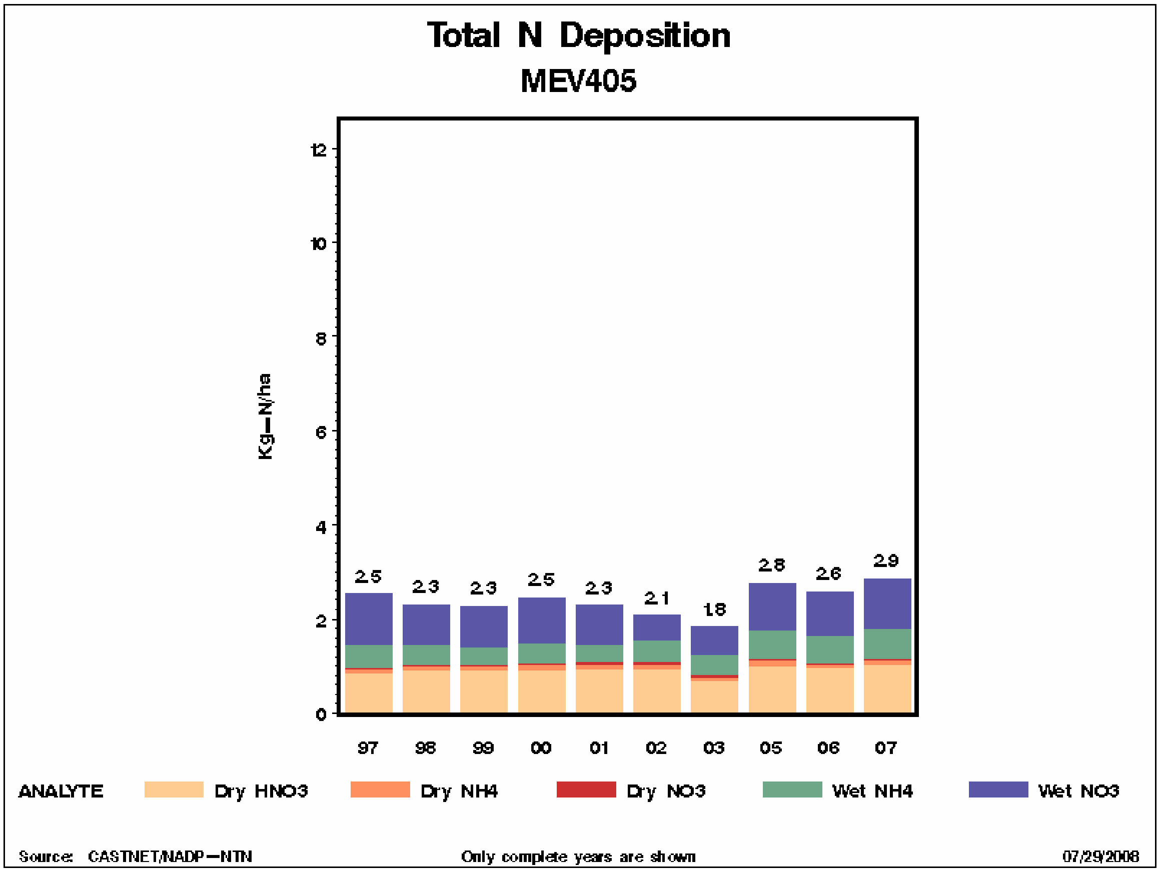



**Figure 3-13. Nitrogen Deposition at Mesa Verde**

### Lake Chemistry

Eleven lakes of concern were identified within the Weminuche Wilderness Area, while the USDI-National Park Service has not identified any sensitive lakes within Mesa Verde National Park. The Weminuche sensitive lakes and their background acid neutralizing capacity (ANC; reported in microequivalents per liter, or µeq/l) values are presented in Table 3-5.

**Table 3-5. Weminuche Wilderness Area Sensitive Lakes**

| Sensitive Lake | Background Acid Neutralizing Capacity (µeq/l) |
|---|---|
| Big Eldorado | 0.9 |
| Four Mile Pothole | 124.8 |
| Lake Due South of Ute Lake | 14.3 |
| Little Eldorado Lake | 0.1 |
| Little Granite Lake | 76.2 |
| Lower Sunlight | 4.6 |
| Middle Ute Lake | 42.5 |
| Small Pond Above Trout Lake | 24.6 |
| Upper Grizzly | 1.7 |
| Upper Sunlight | 1.7 |
| White Dome Lake | 0.1 |

## 3.3 Biological Resources

This section describes the vegetation resources that are present in the study area and includes discussions on vegetative communities, wetlands, culturally important plants, noxious weeds, wildlife and fisheries, and threatened, endangered, and sensitive species. Information on vegetative resources from the 2002 FEIS is incorporated by reference.

### 3.3.1 Vegetative Communities

Vegetative communities in the study area are based on the Provisional Data Set for the Southwest Regional Gap Analysis Project (SWRGAP) (USGS 2004) and are depicted on Map 3-3 (Appendix A). According to the SWRGAP data set, there are 27 distinct landcover types occurring in the study area. Landcover types include vegetative communities, water, and disturbed areas including urban development, agriculture, mining/quarrying, and burned areas. Landcover descriptions were compiled using the information in Landcover Descriptions for the SWRGAP (Natureserve 2004). Table 3-6 displays the study area vegetation communities and the disturbed and undisturbed acreage each in community.

**MONTANE FOREST**

Montane forest communities present in the study area include ponderosa pine (*Pinus ponderosa*), mixed conifer, and aspen (*Populus tremuloides*). These communities generally occur within a similar elevation range and are often intermixed within forest stands. The dominant montane forest type in the study area is ponderosa pine (~14,464 acres). Douglas fir (*Pseudotsuga menziesii*), piñon pine (*Pinus edulis*), and juniper (*Juniperus* spp.) may also be present in ponderosa pine communities. Common understory shrubs may include sagebrush (*Artemisia* spp.), mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), Gambel oak (*Quercus gambelii*), snowberry (*Symphoricarpos oreophilus*), and serviceberry (*Amelanchier* spp.).

Comparatively, only small patches of mesic and dry-mesic mixed conifer occur in the study area, totaling approximately 204 acres. Mixed conifer stands generally occur within or at the edges of larger ponderosa pine stands and are dominated by Douglas-fir and white fir (*Abies concolor*); however, ponderosa pine may also be present.

Small patches of aspen forest totaling approximately 51 acres occur along the Animas River corridor in the southern portion of the study area, as well as within montane forest stands at the extreme eastern end. Aspen stands may have a heavy or sparse herbaceous component dominated by grasses or forbs. Associated shrub species include snowberry, raspberry (*Rubus* spp.), serviceberry, and kinnikinnik (*Arctostaphylos uva-ursi*).

Based on the current level of oil-and-gas development as approved in 2002 (Section 2.1.3), approximately 2 acres of montane forest communities have been disturbed between November 1, 2002, and December 15, 2007, in the study area.

**MONTANE SHRUBLAND/GRASSLAND**

Montane shrubland communities usually occur on foothills that are adjacent to but lower in elevation than montane forests. Montane shrublands in the study area fall into two categories, including those dominated by Gambel oak (Rocky Mountain Gambel Oak-Mixed Montane Shrubland), and those that are absent of oak (Rocky Mountain Lower Montane Foothill Shrubland). Gambel oak shrublands comprise approximately 98% (~20,969 acres) of montane shrublands in the study area; however, this vegetative community often includes other montane shrub species such as serviceberry, mountain mahogany, antelope bitterbrush, snowberry, sagebrush, and chokecherry (*Prunus virginiana*). Rocky Mountain Lower Montane Foothill Shrublands make up less than 2% (~367 acres) of the study area and are comprised of many of the same subordinate species that are present in Gambel oak shrublands, but may also include three-leaf sumac (*Rhus trilobata*), golden currant (*Ribes cereum*), and soapweed (*Yucca glauca*).

Approximately 3,540 acres of montane-subalpine grasslands occur within the study area, generally interspersed among forest and woodland communities. These communities may be dominated by a variety of oatgrasses (*Danthonia* spp.), fescues (*Festuca* spp.), and muhlys (*Muhlenbergia* spp.), with blue grama (*Bouteloua gracilis*), and sandberg bluegrass (*Poa secunda*) commonly present.

Based on the current level of development as approved in 2002 (Section 2.1.3), approximately 13 acres of montane shrubland/grassland communities have been disturbed by oil-and-gas activities between November 1, 2002, and December 15, 2007, in the study area.

**PIÑON-JUNIPER/JUNIPER SAVANNA**

Piñon-juniper woodlands are the most abundant vegetative community in the study area, covering roughly 208,856 acres. Both Colorado Plateau and Southern Rocky Mountain Piñon-Juniper Woodland communities occur in the study area. However, Colorado Plateau comprises greater than 99% of these woodlands (~208,814 acres). Both community types are dominated by piñon pine and Utah juniper (*Juniperus osteosperma*); however, Rocky Mountain juniper (*J. scopulorum*) may also be present at higher elevations within the Southern Rocky Mountain Piñon-Juniper Woodlands cover type. Dominant understory species include big sagebrush (*Artemisia tridentata*), mountain mahogany, antelope bitterbrush, Gambel oak, blue grama, and James's galleta (*Pleuraphis jamesii*).

In addition to piñon-juniper woodlands, the study area also has approximately 8 acres of juniper savanna. This community type generally occurs at lower elevations and more xeric sites than Colorado Plateau piñon-juniper communities. Juniper savannas are more open than piñon-juniper woodlands and are comprised of Utah juniper with perennial bunch grasses and forbs, and commonly, sagebrush species. Blue grama and James's galleta are the most common herbaceous species present.

Based on the current level of oil-and-gas development as approved in 2002 (Section 2.1.3), approximately 95 acres of piñon-juniper/juniper savanna communities have been disturbed between November 1, 2002, and December 15, 2007, in the study area.

**SEMI-DESERT AND SALT DESERT**

Semi-desert and salt desert grasslands and shrublands are scattered throughout the study area, generally occurring at a lower elevation zone than montane and piñon-juniper communities. Several distinct vegetative communities are included in the semi-desert and salt-desert category, including sagebrush-dominated, greasewood-dominated, and mixed shrub-steppe and shrub-grassland communities. Of these vegetative communities, sagebrush is the most widespread in the study area. The Inter-Mountain Basin Big Sagebrush Shrubland community comprises roughly 59,624 acres and is dominated by big sagebrush but may also include rubber rabbitbrush (*Ericameria nauseosa*), antelope bitterbrush, snowberry, greasewood (*Sarcobatus vermiculatus*), saltbush (*Atriplex* spp.), and scattered junipers. Herbaceous cover in big sagebrush shrublands is generally less than 25%. In addition to big sagebrush shrublands, Colorado Plateau Mixed Low Sagebrush Shrublands also occur in the study area, but comprise less than 1% (~52 acres) of shrubland/grassland communities. This community type is dominated black sagebrush (*Artemisia nova*) but may also include Bigelow sage (*A. bigelovii*).

Approximately 14% (~10,023 acres) of the study area is characterized as Inter-Mountain Basin Semi-Desert Shrub Steppe, while 2% (~1,290 acres) is characterized as Inter-Mountain Basin Semi-Desert Grasslands. These two vegetative community types overlap in species composition; however, they differ in relative abundance and structure. The semi-desert shrub-steppe community is dominated by shrub species with less than 25% herbaceous cover, while the semi-desert grassland community is dominated by herbaceous species, with scattered shrubs present. Common shrub species to these two communities include big sagebrush, sand sagebrush (*Artemisia filifolia*), fourwing saltbush (*Atriplex canescens*), Greene's rabbitbrush (*Chrysothamnus greenei*), Mormon tea (*Ephedra viridis*), rubber rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), and winterfat (*Krasheninnikovia lanata*). Common herbaceous species to these communities include Indian ricegrass (*Achnatherum hymenoides*), blue grama, needle-and-thread (*Hesperostipa comata*), James's galleta, and muhly.

Two other semi-desert/salt desert shrubland communities occur in the study area, each comprising less than 1% of study area acreage. These include Inter-Mountain Basin Greasewood Flat and Inter-Mountain Basin Mixed Salt Desert Scrub. The Inter-Mountain Basin Greasewood Flat community occurs on approximately 762 acres of the study area and is dominated by greasewood. Greasewood flats typically occur on stream terraces or other flats near drainages or around playas. Other shrub species occurring in this community may include fourwing saltbush, shadscale (*Atriplex confertifolia*), and winterfat. Approximately 209 acres of salt desert scrub is present in the study area. Salt desert scrub is usually dominated by at least one species of saltbush but may also include big sagebrush, rubber rabbitbrush, Mormon tea, winterfat, and wolfberry (*Lycium* spp.). The herbaceous component of salt desert scrub ranges from sparse to moderately dense.

Based on the current level of development as approved in 2002 (Section 2.1.3), approximately 44 acres of semi-desert and salt desert communities have been disturbed by oil-and-gas activities between November 1, 2002, and December 15, 2007, in the study area.

## Table 3-6. Vegetative Communities in the Study Area.

| Vegetative Community | Acreage[a] | Number of Wells[b] | Acreage Disturbed[c] | Acreage Undisturbed |
|---|---|---|---|---|
| **Montane Forest** | | | | |
| Rocky Mountain Ponderosa Pine Woodland | 14,463.9 | | | |
| Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland | 124.3 | | | |
| Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland | 79.2 | | | |
| Rocky Mountain Aspen Forest and Woodland | 51.4 | | | |
| **Total Montane Forest** | **14,718.8** | **1** | **2.2** | **14,716.6** |
| **Montane Shrubland/Grassland** | | | | |
| Rocky Mountain Gambel Oak-Mixed Montane Shrubland | 20,968.9 | | | |
| Rocky Mountain Lower Montane Foothill Shrubland | 367.2 | | | |
| Southern Rocky Mountain Montane-Subalpine Grassland | 3,539.9 | | | |
| **Total Montane Shrubland/Grassland** | **24,876.0** | **6** | **13.2** | **24,862.8** |
| **Piñon-Juniper/Juniper Savanna** | | | | |
| Colorado Plateau Piñon-Juniper Woodland | 208,813.9 | | | |
| Southern Rocky Mountain Piñon-Juniper Woodland | 42.9 | | | |
| Inter-Mountain Basins Juniper Savanna | 8.2 | | | |
| **Total Piñon-Juniper/Juniper Savanna** | **208,865.0** | **43** | **94.6** | **208,770.4** |
| **Semi-Desert and Salt Desert** | | | | |
| Inter-Mountain Basin Big Sagebrush Shrubland | 59,624.1 | | | |
| Colorado Plateau Mixed Low Sagebrush Shrubland | 52.0 | | | |
| Inter-Mountain Basin Semi-Desert Shrub Steppe | 10,023.3 | | | |
| Inter-Mountain Basin Semi-Desert Grassland | 1,289.5 | | | |
| Inter-Mountain Basin Greasewood Flat | 761.5 | | | |
| Inter-Mountain Basin Mixed Salt Desert Scrub | 209.3 | | | |
| **Total Semi-Desert and Salt Desert** | **71,959.7** | **20** | **44.0** | **71,915.7** |
| **Barren** | | | | |

| Vegetative Community | Acreage[a] | Number of Wells[b] | Acreage Disturbed[c] | Acreage Undisturbed |
|---|---|---|---|---|
| Colorado Plateau Mixed Bedrock Canyon and Tableland | 4,864.2 | | | |
| Inter-Mountain Basin Shale Badland | 3,194.9 | | | |
| Inter-Mountain Basin Wash | 1.6 | | | |
| **Total Barren** | **8,060.7** | **2** | **4.4** | **8,056.3** |
| **Wetland and Riparian** | | | | |
| North American Arid West Emergent Marsh | 183.5 | | | |
| Rocky Mountain Alpine-Montane Wet Meadow | 1.3 | | | |
| Rocky Mountain Lower Montane Riparian Woodland and Shrubland | 6,425.7 | | | |
| Open Water | 1,479.4 | | | |
| **Total Wetland and Riparian** | **8,089.9** | **1** | **2.2** | **8,087.7** |
| **Disturbed** | | | | |
| Agriculture | 84,127.0 | | | |
| Recently Mined or Quarried | 207.7 | | | |
| Developed, Open Space, Low Intensity | 344.5 | | | |
| Developed, Medium, High Intensity | 204.8 | | | |
| **Total Disturbed** | **84,884.1** | **13** | **28.6** | **84,855.5** |
| **TOTAL** | **421,454.1** | **86** | **189.2** | **421,264.9** |

[a] As defined by the Provisional Data Set for the SWRGAP (USGS 2004).
[b] Based on the study area's current development as approved in 2002, including conventional and CBM wells (Section 2.1.3).
[c] Based on a long-term disturbance of 2.2 acres per well (Section 2.1.3).

## BARREN

Barren community types generally have less than 10% vegetative cover and include canyon and tablelands, shale badlands, and washes. Canyon and tablelands include steep cliffs, narrow canyons, and open tablelands, predominantly of sandstone, shale, and limestone. There are approximately 4,864 acres of this landcover type occurring in the southwestern portion of the study area. Vegetation in these areas is characterized as scattered trees and shrubs, including piñon pine, ponderosa pine, or juniper, with a sparse herbaceous layer. Shale badlands cover roughly 3,195 acres, mostly in the central and eastern portion of the study area and are typically derived from marine shales, siltstone, or mudstone. Shale badlands are typically flat to rolling hills with harsh soil properties and high rates of erosion. These communities may support sparse populations of dwarf-shrubs and herbaceous vegetation. The Inter-Mountain Basin Wash cover type comprises approximately 2 acres of the study area and is restricted to intermittently flooded streambeds and banks often lined with greasewood, rubber rabbitbrush, and silver sagebrush (*Artemisia cana*).

Based on the current level of oil-and-gas development as approved in 2002 (Section 2.1.3), approximately 4 acres of barren communities have been disturbed by oil and gas activities between November 1, 2002, and December 15, 2007, in the study area.

## WETLAND AND RIPARIAN

Two distinct wetland community types occur in the study area, including North American Arid Emergent Marsh and Rocky Mountain Alpine-Montane Wet Meadow. The North American Emergent Marsh community covers about 184 acres scattered throughout the study area. Some marshes may be continually inundated with water, while water level in other marches may fluctuate over the course of the growing season. Marshes have mineral soils and can accumulate organic materials. Vegetation in this community type includes herbaceous plants that are adapted to saturated soil conditions, such as rushes (*Scirpus* and *Juncus* spp. *)*, bulrushes (*Schoenoplectus* spp.*),* cattail (*Typha* spp.*),* pondweed (*Potamogeton* spp.*),* buckwheat (*Polygonum* spp.*),* pond lily *(Nuphar* spp.*),* and canary grass (*Phalaris)* species. Marshes with relatively deep water may also have floating-leaf plants, such as duckweed (*Lemna* spp.*)* and pondweed species, as well as submergent and floating plants, such as water milfoil (*Myriophyllum* spp.*),* riverweed *(Ceratophyllum* spp.*)*, and waterweed *(Elodea* spp.*)*.

Only a very small amount (approximately 1 acre) of Rocky Mountain Alpine-Montane Wet Meadow can be found within the study area. These are high-elevation communities dominated by herbaceous vegetation and may occur as meadows or borders to ponds, lakes, streams, and seeps. This community often occurs as a mosaic of several plant associations, often dominated by graminoids such as sedges (*Carex* spp.), slimstem reedgrass (*Calamagrostis stricta*), white marsh marigold (*Caltha leptosepala*), heartleaf bittercress (*Cardamine cordifolia*), tufted hairgrass (*Deschampsia caespitosa*), fewflower spikerush (*Eleocharis quinqueflora*), Drummond's rush (*Juncus drummondii*), icegrass (*Phippsia algida*), alpine yellowcress (*Rorippa alpine*), arrowleaf ragwort (*Senecio triangularis*), Parry's clover (*Trifolium parryi*), and American globeflower (*Trollius laxus*).

Riparian communities within the study area are composed of woodlands and shrublands, totaling about 6,426 acres. Riparian woodlands and shrublands generally occur along the perennial rivers and streams of the study area, but are also found along many of the intermittent and ephemeral drainages. Most, if not all, of these water courses include a mix of native and exotic vegetation. Dominant native tree species may include boxelder (*Acer negundo*), narrow-leaf cottonwood (*Populus angustifolia*), Rio Grande cottonwood (*P. deltoids*), Douglas-fir, blue spruce, or Rocky Mountain juniper. Common shrub species include alder (*Alnus* spp.), chokecherry, three-leaf sumac, and a variety of willow species (*Salix* spp.). Exotic trees commonly occurring in riparian woodlands include Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix* spp.).

Based on the current level of development as approved in 2002 (Section 2.1.3), approximately 2 acres of the wetland and riparian communities have been disturbed by oil-and-gas activities between November 1, 2002, and December 15, 2007.

**DISTURBED**

Disturbed communities include developed areas, areas mined or quarried, and agricultural lands. Agricultural lands comprise important habitats for a variety of wildlife (Section 3.3.5). According to the SWRGAP data, agricultural lands make up about 84,127 acres within the study area. Agricultural lands on the Reservation are discussed in Section 3.6 - Land Use and Ownership. Other disturbed lands in the study area comprise approximately 757 acres.

Based on the current level of development as approved in 2002 (Section 2.1.3), approximately 29 acres of disturbed communities have also been disturbed by oil-and-gas activities between November 1, 2002, and December 15, 2007, in the study area.

### 3.3.2 Culturally Important Plants

Culturally important plants are those that have historically been utilized as food, medicine, crafts, or in Tribal ceremonies (USDI 2002a). These plants include bear root (*Ligusticum porteri*), cattail (*Typha spp.*), narrowleaf cottonwood (*Populus angustifolia*), peppermint (*Lamiaceae spp.*), piñon pine, juniper, Ute lady's tresses (*Spiranthes esdiluvialis*), wild banana yucca (*Yucca baccata*), wild thorns, willow (*Salix spp*.), and yarrow (*Achillea lanulosa*). Refer to Section 3.4.2 in the 2002 FEIS for further discussion of culturally important plants in the study area (USDI 2002a).

### 3.3.3 Noxious Weeds

The Federal Noxious Weed Act of 1974 [7 USC (U.S. Code) §§ 2801−2814, as amended] defines a noxious weed as "any living stage, such as seeds and reproductive parts, of any parasitic or other plant of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation, or the fish or wildlife resources of the United States or the public health."

Noxious weeds are present throughout the Reservation, including in the study area. The most heavily impacted areas are along roadsides and areas associated with disturbance from oil and gas development, agriculture, and grazing. The Reservation has been divided into seven management units to provide direction to the BIA and SUIT staff for the management of natural resources (SUIT 2000). These management units are described in Section 3.6.2. According to the SUIT NRMP (SUIT 2000), the most severe noxious weed infestations occur within the La Plata, Los Piños, Piedra, Lower San Juan, and Upper San Juan Management Units.

The La Plata County Weed Management and Enforcement Plan (Pursuant to Article II of Chapter 58 of the La Plata County Code and the Colorado Noxious Weed Act [CRS 35-5.5-101–119]) mandate landowner management of noxious weeds. Because the state of Colorado does not have jurisdiction over Tribal lands, the SUIT has taken responsibility for all noxious weed management on those lands. Noxious weed species comprising the largest infestations on the Reservation include Canada thistle (*Cirsium arvense*), hoary cress (*Cardaria draba*), leafy spurge (*Euphorbia esula*), musk thistle (*Carduus nutans*), oxeye daisy (*Chrysanthemum leucanthemum*), Russian knapweed (*Acroptilon repens*), spotted knapweed (*Centaurea maculosa*), whorled milkweed (*Asclepias subverticillata*), and yellow toadflax (*Linaria vulgaris*). Further information on these species may be obtained from the La Plata County Weed website (http://www.lpcweeds.org/).

In addition to these infestations, there are several other noxious weed species that are also present on the Reservation, although none has been well established. These include scentless chamomile (*Matricaria perforata*), sulfur cinquefoil (*Potentilla recta*), curly dock (*Rumex crispus*), scotch thistle (*Onopordum tauricum*), bull thistle (*Cirsium vulgare*), diffuse knapweed (*Centaurea diffusa Lam.*), hounds tongue (*Cynoglossum officinale*), and common burdock (*Arctium minus*). Woody noxious species, particularly saltcedar and Russian olive are also a concern in irrigation ditches and riparian areas on the Reservation.

### 3.3.4 Threatened, Endangered, and Sensitive Plant Species

**FEDERALLY LISTED AND CANDIDATE SPECIES**

The ESA of 1973, as amended, provides protection to threatened and endangered species and their critical habitats. Section 7 (a) of the ESA directs federal departments and agencies to ensure that actions of a federal agency are "not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of (its) habitat." Section 7 (a) of the ESA also requires consultation with the USFWS when a federal action may affect a federally listed endangered or threatened species. Through discussions with the USFWS, it was determined that formal consultation is required for this PEA (Terry Ireland, USFWS, personal communication 2/21/2007). In addition, formal consultation would be required for site-specific oil and gas projects that would be developed under this PEA if it is determined a federally listed threatened or endangered species may be affected.

According to the USFWS, there are four federally listed threatened, endangered, and candidate plant species with potential to occur on the Reservation. Refer to Map 3-4 in Appendix A for areas of potential habitat for federally listed and Colorado Natural Heritage Program (CNHP) species within the study area. Federally listed and candidate plant species are presented in Table 3-7 and have been analyzed in detail in the project Biological Assessment (BA) submitted to the USFWS in January 2008.

Of the four species with potential to occur on the Reservation, two have potential to occur within the study area. These include Knowlton's cactus and Mancos milkvetch.

#### Knowlton's Cactus

Knowlton's cactus is known from one locality along the Los Piños River corridor just south of the Colorado-New Mexico border. This population occurs on gravelly hills formed from alluvial deposits at elevations of approximately 6,400 to 6,500 feet (Ecosphere 1995, Spackman et al. 1997). Vegetative communities associated with this population include piñon-juniper woodlands and sagebrush shrublands. Knowlton's cactus is extremely difficult to locate due to its exceptionally small size, less than 2.5 centimeters (cm) wide, unless during the flowering and fruiting period occurring between April and early May and late May to early June, respectively (Spackman et al. 1997). Flowers are short-lived lasting only for about two or three days, and have yellow centers with white to pale pink flowers that are open by mid-morning and close by late afternoon (Spackman et al. 1997).

Knowlton's cactus is one of the rarest species of the *Pediocactus* genus and one of the rarest plants in the U.S.; illegal collections have contributed considerably to its decline (Ecosphere 1995). Although the known population occurs just south of the study area, Knowlton's cactus has not been documented on the Reservation (Steve Whiteman, SUIT DWRM, personal communication, 3/12/2007). Efforts to establish introduced populations of this species have been undertaken; however, success is uncertain due to the slow plant growth.

Potential habitat for Knowlton's cactus in the study area occurs along the La Plata, Animas, Florida, and Los Piños Rivers, and their tributaries, where alluvial deposits and suitable piñon-juniper or sagebrush vegetative communities occur (Map 3−4, Appendix A). Sambrito Creek, a tributary to the San Juan River in the southeastern portion of the study area, also includes alluvial surface geology and some appropriate vegetative substrates.

### Mancos Milkvetch

Mancos milkvetch is a perennial species that occurs on remote exfoliating rock ledges and mesas, formed from Cretaceous Point Lookout Sandstone of the Mesa Verde Series, in piñon-juniper woodlands at elevations from approximately 5,500 to 6,500 feet (USFWS 1989, Ecosphere 1995, Spackman et al. 1997). Its morphology is characterized as clumps as large as 30 cm in width with persistent, spiny leaf stalks. The flowing period is from late April through early June and the fruiting period is from June through early July. Flowers are lavender to purplish with 4.5 millimeter (mm) long to 2 mm wide seed pods (Spackman et al. 1997).

Distribution of Mancos milkvetch includes extreme northwest New Mexico north into extreme southwest Colorado. It is known to occur in scattered populations between the town of Towaoc, Colorado, and the Chaco River of New Mexico (USFWS 1989). Its specificity to the highly localized sandstone outcrops of the Four Corners region is suggestive of a similar historic and current distribution (USFWS 1989).

The study area includes very little Point Lookout Sandstone geology; however, two small patches of this substrate slightly overlap and fall within the northwest portion of the study area (Map 3−4, Appendix A). These areas represent the only potential habitat for Mancos milkvetch in the study area. To date, Mancos milkvetch has not been documented within the study area or elsewhere on the Reservation (Steve Whiteman, SUIT, DWRM, personal communication, 3/12/2007).

## COLORADO NATURAL HERITAGE PROGRAM SPECIES OF CONCERN

According to the CNHP, there are eight plant species of concern that are known to occur, have historically occurred, or have potential to occur within the study area. These species, their habitat descriptions, and determination of their potential to occur in the study area are provided in Table 3-7. Although the potential for these species to occur is presented in this PEA, Colorado State species protection laws (Colorado Title 33/Article 2) are not applicable to Tribal lands. Of the eight CNHP species, six have potential to occur in the study area, including little penstemon (*Penstemon breviculus*), violet milkvetch (*Astragalus iodopetalus*), Missouri milkvetch (*Astragalus missouriensis* var. *humistratus*), Cliff Palace milkvetch (*Astragalus deterior*), New Mexico false carrot (*Aletes sessiflorus*), and Pagosa phlox (*Phlox caryophylla*). These determinations were made based upon the most updated information on species' habitat associations and the known habitats within the study area (Table 3-7).

### 3.3.5 Wildlife and Fisheries

The Wildlife and Fisheries section of this PEA is based on information provided by the SUIT DWRM and recent scientific literature and reference books. Additional information was provided by the Colorado Division of Wildlife (CDOW) and other local area biologists with expertise in wildlife present in the area.

**GAME SPECIES**

Game species are defined as those that are actively managed for harvest on the Reservation by the SUIT DWRM. Hunting activities on the Reservation are regulated and enforced under authority of the Tribe through its Wildlife Conservation Code, Title 13. Historically, hunting permits were made fully available to the public; however, within the last 10 years, the SUIT has significantly reduced non-Tribal member hunting. For about the last 5 years, a limited number of hunting permits have also been made available to non-SUIT members, primarily other Native Americans, based on the SUIT's harvest management needs, particularly on the eastern half of the Reservation (Steve Whiteman, SUIT DWRM, personal communication, 3/12/2007). Game species legal for harvest on the Reservation include a variety of big and small game mammals as well as upland game birds and waterfowl. Big game species include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), mountain lion (*Felis concolor*), and Merriam's wild turkey (*Meleagris gallopavo merriami*). Black bear (*Ursus americanus*) is also considered a big game species in the state of Colorado; however, no black bear hunting occurs on the Reservation. Actual harvest of game species by SUIT members is low because of the relatively small hunter population, less than 250 hunters for deer and elk (Steve Whiteman, SUIT DWRM, personal communication, 3/12/2007).

Most of the SUIT hunting permits that are issued are for mule deer, elk, and wild turkeys. Currently, there are no waterfowl hunters and very few upland gamebird, mountain lion, and small game hunters.

**BIG GAME**

**Elk**

Elk occur throughout the Reservation including within the study area. They are typically associated with open forested habitat or forest edge habitats. Elk are considered generalist feeders, both grazing and browsing depending on food availability (Fitzgerald et al. 1994). Map 3-5 (Appendix A) shows the known winter and year-round range of elk in the study area. Almost the entire study area is considered elk winter range, except for the Los Piños River and U.S. Highway 550 corridors. These two areas, however, represent the bulk of the summer range for resident elk. Some elk also occur year-round in the southwestern portion of the study area. Elk calving areas are shown on Map 3-6 (Appendix A). In addition to summer and winter ranges, there are numerous elk migration corridors, used primarily to move between summer and winter habitat, that exist within the study area. These migration routes are based on information collected from the SUIT DWRM biologists as well as radio-telemetry data from the late 1980s and early 1990s.

**Table 3-7. Potential USFWS Threatened, Endangered and Candidate, and Colorado Natural Heritage Program Sensitive Plant Species in the Study Area.**

| Species | Status[a] | Habitat Associations | Potential to Occur |
|---|---|---|---|
| Knowlton's cactus (*Pediocactus knowltonii*) | E | Rocky, alluvial soils in piñon-juniper and sagebrush communities. | Los Piños, La Plata, Florida, and Animas River Valleys and Sambrito Creek include potential alluvial substrates; known populations exist along the Los Piños River south of the study area. Potential to occur. |
| Mancos milkvetch (*Astragalus humillimus*) | E | Exfoliating sandstone rock ledges and mesas formed from Cretaceous Point Lookout Sandstone of the Mesa Verde Series. | Two small areas with outcrops derived from Point Lookout Sandstone geology are present in the northwestern corner of the study area. Very limited potential to occur. |
| Mesa Verde cactus (*Sclerocactus mesae-verdae*) | T | Salt desert scrub communities on soils derived from the Fruitland and Mancos Shale formations. | Only small, isolated patches of salt desert habitat exists in the study area. No Mancos Shale occurs. Very unlikely to occur. |
| Pagosa skyrocket (*Ipomopsis polyantha*) | C | Fine soils derived from the Mancos formation; in barren shale ponderosa pine, piñon-juniper or scrub oak communities. | No Mancos Shale geology occurs within the study area. No potential to occur. |
| Little penstemon (*Penstemon breviculus*) | G3, S2 | Sandstone and shale substrates in clayey loam soils of piñon-juniper, sagebrush, and grassland habitats. | Study area includes few sandstone and shale habitats within suitable vegetative communities. Limited potential to occur. |
| Cliff Palace milkvetch (*Astragalus deterior*) | G1G2, S1S2 | Cracks and depressions of sandstone rimrock on mesa edges. | A few sandstone outcrops occur in the study area. Limited potential to occur. |
| Aztec milkvetch (*Astragalus proximus*) | G4, S2 | Juniper and sagebrush habitats on mesas, bluffs, and hills with sandy or alkaline clay soils derived from the Lewis or Mancos Shale formations. | No Lewis Shale or Mancos Shale geology in the study area. No potential to occur. |

| Species | Status[a] | Habitat Associations | Potential to Occur |
|---|---|---|---|
| Violet milkvetch (*Astragalus iodopetalus*) | G2, S1 | Sagebrush and piñon-juniper communities, on rocky hillsides. | Study area includes sagebrush and piñon-juniper habitats. Potential to occur. |
| Missouri milkvetch (*Astragalus missouriensis* var. *humistratus*) | G5T1, S1 | Open, dry meadows on sparsely vegetated soils in ponderosa pine or Gambel oak habitats. | Study area includes Gambel oak and ponderosa pine. Potential to occur. |
| New Mexico false carrot (*Aletes sessiflorus*) | G3, S1 | Piñon-juniper woodlands on rocky ledges and crevices derived from the San Jose Formation. | Study area includes piñon-juniper woodlands with San Jose surface geology. Potential to occur. |
| Gray's Townsend-daisy (*Townsendia glabella*) | G2, S2 | Steep shale slopes with clay soils derived from Mancos Shale. | No Mancos Shale geology exists within the study area. No potential to occur. |
| Pagosa phlox (*Phlox caryophylla*), | G4, S3 | Open woodlands, sparsely wooded slopes, and sagebrush communities, often in deep soils. | Study area includes woodlands and sagebrush habitats. Potential to occur. |

[a] USFWS status: E = endangered; T = threatened; C = candidate

Notes: CNHP global imperilment rank: G1 = globally critically imperiled; G2 = globally imperiled; G3 = globally rare or uncommon; G4 = globally widespread, abundant, and apparently secure, but with cause for long-term concern; G5 = globally demonstrably widespread, abundant and secure; G#G# = numeric range rank; T# = rank applies to a subspecies or variety.

CNHP state imperilment rank: S1 = state critically imperiled; S2 = state imperiled; S3 = state rare or uncommon; S4 = state apparently secure; S5 = state demonstrably secure; S#S# = numeric range rank.

Elk populations have been monitored on the Reservation via aerial surveys since 1989. The elk population on the east side of the Reservation (east of the Los Piños River) has remained stable and healthy since 1989 (Figure 3-14). The west side (west of the Los Piños River) elk population appear to be rising slightly (Figure 3-14); however, this population has demonstrated decreasing age ratios, as the numbers of calves that are counted during aerial surveys has dropped steadily in recent years. If current trends continue, elk numbers on the west side may begin to drop in the foreseeable future (Aron Johnson, SUIT DWRM, personal communication, 3/23/2007 and 3/26/2007).

The elk hunting season on the Reservation includes both an archery and general hunting season. In 2007, the archery season began on August 25 and lasted through September 14. The general elk hunt for 2007 began on September 15 and lasted through the end of December. The combined bag limit for both hunting seasons is four elk per hunter, with no more than one bull and three cows. Although the bag limits for elk are extremely generous, very few tribal hunters come close to filling their entire limit.

### Mule Deer

Mule deer also occur throughout the Reservation including within the study area. Mule deer distribution and seasonal use is similar to that of elk (Refer to Map 3-5 and Map 3–6 [Appendix A]). Mule deer high-use highway and major road crossing areas within the study area have been identified by the CDOW and include sections of U.S. Highway 550, Colorado State Highway (SH) 140 and SH 151, and La Plata County Road (CR) 141. Mule deer populations have also been monitored on the Reservation via aerial surveys since 1989. Like the elk population, the deer population on the east side of the Reservation (east of the Los Piños River) has remained stable and healthy since 1989, based on the number of animals observed and age and sex ratios (Figure 3-14). West side (west of the Los Piños River) mule deer numbers, however, have been steadily declining since the late 1980s (Figure 3-14).

The mule deer hunting season on the Reservation also includes both an archery and general hunting season. Archery and general hunting seasons for mule deer are the same as for elk. The combined bag limit for both seasons is three deer per hunter, with no more than one buck and two does.

### Mountain Lion

Mountain lions occur throughout the Reservation in almost every habitat type; however, they are most often found in foothills and canyons associated with piñon-juniper woodlands, montane forests, and shrublands (Fitzgerald et al. 1994). The SUIT in conjunction with the University of Wyoming conducted a study of the mountain lion population on the Reservation between 1999 and 2001. Based on the results of the study, the lion population for the Reservation was estimated to be 55, with 26 adult females, 14 adult males, and 15 sub-adults (Koloski 2002). Approximately one-third of the lions present during the study had home ranges entirely within the exterior boundary of the Reservation; however, only 12 lions were used in the home range analysis and only four of those had home ranges entirely within the exterior boundary. Although this study is six years old, these data represent the best information to date on mountain lions on the Reservation. Hunting seasons on the Reservation have been designed to keep populations at or above the estimates made in 2001 (Aron Johnson, SUIT DWRM, personal communication, 3/23/2007 and 3/26/2007). The 2007-08 mountain lion hunting season began on November 1, 2007, and continued through April 8, 2008. The bag limit was one lion of either sex per hunter; however, a quota system was in place for the hunting season to protect the population from over harvest. The quota system allowed for the harvest of a maximum of: 1) four lions, with no more than two females, east of the Los Piños River, and 2) three lions, with no more than two females west of the Los Piños River. When such quotas are filled, the season ends for that hunting unit regardless of the date.

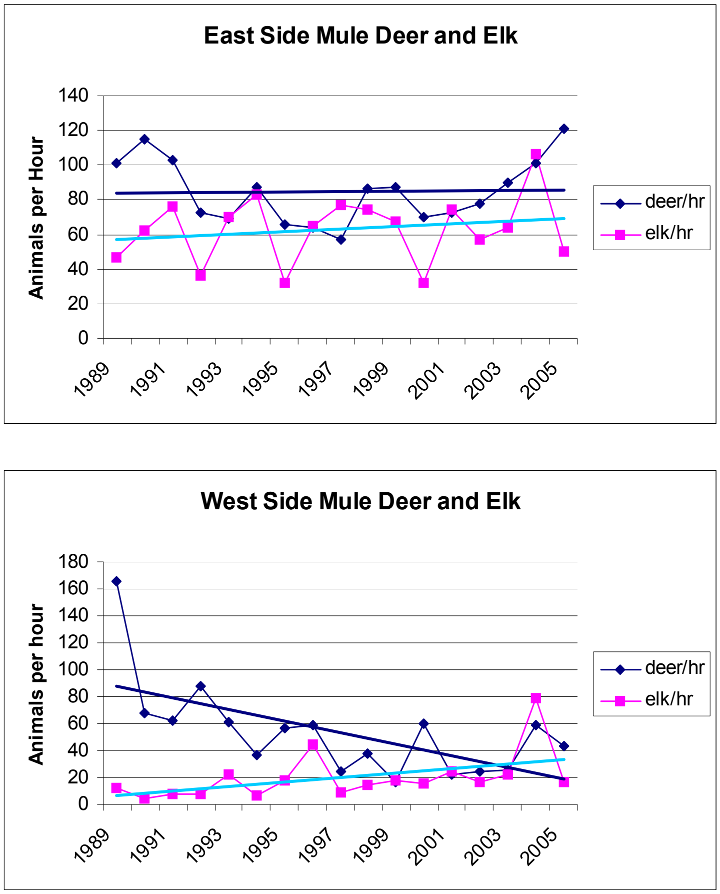



**Figure 3-14. Elk and Mule Deer East Side and West Side Population Trends[5]**

### Merriam's Wild Turkey

Wild turkeys occur throughout the Reservation. While Merriam's turkeys breed primarily in ponderosa pine and pine-oak habitats (Hoffman et al. 1993), breeding turkeys have also been documented in piñon-juniper habitats throughout the Reservation. During winter, turkeys may occur in ponderosa pine or migrate to lower elevation piñon-juniper woodlands (Hoffman et al. 1993). Currently, there are no population estimates for wild turkeys on the Reservation; however, turkeys have been documented by SUIT DWRM staff across the Reservation throughout the study area. Specifically, turkeys have been observed in the following locations: Mesa Mountains, Black Ridge, Cinder Buttes, Valencia Canyon, Morgan Canyon, and Johnny Pond Arroyo (Aron Johnson, SUIT DWRM, personal communication, 3/23/2007 and 3/26/2007). Hunting pressure on the Reservation is light and harvest success appears to be low. Within the last two years, the SUIT DOW has issued more hunting permits for turkeys because the populations appear to be doing well (Aron Johnson, SUIT DWRM, personal communication, 3/23/2007 and 3/26/2007). Turkeys may be hunted on the Reservation during two designated seasons,

[5] East and west of Los Piños River of the Reservation; graph obtained from the SUIT Division of Wildlife Resources Management. These data are animal observation rates as measured during annual aerial game counts conducted by the SUIT.

spring and fall. In 2007, 60 turkey permits were available for the spring season occurring between April 14 and May 27, with a bag limit of one bearded turkey per hunter. The fall turkey season begins on September 15 and lasts through the end of December. During the fall hunt, either sex may be harvested, with a bag limit of one bird.

### Black Bear

There is no black bear hunt on the Reservation due to SUIT cultural beliefs. The black bear is a big game species that occurs on the Reservation. Black bears may occur in almost any habitat type that provides adequate food resources and cover; however, it is most often found in montane shrublands and forests and subalpine forests where oak or berry-producing shrubs occur (Fitzgerald et al. 1994). Currently, there are no data available on black bear population trends or size for the Reservation. Because there is plenty of available habitat for bears and there is no hunting season on the Reservation, the black bear population is assumed to be healthy (Aron Johnson, SUIT DWRM, personal communication, 3/23/2007 and 3/26/2007). SUIT DWRM staff has observed bears in most habitat types across the Reservation.

## SMALL GAME

Small game species may be harvested year round on the Reservation by hunting or trapping with no bag limits. Small game species available for harvest on the Reservation include bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), Gunnison's prairie dog, beaver (*Castor canadensis*), badger (*Taxidae taxus*), black-tailed jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus* spp.), ground squirrels (*Spermophilus* spp.), skunks (*Mephitis and Spilogalus* spp.), and raccoon (*Procyon lotor*). Many of these species, particularly bobcat, coyote, gray and red fox, badger, cottontail, skunk, and raccoon, are considered generalists, occurring in more than one or several habitat types and thus may occur throughout the study area. Prairie dogs and jackrabbits are generally restricted to semi-desert grasslands and open shrublands. Beavers require aquatic habitats and may only be found in riparian woodlands and wetland habitats within the study area.

## UPLAND GAME BIRDS AND WATERFOWL

Upland game birds with hunting seasons on the Reservation include dusky grouse (formerly blue grouse; *Dendragapus obscurus obscurus*), Gambel's quail (*Callipepla gambelii*), and mourning dove (*Zenaida macroura*). These species may be harvested between September 1 and December 31 annually. Bag limits for dusky grouse, Gambel's quail, and mourning dove are three, and 15 birds per hunter per day, respectively.

Waterfowl most likely to occur within the study area include Canada goose (*Branta canadensis*), Bufflehead (*Bucephala albeola*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), northern shoveler (*Anas clypeata*), blue-winged teal (*Anus discors*), cinnamon teal (*Anus cyanoptera*), green-winged teal (*Anas crecca*), redhead (*Aythya americana*), ring-necked duck (*Aytha collaris*), lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), common merganser (*Mergus merganser*), and ruddy duck (*Oxyura jamaicensis*; Andrews and Righter 1992, Kingery 1998). All SUIT waterfowl hunting permittees must also have a Federal duck stamp. Waterfowl hunting season dates and bag limits for the Reservation follow the Pacific flyway season framework and the State of Colorado waterfowl hunting season.

## NON-GAME SPECIES

Non-game species are defined as those species not actively managed for harvest and include a wide variety of mammals, birds, and herpetofauna (e.g., reptiles).

### MAMMALS

The study area includes a variety of forested, woodland, shrubland, grassland, riparian and wetland, and agricultural habitats that support a wide array of non-game mammal species. Some mammals likely to occur in the study area are considered habitat generalists and may be found in numerous vegetative communities, such as dwarf shrew (*Sorex nanus*), Townsend's big-eared bat (*Plecotus townsendii*), least chipmunk (*Eutamius minimus*), Botta's pocket gopher (*Thomomys bottae*), and deer mouse (*Peromyscus maniculatus*). Other species with potential to occur are dependent on a particular vegetative community, such as Merriam's shrew (*Sorex merriami*) and banner-tailed kangaroo rat (*Dipodomys spectabilis*), which are only found in lowland, semi-desert habitats; piñon mouse (*Peromyscus truei*), which is restricted to piñon-juniper woodlands; Abert's squirrel (*Sciurus aberti*), which is only found in ponderosa pine forest; and southern red-backed vole (*Clethrionomys gapperi*) and montane vole (*Microtis montanus*), which are only found in montane forest habitats.

### BIRDS

Each vegetative community within the study area offers potential habitat for a suite of non-game avian species. Most year-round resident birds breed in one habitat type, generally at higher elevations, and migrate to lower elevation habitats during the non-breeding season. Examples include mountain chickadee (*Poecile gambeli*), white-breasted nuthatch (*Sitta carolinensis*), bluebirds (*Sialia* spp.), Townsend's solitaire (*Myadestes townsendi*), and dark-eyed junco (*Junco hyemalis*). The majority of breeding birds in the study area, however, are short-distance or Neotropical migrants that are found in one general habitat type during the breeding season.

A few of the most common breeding birds that utilize ponderosa pine habitats include Grace's warbler (*Dendroica graciae*), yellow-rumped warbler (*Dendroica coronata*), and western tanager (*Piranga ludoviciana*), as well as cavity nesters such as hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), and pygmy nuthatch (*Sitta pygmaea*). Piñon-juniper woodlands provide breeding habitat for another suite of avian species including Virginia's warbler (*Virmivora virginiae*), juniper titmouse (*Baeolophus ridgwayi*), bushtit (*Psaltiparus minimus*), gray flycatcher (*Empidonax wrightii*), and piñon jay (*Gymnorhinus cyanocephalus*), among others. The study area also contains a variety of semi-desert shrubland/grassland communities which provide breeding habitat for species such as sage thrasher (*Oreoscoptes montanus*), northern mockingbird (*Mimus polyglottos*), and green-tailed towhee (*Pipilo chlorurus*), as well as a variety of sparrow species including sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), and lark sparrow (*Chondestes grammacus*). Agricultural areas such as pastureland and fencerow habitat provide nest sites for avian species such as western meadowlark (*Sturnella neglecta*), Say's phoebe (*Saya saynoris*), vesper sparrow (*Poocetes gramineus*), horned lark (*Eremophila alpestris*), and loggerhead shrike (*Lanius ludovicianus*). Riparian communities and wetlands throughout the study area contain suitable breeding habitat for another group of birds including yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), western wood-pewee (*Contopus sordidulus*), and belted kingfisher (*Ceryle alcyon*), as well as a variety of wading and shorebirds which typically nest on the ground.

These may include spotted sandpiper (*Actitis macularia*), killdeer (*Charadrius vociferus*), Virginia rail (*Rallus limicola*), and sora (*Porzana carolina*).

### Migratory Bird Treaty Act

In general, all native, non-game bird species, regardless of migratory status, are protected under the Migratory Bird Treaty Act (MBTA). The MBTA and the international migratory bird treaties implemented through the Act, impose substantive obligations on federal agencies to conserve migratory birds and their habitats (16 USC 703-711). According to the MBTA, "Unless and except as permitted by regulations made as hereinafter provided in this subchapter, it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or eggs of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg [thereof]…". A complete list of species protected under the MBTA can be obtained at the following website created by the USFWS: http://www.fws.gov/migratorybirds/intrnltr/mbta/mbtintro.html.

### Raptors

The most common raptor species in the study area are the habitat generalist red-tailed hawk (*Buteo jamaicensis*) and great-horned owl (*Bubo virginianus*). Both species may be found foraging in most of the vegetative communities within the study area, particularly ponderosa pine, montane shrublands, piñon-juniper, semi-desert shrublands and grasslands, riparian woodlands, and agricultural areas. The study area also includes countless cliff faces and large trees that offer suitable nesting sites.

Piñon-juniper woodlands and ponderosa pine forests provide foraging and breeding habitat for the woodland dwelling Accipiter species: northern goshawk (*Accipiter gentilis*), Cooper's hawk (*A. cooperi*), and sharp-shinned hawk (*A. striatus*), as well as a variety of owl species such as flammulated owl (*Otus flammeolus*), northern pygmy owl (*Glaucidium californium*), and northern saw-whet owl (*Aegolius acadicus*).

Semi-desert grasslands and shrublands provide foraging habitat for a variety of raptors, including golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), and western screech owl. Cliffs adjacent to grassland and shrubland habitats provide nesting opportunities for golden eagles, ferruginous hawks, prairie falcons and American kestrels; while tree cavities provide nests for western screech owls. Golden eagles may also nest in large trees where cliffs are absent. Rough-legged hawks (*Buteo lagopus*) breed in northern latitudes but are common winter residents on SUIT lands where they forage in open habitats.

Riparian woodlands in the study area occur along the Animas, Florida, La Plata, and Los Piños rivers. These habitats provide potential foraging and nesting habitat for long-eared owl (*Asio otus*), Cooper's hawks, western screech owl (*Otus kennicottii*), northern saw-whet owl, and northern pygmy owl. Marshy habitat adjacent to riparian areas provide nest sites for northern harriers (*Circus cyaneus*) and short-eared owls (*Asio flammeus*).

Riparian habitats also attract raptors such as American peregrine falcon (*Falco perigrionus anatum*), which preys on shorebirds and waterfowl, and bald eagle and osprey (*Pandion haliaetus*), which prey primarily on fish. Peregrine falcons nest on tall, sheer cliff faces and ospreys nest in trees; both species generally nest near perennial water sources. Bald eagles occur on the Reservation primarily as migrants and winter residents; however, six historic bald eagle nests have been reported in or near the study area. Two nests occur in the vicinity of the La Plata River, and both have been reported active within the last five years (Michael Francis, Bureau of Reclamation, personal communication, 3/28/2007). Two bald eagle nests were also reported along the Los Piños River between Bayfield and Ignacio (CDOW, unpublished data); however, these records may have erroneously reported the nests as being occupied by bald eagles. Ground visits by SUIT DWRM personnel to both nests have not confirmed occupancy by bald eagles in recent years (S. Whiteman, SUIT DOW, personal communication, 3/12/2007). A fifth historic nest is located southeast of Allison, Colorado; this nest was occupied by nesting bald eagles in 2007 (Andy Holland, CDOW, personal communication, 4/18/2007). Finally, one new bald eagle nest was identified northwest of Ignacio on private land in 2006 (Steve. Whiteman, SUIT DWRM personal communication, 3/12/2007). In addition to nest locations, bald eagle winter roosting sites have been documented on the La Plata, Florida, Los Piños, and Piedra rivers (CDOW, unpublished data). According to the CDOW Natural Diversity Information System (NDIS), almost the entire study area lies within the designated winter range for bald eagles. Further, the La Plata, Animas, Florida, Los Piños, and Piedra drainages are defined as winter concentration areas.

#### Bald and Golden Eagle Protection Act

On August 8, 2007, the bald eagle was removed from the USFWS threatened and endangered species list; therefore, the species no longer warrants protection under the ESA. However, bald (and golden) eagles are protected under the MBTA and the BGEPA. The BGEPA provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds (16 USC 668).

### REPTILES

The study area provides potential habitat for a variety of reptilian species, particularly lizards and snakes. Probably the most abundant lizards are the sagebrush lizard (*Scleroporus graciosus*), collared lizard (*Crotaphytus collaris*), short horned lizard (*Phrynosoma douglasi)* eastern fence lizard (*Sceloporus undulatus*), and plateau-striped whiptail, each of which can occur in multiple vegetative communities throughout the study area. Tree lizards (*Urosaurus ornatus*) are also locally common wherever there are cliffs, canyons, talus slopes, or boulders. The most common snake species are the bullsnake (*Pituophis catenifer*), western terrestrial garter snake (*Thamnophis elegans*), and rattlesnake (*Crotalis viridis*), which are known to occur in almost every vegetative community type in the study area. Other common snake species may include striped whipsnake (*Masticophis taeniatus*), found in piñon-juniper, semi-desert shrublands, arroyos, and streams, and smooth green snake (*Liochlorophis vernalis*), which is found in moist montane habitats. In addition to lizards and snakes, one skink species, variable skink (*Eumeces multivirgatus gaigeae*), is also likely to occur in the study area.

### AMPHIBIANS

Study area wetlands, ponds, lakes, streams, and rivers provide potential breeding grounds for numerous amphibian species. Probably the most common amphibians in the study area are tiger salamander (*Ambystoma tigrinum*), which may occur in wetland or riparian habitats throughout almost all the vegetative communities in the study area, Woodhouse's toad (*Bufo woodhousei*), and western chorus frog (*Pseudacris triseriata*), both of which are widespread and common throughout their range. Other species that are known to occur or have historically occurred in the study area include New Mexico spadefoot (*Spea multiplicatus*), bullfrog (*Rana catesbeiana*), and northern leopard frog (*Rana pipiens*) (Al Spencer, personal communication, 3/27/2007).

## FISHERIES

Fisheries resources are found throughout the Reservation, except in the Mesa Mountains Management Unit (SUIT 2000). Major perennial rivers occurring in the study area include the Animas, Florida, La Plata, Piedra, Los Piños, and San Juan; however, only a small section each of the Piedra and San Juan rivers occurs in the study area. These water sources and their perennial tributaries provide habitat for a variety of lotic (i.e., rivers and streams) fisheries resources. In addition to perennial rivers and streams, the study area also includes several ephemeral streams, such as Basin and Rock Creeks, which receive seasonal use by fish species (SUIT 2000). Pastorius Reservoir, Mormon Reservoir, Scott's pond and other smaller ponds in the study area also provide habitat for lentic (i.e., lakes and ponds) fish species.

Native fish species occurring on the Reservation include bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), roundtail chub (*Gila robusta*), speckled dace (*Rhinichthys osculus)*, rainbow trout (*Oncorhynchus mykiss*), Snake River cutthroat trout (*O. clarki* ssp.), brown trout (*Salmo trutta*), mottled sculpin (*Cottus bairdi*), Kokanee salmon (*Oncorhynchus nerka*), white sucker (*Catostomus commersoni*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), red shiner (*Notropis lutrensis*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieui*), largemouth bass (*Micropterus salmoides)*, green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus),* white crappie (*Pomoxis annularis),* northern pike (*Esox lucius*), and yellow perch *(Perca flavescens*) (SUIT 2000). Fishing on the Tribal lands is regulated and enforced under authority of the SUIT through its Wildlife Conservation Code, Title 13. Fishing permits are available for free to SUIT members and for sale to non-members.

## THREATENED, ENDANGERED, AND SENSITIVE FAUNA SPECIES

### FEDERALLY LISTED AND CANDIDATE SPECIES

According to the USFWS, there are seven federally listed threatened, endangered, and candidate wildlife species with potential to occur on the Reservation. Federally threatened and endangered species are protected under the ESA of 1973, as amended. Federal candidate species are not protected under the ESA. Federally listed and candidate wildlife species are presented in Table 3-8 and have been analyzed in detail in the project BA, submitted to the USFWS in January of 2008.

Of the seven federally listed and candidate species with potential to occur on the Reservation, four have the potential to be affected by activities within the study area. These include southwestern willow flycatcher, yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Colorado pikeminnow, and razorback sucker.

#### Southwestern Willow Flycatcher

The southwestern willow flycatcher is a Neotropical migrant that winters in Central and South America and breeds in the southwestern U.S. Typical breeding habitat consists of relatively dense riparian vegetation along streams or other wetlands, near or adjacent to surface water or underlain by saturated soils (Sogge et al. 1997, USFWS 2002a). Historically, southwestern willow flycatchers nested in native riparian vegetation such as willows and boxelder. Following changes in vegetation patterns, flycatchers still nest in native vegetation where available, but they also nest in riparian exotics such as saltcedar and Russian olive (USFWS 2002a). Additionally, flycatchers are know to nest in irrigation-induced wetland areas in the Los Piños corridor (Steve Whiteman, personal communication 4/19/2007). Suitable habitat, as defined by the USFWS southwestern willow flycatcher recovery plan (USFWS 2002a) consists of mesic riparian shrub and tree communities 0.1 hectare (ha) or greater in size within floodplains large enough to accommodate riparian patches at least 10 meters (m) wide. Other sub species (*Empidonax traillii adastus*) of flycatchers are known in the study area and potentially a hybrid species of *adastus* and *extimus.* However, from a regulatory standpoint all species of southwestern willow flycatchers within the study area are treated as the *extimus* subspecies.

Suitable breeding and migratory habitat for southwestern willow flycatcher occurs on the Reservation along portions of the La Plata, Animas, Florida, Los Piños, Piedra and San Juan rivers. Annual surveys on the Reservation have identified six breeding territories (annual average) on the Los Piños River near Ignacio, Colorado (Steve Whiteman, SUIT DWRM, personal communication, 4/19/2007).

### Yellow-billed Cuckoo

Yellow-billed cuckoo is a Neotropical migratory bird that breeds throughout the U.S. The breeding range of the western populations historically occurred in southwest British Columbia, western Washington, northern Utah, central Colorado, and western Texas south to southern Baja California, Sinaloa, and Chihuahua in Mexico (Hughes 1999). Western populations declined sharply in the 20th century due to destruction of riparian habitat and pesticide use. Furthermore, this species appears to be extirpated from much of its range in the west including British Columbia, Washington, Oregon, and possibly Nevada (Hughes 1999). Cuckoos are generally found in open woodlands with dense, scrubby understory vegetation, and, in the southwest, associated with watercourses. Typical habitat in the west includes a cottonwood overstory with a dense understory of native (e.g., willow) or exotic (e.g., saltcedar) vegetation. Recent research has shown that 4.94 acres is the minimum patch size for yellow-billed cuckoos in the west. In general, only single cuckoos have been detected in patches as small as 2 ha; no breeding activity or nests have been documented (Halterman et al. 2005).

Potential migratory and breeding habitat for yellow-billed cuckoo in the study area may occur in patches along the Animas, Los Piños, Piedra, and San Juan rivers. In general, these river corridors provide marginal habitat for cuckoos at best, although there are patches of suitable stopover and breeding habitat (Chris Kloster, Wildlife Biologist, CDOW, personal communication, 4/2/2007). A single yellow-billed cuckoo was detected along the Piedra River within the last 10 years; however, this detection was outside of the study area (Steve Whiteman, SUIT DWRM, personal communication, 3/22/2007).

### Colorado Pikeminnow

The Colorado pikeminnow is North America's largest minnow species and can reach up to approximately 6 feet in length and weigh as much as 80 pounds (USFWS 2002b). This species prefers fast, muddy rivers with quiet backwaters, pools, deep runs, and eddies maintained by high spring flows (USFWS 2002b). They can tolerate a broad range of water temperatures from 95°F in the summer to 50°F in the winter. Pikeminnows migrate hundreds of kilometers to and from their spawning grounds. Spawning occurs after spring runoff in riffles with gravel or cobble substrates at water temperatures typically between 65°F and 73 °F. After hatching and emerging from the spawning substrate, pikeminnow larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows.

Colorado pikeminnow historically has occurred throughout the Colorado River system in Colorado, Wyoming, Utah, New Mexico, Arizona, Nevada, California, and Mexico. Presently, there are three wild populations that occur in the Green River, upper Colorado River, and San Juan River sub-basins (USFWS 2002b). The population in the San Juan River sub-basin is known to occur along the San Juan River from Shiprock, New Mexico, downstream to the Lake Powell inflow (USFWS 2002b). Recent population estimates for the three wild populations of Colorado pikeminnow ranged from approximately 6,600 to 8,900 adults; however, the estimate for the San Juan River population ranged between only 19 and 50 adults (USFWS 2002b). Although the wild San Juan River population is known to reproduce naturally, few age-0 fish have been collected (USFWS 2002b). Stocking efforts for Colorado pikeminnow are ongoing in the San Juan River as part of the USFWS San Juan River Basin Recovery Implementation Program (SJRBRIP).

Presently, potential habitat for Colorado pikeminnow in the study area exists only in the Animas River. Wild or stocked pikeminnows occurring in the San Juan River may migrate upstream and into the Animas River, which flows into the San Juan River at Farmington, New Mexico, approximately 27 miles south of the study area. To date, pikeminnows have not been identified in the Animas River within the study area (Steve Whiteman, SUIT DWRM personal communication, 4/2/2007). Pikeminnows would be precluded from migrating into the study area via the San Juan River and its tributaries east of the Animas River because of the presence of Navajo Dam, located approximately 13 miles south of the study area.

**Razorback Sucker**

Razorback sucker is one of North America's largest suckers and can reach approximately 3 feet in length and up to a weight of 11−13 pounds (USFWS 2002c). This species can be found in large rivers with depths ranging from 4 to 10 feet as well as some reservoirs. Habitat for razorback sucker varies seasonally, with deep runs, eddies, backwaters, and flooded off-channels utilized in spring, runs and shallow pools in summer, and low-velocity runs, pools, and eddies in winter (USFWS 2002c). Turbidity can range from clear to muddy, and substrate can range from mud to sand to gravel. This species may spawn in a variety of river or reservoir habitats, and young require nursery environments with quiet, warm, shallow waters (USFWS 2002c).

Historically, razorback suckers were widespread in warm-water reaches of large rivers within the Colorado River Basin, from Wyoming south to Mexico, east to Wyoming (USFWS 2002c). Presently, they are found in the Green River, upper Colorado River, and San Juan River sub-basins, the lower Colorado River between Lake Havasu and Davis Dam, reservoirs of Lake Mead and Lake Mohave, and small tributaries of the Gila River sub-basin; however, little to no recruitment has been occurring in many of these populations (USFWS 2002c). Currently, the largest population of razorback sucker in the Colorado River Basin is in Lake Mohave. The sucker population in the San Juan River sub-basin is known to occur along the San Juan River from Shiprock, New Mexico, downstream to the Lake Powell inflow (USWFS 2002c). While there have been only two records of wild razorback suckers documented in the San Juan River, hatchery-raised suckers were introduced in the 1990s and some have survived and reproduced in the wild (Ryden 2000 in USFWS 2002c). Recent stocking efforts are ongoing in the San Juan River as part of the SJRBRIP.

**Table 3-8. Potential USFWS Threatened, Endangered and Candidate, and State of Colorado Threatened and Endangered Wildlife Species in the Study Area**

| Species | Status[a] | Habitat Associations | Potential to Occur |
|---|---|---|---|
| Black-footed ferret (*Mustela nigripes*) | FE<br>SE | Open grasslands with large prairie dog colonies year-round. | Ferrets have been extirpated from most of their historic range. Very unlikely to occur. |
| Canada lynx (*Lynx canadensis*) | FT<br>SE | High elevation (>8,000 ft) mixed coniferous forests. | The study area includes only very small, isolated patches of mixed conifer. No potential to occur. |
| Southwestern willow flycatcher (*Empidonax traillii extimus*) | FE<br>SE | Dense, shrubby riparian habitats (e.g. willows, cottonwoods, tamarisk, Russian olive) in close proximity to surface water or saturated soil. | Potential habitat occurs along the Animas, La Plata, Los Piños, Piedra, and San Juan rivers. Breeding birds have been documented on the Los Piños River in the study area. |
| Mexican spotted owl (*Strix occidentalis lucida*) | FT<br>ST | Mature ponderosa pine or mixed conifer forests in canyon or cliff habitat. | Only small, isolated patches of mixed conifer and ponderosa pine occurs in the study area; these areas are absent of canyons/cliffs. No potential to occur. |
| Yellow-billed cuckoo (*Coccyzus americanus*) | FC | Riparian (cottonwood) gallery forests with dense understory vegetation. | Animas, Los Piños, Piedra, and San Juan river corridors offer some potential breeding habitat; however, no breeding records exist for La Plata or Archuleta Counties. Potential to occur. |
| Colorado pikeminnow (*Ptychocheilus lucius*) | FE<br>ST | Large rivers with strong currents, deep pools, eddies, and quiet backwaters. | Colorado pikeminnows could migrate into the Animas River from the stocked San Juan River population in New Mexico. No other study area rivers would be accessible. |
| Razorback sucker (*Xyrauchen texanus*) | FE<br>SE | Rivers with strong currents over sandy bottoms. | Razorback suckers could migrate into the Animas River from the stocked San Juan River population in New Mexico. No other study area rivers would be accessible. |

| Species | Status[a] | Habitat Associations | Potential to Occur |
|---|---|---|---|
| Kit fox (*Vulpes macrotis*) | SE | Sparsely vegetated saltbrush, shadscale, and greasewood shrublands. | Only small, isolated patches of salt desert or greasewood shrublands occur in the study area. Very unlikely to occur. |
| Wolverine (*Gulo gulo*) | SE | Large, remote tracts of boreal forest and alpine tundra habitat. | No tundra or boreal forest exists in the study area. No potential to occur. |
| River otter (*Lontra canadensis*) | ST | Riparian habitats with permanent water (min. flow 10 cfs) and abundant food resources (fish/crustaceans). May occur from semi-desert up to sub-alpine habitats. | Study area includes the following permanent rivers with potential food resources for otters: Animas, La Plata, Los Piños (confirmed sightings), Piedra, and San Juan (anecdotal sightings) rivers. |
| Boreal toad (*Bufo boreas boreas*) | SE | Springs, streams, ponds, and lakes in lodgepole pine and spruce-fir forests and alpine meadows. | No lodgepole pine, spruce-fir, or alpine meadow habitats occur in the study area. No potential to occur. |
| Bald eagle (*Haliaeetus leucocephalus*) | ST | Associated with aquatic habitats with forested shorelines or cliffs; nests in trees or on cliffs. | Study area river corridors offer potential nesting habitat; historic nests exists in the study area. Bald eagles are known to winter along study area rivers. |
| Burrowing owl (*Athene cunicularia*) | ST | Grassland habitats; highly associated with prairie dog towns. Uses underground burrows for nesting. | Study area includes some grassland habitats and prairie dog colonies are known to occur. |

[a] FE = Federally Endangered; FT = Federally Threatened; FC = Federal Candidate; SE = State Endangered; ST = State Threatened

Presently, potential habitat for razorback sucker in the study area exists only in the Animas River. Stocked suckers occurring in the San Juan River may migrate upstream and into the Animas River, which flows into the San Juan River at Farmington, New Mexico, approximately 27 miles south of the study area. To date, razorback suckers have not been identified in the Animas River within the study area (Steve Whiteman, SUIT DWRM personal communication, 4/2/2007). Suckers would be precluded from migrating into the study area via the San Juan River and its tributaries east of the Animas River because of the presence of Navajo Dam, located approximately 13 miles south of the study area.

**STATE LISTED THREATENED AND ENDANGERED SPECIES**

According to the CDOW, there are six state listed wildlife species, not already federally listed, that have potential to occur in Archuleta, La Plata, and Montezuma counties (Chris Kloster, CDOW, personal communication, 4/2/2007). These species, their habitat descriptions, and determination of their potential to occur in the study area are provided in Table 3-8. Although the potential for these species to occur is presented in this PEA, Colorado State species protection laws (Colorado Title 33/Article 2) are not applicable to Tribal lands. Of the six state listed species that are not already federally listed, three species, river otter (*Lontra canadensis*), bald eagle, and burrowing owl (*Athene cunicularia*), have potential to occur in the study area.

## 3.4 Geology, Minerals, and Soils

This section describes the geological resources that are present in the study area and includes discussions on the following: oil and gas resources, coal resources, sand and gravel, soils, and prime farmland. Information on geological resources from the 2002 FEIS is incorporated by reference.

### 3.4.1 Geology

Refer to Section 3.4.1.1 in the 2002 FEIS for a detailed discussion of physiography and topography, and stratigraphy in the study area. Refer to Section 3.4.1.2 in the FEIS for a discussion of tectonics and structural regime in the study area (USDI 2002a).

### 3.4.2 Minerals

This section summarizes and updates the information provided in the 2002 FEIS (USDI 2002a) concerning the following mineral resources on the Reservation: oil and gas resources, coal resources, and sand and gravel resources. These minerals are the basis for commercial industries such as natural gas drilling (including CBM production), coal mining, and sand and gravel quarrying. The Fruitland Formation contains coal and natural gas (of which methane is the primary component) as well as some mineable coal resources. Hydrocarbon resources also exist in several other formations, including the Dakota Sandstone, the Mesaverde Group, the Pictured Cliffs/Fruitland Sandstone, and to a lesser degree in the Molas Formation, Paradox Formation, and Mancos Shale. Sand and gravel resources are found in surficial deposits associated with fluvial sediments.

**OIL AND GAS RESOURCES**

Natural gas occurs in many of the geologic units in the study area, including the Dakota Sandstone, the Mesaverde Group, the Pictured Cliffs Sandstone, and the Fruitland Formation. Conventional natural gas production, a different process from CBM production, occurs throughout the Four Corners Platform and SJB. Within the SJB, conventional natural gas production is declining and CBM production is the predominant activity. The portion of the study area outside of the SJB, in the Four Corners Platform, primarily extracts oil and gas from the Molas Formation, the Paradox Formation, the Dakota Sandstone, and the Mancos Shale. Refer to Section 3.4.2.1 in the 2002 FEIS for further discussion of oil and gas resources including CBM production in the study area (USDI 2002a).

The SJB of Colorado and New Mexico is the largest gas field reserves in the United States (Energy Information Administration 2007). Map 3-7 (Appendix A) shows currently producing wells in La Plata County, Colorado. As of April 2008, La Plata County had approximately 2,917 active gas wells (COGCC 2008b). Table 3-9 provides the natural gas production for La Plata County from 1999-2007, and the percent change in production per year (COGCC 2008b). A large portion of production in the SJB is within the study area, in the Ignacio Blanco Field. As shown in Table 3-9, natural gas production in La Plata County is variable. Between 1999 and 2007, production peaked in 2003 at 473,838,077 MMcf and declined by an average of 3.7% per year in that time frame. Between 2006 and 2007, total natural gas production in the county declined 6.9% in La Plata County.

CBM production accounts for approximately 90% of total natural gas production in La Plata County. Table 3-10 displays total CBM water and natural gas production, and the percent of total CBM production between 1999 and 2007 (COGCC 2008b). Between 1999 and 2007, CBM production peaked in 2003 and has declined an average of 4.7% since 2003. Total water production corresponding peaked in 2003 and has shown a gradual declining trend (Table 3-10).

Natural gas seeps observed along the outcrop are composed primarily of methane with carbon dioxide and hydrogen sulfide (USDI 2002a). Additionally, methane seeps represent a loss of valuable gas resources. The relationship between CBM production and methane seeps is currently undergoing several studies. Refer to Section 3.5.1 and 3.5.2 for further discussion of methane levels in ground and surface waters.

### Table 3-9. Total Natural Gas Production in MMcf per month for La Plata County 1999-2006.

| Month | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|
| JANUARY | 34,940,565 | 36,287,530 | 37,466,459 | 37,704,262 | 40,731,653 | 40,543,062 | 39,489,588 | 38,125,594 | 35,956,550 |
| FEBRUARY | 38,505,221 | 34,079,744 | 33,880,606 | 35,195,383 | 36,869,871 | 37,751,924 | 35,433,840 | 34,683,626 | 30,857,170 |
| MARCH | 34,845,515 | 36,879,937 | 35,339,842 | 38,884,016 | 40,408,910 | 40,216,926 | 39,176,010 | 38,259,287 | 34,206,946 |
| APRIL | 32,718,731 | 33,573,188 | 35,038,685 | 35,317,852 | 37,899,045 | 38,487,752 | 37,427,997 | 36,284,087 | 31,426,651 |
| MAY | 34,215,333 | 36,150,653 | 34,854,475 | 38,301,285 | 39,179,651 | 39,729,215 | 39,270,548 | 37,561,026 | 33,421,442 |
| JUNE | 32,806,136 | 33,430,065 | 34,388,432 | 36,901,130 | 38,723,367 | 38,770,191 | 38,029,164 | 36,176,922 | 34,934,672 |
| JULY | 34,390,965 | 35,990,607 | 33,659,465 | 38,200,357 | 39,555,982 | 39,431,761 | 38,638,101 | 37,110,982 | 36,245,453 |
| AUGUST | 34,791,167 | 36,013,568 | 36,730,114 | 37,915,025 | 40,127,201 | 39,514,219 | 38,903,808 | 37,038,961 | 32,303,183 |
| SEPTEMBER | 33,450,687 | 35,645,004 | 35,875,932 | 37,633,787 | 39,429,730 | 37,684,072 | 37,507,249 | 33,678,519 | 34,953,347 |
| OCTOBER | 35,324,123 | 35,862,305 | 37,578,788 | 39,678,324 | 40,577,004 | 39,302,471 | 38,880,033 | 36,434,397 | 35,621,963 |
| NOVEMBER | 34,097,221 | 36,017,141 | 36,777,359 | 39,133,839 | 39,528,650 | 38,667,254 | 37,694,410 | 35,241,650 | 34,620,753 |
| DECEMBER | 35,753,833 | 37,436,372 | 37,710,922 | 40,353,686 | 40,807,013 | 39,784,330 | 37,913,046 | 36,535,347 | 32,413,441 |
| | | | | | | | | | |
| **Totals** | **415,839,497** | **427,366,114** | **429,301,079** | **455,218,946** | **473,838,077** | **469,883,177** | **458,363,794** | **437,130,398** | **406,961,571** |
| **Percent Change** | | **2.77%** | **0.45%** | **6.04%** | **4.09%** | **-0.83%** | **-2.45%** | **-4.63%** | **-6.90%** |

Source: Colorado Oil and Gas Conservation (COGCC) 2008b

**Table 3-10. La Plata County CBM Production in MMcf and the Percent of Total Natural Gas Production, 1999-2007.**

| Year | CBM Production | Total Water Production (Barrels) | Total Production | CBM Percent of Total |
|---|---|---|---|---|
| **1999** | 376,530,689 | 23,732,528 | 415,839,497 | 90.6 |
| **2000** | 386,320,172 | 24,215,578 | 427,366,114 | 90.4 |
| **2001** | 391,068,091 | 24,107,310 | 429,301,079 | 91.1 |
| **2002** | 419,531,251 | 24,810,628 | 455,218,946 | 92.2 |
| **2003** | 438,090,421 | 24,844,199 | 473,838,077 | 92.5 |
| **2004** | 427,244,909 | 24,652,578 | 469,883,177 | 90.9 |
| **2005** | 409,409,011 | 23,213,959 | 458,363,794 | 89.3 |
| **2006** | 388,749,890 | 24,104,430 | 437,130,398 | 88.9 |
| **2007** | 361,256,850 | 23,032,000 | 406,961,571 | 88.8 |

Source: Colorado Oil and Gas Conservation (COGCC) 2008b

## COAL RESOURCES

Refer to Section 3.4.2.2 in the 2002 FEIS for a general discussion of coal resources in the study area (USDI 2002a). There are extensive coal-bearing geologic units within the study area, however only a small portion of these, specifically the Fruitland and Menefee formations, are currently considered economically viable for mining.

According to geologic evidence, subsurface coal bed fires naturally occur in the Fruitland Formation. Three coal fires currently exist on the Reservation: the Northern Cinder Buttes and Southern Cinder Buttes fires (Township 32 North, Range 12 West), and the Bridge Timber Fire (Township 34 North, Range 11 West). The relationship between CBM development and coalbed fires is not well understood; however, there is a potential correlation. As described by the BLM, "…down-dip extraction of water could have a substantial effect by dewatering the shallow coals if the seams are hydraulically connected to the nearby producing gas wells" (BLM 1999). SUIT, with assistance from the Stanford Global Climate and Energy Project, currently monitors the fires and takes steps to minimize the potential for subsurface fires to spread to the surface. The vent well project was approved by Tribal Council in July 2008 and was implemented in December 2008.

## SAND AND GRAVEL

Surface sand and gravel mines exist on both Tribal and fee lands within the study area, primarily on terraces and alluvial floodplains. Sky Ute Sand and Gravel (SUSG) is a wholly owned enterprise of the SUIT established in 2001 which operates one extraction, mining, and wash plant on the Reservation near Weaselskin Bridge, south of Durango. Additionally, SUSG operates a batch plant west of Ignacio within the Reservation boundary.

Gosney and Sons operates a batch plant east of Ignacio within the Reservation boundary on fee land. SUSG and Gosney and Sons extract gravel, cobble, and sand which are used for construction and road building activities both on and off the Reservation.

### 3.4.3 Soils

The discussion of soils on the Reservation has been based on soil types and erosion potential of soils as defined by the Natural Resources Conservation Service (NRCS), and prime Farmland areas as defined by the USDA.

The soils in the study area are derived from regional sandstone and shale and consist of various types of loam. The north-central and western regions of the study area contain irrigated lands with soils classified as prime farmland. The erosion potential of the soils is classified by the NRCS and is dependent on several factors, including soil type, slope and vegetation.

**PRIME FARMLAND**

According to the NRCS, prime farmland soil, “has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management” (USDA 1993). The NRCS’s nationwide program identifies areas qualifying as ‘prime farmlands’ in order to facilitate protection of these soils and encourage productive and efficient farming. In the study area, prime farmland soils are dependent on reliable irrigation, and are found primarily between the Animas and Florida Rivers, as shown on Map 3-8 (Appendix A). Because the extent of prime farmland soils in the study area is dependent on irrigation, this classification could change with future development. Demographic data for La Plata County show that population in rural areas is increasing, while agriculture activity is decreasing (La Plata County 2001a).

The facilities associated with oil and gas development (well pads, roads, pipelines, ROWs) have disturbed areas of prime farmland. There are approximately 21,400 acres of prime farmland in the study area. Since 2002, under the 160-acre infill ROD, approximately 22 wells have been built on prime farmland areas resulting in 48 acres of long-term disturbance to prime farmland.

### 3.4.4 Erosion Potential

Erosion potential varies across the study area according to the combination of many factors. In general, the region has a mild semi-arid to sub-humid climate. Map 3-8 shows highly erodible soils within the study area (Appendix A). The gradient is slight on river terraces, floodplains and valley floors. Relatively rich, deep soils develop in these areas. Gently sloping areas, including mesas, foothills, and upland valleys have shallow to deep well drained soils. Steep slopes with shallow soils occur along escarpments.

Erosion potential of a soil is determined by several soil characteristics, including parent material, vegetation cover, soil chemistry and others. According to these factors, a rating on the Natural Resource Inventory Erodibility Index is calculated for each soil (USDA 2003). Based on this rating, a soil’s erosion potential is ranked from low to high. The higher erosion potential, the more work BMPs and design features must be done in order to conserve the soil resources.

Within the study area, the highest soil erosion potential occurs in the clay rich south-central to southwest region and on areas of very steep slopes. Current development (under the 160-acre infill ROD) has resulted in 25 wells being constructed on soils with a high erosion potential since 2002. The long-term disturbance from these wells is estimated to be 55 acres.

### 3.4.5 Paleontology

The BLM is charged with the management, protection, and use of paleontological resources on public lands under the FLPMA of 1976 and NEPA. These resources represent a fragile and nonrenewable scientific record of the history of life on earth. The geologic units that crop out across the Reservation are primarily Cretaceous to Tertiary in age with Quaternary alluvial deposits in the major drainages. The Cretaceous rocks consist of marine, marginal-marine, and coastal plain deposits. The Tertiary sedimentary rocks are mostly fluvial in origin. As a result of deposition during transgressive-regressive cycles of an epicontinental sea, many of these siltstones, sandstones, shales, and conglomeratic deposits are interbedded.

Limited paleontological resources have been discovered on the Reservation; however, several geologic formations may contain fossil resources. The type area of the Tiffanian, a North American Land Mammal Age, is located near the town of Tiffany in the eastern portion of the study area (USDI 2002a).

## 3.5 Water Resources

### 3.5.1 Groundwater

This section describes the groundwater resources that are present in the study area and discusses groundwater resources in the region, including studies pertaining to the hydrogeology of the SJB, the potential impacts of dewatering the Fruitland Formation due to CBM production, and the presence of methane in groundwater. Information on water resources from the 2002 FEIS is incorporated by reference.

**GROUNDWATER OCCURRENCE AND WATER QUALITY**

Many geologic units in the study area contain aquifers, some of which have a depth and water quality that makes them a viable water supply source. The principal aquifers in the study are the surface unconsolidated aquifers, Tertiary-age aquifers and the Cretaceous-age aquifers (including the Fruitland Formation). Table 3-14 of the 2002 FEIS describes in detail the hydrologic characteristics of each relevant geologic formation (USDI 2002a). The water quality and yield of these groundwater resources is variable across the study area, as described in the following sections. Map 3-9 (Appendix A) shows the locations of permitted water wells in the study area.

**UNCONSOLIDATED AQUIFERS**

*Quaternary-Age Aquifers* - Quaternary alluvial aquifers are found in the unconsolidated sediments on river terraces and floodplains in the study area. These shallow aquifers are directly recharged through bedrock groundwater discharge, precipitation, rivers, and/or irrigation. Wells in these aquifers generally have a good sustainable yield, though discharge rates [measured in gallons per minute (gpm)] vary widely with location. Within the study area, alluvial aquifers in the Animas, Florida and La Plata river valleys typically produce 1-10 gpm, Los Piños and Piedra river valleys typically yield 5-25 gpm, and the river-terrace aquifers typically yield less than 10 gpm (USDI 2002a). The groundwater quality of water wells in the study area varies depending on the aquifer and the well location in the aquifer. In some instances, there are high concentrations of total dissolved solids (TDS) and inorganic constituents, making the water non-potable. However, most of the alluvial and terrace groundwater, is of good quality due to direct connection with the river and short underground residence time.

## BEDROCK AQUIFERS

_Tertiary-Age Aquifers_ – Tertiary-age aquifers occur in the San Jose, Nacimiento and Animas formations, with the Animas Formation aquifer typically being the most productive source (USDI 2002a). These formations consist of sandstone and interbedded shales that are exposed at the ground surface or overlain by unconsolidated terrace deposits. When an aquifer subcrops beneath a terrace deposit, it is typically hydraulically connected to the terrace deposit. Precipitation provides only a small amount of recharge to these units because of low precipitation amounts, slow infiltration rates, and high run off rates. Infiltration of irrigation water and seepage from irrigation canals and ditches constitute the primary sources of recharge to Tertiary aquifers; areas without irrigation receive only minor recharge amounts from precipitation. As land use in the area shifts away from agriculture (and irrigation) to residential development (without irrigation or with inefficient irrigation), these aquifers may be depleted. The water quality of the Tertiary aquifers is generally good, though it varies across the region according to depth and local characteristics. The Animas Formation aquifer has the most potential for further groundwater development and water supply within the Reservation.

_Cretaceous-Age Aquifers_ - Many of the sandstone units within the Cretaceous period contain aquifers including, in ascending order, the Dakota Sandstone, the Mesaverde Group, and the Fruitland Formation-Pictured Cliffs Sandstone. However, these aquifers are generally too deep to provide an accessible water supply source. Due to an increased residence time, groundwater in the Cretaceous-age aquifers is generally characterized by high TDS concentrations which make the aquifers unsuitable as a water source (USDI 2002a).

## HYDROGEOLOGY OF THE FRUITLAND FORMATION

The coalbeds of the Fruitland Formation contain water. A fracture network, which is extensive in places, increases hydraulic conductivity and facilitates water production within the Fruitland Formation. However, due to the long residency period, depth, and geology, most of the water in the Fruitland Formation is not a viable domestic, livestock, or irrigation water supply. The limited area of the Fruitland Formation between the outcrop and the flexure (geologic fold) has a shorter residency period and therefore better water quality than the rest of the Fruitland aquifer. This water could provide usable groundwater supply (USDI 2002a). Outside of the study area, groundwater wells on or near the Fruitland outcrop (usually at depths of less than 500 feet) use this aquifer for irrigation and livestock water as well as for domestic water supply. The extent of the hydraulic connection of these near-outcrop groundwater wells with CBM wells is currently being studied.

There is no historic baseline data documenting surface water recharge from the Fruitland Formation previous to CBM development. However, studies have found that the water table of the Fruitland Formation has dropped by varying degrees due to dewatering associated with CBM production (S.S. Papadopulos & Associates inc. [SSPA] 2006a, USDI 2002a). The three western-most major rivers in the San Juan Basin (Animas, Florida, and Los Piños) cross the Fruitland outcrop north of the study area, and are more influenced by CBM wells in that region than by wells in the Reservation (USDI 2002a). Groundwater depletions from CBM development in the study area also impact surface water. See Section 3.5.2 for further discussion.

## PRODUCED WATER

The water that is in the Fruitland Formation is of relatively low quality and must be removed in order to produce CBM gas. The amount of water produced decreases over the lifespan of a CBM well and the lifespan of the field. The total cumulative amount of produced water for all CBM wells on the Reservation was approximately 34,648 bbls per day in 2007 (CG&A 2007, unpublished). The rate of water production of a specific well depends on many localized factors. Between 1984 and 1993, produced water production in the SJB in Colorado increased dramatically, peaking in 1993 at approximately 34 million bbls (4,300 acre feet). Since that time water production levels have declined to about 23 million bbls (3,000 acre feet) and remain fairly consistent (SSPA 2006a). The rate of water production from CBM wells will decrease over time in individual wells and across the Fruitland Formation.

## METHANE CONTAMINATION

Refer to Section 3.5.12 in the 2002 FEIS for a general discussion of methane concentration in the study area (USDI 2002a).

Since the first Fruitland Formation water wells were developed, the presence of methane in groundwater, as well as surface seeps, has been documented. Historical data shows that methane seeps occurred prior to CBM development. It is difficult to trace a methane seep to a specific source due to variations in the geology and hydrology of the Fruitland Formation. Methane can have a biogenic or thermogenic origin. Biogenic methane is produced from leach fields, landfills, and surficial decaying matter. Thermogenic methane is most likely related to oil and gas production, though it may also exist due to geologic conditions in the area. Methane gas is non-toxic; however, it poses an explosive hazard at certain concentrations within a confined area.

Results of a BLM-COGCC study (1995b) have shown that the Sunnyside and Bondad areas had methane contamination of groundwater related to CBM development. The origins of methane seeps in the Piedra River area, the southeast Durango area, and the Animas River area were ambiguous. The results for methane testing in the Ignacio and on the southern portion of Florida Mesa samples did not show CBM as a source. Some of the thermogenic sources detected in these groundwater wells are due to wells not constructed in a manner sufficient to prevent seepage of deep methane into shallower water supplies (BLM 1995b). Remediation of these wells helps to minimize the potential of creating a conduit for methane to contaminate other groundwater aquifers.

A Bradenhead Pressure Monitoring program is conducted on conventional and CBM wells on Tribal and private lands within the study area to help identify any possible cross-flow of gas between geologic formations via the well bore and is conducted by SUIT Environmental Protection Division (EPD) on a quarterly basis. Bradenhead testing is a measurement of the pressure between the surface casing and production casings. If the pressure exceeds the BLM thresholds (critical areas = 5 pound per squre inch [psi], non-critical areas = 25 psi), then the gas is sampled to determine what formation it came from. The well is inspected for leaks or cross-flow and naturally occurring gases are vented safely.

The SUIT has water quality protection recommendations for the oil and gas industry to follow regarding groundwater testing. These recommendations are being revised and proposed as regulations for adoption by SUIT. The proposed recommendations could include requirements similar to the existing COGCC rules for groundwater testing and monitoring by operators that propose to drill a CBM well within close proximity to existing groundwater wells. Within the study area, the SUIT Water Quality Program (WQP) conducts groundwater quality testing to ensure safe drinking water in all domestic wells of Tribal members. Indian Health Service (IHS) can request the SUIT WQP to complete analysis if there is a concern or one year after well driller has completed drilling and initial analysis. Also, IHS will on occasion request that WQP sample well because of health concerns.

The SUIT, in conjunction with the BLM, has identified surface methane seeps and has been monitoring them since 1993 in order to document changes or possible correlations to CBM activities or mitigation measures. The COGCC program, the *Preliminary Evaluation of Methane Seepage Mitigation Alternatives*, commonly referred to as the 4M study (LT Environmental, Inc. [LTE] 2006), involves several methods of monitoring methane concentrations including gas flux chambers (discontinued in 2006), detailed seep mapping, permanent monitoring probes, and natural spring surveys (LTE 2006). Infrared aerial photography is conducted on a three-year interval (last flight in June of 2008) to provide additional information for identifying and mapping seeps. Generally, methane seeps occur in topographical lows or in areas that are underlain by a conduit, such as major fracturing, in the Fruitland Formation. LTE findings from 2002 to 2006 have varied across the region, showing increased methane levels at some established seeps, while decreasing levels at others. The overall trend is a very minor increase in methane seeps, with no significant changes in the area of extent of methane seeps, nor any consistent change in subsurface methane levels (LTE 2008).

At this time, the COGCC is collaborating with public, industry and governmental entities to develop mitigation measures according to the 4M study that will be funded by mill levies (COGCC 2008a). In order to decrease methane seeps, reduce pollution and capture the valuable methane gas, the Southern Ute Growth Fund (SUGF) is currently attempting to capture methane escaping from vent wells along the outcrop for processing. The SUGF is converting 12 existing shallow vent wells along the outcrop into production wells. In theory, the gas that would escape as a seep would be captured by these vent wells near the outcrop, processed and sold. This would reduce methane pollution and public safety hazards related to the seeps. The effectiveness of this method in reducing methane seeps will be monitored throughout the project.

### 3.5.2 Surface Water

This section describes the surface water resources that are present in the study area (including discussions of surface water characteristics, quantity, and water quality) and is divided into the following sections: watershed characteristics, hydrology, surface water studies (including water quality within the study area), water quality in the San Juan River Basin, and studies concerning possible impacts of oil and gas development on surface water. Information on surface water resources from the 2002 FEIS is incorporated by reference.

#### WATERSHED CHARACTERISTICS

Refer to Section 3.5.12 in the 2002 FEIS for a general discussion of watershed characteristics within the study area (USDI 2002a).

The three major rivers in the study area are the La Plata, the Animas (including its major tributary, the Florida), and Los Piños. These rivers, along with Trail Canyon (an approximately 33-square-mile sub watershed on the Reservation), are tributaries to the

San Juan River (Map 3-9, Appendix A). The three main watersheds roughly cover equal areas of the study area and are fed by run-off from the mountains north of the Reservation, reservoirs, irrigation return flows, and precipitation. The characteristics for each of the main watersheds within the Reservation are summarized in Table 3-11.

**Table 3-11. Characteristics of Watersheds in the Study Area.**

| Watershed | Watershed Acreage in study area ($mi^2$) | Average Annual Streamflow (AF/yr)[a] | Reservoirs | Major Tributaries | Primary Water Uses |
|---|---|---|---|---|---|
| La Plata River | 257 | 25,200 at Stateline | Mormon Reservoir | Cherry Creek, Long Hollow, Hay Gulch | Residential wells, irrigation, stock, fish and wildlife |
| Animas River | 196 | 592,100 at Durango | Lemon Reservoir (via the Florida River) | Florida River | Residential wells, irrigation, municipal, industrial, recreation, fish and wildlife |
| Los Piños River | 181 | 81,200 at Ignacio | Vallecito Reservoir | Spring Creek | Residential wells, irrigation, municipal (Ignacio), recreation, fish and wildlife. |
| Trail Canyon | 33 | Not available | None | None | None |

Source: USGS 2008
[a] AF/yr = Acre feet per year

## HYDROLOGY

The streamflows of the La Plata, Animas and Los Piños rivers are monitored instantaneously by the USGS. The monthly average streamflows for these rivers, over the period of record, is summarized in Figure 3-15. According to the USGS data, the average annual streamflows – in acre feet per year (AF/yr) – on the rivers is as follows (USGS 2008):

- Animas at Durango: 593,100 AF/yr
- Florida at Bondad 55,200 AF/yr
- Los Piños near Ignacio: 70,000 AF/yr
- La Plata at the Stateline: 25,300 AF/yr

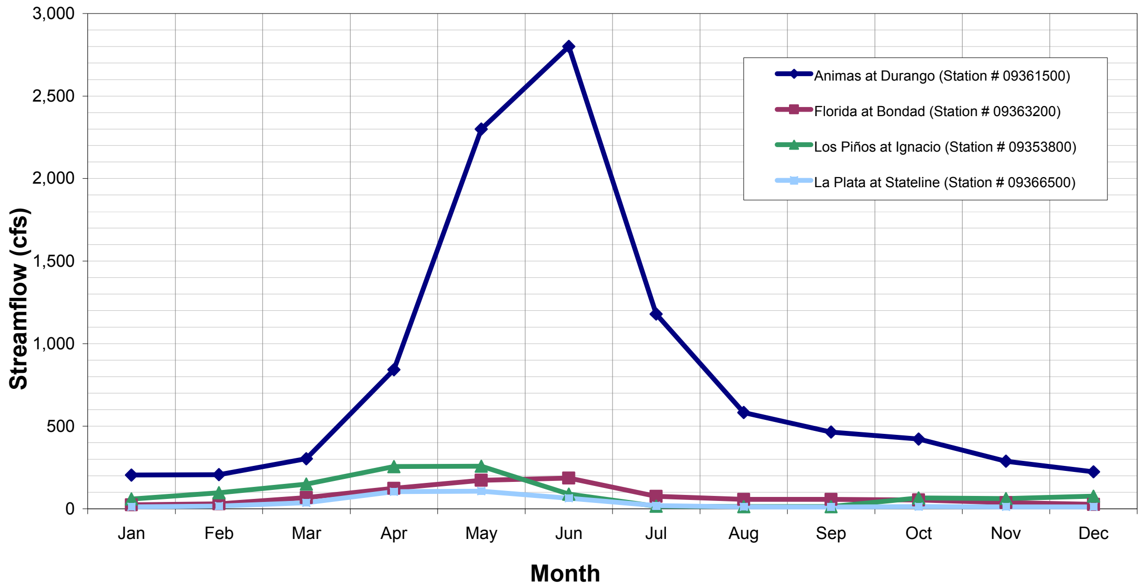



**Figure 3-15. Average Monthly Streamflows on the Animas, Florida, Los Piños, and La Plata Rivers (USGS 2008)**

Peak streamflows occur from May through June due to meltwater from the San Juan Mountains, and gradually decrease throughout the rest of the year (Figure 3-15).

## ANIMAS RIVER

The Animas River does not have any major dams, and is one of a small number of free-flowing rivers remaining in the southwest. The river is an important source of irrigation water which is diverted through the Animas valley and south. The unused portion of the water that is diverted for irrigation returns to the river as irrigation flows. The Animas La-Plata project (ALP) is being constructed in south Durango and will have an influence on the streamflows and water rights administration of the Animas River. This project is designed to pump up to 111,500 AF/year from the Animas River to the future Lake Nighthorse Reservoir. This water will meet municipal and industrial needs for sponsor entities, including SUIT, and is anticipated to begin pumping water in April 2009.

## FLORIDA AND, LOS PIÑOS RIVERS

Agricultural water diversions and return flows within and outside of the study area have a dramatic impact on streamflow in the Florida and Los Piños rivers. Approximately 204,500 acres (25%) of the Reservation is irrigated farmland. The streamflows in the Florida and Los Piños rivers are determined largely by upstream reservoir releases (Lemon Reservoir and Vallecito Reservoir, respectively). The operation and maintenance of these reservoirs is controlled by the Florida Water Conservancy District and the Pine River Irrigation District, respectively. Water is released from reservoirs during the irrigation season for downstream water users. SUIT has water rights in the Los Piños to irrigate approximately 22,000 acres of land. The Pine River Irrigation District, SUIT and Colorado Water Conservation Board are negotiating an agreement that would allow for releases of water from Vallecito Reservoir throughout the year to improve stream habitat as well as facilitate better management of spring runoff. The Los Piños River also serves as the municipal water source for the Town of Ignacio and the SUIT and receives discharge from the Town of Bayfield Waste Water Treatment Plant and the Ignacio Waste Water Treatment Plant. The SUIT operates the drinking water facility for Ignacio. The Town of Bayfield has had repeated violations of its wastewater treatment plant operational permit and the Town is currently planning to construct a new plant.

## SURFACE WATER QUALITY

According to the SUIT EPD, surface water quality in the study area is generally good, based on water quality standards set by the CDPHE and the SUIT Water Quality Program (Michiko Burns, SUIT EPD, personal communication, 5/24/2007). However, there is concern about potential impacts to water quality due to historical and current uses of the land within these watersheds, specifically mining, agriculture, municipal discharge, and oil and gas production. To address these concerns and monitor the health of the ecosystem, water quality data are collected by SUIT at several locations along the La Plata, Animas and Los Piños rivers and other surface waters on the Reservation. These data include measurements of total and dissolved metals, nutrients and macro invertebrates as well as field parameters of dissolved oxygen, conductivity, pH, temperature, and turbidity. This is input into the USEPA's water quality database, STORET (Michiko Burns, SUIT EPD, personal communication, 5/24/2007).

Table 3-12 summarizes historic metals water quality data and Table 3-13 summarizes nutrient water quality data from the Tribal EPD. Surface water quality in the study area is generally good, as indicated in these tables. According to the metals data, aluminum, iron, selenium, arsenic, manganese and zinc are most commonly detected in surface waters in the study area. Aluminum is one of the most abundant metals on earth and is common in many rocks and ore. The presence of aluminum in the study area likely is a result from the regional geology and from wash water of drinking water treatment plants. Aluminum is regulated by the USEPA as a non priority pollutant. Waters containing high concentrations of aluminum could become toxic to fish if the pH is lowered. Other than aluminum, there are few other Reservation or Colorado exceedances of metals in surface waters. Manganese is not considered to be a problem in fresh waters by the USEPA, and no exceedances to the Colorado or Reservation standards were recorded from 1992-2007 (Table 3-12).

Metals, such as copper and iron, may have elevated concentrations in surface waters as a result of mining activities (particularly abandoned tailings piles within the watershed). The Animas River Stakeholders Group (which includes municipal, federal, mining industry, SUIT, and volunteer organizations) is working to monitor and remediate many of the abandoned mine sites in the upper Animas River Basin, which are contributing metals to the watershed (Michiko Burns, SUIT EPD, personal communication, 5/24/2007). Metal concentrations tend to decrease downstream, as the metals settle out and the volume of water in the river increases (U.S. Bureau of Reclamation [BOR] 2000). Copper concentrations from water quality monitoring have historically exceeded the aquatic life standards in Colorado (Table 3-12).

Selenium, which naturally occurs in the SJB, has elevated concentrations in surface waters due to runoff from mining sites as well as leachate from agricultural irrigation. Water quality studies conducted for the ALP project found that selenium leaches from the soil profile quickly and concentrations reduce after several applications (BOR 2000). Selenium concentrations appear to increase across the Reservation as noted by the number of detections at sample locations (Table 3-12). Selenium was observed most frequently in the La Plata River at Long Hollow, with two exceedances of the State of Colorado and SUIT water quality standards out of 20 events.

Urban and fertilizer runoff, wastewater effluent, decaying plants and animals, watershed geology, and soils influence the TDS concentrations in surface waters. Concentrations of TDS may be increased in heavily irrigated areas along the La Plata and the Florida rivers. According to the Tribal EPD water quality data, TDS values are highest in the Animas River, with other high results occurring in the La Plata River near Long Hollow. The SUIT Water Quality Monitoring Program is monitoring non-point sources that are detrimental to water quality on Los Piños River. The program promotes new agricultural and irrigation practices to decrease impacts to water quality. The program also has begun monitoring water quality and benthic macro-invertebrates in select wetlands adjacent to the major rivers (Michiko Burns, SUIT EPD, personal communication, 5/24/2007).

Currently no surface waters within the study area are listed as impaired. The La Plata River is impaired for dissolved oxygen, sedimentation/siltation, and fecal coliform from McDermott Arroyo to the San Juan River primarily from animal feeding operations, drought, water diversions, loss of riparian habitat, rangeland grazing, onsite treatment systems (septic systems), and stream bank modifications. The San Juan River from the Animas River upstream to Largo Canyon is impaired for mercury in fish tissue, sedimentation/siltation and fecal coliform. The Animas River from the confluence with the San Juan upstream to Estes Arroyo is impaired for nutrients (eutrophication) and fecal coliform (Surface Water Quality Bureau [SWQB] 2005).

In 2002, there was an algal bloom in the Animas River due to a wastewater treatment facility discharge near the Reservation boundary. In response, the Animas River Nutrient Workgroup, which includes public, state, federal and Tribal entities, was established to monitor nutrient levels on the Animas. The workgroup also is developing plans to address non-point sources that contribute nutrients to the Animas River (Michiko Burns, SUIT EPD, personal communication, 5/24/2007).

The 2002 Missionary Ridge fire burned 72,000 acres, much of which was steep mountainous terrain. As a result, erosion and surface water runoff with high sediment loading continues to occur in the watersheds of the Animas, Florida and Los Piños rivers. The fire suppression slurry that was dumped in the area during the fire has contributed to high nutrient levels in surface water runoff. The Missionary Ridge fire has negatively impacted the water quality of the Animas, Florida and Los Piños rivers on the Reservation, according to preliminary findings by the EPD. In response, the SUIT EPD has established the Missionary Ridge Fire Assessment, a study administered by the Water Quality Monitoring Program. The monitoring program is in the process of analyzing the data collected to determine the impacts on surface water quality on the Reservation (Michiko Burns, SUIT EPD, 5/24/2007).

## Table 3-12. Number of Exceedances of Colorado State or SUIT Water Quality Standards for Trace Metal Concentrations (mg/L unless otherwise noted) (1992-2007).

| Location | Aluminum (Al) CO Standard Dissolved 0.087[1]; SUIT Standard Dissolved 0.087 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[(2)] | | Min Detected | | Max | | Mean[(3)] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedances (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 21 | 21 | 19 | 11 | 0.03 | 0.04 | 15.9 | 0.14 | 1.78 | 0.07 | 10 | 10 |
| Animas 2 (Twin Crossing) | 20 | 20 | 20 | 13 | 0.03 | 0.03 | 12.2 | 0.18 | 1.75 | 0.07 | 8 | 8 |
| Pine 1 (Bayfield) | 21 | 22 | 17 | 7 | 0.04 | 0.04 | 3.7 | 0.17 | 0.34 | 0.05 | 2 | 2 |
| Pine 2 (La Boca) | 20 | 19 | 19 | 13 | 0.07 | 0.03 | 2.93 | 0.38 | 1.32 | 0.09 | 6 | 6 |
| Florida 1 (CR 510) | 22 | 23 | 20 | 21 | 0.04 | 0.03 | 2.2 | 0.16 | 0.41 | 0.04 | 1 | 1 |
| Florida 2 (Salt Creek) | 21 | 21 | 19 | 7 | 0.03 | 0.03 | 3.9 | 0.16 | 0.61 | 0.04 | 2 | 2 |
| La Plata 1 (Breen) | 19 | 20 | 7 | 3 | 0.03 | 0.03 | 0.12 | 0.14 | 0.05 | 0.04 | 1 | 1 |
| La Plata 2 (Long Hollow) | 17 | 18 | 14 | 5 | 0.03 | 0.03 | 3.74 | 0.06 | 0.46 | 0.04 | 0 | 0 |

| Location | Cadmium (Cd) CO Standard Dissolved 0.0006; SUIT Standard Dissolved 0.0002 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[(2)] | | Min Detected | | Max | | Mean[(3)] | | Number of CO Exceedances (Diss) | Number of SUIT Exceedances (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 40 | 22 | 1 | 0 | 0.01 | <0.005 | 0.01 | <0.005 | 0.002 | 0.002 | 0 | 0 |
| Animas 2 (Twin Crossing) | 34 | 22 | 1 | 0 | <0.004 | <0.005 | 0.004 | <0.005 | 0.002 | 0.002 | 0 | 0 |
| Pine 1 (Bayfield) | 37 | 24 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.003 | 0.002 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.002 | 0.002 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.002 | 0.002 | 0 | 0 |
| Florida 2 (Salt Creek) | 40 | 22 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.002 | 0.002 | 0 | 0 |
| La Plata 1 (Breen) | 33 | 21 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.002 | 0.002 | 0 | 4 |
| La Plata 2 (Long Hollow) | 38 | 20 | 1 | 1 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 1 | 1 |

| Location | Copper (Cu) CO Standard Dissolved 0.016; SUIT Standard Dissolved 0.021 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedances (Diss) | Number of SUIT Exceedances (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 22 | 8 | 1 | 0.02 | 0.04 | 0.04 | 0.04 | 0.01 | 0.01 | 2 | 1 |
| Animas 2 (Twin Crossing) | 31 | 19 | 3 | 1 | 0.02 | 0.04 | 0.03 | 0.04 | 0.01 | 0.01 | 1 | 1 |
| Pine 1 (Bayfield) | 36 | 23 | 2 | 1 | 0.007 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 | 1 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 2 | 1 | 0.007 | 0.03 | 0.01 | 0.03 | 0.01 | 0.01 | 1 | 1 |
| Florida 1 (CR 510) | 33 | 23 | 2 | 2 | 0.007 | 0.02 | 0.01 | 0.04 | 0.01 | 0.01 | 2 | 1 |
| Florida 2 (Salt Creek) | 39 | 21 | 1 | 1 | 0.05 | 0.04 | 0.05 | 0.04 | 0.01 | 0.01 | 1 | 1 |
| La Plata 1 (Breen) | 33 | 21 | 4 | 1 | 0.01 | 0.03 | 0.03 | 0.03 | 0.01 | 0.01 | 2 | 1 |
| La Plata 2 (Long Hollow) | 38 | 20 | 5 | 1 | 0.01 | 0.05 | 0.03 | 0.05 | 0.01 | 0.01 | 1 | 1 |

| Location | Lead (Pb) CO Standard Dissolved 0.002; SUIT Standard Dissolved 0.008 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedances (Diss) | Number of SUIT Exceedances (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 21 | 3 | 0 | 0.03 | <0.04 | 0.08 | <0.04 | 0.02 | 0.02 | 0 | 0 |
| Animas 2 (Twin Crossing) | 33 | 21 | 2 | 0 | 0.03 | <0.04 | 0.05 | <0.04 | 0.02 | 0.01 | 0 | 0 |
| Pine 1 (Bayfield) | 36 | 23 | 1 | 0 | 0.009 | <0.04 | 0.009 | <0.04 | 0.01 | 0.03 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 4 | 0 | 0.004 | <0.04 | 0.06 | <0.04 | 0.02 | 0.02 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 1 | 0 | 0.008 | <0.04 | 0.008 | <0.04 | 0.01 | 0.02 | 0 | 0 |
| Florida 2 (Salt Creek) | 38 | 21 | 2 | 1 | 0.02 | 0.02 | 0.31 | 0.02 | 0.01 | 0.02 | 1 | 1 |
| La Plata 1 (Breen) | 33 | 21 | 0 | 0 | <0.04 | <0.04 | <0.04 | <0.04 | 0.02 | 0.02 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 0 | 0 | <0.04 | <0.04 | <0.04 | <0.04 | 0.01 | 0.02 | 0 | 0 |

| Location | Mercury (Hg) CO Standard Total Recoverable 0.00001; SUIT Standard Dissolved 0.000012 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Trec) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 38 | 22 | 1 | 1 | 0.0006 | 0.0003 | 0.0006 | 0.0003 | 0.0002 | 0.0002 | 1 | 1 |
| Animas 2 (Twin Crossing) | 32 | 20 | 1 | 0 | 0.0004 | <0.001 | 0.0004 | <0.001 | 0.0001 | 0.0001 | 1 | 0 |
| Pine 1 (Bayfield) | 36 | 23 | 1 | 0 | 0.0002 | <0.001 | 0.0002 | <0.001 | 0.0001 | 0.0001 | 1 | 0 |
| Pine 2 (La Boca) | 37 | 18 | 0 | 0 | <0.001 | <0.001 | <0.001 | <0.001 | 0.0001 | 0.0001 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 1 | 0 | 0.0002 | <0.001 | 0.0002 | <0.001 | 0.0002 | 0.0002 | 1 | 0 |
| Florida 2 (Salt Creek) | 36 | 18 | 0 | 0 | <0.001 | <0.001 | <0.001 | <0.001 | 0.0001 | 0.0002 | 0 | 0 |
| La Plata 1 (Breen) | 33 | 21 | 0 | 1 | <0.001 | 0.0003 | <0.001 | 0.0003 | 0.0002 | 0.0002 | 0 | 1 |
| La Plata 2 (Long Hollow) | 38 | 20 | 2 | 0 | 0.0003 | <0.001 | 0.0003 | <0.001 | 0.0001 | 0.0002 | 1 | 0 |

| Location | Selenium (Se) CO Standard Dissolved 0.0046; SUIT Standard Dissolved 0.005 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 22 | 1 | 1 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0009 | 0.0011 | 0 | 0 |
| Animas 2 (Twin Crossing) | 32 | 20 | 5 | 1 | 0.0003 | 0.0003 | 0.003 | 0.0003 | 0.001 | 0.001 | 0 | 0 |
| Pine 1 (Bayfield) | 36 | 23 | 1 | 1 | 0.005 | 0.005 | 0.005 | 0.005 | 0.0011 | 0.0013 | 1 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 4 | 1 | 0.0005 | 0.0005 | 0.004 | 0.0005 | 0.001 | 0.001 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 1 | 1 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0009 | 0.001 | 0 | 0 |
| Florida 2 (Salt Creek) | 39 | 21 | 8 | 2 | 0.0004 | 0.0005 | 0.002 | 0.005 | 0.001 | 0.0011 | 1 | 0 |
| La Plata 1 (Breen) | 33 | 21 | 1 | 1 | 0.001 | 0.0002 | 0.001 | 0.0002 | 0.0009 | 0.0011 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 13 | 7 | 0.0002 | 0.0002 | 0.007 | 0.006 | 0.0014 | 0.0016 | 2 | 2 |

| Location | Zinc (Zn) CO Standard Dissolved 0.224; SUIT Standard Dissolved 0.191) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 21 | 39 | 17 | 0.02 | 0.02 | 0.18 | 0.07 | 0.07 | 0.03 | 0 | 0 |
| Animas 2 (Twin Crossing) | 32 | 20 | 31 | 12 | 0.02 | 0.01 | 0.22 | 0.07 | 0.06 | 0.02 | 0 | 0 |
| Pine 1 (Bayfield) | 35 | 22 | 13 | 4 | 0.01 | 0.006 | 0.53 | 0.14 | 0.03 | 0.01 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 17 | 4 | 0.01 | 0.007 | 0.45 | 0.03 | 0.03 | 0.01 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 21 | 12 | 6 | 0.01 | 0.009 | 0.84 | 0.04 | 0.04 | 0.01 | 0 | 0 |
| Florida 2 (Salt Creek) | 39 | 21 | 19 | 5 | 0.01 | 0.01 | 0.47 | 0.05 | 0.03 | 0.01 | 0 | 0 |
| La Plata 1 (Breen) | 33 | 20 | 13 | 6 | 0.01 | 0.007 | 0.05 | 0.02 | 0.01 | 0.01 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 19 | 15 | 2 | 0.01 | 0.01 | 0.06 | 0.05 | 0.01 | 0.01 | 0 | 0 |

| Location | Arsenic (As) CO Standard Total Recoverable 0.00002; SUIT Standard Dissolved 0.15 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 21 | 9 | 2 | 0.0006 | 0.0007 | 0.009 | 0.0009 | 0.0012 | 0.0009 | 9 T rec | 0 |
| Animas 2 (Twin Crossing) | 34 | 21 | 6 | 2 | 0.0006 | 0.0006 | 0.007 | 0.0007 | 0.0005 | 0.0001 | 6 T rec | 0 |
| Pine 1 (Bayfield) | 38 | 25 | 2 | 2 | 0.001 | 0.001 | 0.001 | 0.001 | 0.0014 | 0.0019 | 2 T rec | 0 |
| Pine 2 (La Boca) | 38 | 20 | 9 | 3 | 0.0009 | 0.0008 | 0.002 | 0.001 | 0.0014 | 0.0019 | 9 T rec | 0 |
| Florida 1 (CR 510) | 33 | 22 | 0 | 0 | <0.005 | <0.005 | <0.005 | <0.005 | 0.0008 | 0.0009 | 0 T rec | 0 |
| Florida 2 (Salt Creek) | 40 | 22 | 9 | 5 | 0.0006 | 0.0007 | 0.002 | 0.001 | 0.0008 | 0.0009 | 9 Trec | 0 |
| La Plata 1 (Breen) | 33 | 21 | 12 | 3 | 0.0007 | 0.0008 | 0.012 | 0.0012 | 0.0015 | 0.0011 | 0 Diss | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 16 | 5 | 0.0008 | 0.001 | 0.006 | 0.005 | 0.0012 | 0.0012 | 0 Diss | 0 |

| Location | Chromium (Cr) CO Standard Dissloved 0.1308; SUIT Standard Dissolved 0.3652) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 22 | 2 | 1 | 0.0002 | 0.0002 | 0.0007 | 0.0002 | 0.0064 | 0.0051 | 0 | 0 |
| Animas 2 (Twin Crossing) | 32 | 20 | 2 | 2 | 0.0005 | 0.0009 | 0.02 | 0.001 | 0.0053 | 0.0045 | 0 | 0 |
| Pine 1 (Bayfield) | 35 | 23 | 3 | 1 | 0.0003 | 0.0003 | 0.0009 | 0.0003 | 0.0053 | 0.0055 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 4 | 0 | 0.0002 | <0.01 | 0.0006 | <0.01 | 0.005 | 0.0049 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 2 | 1 | 0.0002 | 0.0002 | 0.0003 | 0.0002 | 0.0058 | 0.0062 | 0 | 0 |
| Florida 2 (Salt Creek) | 39 | 21 | 3 | 0 | 0.0002 | <0.01 | 0.0003 | 0.0001 | 0.005 | 0.0058 | 0 | 0 |
| La Plata 1 (Breen) | 33 | 21 | 2 | 1 | 0.0002 | 0.0002 | 0.03 | 0.0002 | 0.0065 | 0.0062 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 6 | 0 | 0.0003 | <0.01 | 0.033 | <0.01 | 0.006 | 0.0053 | 0 | 0 |

| Location | Iron (Fe) CO Standard Dissolved 0.3; SUIT Standard Dissolved 1.0 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 40 | 21 | 38 | 14 | 0.04 | 0.02 | 23.6 | 0.2 | 1.5 | 0.07 | 0 | 0 |
| Animas 2 (Twin Crossing) | 33 | 19 | 33 | 11 | 0.08 | 0.03 | 22 | 0.12 | 1.68 | 0.06 | 0 | 0 |
| Pine 1 (Bayfield) | 38 | 22 | 38 | 14 | 0.07 | 0.02 | 2.2 | 0.09 | 0.25 | 0.04 | 0 | 0 |
| Pine 2 (La Boca) | 40 | 21 | 40 | 17 | 0.16 | 0.03 | 4.26 | 0.55 | 1.15 | 0.09 | 1 | 0 |
| Florida 1 (CR 510) | 34 | 21 | 33 | 13 | 0.02 | 0.01 | 1.95 | 0.07 | 0.27 | 0.03 | 0 | 0 |
| Florida 2 (Salt Creek) | 40 | 21 | 40 | 15 | 0.03 | 0.02 | 3.33 | 0.15 | 0.41 | 0.04 | 0 | 0 |
| La Plata 1 (Breen) | 34 | 21 | 32 | 14 | 0.03 | 0.01 | 1.83 | 0.21 | 0.24 | 0.04 | 0 | 0 |
| La Plata 2 (Long Hollow) | 39 | 19 | 38 | 14 | 0.04 | 0.02 | 14 | 0.14 | 1 | 0.04 | 0 | 0 |

| Location | Manganese (Mn) CO Standard Dissolved 2.078; SUIT Standard Dissolved 1.0 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 21 | 22 | 19 | 18 | 0.019 | 0.009 | 0.284 | 0.142 | 0.112 | 0.053 | 0 | 0 |
| Animas 2 (Twin Crossing) | 19 | 20 | 19 | 18 | 0.035 | 0.004 | 0.37 | 0.124 | 0.125 | 0.036 | 0 | 0 |
| Pine 1 (Bayfield) | 24 | 23 | 24 | 16 | 0.019 | 0.005 | 0.31 | 0.051 | 0.056 | 0.017 | 0 | 0 |
| Pine 2 (La Boca) | 21 | 20 | 21 | 14 | 0.032 | 0.006 | 0.154 | 0.084 | 0.079 | 0.02 | 0 | 0 |
| Florida 1 (CR 510) | 22 | 21 | 19 | 14 | 0.01 | 0.005 | 0.15 | 0.036 | 0.048 | 0.016 | 0 | 0 |
| Florida 2 (Salt Creek) | 21 | 22 | 21 | 17 | 0.015 | 0.005 | 0.164 | 0.13 | 0.072 | 0.025 | 0 | 0 |
| La Plata 1 (Breen) | 22 | 23 | 18 | 19 | 0.009 | 0.009 | 0.376 | 0.28 | 0.065 | 0.045 | 0 | 0 |
| La Plata 2 (Long Hollow) | 20 | 21 | 20 | 20 | 0.017 | 0.006 | 0.539 | 0.212 | 0.1 | 0.056 | 0 | 0 |

| Location | Nickel (Ni) CO Standard Dissolved 0.093; SUIT Standard Dissolved 0.283 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[2] | | Min Detected | | Max | | Mean[3] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 22 | 2 | 0 | 0.02 | <0.01 | 0.03 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| Animas 2 (Twin Crossing) | 32 | 21 | 1 | 0 | 0.03 | <0.01 | 0.03 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| Pine 1 (Bayfield) | 36 | 23 | 0 | 0 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 1 | 0 | 0.02 | <0.01 | 0.02 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| Florida 1 (CR 510) | 33 | 22 | 0 | 0 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| Florida 2 (Salt Creek) | 39 | 21 | 0 | 0 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| La Plata 1 (Breen) | 33 | 21 | 0 | 0 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 5 | 5 | 0.001 | 0.001 | 0.05 | 0.05 | 0.01 | 0.01 | 0 | 0 |

| Location | Silver (Ag) CO Standard Dissolved 0.001; SUIT Standard Dissolved 0.0001 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Events | | Detections[a] | | Min Detected | | Max | | Mean[b] | | Number of CO Exceedences (Diss) | Number of SUIT Exceedences (Diss) |
| | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | T Rec | Diss | | |
| Animas 1 (Basin Creek) | 39 | 22 | 1 | 0 | 0.09 | <0.01 | 0.09 | <0.01 | 0.01 | 0 | 0 | 0 |
| Animas 2 (Twin Crossing) | 32 | 20 | 0 | 0 | ≤0.01 | <0.01 | <0.01 | <0.01 | 0 | 0 | 0 | 0 |
| Pine 1 (Bayfield) | 36 | 39 | 3 | 0 | 0.002 | <0.01 | 0.08 | <0.01 | 0.01 | 0 | 0 | 0 |
| Pine 2 (La Boca) | 38 | 20 | 2 | 1 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0 | 1 | 1 |
| Florida 1 (CR 510) | 33 | 22 | 2 | 0 | 0.002 | <0.01 | 0.006 | <0.01 | 0 | 0 | 0 | 0 |
| Florida 2 (Salt Creek) | 39 | 21 | 3 | 1 | 0.01 | 0.03 | 0.03 | 0.03 | 0.01 | 0.01 | 1 | 1 |
| La Plata 1 (Breen) | 33 | 21 | 2 | 0 | 0.005 | <0.01 | 0.005 | <0.01 | 0.01 | 0.01 | 0 | 0 |
| La Plata 2 (Long Hollow) | 38 | 20 | 1 | 1 | 0.02 | 0.03 | 0.03 | 0.03 | 0.01 | 0.01 | 1 | 1 |

Sources: Data provided by SUIT EPD for the period of record from May 12, 1992, to August 28, 2006.

CO standards compiled from CDPHE Water Quality Control Commission, 5 CCR 1002-34, Regulation No. 34, Classification and Numeric Standard for the San Juan and Dolores River basins, effective July 1, 2007. SUIT standards compiled from the Water Quality Standards for the Southern Ute Reservation Report Revised October 1997 prepared by the SUIT Water Quality Department. All standards are chronic standards. For the following metals requiring a table value standard equation, a hardness of 200 was used in the equation: Cd, Cu, Pb, Mn, Ni, Se, Ag, and Zn. Dissolved values often do not have the same period of record as total recoverable. All standards are for aquatic life. Detection limits have changed throughout the period of record (1992). Detection limits were occasionally higher than standards. Number of exceedances may subsequently be higher than noted.

Notes: ND = Not Detected; T Rec = Total Recoverable; Diss = Dissolved; mg/L – milligrams per liter

[a] Number of events with concentrations above Method Detection Limits.

[b] Mean calculated using one-half of the value of the Method Detection Limit where analyte not detected. Therefore, in some cases where there are many non-detects, the mean will be lower than the minimum.

QA/QC of data by SUIT EPD.

**Table 3-13. Historic SUIT Nutrient Water Quality Data (1992 – 2007).**

| Location | Temp C Mean | pH (s.u.) Mean | Dissolved Oxygen (mg/L) Mean | TDS (mg/L) Mean | TSS (mg/L) Mean | Total Ammonia (mg/L) Mean | Nitrates (mg/L) Mean |
|---|---|---|---|---|---|---|---|
| Animas 1 (Basin Creek) | 11.7 | 8.3 | 10.6 | 338 | 55 | 0.07 | 0.3 |
| Animas 2 (Twin Crossing) | 10.9 | 8.2 | 10.8 | 339 | 54 | 0.05 | 0.3 |
| Pine 1 (Bayfield) | 10.1 | 8.0 | 10.1 | 82 | 17 | 0.08 | 0.2 |
| Pine 2 (La Boca) | 11.3 | 8.1 | 10.3 | 149 | 35 | 0.03 | 0.8 |
| Florida 1 (CR 510) | 10.2 | 8.2 | 10.2 | 215 | 8 | 0.02 | 0.2 |
| Florida 2 (Salt Creek) | 11.5 | 8.2 | 9.5 | 214 | 11 | 0.03 | 0.3 |
| La Plata 1 (Breen) | 8.7 | 7.9 | 9.3 | 190 | 6 | 0.06 | 0.1 |
| La Plata 2 (Long Hollow) | 12.1 | 8.2 | 9.9 | 883 | 23 | 0.04 | 0.3 |

Source: SUIT EDP
Notes: C = Degrees Celsius
s.u. = Standard Unit
mg/L = milligrams per liter
TDS = Total dissolved solids
TSS = Total suspended solids

## WATER QUALITY STUDIES WITHIN THE SAN JUAN RIVER BASIN

The University of New Mexico (UNM) conducted a comprehensive study on the San Juan River Basin in 1990 which included the water quality investigation of the La Plata, Animas and Los Piños rivers. Conclusions of the study discussed the possibility of surface and groundwater contamination from leaks, runoff, or inadequate treatment/disposal of produced water (UNM 1994). Further findings disclosed that improved technology, as well as compliance with construction and production codes, would decrease the chances of these potential forms of contamination. The UNM study also raised concern over the elevated levels of polycyclic aromatic hydrocarbons (PAHs) found in SJB river fisheries. Oil and gas production was cited as one of the possible sources of this contamination; as a result the BLM performed a study to investigate any possible correlations. This study concluded that the oil and gas program was not contributing PAHs to surface water runoff (Odell 1997).

## SURFACE WATER DEPLETIONS

Within the study area, there is hydraulic communication between surface water and Tertiary-age shallow groundwater aquifers. These aquifers are isolated from the Fruitland Formation by the intermediate Kirtland Shale, a relatively impermeable aquitard. The Fruitland Formation produces springs at some locations at the outcrop and, according to studies, historically discharged water into rivers where they cross the outcrop (Cox et al. 2001).

Surface water depletions due to CBM wells can occur in two ways. Surface water from streams can infiltrate into the Fruitland outcrop or discharge from the outcrop to surface water can be captured. The infiltration of surface water into the Fruitland Formation is limited because the effective permeability to water is dramatically reduced due to the presence of methane in the Fruitland Formation (Cox et al. 2001, SSPA 2006a).

The current CBM water production rate in the Colorado portion of the SJB is approximately 3,000 AF/yr. The Fruitland Formation water production rate from CBM development is not directly correlated to the amount of stream depletion. The majority of the stream depletions occur from CBM activities north of the study area, in locations that have higher hydraulic connection to the points where the Animas, Florida and Los Piños rivers cross the Fruitland outcrop (Map 3-9, Appendix A).

In 2000, the 3M CBM Model was developed for the SUIT, COGCC, and BLM (Questa Engineering Corporation [Questa] 2000). The purpose of this study was to develop an understanding of the relationship between methane seepage at the outcrop and CBM development within the basin. The study did not address potential surface water depletions. However, the model calculated that approximately 194 AF/yr of groundwater was discharging from the outcrop of the Fruitland Formation and the underlying Pictured Cliffs Sandstone into surface water and shallow groundwater systems prior to CBM development.

Findings from the 3M study were utilized as background information for the S*an Juan Basin Ground Water Modeling Study: Ground Water – Surface Water Interactions Between Fruitland Coalbed Methane Development and Rivers.* (Cox et al. 2001, Questa 2000). This study conservatively estimated depletions to surface water in rivers due to Fruitland Formation dewatering (Cox et. al. 2001). According to the Cox study, maximum surface water depletions associated with full-field CBM development (at 160-acre well spacing) are predicted to be 140 AF/yr for the Animas, Los Piños and Florida rivers combined. Incremental depletions to the Animas, Florida and Los Piños rivers that resulted from downspacing from the existing conditions, which were essentially equivalent to 320-acre spacing, to 160-acre in the northern basin (which excludes development on the Reservation) were found to be small (7 AF/yr), which represents an increase in depletions of 5% (Cox et al. 2001).

The *Coalbed Methane Stream Depletions Assessment Study – Northern San Juan Basin* was jointly sponsored by the Colorado Division of Water Resources, the Colorado Geological Survey, and COGCC in 2006 (SSPA 2006a). The findings of the SSPA study show that development within 1.5 miles of the outcrop has a more immediate and dramatic affect on depleting surface water flows within the Animas, Florida and Los Piños river basins, while CBM-associated groundwater production farther from the outcrop has a more tempered effect. CBM wells on the Reservation likely have a more tempered effect on surface water depletions due to their distance from the eastern half of the study area including where the major rivers cross the Fruitland outcrop.

The SSPA stream depletion analysis, based on production history from 1,686 CBM wells, was conducted to calculate current and future depletions due to the dewatering of the Fruitland Formation by CBM production. According to the SSPA model, basin-wide surface water depletions in the Colorado portion of the SJB for wells that were operational in 2005 in the Animas, Florida, Los Piños and Piedra rivers were calculated to be 164 AF/yr in 2020 (SSPA 2006a).

SSPA calculated future depletions under a full development scenario. Full development is defined in the SSPA study as 160-acre spacing in the northern basin outside of the Reservation, and either 320- or 80-acre CBM well spacing within the Reservation (SSPA 2006a). Under the full development condition, wells on SUIR that had 320-acre spacing in 2005 were not down spaced to 80-acres; wells with 160-acre spacing in 2005 were down spaced to 80-acres.

Maximum depletions for the full development scenario were calculated to be 500 AF/yr in year 2025. If no wells are drilled within 1.5 miles of the Fruitland outcrop, maximum depletions would be reduced to 170 AF/yr and would occur in 2035. Hence, a 330 AF/yr increase in depletion occurs if future wells are drilled near the outcrop (SSPA 2006a).

Surface water depletions due to CBM wells can occur in two ways. Water that currently discharges from the Fruitland outcrop to streams can be reduced due to CBM well pumping. The Cox model estimated that pre-development discharge to surface waters in the SJB was 145 AF/yr (Cox et al. 2001). Depletions may also occur at locations where streams flow over the Fruitland Formation when surface water and associated alluvial groundwater infiltrate into the Fruitland Formation. Currently, the infiltration of surface water into the Fruitland Formation is limited because the effective permeability to water is significantly reduced due to the presence of methane in the Fruitland Formation (Cox et al. 2001, SSPA 2006a).

## 3.6 Land Use and Ownership

This section describes the regional land use inventory conducted to assess the sensitivity and effects from the construction, operation, maintenance, and abandonment of oil and gas development on the Reservation. Land use data are organized into land ownership, Reservation management plan and management units, existing land uses, and future land uses. Information on land use and ownership from the 2002 FEIS (USDI 2002a) is incorporated by reference.

### 3.6.1 Land Ownership

Refer to Section 3.6.2 in the 2002 FEIS for a discussion of land ownership in the study area (USDI 2002a).The study area is located in southwestern Colorado and includes portions of La Plata, Archuleta, and Montezuma counties. The land ownership in this area resembles a checkerboard pattern of Tribal and non-Tribal lands resulting from homesteading activities that occurred from 1899 to 1938. The study area consists of approximately 421,000 acres including 195,000 acres of Tribal surface and subsurface lands held in trust by the federal government for the SUIT, 5,000 acres of allotted lands that have been transferred or allotted to individual Tribal members as a result of congressional action and held in trust by the federal government, 180,000 acres of fee surface lands where the SUIT owns only the coal estates, and 41,000 acres of fee surface lands where the Tribe owns the entire mineral estate. The study area also includes isolated parcels of fee land that is not held in trust by the United States but is owned outright by individual Tribal members or the Tribe. The land beneath and immediately surrounding Navajo Reservoir is owned by the federal government and managed by the BOR.

### 3.6.2 Reservation Management Plan and Units

The Reservation is divided into seven management units that primarily follow watershed boundaries as shown on Map 3-10 (Appendix A). Six of these management units occur within the study area. The 2002 FEIS (USDI 2002a) describes ten management units with boundaries that generally followed drainage channels. The 2000 update to the NRMP replaced the original 10 management units with seven to promote more coordinated and coherent resource management within identifiable watershed drainages, to conform to resource management practices and applications in widespread use, and to make it possible to share resource data more easily with outside resource agencies (SUIT 2000). The new management units, with the exception of one unit, conform to larger watershed boundaries defined in the Colorado Unified Watershed Assessment. Each of the management units has established priorities that provide management direction for the BIA and Tribal staff. Oil and gas development has previously occurred in each of the management units. The following is an overview of the six SUIT management units within the study area (SUIT 2000).

**UNIT 1 – LA PLATA MANAGEMENT UNIT**

The La Plata management unit is the largest and consists of approximately 164,300 acres in the western part of the Reservation. The major river drainage within the La Plata unit is the La Plata River and major tributaries include Long Hollow Creek and Cherry Creek. The La Plata unit contains more non-Tribal land than Tribal lands. Tribal lands within the La Plata unit are located mostly in steeper, upland areas that have shallow soils. There is little development or use of these tracts, which are largely unfenced with few if any watering devices. Residential development is minimal within this unit and commercial development is concentrated in the small communities scattered along State Route 140. The most prevalent human use of this unit is oil and gas development.

**UNIT 2 – ANIMAS MANAGEMENT UNIT**

The Animas Management Unit is the second largest unit on the Reservation and is comprised of 117,877 acres. The major river drainages are the Animas and Florida rivers. Major tributaries in this unit include Indian Creek and Salt Creek. The Animas unit is located in the west-central part of the Reservation and includes the southern and western portion of Florida Mesa. Approximately two-thirds of the unit is non-Tribally owned land, while one-third is Tribal land with a very small amount of allotted land. Florida Mesa and the Animas River Valley support over 885 acres of irrigated agricultural land within the Animas unit. The La Plata County Airport and Animas Air Park are located within this unit. Major transportation corridors include U.S. Highway 550, SH 172, and La Posta Road. Scattered subdivisions occur within the unit. Many of the agricultural lands on Florida Mesa have been converted to homesites and residential development has been increasing near La Posta Road. Small commercial areas exist at Oxford and near Sunnyside. Light industrial development is increasing near the airport and at the north end of La Posta Road. Extensive gas development has occurred throughout the unit and several large natural gas pipelines cross the unit (SUIT 2000).

## UNIT 3 – MESA MOUNTAINS MANAGEMENT UNIT

The Mesa Mountains Management Unit is the smallest management unit and encompasses 31,718 acres of primarily Tribal land. The border of the unit follows the contour of the Mesa Mountains. There are no perennial streams or tributaries in this unit. Trail and Line Canyons are the main drainages. The unit has no residences, farmlands, or Tribal land assignments, but resident wildlife populations are present. The Mesa Mountains Unit is managed as wildlands and rangelands and has extensive facilities for producing natural gas.

## UNIT 4 – LOS PIÑOS MANAGEMENT UNIT

The Los Piños Management Unit contains approximately 107,366 acres. The major river drainage is the Los Piños. Major tributaries in this unit include Rock Creek, Ignacio Creek, Dry Creek, Beaver Creek, Ute Creek, Spring Creek, and Devil Creek. This unit is the most developed management unit with the greatest population. Approximately one-third of the unit is Tribal-owned. The Town of Ignacio, Tribal Headquarters, and BIA Southern Ute Agency are centrally located within this unit. The majority of Tribal homes, land assignments, and allotments within the Reservation are within the Los Piños Management Unit. Homes and farms are scattered throughout all but the eastern upland portion of the unit, which is primarily woodland and rangeland. This unit also contains the majority of Tribal agricultural land.

## UNIT 5 – PIEDRA MANAGEMENT UNIT

This unit includes 87,353 acres. The Piedra is the major river drainage and major tributaries include Stollsteimer Creek, Bull Creek, Turkey Creek, and Goose Creek. The southern end of the Piedra Management Unit is located within the eastern end of the study area. The lands in the portion of this unit that is located within the study area are private and BOR lands. The BOR lands surround the northern tip of Navajo Reservoir.

## UNIT 6 – LOWER SAN JUAN MANAGEMENT UNIT

The Lower San Juan Management Unit contains 97,010 acres. The western portion of this unit is within the eastern end of the study area. The major river drainage is the San Juan River and major tributaries include Sambrito Creek, Cat, Sandoval, Ignacio, Gallegos, Payan, Deep Canyon, and Round Meadow. These drainages all flow into Navajo Reservoir. The majority of the land within the study area in this management unit is privately owned farmland. The Town of Allison is located within this area.

### 3.6.3 Existing Land Uses

Existing land uses within the study area include residential, commercial and public uses; developed and dispersed recreation; industrial/resource extraction; agriculture; grazing; forest resources; and Tribal and multi-use lands.

**RESIDENTIAL**

The majority of towns and clustered residential developments are located adjacent to the major rivers within the study area, including the La Plata, Animas, Florida, and Los Piños rivers. Most residential development within the study area occurs in small communities. Ignacio is the largest community within the Reservation and had a population of 669 in 2000 (U.S. Census Bureau 2000). Smaller communities located within the eastern portion of the study area along with Ignacio include Oxford, Tiffany, Allison, La Boca, and Arboles. Breen, Kline, Red Mesa, and Marvel are located in the western portion of the study area. Bondad and La Posta are residential areas centrally located within the study area. Agricultural and rangeland areas extend outward from the centrally developed areas. Rural residences are dispersed throughout the agricultural areas on both Tribal and private lands.

**COMMERCIAL/PUBLIC USES**

Ignacio is home to most commercial establishments on the Reservation. These include retail establishments, offices, and warehouses. Additional commercial development is associated with the small communities located within the study area. Public facilities are also located primarily in Ignacio, including schools, local government buildings, the Sky Ute Fairgrounds, and the Tribal police. The Durango-La Plata County Airport is located approximately 7 miles northwest of Ignacio. The SUIT and Sky Ute Casino recently constructed a new resort casino in Ignacio. The casino is 300,000 square feet in size and includes a 24-lane bowling center, retail spaces, indoor pool, day-care facilities, putt-putt golf, and several restaurants.

**DEVELOPED RECREATION FACILITIES**

Developed facilities for recreational activities, including cultural events, are located primarily in or adjacent to Ignacio. Recreational facilities include the Ignacio City Park, Shoshone Park, Sky Ute Fairgrounds, and the Sun Ute Community Center and Bear Dance Grounds. Ute Park is located immediately north of Ignacio. Sky Ute Casino in Ignacio attracts tourists and visitors for recreation.

Navajo Lake is a State Park and major recreational facility within the study area. Annual visitation to Navajo State Park in Colorado increased by 56% between 1990 and 1999 (BOR 2007). Developed recreation facilities at Navajo State Park include visitor centers, full service marinas, boat launch facilities, developed and primitive campgrounds, picnic areas, hiking trails, watchable wildlife areas, and other amenities. Boating and camping uses on the Reservoir are concentrated within a four-month period in the summer (BOR 2007). Pastorius Reservoir and Scott's Pond are two other recreational facilities used by Tribal members and local residents

**DISPERSED RECREATION**

Refer to Section 3.6.4.4 in the 2002 FEIS for a discussion of dispersed recreation on the SUIT (USDI 2002a).

## INDUSTRIAL/EXTRACTION

The primary industrial land use in the study area is oil and gas exploration and production. The average disturbance for a well pad, pipeline, and access road is 3.2 acres. The well pads are partially reclaimed during operation resulting in an average of 2.2 acres of long-term disturbance for each well. Since November 1, 2002, a total of 460 wells have been drilled within the study area, requiring approximately 1,472 acres of surface. Approximately 86 of these wells have been drilled to SUIT minerals as approved under the 2002 FEIS, including 56 CBM wells and 30 conventional wells.

Other industrial activities include manufacturing facilities, landfills, and material processing plants. Extractive uses consist of major active surface mining operations such as sand and gravel quarries.

## AGRICULTURE

Farming on the Reservation includes both irrigated and non-irrigated lands. Dryland farming is most prevalent on Red Mesa (SUIT 2000). Irrigated lands are supplied by the La Plata River on Red Mesa, the Florida River on Florida Mesa, and the Los Piños River along the Los Piños River corridor. The great majority of Tribal agricultural assignments are located in the Los Piños corridor (SUIT 2000). The Pine River Indian Irrigation Project is a system of canals, laterals, and related structures that supply irrigation water to lands in the Los Piños valley owned by the Tribe, allottees, and fee property owners (SUIT 2000). Water is stored on the Los Piños River in Vallecito Reservoir, approximately 11 miles north of the Reservation, for both Tribal and non-Tribal lands (SUIT 2000). The Florida Project, a participating project of the Colorado River Storage Project, supplies irrigation water to lands on Florida Mesa. Water for the Florida Project is stored in Lemon Reservoir, approximately 12 miles north of the Reservation on the Florida River (BOR 2006). Some of the agricultural lands in the study area meet criteria for prime farmland if a dependable and adequate water supply (i.e., irrigation) is available.

## GRAZING

Livestock and wildlife grazing occurs on nearly all but the steepest areas of the Reservation. Cattle, horses, and sheep are the principal livestock on the Reservation. Regularly grazed areas have been designated as official grazing units that have established boundaries and a set carrying capacity measured in “animal unit months,” or AUMs. The study area includes 11 designated range units, although only seven remain open for use (SUIT 2000). The majority of lands designated as grazing units within the study area are located within the La Plata and Mesa Mountains Management Units (Map 3-10, Appendix A).

Two tracts within the Los Piños Management Unit are devoted exclusively to grazing and raising a Tribal bison herd. Although not hunted on the Reservation, the SUIT DWRM manages a small herd of approximately 15 bison, primarily for educational purposes and cultural preservation. A few bison are culled from the herd each year to provide meat for Tribal functions. The non-meat portions of these bison (e.g., hides and skulls) are utilized for other traditional SUIT purposes. The SUIT DWRM provides educational presentations on the importance of bison to Ute culture to the Southern Ute Academy and other area local schools (SUIT 2007a).

A Tribal resolution was passed in December 2002 as recommended by the SUIT DNR to rehabilitate Tribal rangelands damaged by the ongoing drought and grazing pressure and to protect wildlife. The resolution included the deferment of grazing on the Reservation for no longer than one five-year permit cycle. The “grazing moratorium” expired in December 2007. The SUIT DNR has received substantial funds approved by the Tribal Council for range improvement projects during the “grazing moratorium.” Also, three grazing units within the study area, Sambrito, Spring Creek, and Sixshooter, were re-designated as wildlife habitat as a result of the resolution (Jim Formea Sr., personal communication, 3/23/2007).

#### FOREST RESOURCES

Forested lands are one of the largest resources on the Reservation. Woodlands are the most extensive vegetation type on the Reservation. Commercial woodlands are managed for forest products such as firewood, poles, posts, and piñon nuts. Trees important for religious ceremonies, such as cottonwoods, also are managed in woodland areas. Harvest of woodland products is typically carried out by individual Tribal members who have acquired a free-use permit. Non-Tribal entities may purchase permits for a fee. New gas development removes enough wood to supply local needs for firewood and posts, the primary uses (SUIT 2000). The study area contains only small, widely scattered stands of commercial timberland and most of the timbered area accessible to harvest has been cut at least once.

#### TRIBAL AND MULTI-USE LANDS

Refer to Section 3.6.4.9 in the 2002 FEIS for a discussion of Tribal and multi-use lands on the Reservation (USDI 2002a).

### 3.6.4 Future Land Uses

The future land use category includes general and specific planned land uses within the study area. Information from county and SUIT land use plans was used to determine general trends regarding future land use within the study area. The following discussion presents an overview of planned future land uses for each county within the study area and Tribal lands.

#### ARCHULETA AND MONTEZUMA COUNTIES

The Archuleta County Community Plan, adopted by the Archuleta County Government Planning Commission in March 2001, presents a conceptual plan to guide decisions about the future uses of land within Archuleta County (Archuleta County Government 2001). The eastern end of the study area is located in Archuleta County and is mostly private agricultural or vacant land. The goals for future development of the Archuleta County lands with the study area include preserving open space through very low density residential development, avoiding or minimizing disruption to wildlife habitat identified by the CDOW’s local managers, and developing Arboles as a village center with small-scale commercial and service facilities and nearby higher density residential areas.

Within Montezuma County, there are approximately 5 square miles of private and Tribal trust land included in the western end of the study area. The Montezuma County Comprehensive Land Use Plan was adopted by the Montezuma County Board of Commissioners January of 1997 (Montezuma County Planning Department 1996). The Land Use Plan implemented a system of landowner initiated zoning. Currently, the Montezuma County lands within the study area are not zoned.

## LA PLATA COUNTY

The majority of the study area is located in La Plata County. The La Plata County Planning Commission adopted the La Plata County Comprehensive Plan in 2001 to guide future development within the county (La Plata County Planning Department 2001). The La Plata County Comprehensive Plan does not apply to Tribal lands. As part of the comprehensive planning process, the county established 10 separate planning districts, five of which have portions within the study area: Ft. Lewis Mesa, Florida Mesa, Southeast La Plata, West Durango, and Bayfield. Each planning district has developed a land use plan or mission statement to guide future land use decisions within their district, with the exception of the Southeast La Plata Planning District. The district land use plans identify preferred land use types and densities within each district, establish goals and objectives for each district, and create a process for implementation of each plan. While each of the plans has its own unique vision, several prevailing themes tie the district plans together. These include such things as retaining rural character, accommodating new growth, protecting the environment, respecting private property rights, and ensuring housing affordability. The district land use plans are an integral sub element of the countywide comprehensive plan and are incorporated in the comprehensive plan. The future land use goals of La Plata County outlined in the comprehensive plan include encouraging growth hubs in the county that would provide opportunities for higher density commercial and residential development and employment centers, supporting efforts to extend central services to growth hubs and other areas envisioned for higher densities in the district plans, supporting efforts to create a rural water system to serve areas consistent with the district plans, and encouraging the preservation of contiguous open lands in La Plata County. In April and May of 2009, La Plata County began a major update of the existing Comprehensive Community Plan. The update will continue through the winter of 2010.

In 2007, the La Plata County Board of County Commissioners initiated a strategic planning process called the "La Plata County Compass". Community meetings were held to discuss the County's role in Colorado local and regional government, and to provide input on issues of importance to La Plata County citizens. Core strategies identified included economic vitality, sustainable development, transportation, healthy natural environment, thriving families and healthy community.

## TRIBAL LANDS

The NRMP for the Reservation was completed in 1990 to provide guidance for natural resource management on the Reservation. The NRMP was updated in 2000 and tiered to the Tribe's comprehensive plan (SUIT 2000). The NRMP guides the management of resources such as agricultural lands, soils, forest lands, grazing lands, water resources, and wildlife. The NRMP also includes information on housing, transportation, historical uses, and other uses affecting natural resources.

## CONSISTENCY WITH REGULATIONS AND LAND USE PLANS

The Reservation is covered by the SUIT NRMP (SUIT 2000) which provides planning guidance for Tribal and allotted lands within the Reservation. Oil and gas development and the actions and decisions in the PEA would be in conformance with this plan.

The majority of non-Tribal land in the study area is regulated by La Plata County. The La Plata County Planning Commission adopted the La Plata County Comprehensive Plan in 2001 to guide future development within the county and is advisory only (La Plata County Planning Department 2001). The La Plata County Comprehensive Plan does not apply to

Tribal lands. A County Impact Report (CIR) that was prepared to identify the potential impacts to and mitigation measures for specific resources in La Plata County from the anticipated development of CBM. The resources addressed were selected based on the goals and objectives defined by La Plata County. The CIR addresses potential impacts of and mitigation measures for land use, socioeconomics, traffic and transportation, visual resources, noise, and public health and safety.

Oil and gas development by non-Tribal entities accessing private minerals with private surface in La Plata County is permitted through the COGCC and is not subject to NEPA analysis. However, minor oil and gas development (i.e., natural gas wells, gathering lines, and access roads) by such entities requires a permit from La Plata County on unincorporated lands. The County permitting process does not apply to Tribal lands or to the Tribe within the boundaries of the Reservation.

## 3.7 Traffic and Transportation

### 3.7.1 Existing Transportation System

The primary transportation network within the Reservation is the road system which is comprised of federal and state highways, county roads and private access roads. The Durango-La Plata County airport is located within the exterior boundaries of the Reservation and provides commercial passenger service, cargo transport service and private aviation services. Public transportation within the Reservation is provided by Roadrunner Transport – a subsidiary business of the Southern Ute Community Action Program (SUCAP). Roadrunner Transport provides public transportation services between Ignacio, Bayfield, and Durango. The town of Ignacio and Durango were formerly connected by rail service provided by the Rio Grande Southern rail road line. The rail service was abandoned in the early 1950s.

The road network includes federal highways, State of Colorado highways and a network of county roads maintained by La Plata County Road and Bridge Department. The principal federal highway within the Reservation is U.S. Highway 550 which runs north to south through the center of the reservation parallel to the Animas River (Map 3-9, Appendix A). U.S. Highway 550 is the main north south transportation route in northwest New Mexico and southwest Colorado, providing a transportation route from Albuquerque, New Mexico to Grand Junction, Colorado. Within the Reservation, U.S. Highway 550 is a two lane highway with open access. The primary east to west transportation route through southwest Colorado is U.S. Highway 160. This federal highway is located almost entirely to the north of the northern exterior boundary of the Reservation.

The state highways within the Reservation include SH 151, SH 172 and SH 140. Access to the eastern portion of the Reservation (from the Chimney Rock area to Ignacio) is provided by SH 151 that connects U.S. Highway 160 to SH 172 in Ignacio. State Highway 172 is a primary connecting route from Durango/U.S. Highway 160 to Ignacio, and the Pine River valley area south of Ignacio. In the western portion of the Reservation, SH 140 is a north to south transportation route from Hesperus, Colorado, south to Farmington, New Mexico (Map 3-11, Appendix A).

Paved and gravel surface county roads provide secondary access within the exterior boundaries of the Reservation. The county roads are maintained and improvements provided by the La Plata County Road and Bridge Department. The county road network includes major collector roads such as CR 310 that connects U.S. Highway 550 with Ignacio, and CR 521 (Buck Highway) that connects the towns of Bayfield and Ignacio. The remaining county road network is comprised of single and double lane gravel roads that provide local access to residential areas of the reservation.

From the existing county road network, private access roads provide access to residences and to oil and gas well pads and compressor stations. The average length of a well pad access road is approximately 0.25 mile. These access roads are generally maintained by the oil and gas development operator, with access provided through private easements or ROW grants approved by the BIA. A summary of the mileage associated with each of the road types is provided in Table 3-14.

**Table 3-14. Summary of Highways and Roads within the Study Area.**

| Highway/Road Type | Typical ROW Width (Feet) | Total Length Within Study Area (Miles) |
|---|---|---|
| Federal (U.S.) Highway | 120 | 15.8 |
| State (CO) Highway | 100 | 58.2 |
| County Road (La Plata County) | 60 | 360.6 |
| County Road (Archuleta County) | 60 | 13.1 |
| Tribal Roads | Unknown | 78.4 |
| Other access roads (including oil and gas access roads) | 40 | 833.9 |

### 3.7.2 Traffic Volumes

Traffic volumes for state and federal highways within the Reservation are compiled by the Colorado Department of Transportation (CDOT) – Region 5 (CDOT 2008). A summary of Annual Average Daily Trips (AADT) for U.S. Highway 550 and SH 140, 151 and 172 are provided in Table 3-15.

**Table 3-15. Annual Average Daily Trips on Federal and State Highways Within the Reservation.**

| County Road/Location | Average Annual Daily Trips |
|---|---|
| SH 140 – NM State line | 966 |
| SH 140 – at CR 134 | 2600 |
| U.S. 550 – NM State line | 7900 |
| U.S. 550 – at CR 310 | 5500 |
| U.S. 550 – at CR 302 | 6500 |
| SH 172 – at NM State line | 440 |
| SH 172 – at CR 318 | 5100 |
| SH 172 – at SH 151 (Ignacio) | 7000 |
| SH 172 – at CR 309 (Airport) | 5600 |
| SH 151 – at SH 172 (Ignacio) | 3600 |
| SH 151 – at CR 521 (Buck Highway) | 3100 |
| SH 151 – at CR 334 | 1400 |

Source: CDOT 2008

Roadway capacities for federal and state highways were evaluated in the southwest Colorado highway system evaluation report (CDOT 2005). The report identified U.S. Highway 550 from the intersection with U.S. Highway 160 south to the New Mexico state line as over capacity and in need of additional lanes. Improvements to U.S. Highway 550 are scheduled to occur within the next five years. No other state or federal highways within the Reservation are proposed for major improvements based on exceedance of design capacity (CDOT 2005).

Traffic volumes on county roads are compiled by the La Plata County Road and Bridge Department (LSA Associates 2006). A summary of AADT for major county roads within the Reservation is provided in Table 3-16.

**Table 3-16. Annual Average Daily Trip Summary Table – La Plata County Major County Roads within Reservation.**

| County Road/Location | Average Annual Daily Trips | Year |
|---|---|---|
| CR 213 – Durango city limit | 966 | 2007 |
| CR 213/CR 214 intersection | 1251 | 2007 |
| CR 213 at U.S. 550 | 1430 | 2007 |
| CR 310 at U.S. 550 | 3839 | 2006 |
| CR 310 at CR 318 | 257 | 2007 |
| CR 318 at CO Hwy 172 | 4632 | 2007 |
| CR 521 at CO Hwy 151 | 1329 | 2007 |
| CR 521 at CR 522 | 1319 | 2007 |
| CR 521 at CR 523 | 1818 | 2007 |
| CR 521 at Mesa Drive | 1921 | 2007 |

Source: LSA Associates 2006

Roadway capacities and a description of the level of congested county roads within the Reservation were compiled in the La Plata County and City of Durango 2030 Transportation Integrated Plan (LSA Associates 2006). The study describes the current conditions for county roads within La Plata County, including county roads located within the Reservation. All county roads located within the Reservation are described as un-congested, with a Level of Service for the roads representative of the un-congested condition.

### 3.7.3 Traffic Accidents

Refer to Section 3.7.4 in the 2002 FEIS for a detailed discussion of traffic accidents on the Reservation (USDI 2002a). A review of more recent data for the Reservation indicates that accident rates have remained at the same rate per mile as reported in 2002. A review of annual traffic fatalities within La Plata County for the years 2001 to 2005 do not show any obvious trend (National Highway Traffic Safety Administration 2007).

### 3.7.4 Oil and Gas Development Characteristics Related to Transportation

Refer to Section 3.7.5 in the 2002 FEIS for a detailed discussion of oil and gas development characteristics related to transportation on the Reservation (USDI 2002a). The 2002 FEIS estimated 239 daily vehicle trips for natural gas well drilling, completion, well operation, recompletion or fracing activities, based on a total of 1,877 active wells operating within the Reservation. An additional 30 conventional wells and 56 CBM wells have been drilled between December 2002 and December 2007. Based on all these wells being currently active, there are currently 1,963 active wells within the Reservation. Based on the previously developed estimate included in the 2002 FEIS, this number of active natural gas wells requires 250 daily vehicle trips for on-going natural gas well operations and new well drilling activities operations.

Refer to Section 3.7.5 and Table 3-24 in the 2002 FEIS for a discussion of compression facilities on the Reservation (USDI 2002a). For the three types of compressor facilities there were 225 compressors within the Reservation in 2002. The total daily vehicle trips required for the three compressor types was estimated at 64. There are currently 232 active compressor stations within the Reservation. Based on the average daily trip summary model developed for the 2002 FEIS, this number of compressors requires 66 daily vehicle trips for on-going compressor operation activities. Therefore the total number of daily vehicle trips for current well operations (250) and compressor operations (66) would be 316.

## 3.8 Cultural Resources

This section describes the cultural environment including those aspects of the physical environment that relate to human cultural and society, with a focus on: 1) historic preservation issues which relate primarily to protecting archaeological and historical properties within the study area, and 2) traditional cultural concerns. Most inventories were conducted between the mid-1970s and 2002. Though the inventory of cultural resources has grown slightly since 2002, the overall character (types and numbers of sites) has not changed appreciably. Information on cultural resources from the 2002 FEIS is incorporated by reference.

### 3.8.1 Regulatory Requirements

Refer to Section 3.8.2 in the 2002 FEIS for a detailed discussion of cultural resources regulatory requirements on the Reservation (USDI 2002a).

### 3.8.2 Archaeological and Historical Sites

Refer to Section 3.8.3, Appendix K and Table 3-27 in the 2002 FEIS for a detailed discussion of archaeological and historical sites on the Reservation (USDI 2002a).

Over 1,000 archaeological or historical sites have been recorded in the study area, with the majority having been recorded since the mid-1970s. Table 3-27 in the 2002 FEIS presents Colorado Historical Society data, current as of that time, with more than 1,000 temporal site components, known to range from the Archaic Period (as early as 8,000-10,000 BC) up to the Historic Period (AD 1950). The overall sequence of human occupation in southwest Colorado is reviewed in the 2002 FEIS (Section 3.8.3 and Appendix K) (USDI 2002a). The majority of site components date to the Ancestral Puebloan era (56% of total site components), primarily between A.D. 600 and 1200. Other spikes in the population of southwest Colorado appear to have occurred during the early Navajo (7.5% of total site components) occupation of the area (AD 1500 to 1750), and again in the early 20th Century, this time mostly by EuroAmerican homesteaders (8.6% of total site components).

The 2002 FEIS projected that the highest site densities (>20 sites per square mile) would occur in the major valleys and adjacent tributaries associated with the La Plata, Animas, and Los Piños Rivers. Lower site densities (<10 sites per square mile) would be at higher elevations in the pine-oak forests, in badlands, in rough topography, and in areas disturbed by agricultural activities. Remaining areas were predicted to contain moderate site densities (10-20 sites per square mile). Though these projections are based on 2002 data, it is unlikely that subsequently obtained information would alter these projections. The original modeling of site density contained in the 2002 FEIS was necessarily coarse and probably not that meaningful. Whereas the highest density of sites would be expected along major watercourses, areas set back along secondary or intermittent drainages exhibit some of the highest documented site densities (Wilshusen 1995), at least immediately to the south of the project area. Many factors influence site density, such as local topography, local soils, growing season, and aspect, as well as the availability of water. The distribution of previous surveys in the study area has also been skewed to the southwest, making any broad generalizations concerning site density and distribution to be somewhat inaccurate and premature. A more rational working model, based on the limited available data, would be to assume that the overall site density in the study area is about 24 sites per square mile, and that density could vary locally from low to high, but that meaningful modeling of that variation would need fine-grained analyses that are beyond the scope of the available databases. A further assumption that will be used in subsequent analyses is that the average site size is estimated to be 100 feet in diameter, covering 0.18 acre. This is likely to conservatively overestimate the actual mean size.

Most archaeological work in the study area has been in support of oil and gas development, with many surveys for well pads, roads, pipelines, and other infrastructure having been conducted between the mid-1970s and the present. It is estimated that no more than 10% of the study area has been covered by previous cultural resources surveys, weakening inferences and assumptions concerning site density and distribution within the study area. SUIT policies, concerning the lack of recordation for many avoided sites, probably also skews these assumptions. Nearby archaeological work for the Animas-La Plata Project on the north edge of the study area may be a source of data on this area's prehistoric and historic past, but the results of that project are not yet available.

### 3.8.3 Traditional Cultural Places and Resources

Section 3.8.4 in the 2002 FEIS states that an inventory of traditional places or resources in the study area is not available (USDI 2002a). Whereas there were a variety of traditional activities occurring on the Reservation during the Historic and Modern era, the Mouache and Capote bands' ancestral territories were to the east and, thus, there are no ancient Ute ties to land within the study area. At that time the Tribal Historian indicated that traditional Ute cultural concerns regarding oil and gas development focus on protection of archaeological sites and minimizing new disturbance. According to Byron Frost, Head, Reservation Lands Division (personal communication, 2/23/2007), most modern gathering of wild plants likely occurs to the east of the Piedra River, where oil and gas development has been minimal. Other tribes in New Mexico, Arizona, and Colorado may also have traditional ties to resources in the study area, including archaeological sites, and will be consulted on a case-by-case basis as warranted.

## 3.9 Visual Resources

This section describes the existing visual environment in the study area, including the visual impacts of current development. No specific Tribal visual resource designations or federal agency guidelines have currently been identified or established within the study area on SUIT or private lands.

However, the 2002 FEIS did identify several areas of high scenic quality and sensitivity within the study area based on evaluation techniques generally associated with the BLM's visual resources rating system. The BLM has developed standard methodologies to determine visual values utilizing scenic quality evaluations, sensitivity level analysis, and identification of distance zones based upon relative visibility from travel routes or sensitive observation areas (BLM 2007b). In addition to the BLM guidance, general visual standards for La Plata County are defined in the *La Plata County Code, Chapter 90, Natural Resources, Section 90-123(a,b,c)* (La Plata County 2008).

Techniques that are recommended in these documents for determining visual values and information provided in the 2002 FEIS were utilized in this PEA to identify visually sensitive locations in the study area. In addition, the NRMP identifies the Navajo Reservoir area and a historic narrow gauge railroad route along the San Juan and Navajo rivers as important visual attractions in the study area (SUIT 2000). Information on visual resources from the 2002 FEIS is incorporated by reference.

### 3.9.1 Visual Characteristics of Existing Conditions

Landscapes found within the study area were previously characterized based upon scenic value, sensitivity, and distance zone categories identified in that the 2002 FEIS (USDI 2002a). Landscape types identified in the study area include: ridges and narrow valleys, mountain areas, upland hills, rolling uplands, canyons, mesa tops, mesa rims and escarpments, river valleys, and reservoirs. The La Plata and San Juan mountains, located north of the study area, and the Fruitland Escarpment are prominent visual backdrops to a large portion of the study area. The main drainages found in the area include the Animas, Los Piños, La Plata, and Florida rivers. Navajo, Pastorious, and Mormon reservoirs are the major water bodies found within the study area. General descriptions of these landforms as well as existing oil and gas development in the area are provided in Chapter 3.9 in the 2002 FEIS (USDI 2002a).

The 2002 FEIS defined existing visual resource conditions within the study area based upon identification of sensitive views or viewshed locations and use, and analysis of landscape characteristics, and viewshed distance zones. Current conditions associated with this project are assumed to generally mimic those defined in the FEIS, with exceptions as described below. Sensitive visual resource zones are typically identified by overlaying data on sensitive viewshed locations, distance zones, and scenic quality areas and determining how and where they overlap. The following sections summarize current information regarding these visual resource factors used to establish visual resource baselines in the study area.

#### SENSITIVITY LEVEL EVALUATION CRITERIA AND RESULTS

Sensitive viewshed locations and use levels in the study area were identified in the 2002 FEIS based upon discussions with SUIT planners and agency resource specialists. Sensitive views in the study area were typically identified using the following criteria:

- **Amount of Use.** Areas seen and used by large numbers of people were considered to be potentially more visually sensitive. Within the project area, traffic routes with high to moderate traffic volumes were included in the sensitive viewshed location list. These included: U.S. Highway 550, SH 140, SH 150, and SH 172. Wildcat Canyon Road (SH 141) was not included in the 2002 FEIS's original list, but is a major highway in the area that receives moderate traffic use.
- **High Public Interest and Types of Users.** The visual quality of an area may be of concern to local, State, National, or special interest groups. Indicators of this concern are usually expressed in public meetings, letters, newspaper or magazine articles, newsletters, land-use plans, etc. High public interest areas identified in the NRMP

included the Navajo Reservoir area and a historic railroad grade located near Arboles (Refer to Map 22 in the 2002 FEIS).

- **Adjacent Land Uses.** The interrelationship with land uses in adjacent lands can affect the visual sensitivity of an area. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive. Sensitive land use areas identified for the study area included communities such as Breen, Kline, Red Mesa, and Marvel in the western portion of the study area and La Posta, Ignacio, La Boca, Tiffany, Oxford, Allison, and Arboles in the central to eastern portions of the study area.
- **Special Areas.** Management objectives for special areas such as Natural Areas, Wilderness Areas, or Wilderness study areas, recreation areas, Wild and Scenic Rivers, Scenic Areas, Scenic Roads or Trails, and ACECs, frequently require special consideration for the protection of the visual values. Recreational areas with sensitive viewpoints in the project area include Navajo State Park and Wildlife Area, Scott's Pond, Ute Park, and Pastorious Reservoir State Wildlife Area. No Wilderness Areas, Wild and Scenic Rivers, or ACECs are located within the study area.

Based upon the criteria identified above, existing sensitive view locations within the study area, as modified from the 2002 FEIS, are identified in Table 3-17.

## VIEWSHED DISTANCE EVALUATION CRITERIA AND RESULTS

Landscapes are generally subdivided into three distance zones based on relative visibility from travel routes or sensitive observation points. The three zones are: foreground-middleground, background, and seldom seen. The foreground-middleground (fm) zone includes areas seen from highways, rivers, residences, or other viewing locations that are less than 1 mile away. The background (bg) zone are seen areas beyond the foreground-middleground zone, but usually less than 5 miles away. The seldom-seen (ss) zone are areas not seen as foreground-middleground or background (i.e., hidden from view or greater than 5 miles away).

Distance modeling studies were completed in the 2002 FEIS for the sensitive view locations (Table 3-8), with the exception of the Wildcat Canyon area and historic railroad grade, and were mapped by general sensitive viewshed categories, including residences, recreation, and travel routes (USDI 2002a). The distance studies modeled what an observer at these sites or traveling along these highways would be able to see in the foreground (300 feet to 0.25 mile), middleground (0.25 mile to 1 mile) and background views (1 mile to 5 miles); the results of that modeling is provided in Maps 25, 26, and 27 in the 2002 FEIS (USDI 2002a). It is assumed that the modeling did not consider vegetation as a screening mechanism. Additional distance modeling conducted for this PEA is included on Map 3-12 (Appendix A).

Distance zones along Wildcat Canyon Road (SH 141) were not modeled in the 2002 FEIS, but generally mimic those found along Highway 140 near Breen; distance zones near the historic railroad grade generally mimic those found between Tiffany and Arboles. According to the 2002 FEIS, approximately 4.7% of the study area contains sensitive viewpoints in the immediate foreground distance zone, 17.5% occur in foreground distance zones, and 35.8% occur in middleground distance zones (USDI 2002a).

**Table 3-17. Sensitive View Locations in the Study Area.**

| Sensitive Viewpoint | Location | Use and Sensitivity Level |
|---|---|---|
| **Travel Routes /Trails** | | |
| U.S. Highway 550 | Connects U.S. Highway 160 and Bondad | High |
| SH 140 | Connects Durango, Breen, Kline, and Red Mesa | High |
| SH 151 | Connects Ignacio and Arboles | High |
| Wildcat Canyon Road (SH 141) | Connects Durango, Breen, Kline, and Red Mesa | Moderate |
| SH 172 | Connects U.S. Highway 160 and Ignacio | High |
| Lower Animas River Road (CR 213) | Connects U.S. Highway 160 and Bondad | Moderate |
| Buck Highway (CR 321) | Connects Ignacio and Bondad | Moderate |
| CR 318/310 | Connects Ignacio and Bondad | Moderate |
| CR 500 (Trujillo Road) Wahnita to Dulce | An old railroad grade that connects Navajo State Park and SH 151 and 172; proposed as a scenic byway | High |
| **Recreational Use Areas** | | |
| Navajo State Park | East of Arboles and SH 151 | High |
| Navajo Reservoir State Wildlife Area | Southwest of Arboles, adjacent to Navajo State Park | High |
| Pastorious Reservoir State Wildlife Area | 0.5 mile south of the northern SUIT boundary between U.S. Highway 550 and SH 172 | Moderate |
| **Other** | | |
| Subdivisions | Throughout the study area | High |
| Residences | Throughout the study area | High |
| Breen | North of Kline on SH 140 | Moderate |
| Kline | North of Red Mesa on SH 140 | Moderate |
| Red Mesa | North of the SH 140 crossing of La Plata River | Moderate |
| Marvel | North of Red Mesa on SH 140 | Moderate |
| La Posta | North from Bondad, east of the Animas River | Moderate |
| Ignacio | West of the Pine River, at the intersection of SH 151 and SH 172 | High |
| La Boca | South of Ignacio on SH 172 | Moderate |
| Tiffany | West of Arboles on SH 151 | Moderate |
| Allison | East of Tiffany | Moderate |
| Arboles | West of the Navajo Reservoir on SH 151 | Moderate |

Source: Modified from USDI 2002a

## SCENIC QUALITY EVALUATION CRITERIA AND RESULTS

Scenic quality is a measure of the visual appeal of a landscape and several methodologies to measure this appeal have been developed by various agencies. Generally speaking, landscapes can be rated on apparent scenic quality using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity of the landform, and cultural modifications to the landscape. During the rating process, each of these factors is generally ranked on a comparative basis with similar features within the physiographic province (Refer to Table 3-18 for ranking criteria). A final tally of the overall ranking of the factors then determines the landscape's overall scenic quality.

For this analysis, the following three scenic quality ranking categories were identified:

- **A = 19 or more - Distinctive scenic quality**: Areas containing features such as landforms, vegetative patterns, water forms, and rock formations that are of an unusual or outstanding visual quality not common in the surrounding area.
- **B = 12-18 - Common scenic quality**: Areas containing features with a variety of form, line, color, and texture, or combinations thereof, tending to be common throughout the surrounding area and not outstanding in visual quality.
- **C = 11 or less - Minimal scenic quality**: Areas generally characterized by little or no variety in form, line, color, texture, or combination thereof.

General physiographic regions or landforms in the study area were identified on Map 24 in the 2002 FEIS. Although the 2002 FEIS did not specifically rank these landform units as to their scenic quality; it did identify riparian and other waterway localities as areas with high scenic attractiveness. According to the 2002 FEIS, areas considered to be most distinctive in the study area occur along the major drainages and canyons. The Animas River, Florida River, and Pine River valleys, and Cherry Creek Canyon, Long Hollow Canyon, and Red Horse Gulch were found in the 2002 FEIS to have the most distinctive scenic qualities in the study area (USDI 2002a).

To determine the levels of scenic quality of specific landforms within the study area, general landform areas identified on Map 24 (USDI 2002a), such as the Animas River valley, were evaluated on standardized scenic quality ranking forms using criteria identified on Table 3-18. The results of ratings for the various landform units in the study area are identified on Map 3-12 (Appendix A). Areas such as the Fruitland Escarpment and the La Plata River valley, which were not identified in the 2002 FEIS as scenic, along with Navajo Reservoir and other water features, were rated as having distinctive scenic quality due to their unique characteristics.

### Table 3-18. Scenic Quality Inventory and Evaluation Chart.

| Key Factors | Rating Criteria and Scoring For Physiographic Areas | | |
|---|---|---|---|
| **Landform** | High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. | Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. | Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. |
| **Scoring** | **5** | **3** | **1** |
| **Vegetation** | A variety of vegetative types as expressed in interesting forms, textures, and patterns. | Some variety of vegetation, but only one or two major types. | Little or no variety or contrast in vegetation. |
| **Scoring** | **5** | **3** | **1** |
| **Water** | Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. | Flowing, or still, but not dominant in the landscape. | Absent, or present, but not noticeable. |
| **Scoring** | **5** | **3** | **0** |
| **Color** | Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. | Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. | Subtle color variations, contrast, or interest; generally mute tones. |
| **Scoring** | **5** | **3** | **1** |
| **Influence of Adjacent Scenery** | Adjacent scenery greatly enhances visual quality. | Adjacent scenery moderately enhances overall visual quality. | Adjacent scenery has little or no influence on overall visual quality. |
| **Scoring** | **5** | **3** | **0** |
| **Scarcity** | One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. | Distinctive, though somewhat similar to others within the region. | Interesting within its setting, but fairly common within the region. |
| **Scoring** | **5+** | **3** | **1** |
| **Cultural Modifications** | Modifications add favorably to visual variety while promoting visual harmony. | Modifications add little or no visual variety to the area, and introduce no discordant elements. | Modifications add variety but are very discordant and promote strong disharmony. |
| **Scoring** | **2** | **0** | **-4** |

Source: Modified from BLM 2007a.

Note: Values for each rating criteria are maximum and minimum scores only. It is also possible to assign scores within these ranges.

### 3.9.2 Visual Characteristics of Current Development

Refer to Section 3.9.3, Photograph 3-1 to 3-15 and Table 3-28 in the 2002 FEIS for a detailed discussion of visual characteristics of current development on the Reservation (USDI 2002a).

### 3.9.3 Visual Characteristics Summary

To determine the most high to moderate visual resource values for locations within the study area, overlays of the sensitive viewshed locations, distance zones, and scenic quality rankings were examined. This technique is similar to that used by the BLM in visual resource evaluations on lands managed by that agency. By overlaying and comparing sensitive viewshed locations in the study area with areas seen in the foreground or middleground, and areas with distinct to common scenic qualities, visual resource values in the study area were identified and are defined in Table 3-19 and shown on Map 3-13 (Appendix A).

Level I is typically assigned to all special areas where the current management objectives require maintaining a natural environment essentially unaltered by man. No Level I areas have been identified in the study area. Levels II, III, and IV are assigned based on combinations of scenic quality, resource values, and distance zones as shown in Table 3-19. The management objectives for Levels II, III, and IV are as follows:

- **Level II Visual Resource Value**: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.

- **Level III Visual Resource Value**: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.

- **Level IV Visual Resource Value**: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

**Table 3-19. Determining Visual Resource Values**

| | | Sensitive View Location Use | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | High | | | Medium | | | Low |
| Special Areas | | I | I | I | I | I | I | I |
| Scenic Quality | A | II | II | II | II | II | II | II |
| | B | II | III | III[a] | III | IV | IV | IV |
| | | | | IV[a] | | | | |
| | C | III | IV | IV | IV | IV | IV | IV |
| Distance Zones[b] | | f/m | b | s/s | f/m | b | s/s | s/s |

Source: Modified from BLM 2007b
[a] If adjacent areas is Level III or lower assign Level III, if higher assign Level IV
[b] Distance zones: f/m = foreground-middleground, b = background, s/s = seldom seen

The 2002 FEIS generally identified the Cherry Creek, Long Hollow, Animas, Piedra, and Florida rivers, and Navajo Reservoir as areas of high scenic attractiveness. Additional analysis, indicates that sensitive and high use viewpoints with foreground and middleground views overlap with areas of high to moderate scenic quality in the Navajo Reservoir area, along the river drainages, including the La Plata, Animas, Los Piños, Florida rivers, and Cherry Creek, Long Hollow, and along major travel routes, including Wildcat Canyon Road, SH 140, U.S. Highways 550 and 151. Residences scattered throughout the study area can also occur within sensitive viewsheds.

Based on overlaying and updating modeled data from the 2002 FEIS, visual resource value levels were identified in the study area in order to analyze potential impacts and to provide land managers with additional information to determine appropriate design features to minimize impacts to visual resource values. No Level I areas were identified. Within the study area approximately 19% is classified as Level II, 15% as Level III, and approximately 66% as Level IV.

Oil and gas well development has and is currently occurring within the study area. Since 2002, approximately 86 CBM and conventional wells have been drilled within the study area on Tribal minerals and/or surface as approved in 2002. Approximately 10 of these wells have been drilled within 0.25 mile of sensitive viewpoints (Map 2-1, Appendix A). These include two wells within the Animas River/U.S. Highway 550 corridor, one well within the Florida River corridor, and seven wells in the Los Piños River/Colorado SH 172 corridor (with five others located nearby). There are no wells drilled to date within 0.25 mile of recreational areas and the majority of wells were drilled in relatively remote areas. A total of 506 wells have been drilled to date on Tribal and private lands located in the study area, including those drilled since approval of the 2002 ROD.

Photographs of typical natural gas well pad equipment may be found in the 2002 FEIS (USDI 2002a). All of these structures are prominent in the immediate view of the observer, and most are prominent in the foreground view with only the smallest being subordinate. Small scale equipment structures, well heads, and meter houses are the most common oil and gas equipment identified throughout the study area. Well pads are prominent from middleground to background and aerial views while the associated equipment structures are not prominent. Pipeline ROWs, well pads and access roads are the most prominent features associated with well development. Large support facilities, such as water injection well facilities, compressor stations, and gas plants are less common, but are prominent from immediate foreground to middleground and subordinate in background and aerial views.

## 3.10 Socioeconomics

This section describes socioeconomics and includes baseline information for Archuleta, La Plata, and Montezuma counties in Colorado, and Rio Arriba and San Juan counties in New Mexico, and Reservation demographic data (population, housing, economic activity in terms of employment and personal income, public infrastructure and services, and local government and Tribal finances). Information for socioeconomics from the 2002 FEIS is incorporated by reference (USDI 2002a).

### 3.10.1 Demographics

The following subsection summarizes population growth and trends, age distribution, racial, and ethnic characteristics of the population in the area of influence (the SJB).

Historic population and projections are presented in Table 3-20 for each of the five counties and the Reservation.

**Table 3-20. Historic Population and Projections in the Area of Influence.**

| State/County Area | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| **Colorado** | 4,334,000 | 4,706,800 | 5,149,100 | 5,640,000 | 6,137,500 |
| Archuleta | 10,000 | 11,900 | 14,300 | 16,800 | 19,700 |
| La Plata | 44,600 | 48,200 | 54,800 | 61,500 | 68,200 |
| Montezuma | 23,900 | 25,500 | 28,100 | 31,100 | 34,100 |
| SUIT members | 1,305 | 1,415 | 1,480 | 1,555 | 1,635 |
| **New Mexico** | 1,826,300 | 1,971,000 | 2,113,000 | 2,251,300 | 2,383,200 |
| Rio Arriba | 41,300 | 43,100 | 45,100 | 47,000 | 48,700 |
| San Juan | 114,300 | 121,400 | 128,600 | 135,500 | 142,100 |

Sources: U.S. Department of Commerce 2007
2010-2020 population forecast from Colorado Department of Local Affairs (2007), University of New Mexico Bureau of Business and Economic Research (UNM-BBER 2004). SUIT members estimated to grow at 1% growth rate per year.

The State of Colorado has been averaging population growth of about 2% annually since 1995. During that time, population in the southwestern part of the state has grown at an average annual rate of about 3% or higher. Between 1990 and 2005, population in Archuleta County more than doubled, La Plata County grew by 50%, and Montezuma County by 33%. The State of New Mexico experienced a 30% increase in population between 1990 and 2005. During that time, Rio Arriba County grew by 25% and San Juan County by 33%. The population within exterior boundaries of the Reservation has experienced similar growth increasing by more than 33% between 1990 and 2000. Tribal enrollment has grown from 1,305 in 1995 to 1,415 in 2005. Member growth is estimated to increase at an average annual rate of 1% in the future.

Population growth in and around the study area has been driven by two forces: 1) natural gas development in the SJB that has accelerated job and income growth in the region; and 2) amenity migration or people moving into the area for quality of life such as young retirees moving to the area for natural beauty and recreation opportunities as well as lower cost of living. These amenity migrants bring a large source of non-labor income (rental and investment income and social security) that serves to stabilize and diversify the local economy.

Table 3-21 presents population totals for incorporated cities within the five-county area. The town of Ignacio is the largest community on the Reservation and serves as a shopping, medical, and service center. The SUIT government and most of its services are located adjacent to the town of Ignacio, making it an employment and cultural center as well, especially for Tribal members. The primary municipalities serving the oil and gas industry in the area are Durango, Cortez, Ignacio, and Farmington. The service companies draw employees from throughout the five-county area.

**Table 3-21. Population of Municipalities in the Area of Influence.**

| State/Community | 1990 | 2000 | 2005 |
|---|---|---|---|
| **Colorado** | 3,294,400 | 4,334,000 | 4,706,800 |
| Bayfield | 1,100 | 1,550 | 7,730 |
| Durango | 12,400 | 13,900 | 15,900 |
| Pagosa Springs | 1,200 | 1,600 | 1,640 |
| SUIT Reservation | 7,800 | 11,200 | 13,000 |
| Town of Ignacio | 720 | 670 | 750 |
| **New Mexico** | 1,515,100 | 1,826,300 | 1,971,000 |
| Farmington | 34,000 | 37,800 | 43,200 |
| Chama | 1,100 | 1,200 | 1,170 |
| Bloomfield | 5,200 | 6,420 | 7,440 |
| Aztec | 5,500 | 6,380 | 7,080 |

Source: U.S. Department of Commerce 2007

According to U.S. Census data from 2000, the median age was 34.3 in Colorado and 34.6 in New Mexico. In 2000, the median age in Archuleta County was 40.8; 35.6 in La Plata County, and 27.5 on the Reservation. This range of median ages reflects migration and growth patterns in southwestern Colorado. Archuleta County has been attracting retired amenity migrants. On the Reservation, population growth has been maintained through birthrates.

Table 3-22 summarizes 2000 census information on race and Hispanic origin for the area of influence. Whites comprised between 80% and 81% of the population in the Colorado counties and between 53% and 57% of the population in the New Mexico counties. The Native American population ranged between 1% and 37% of the population in the five counties, being most significant in Montezuma, Rio Arriba, and San Juan counties. According to the 2000 census, non-white race populations comprised 19% of the Reservation, and Hispanics of any race comprised 15% of the Reservation population. Native Americans represented 13% of the population living on the Reservation. The term “tri-ethnic community” has been used to describe Ignacio because of the mix of white, Hispanic, and Native American residents living there (Keck 1994).

**Table 3-22. Race and Hispanic Origin in 2000 in the Area of Influence.**

| State or County | White | Black | Native American | Asian-Pacific | Other | Hispanic Latino[a, b] | Hispanic White[c] |
|---|---|---|---|---|---|---|---|
| Colorado | 82% | 4% | 0.1% | 0.2% | 10% | 17% | n/a |
| Archuleta | 87% | 0.1% | 1% | 0.1% | 10% | 17% | n/a |
| La Plata | 86% | 0.1% | 6% | 0.1% | 6% | 10% | n/a |
| Montezuma | 81% | 0.1% | 11% | 0.1% | 7% | 9% | n/a |
| SUIT Reservation | 78% | 0.1% | 13% | 0.1% | 6% | 15% | n/a |
| New Mexico | 57% | 2% | 10% | 1.1% | 17% | 42% | 45% |
| Rio Arriba | 57% | 0.3% | 14% | 0.1% | 26% | 73% | 14% |
| San Juan | 53% | 0.4% | 37% | 0.3% | 7% | 15% | 47% |

Source: U.S. Census Bureau 2000

[a] The total population and the Hispanic/Latino population are not affected by whether data on race are for race alone, for race in combination, race alone or in combination.

[b] Since the question on Hispanic ethnicity was asked separately from the question regarding racial identification, persons of Hispanic or Latino origin can be of any race. Adding percentages of Hispanic (or non-Hispanic) persons to the sum of percentages by racial category will result in double counting.

[c] Percent of respondents who are non-Hispanic and who identified with only the White racial category. Non-Hispanic Whites are often referred to as Anglos in the American Southwest.

### 3.10.2 Housing

Housing characteristics of the area of influence and the Reservation, including housing units and vacancy rates, are discussed in this section and summarized in Table 3-23. Vacancy rates in the study area for year-round housing range between 7% and 13%. Rental housing has been in short supply in both Durango and other portions of La Plata County because of demand created by students at Fort Lewis College and employees in the tourism- and recreation-based economy, as well as positive net migration driven by employment growth (La Plata County 2002).

**Table 3-23. 2000 Housing Characteristics in the Area of Influence.**

| Location | Housing Units | Vacant Units (without seasonal housing) | Vacancy Rate Available Housing (%) |
|---|---|---|---|
| **Colorado** | | | |
| Archuleta | 6,200 | 780 | 13 |
| La Plata | 20,800 | 980 | 5 |
| Montezuma | 10,500 | 800 | 7 |
| SUIT Reservation | 4,800 | 340 | 7 |
| **New Mexico** | | | |
| Rio Arriba | 18,000 | 1,900 | 11 |
| San Juan | 43,200 | 3,800 | 9 |

Source: Colorado Department of Local Affairs 2008, UNM-BBER 2004

The effect of CBM wells on property values in La Plata County was previously studied using a hedonic pricing model that quantified variation in selling prices for residential properties with a CBM well on the property (BBC 2001). The study found that there was an estimated net reduction in selling price of about 22% for residential properties with CBM wells on the property sold between 1989 and 2001. However, when accounting for other factors, the study estimates that an "average property" would have an estimated reduction in selling price of less than 1%.

### 3.10.3 Economic Activity

This subsection summarizes economic activity within the area of influence, including employment and income. Table 3-24 presents 2005 data on the labor force and unemployment situation for the states, the five project region counties, and the Reservation.

**Table 3-24. 2005 Labor Force and Unemployment Statistics in the Area of Influence.**

| State/County | Civilian Labor Force | Total Unemployment | Unemployment Rate (%) |
|---|---|---|---|
| **Colorado** | 2,511,900 | 140,400 | 5.6 |
| Archuleta | 6,035 | 317 | 5.3 |
| La Plata | 30,009 | 1,163 | 3.9 |
| Montezuma | 12,970 | 693 | 5.3 |
| **New Mexico** | 916,300 | 50,500 | 5.5 |
| Rio Arriba | 21,881 | 1,295 | 5.9 |
| San Juan | 54,491 | 2,976 | 5.5 |

Source: U.S. Department of Labor 2005

In the five-county area in 2005, unemployment was lowest in La Plata County and highest in Rio Arriba County. Unemployment of both Tribal member and non-Tribal persons on the Reservation was 12% in 2005 (U.S. Department of Labor 2005). Current estimates of unemployment among Tribal members are not available.

Table 3-25 presents employment data by sector for the five counties in the area of interest. Services and government are dominant employment sectors in all five of the study area counties, reflecting the importance of tourism and recreation in the area. Popular tourist attractions include the Durango-Silverton Narrow Gauge Railroad, Mesa Verde National Park, and Durango Mountain Resort. The services sector is strongest in Montezuma, Rio Arriba, and La Plata counties. Mining (including oil and gas production), transportation, communications, and public utilities are strong sectors in San Juan County, and public administration and construction are also relatively strong in Rio Arriba County.

**Table 3-25. 2005 Employment Statistics by Sector and County.**

| | Colorado Counties | | | New Mexico Counties | |
|---|---|---|---|---|---|
| **Sector** | **La Plata** | **Montezuma** | **Archuleta** | **Rio Arriba** | **San Juan** |
| Agriculture | 2% | 7% | 4% | 1% | 1% |
| Mining and Utilities | 2% | 2% | 1% | 2% | 13% |
| Construction | 11% | 9% | 16% | 5% | 8% |
| Manufacturing | 3% | 4% | 1% | 2% | 3% |
| Transportation & Warehousing | 2% | 2% | 1% | 1% | 3% |
| Trade (Retail + Wholesale) | 14% | 15% | 16% | 14% | 16% |
| Finance, Insurance & Real Estate | 6% | 5% | 11% | 2% | 3% |
| Services | 43% | 31% | 38% | 31% | 30% |
| Government | 17% | 25% | 12% | 42% | 23% |

Source: Region 9 Report – Revised 2007 and New Mexico Department of Labor, Economic Research and Analysis Bureau 2005.

The top five employers in La Plata County, by number of employees in 2005 was the SUIT (1,091), Mercy Medical Center (750), Durango School District (660), Fort Lewis College (650), and Federal Government (459) (La Plata Economic Development Action Partnership [LEAD] 2007).

The oil and gas industry has traditionally been an important source of employment in the area of influence, especially La Plata County. In La Plata County, the number of people employed in the oil and gas industry fell between 1990 and 1999; however, total earnings increased, resulting in a dramatic rise in per capita earnings as shown in Table 3-26. Although these increases in per capita earnings were substantial, they represent a small share of the total earnings in La Plata County. In 1999, earnings by employees of the oil and gas industry accounted for only about 1.9% of all earnings in the county (La Plata County 2002).

The major economic sectors of the Reservation include government, energy development, casino gambling, and agriculture. As reported above, the SUIT was the largest employer in La Plata County in 2005. The Tribe and its enterprises employed over 1,400 individuals in 2006 with more than 350 working at the SUIT Casino (SUIT 2007b).

**Table 3-26. Measures of Income in Colorado and New Mexico Counties.**

| State/County | Per Capita Income ($) | | Median Household Income ($) | | Percent of population for whom poverty status is determined |
|---|---|---|---|---|---|
| | 1995 | 1999 | 1995 | 1999 | 1999 |
| **Colorado** | $19,347 | $24,000 | $30,140 | $47,200 | 9% |
| Archuleta | $23,083 | $21,700 | $22,894 | $37,100 | 12% |
| La Plata | $15,932 | $21,500 | $34,137 | $40,200 | 12% |
| Montezuma | $14,477 | $17,000 | $22,491 | $32,100 | 16% |
| Reservation | $10.400 | $16,900 | $24,100 | $35,000 | 12% |
| **New Mexico** | $12,095 | $17,300 | $25,851 | $34,100 | 18% |
| Rio Arriba | $8,935 | $14,300 | $20,718 | $29,400 | 20% |
| San Juan | $10,097 | $14,300 | $25,723 | $33,800 | 22% |

Source: U.S. Census 2000

In the five-county study area, median household and per capita income levels were below the respective state averages in 2000. Similarly, the proportion of the population below the poverty status was higher in the five counties than in the states as a whole. The percentages of persons below poverty status ranged from 12% in La Plata County to 22% in San Juan County. Annual dividends, retirement payments, and other forms of revenue sharing have kept Tribal members above poverty status from 2000 to 2006 (Brian Zink, personal communication, 3/12/2007).

### 3.10.4 Public Infrastructure and Services

Since the 1970s and the passage of the Indian Self-Determination and Education Assistance Act an its implementing regulations, the SUIT has greatly increased services provided by the Tribal government. In 1980, the Tribe implemented an aggressive program to manage its resources, and in 1999 the plan was restructured to clearly support the Tribe's Long Term Financial Plan (LTFP). That plan continues to be updated including a Campus Master Plan which outlines the long-term development goal for SUIT.

The growth and development of SUIT infrastructure has led to an increase in the Tribe's ability to provide housing, utilities, office space, social services, municipal water supply, sewage treatment, and educational facilities. Housing has increased through both construction and leasing of modular homes. The new Leonard C. Burch Administrative Building now houses most Tribal governmental offices. A new water supply and treatment system has been constructed and updated within the past five years. Construction of the Southern Ute Academy was completed in 2000 which provides education to Southern Ute Indian children from birth to $6^{th}$ grade. Tribal students from grades 6 through 12 may attend schools in Ignacio, Durango, or Bayfield. Ignacio School District 11 consists of one high school, one junior high, one intermediate and one elementary school. A total of 1,054 students attended Ignacio schools in 2000 (LEAD 2007).

There has been an increase in the level of social services provided through SUCAP, and a broad range of family programs are provided through the Tribal Court System. The Sun Ute Community Center features state-of-the-art recreational facilities. Projects that have been funded as a result of long-term planning are the Tribal Life Insurance Fund, Scholarship Fund for college and graduate education of Tribal members, construction and building repair projects such as the new Justice Center, The Sun Ute Community Center, the wastewater treatment plant, and the Tribal Elders Per Capita Fund (pension fund).

Public facilities and services that are most sensitive to population growth include roads and bridges, law enforcement, administrative services, social services, public education, and water and wastewater services. Of these, La Plata County provides non-Tribal services in unincorporated areas with the exception of education, water, and wastewater. However, there is a cooperative agreement with La Plata County and the SUIT to maintain roads. The Tribe is continuing with its overall Master Plan to expand its administrative, social, educational, utility, and environmental services.

### 3.10.5 Local Government and Tribal Finances

Refer to Section 3.10.6 of the 2002 FEIS for a detailed discussion of major oil and gas related revenue sources for the SUIT (USDI 2002a).

In the 2002 FEIS, the finances of the SUIT government are described at length because of the dominant role of energy development in maintaining the Tribe's fiscal health. However, the SUIT regards the details of its finances as proprietary, non-public information. For this reason, much of the material on Tribal finances is presented as percentages or averages rather than in absolute dollars.

The SUIT is nationally known as a prudently managed Indian Tribe. The SUIT is the first and only American Indian tribe to receive the highest possible ratings from two national credit-rating agencies (Dugan 2003). This is due mainly to the development and implementation of the SUIT's LTFP. Diversification of investments, both on and off the Reservation, as outlined in the Plan in 1999, have reduced the SUIT's total reliance on on-Reservation oil and gas revenues. In 2003, 87% of SUIT's operating revenues were from oil and gas related activities on the Reservation. In 2006, 51% of operating revenues came from this source. Changes to the LTFP and the structural and operating results are detailed in Section 3.10.6 of the 2002 FEIS.

#### LOCAL GOVERNMENT FINANCES

La Plata, Montezuma, and Archuleta counties continue to maintain robust budgets and strong levels of general government as demonstrated by the continuous revenue growth between 2000 and 2005. Revenue sources and expenditures are summarized in Table 3-27 and Table 3-28 for the three counties for 2005.

**Table 3-27. 2005 Property Tax Sources for La Plata, Archuleta and Montezuma Counties.**

| Property Tax Source | Archuleta | La Plata | Montezuma |
|---|---|---|---|
| Oil, Gas and Natural Resources | 2% | 61% | 30% |
| Residential Property | 43% | 16% | 29% |
| Commercial and Industrial Property | 19% | 13% | 20% |
| Agricultural Property | 2% | 1% | 3% |
| Vacant Land | 30% | 6% | 6% |
| State Assessed Taxes | 4% | 3% | 11% |
| **Total Revenue** | **$15,100,000** | **$73,300,000** | **$16,800,000** |

Source: Archuleta, La Plata, and Montezuma County; Abstract of 2005 Assessment and Summary of Taxes

**Table 3-28. 2005 Expenditures for La Plata, Archuleta, and Montezuma Counties.**

| | Archuleta | La Plata | Montezuma |
|---|---|---|---|
| County General Fund | 23% | 24% | 18% |
| Road/Bridge | 5% | 2% | 4% |
| Social Services | 1% | 1% | 3% |
| School Districts | 38% | 51% | 45% |
| Cities | 1% | 1% | 2% |
| Special Districts | 31% | 18% | 28% |
| Other | 1% | 3% | |

Source: Archuleta, La Plata, and Montezuma County; Abstract of 2005 Assessment and Summary of Taxes

Oil and gas development contributes to county, city, school and special district revenues primarily through the *ad valorem* property tax on oil and gas production and field equipment. These taxes are levied on the assessed value of oil and gas produced in the preceding year, the treatment and transmission facilities located within the county, and personal property tied to the production of gas.

Table 3-29 indicates 2005 assessed values of total real and personal property and of oil and gas property, and 2005 property tax collections in Archuleta, La Plata, and Montezuma counties. Oil and gas assessed value represents 2% of total assessed valuation in Archuleta County, 61% in La Plata County, and 30% in Montezuma County. It should be noted that in Montezuma County *ad valorem* property tax is primarily on production and field equipment for carbon dioxide extraction rather than oil and gas.

**Table 3-29. Assessed Values and Property Taxes for Archuleta, La Plata and Montezuma Counties.**

| County | Total Assessed Property Value 2005 | Oil and Gas Assessed Property Value 2005 | County Property Tax Revenues 2005[a] |
|---|---|---|---|
| Archuleta | $223,768,400 | $5,310,727 | $4,100,000 |
| La Plata | $2,483,085,200 | $1,510,431,260 | $18,100,000 |
| Montezuma | $304,019,100 | $92,338,450 | $4,300,000 |

[a] County governments only; school and other special districts are funded separately.

La Plata County is the most sensitive to changes in oil and gas production compared to the other two counties. As a result, the remainder of this section focuses on La Plata County. Between 2000 and 2005, oil and gas related properties have comprised half or more of all the taxable assessed property in La Plata County (La Plata County 2006). In 2003 and 2005, property taxes comprised about one third of total revenue sources for La Plata County. Recent studies on the impacts of natural gas development on La Plata County have found that because oil and gas production and property comprises about half of all property taxes, if this tax revenue were to be eliminated, La Plata County residents would pay about one and half times more property tax. The property tax bill for La Plata County businesses would triple (La Plata County 2002; La Plata County Energy Council 2005).

As illustrated in Table 3-28, school districts within La Plata County have received about half of all county revenues. However, school funding is provided primarily by the property tax mill levy. For 2005, La Plata County's mill levy was 8.5, the Durango School District 9R mill levy was 16.347; Bayfield School District was 19.429; and the Ignacio School District mill levy was 6.217 (La Plata County 2007b) With oil and gas production comprising, about half of all assessed properties in La Plata County, it also is supporting a large share of La Plata County school district funding. In November 2002, voters approved an $84.5 million construction bond to expand, repair, and renovate the district's schools. They also approved a $2.4 million mill-levy override to fund program improvements, provide salary increases for teachers and staff, and fund long-term maintenance and repair. The mill-levy offset recent state and federal budget cuts (LEAD 2007).

In 1996, La Plata County and the State of Colorado negotiated a taxation compact with the SUIT (House Bill 96-1367). That taxation compact recognized that all Indian trust lands within the Reservation were exempt from property taxation. However, even under that compact, production and equipment associated with the leasehold interests of non-tribal lessees is subject to such taxation. The compact also provided that all lands held by the Tribe in its own name in fee within the exterior boundaries of the Reservation were not to be subject to property taxation. As to those lands, the Tribe contributes payments in lieu of taxes (PILT) to La Plata County that are distributed proportionately to appropriate special districts, the County General Fund, Road and Bridge, and the Social Services Fund. The PILT in 2005 amounted to $260,000 (La Plata County Budget 2007).

Another source of state and local revenue related to oil and gas development are severance taxes. Severance tax is not assessed on working interests owned by the SUIT, but is assessed on other properties within the exterior boundaries of the Reservation.

Table 3-30 illustrates 2006 county and local receipts for direct severance tax distributions and energy impact assistance grants and payments. In recent years, La Plata County has used severance tax distributions and grants for projects such as road and bike path construction, public library construction, and wastewater treatment facility upgrades.

**Table 3-30. 2006 Distribution of Severance Tax and Energy Impact Assistance Grants.**

| Jurisdiction | Severance Tax Direct Distribution 2006 | Energy Impact Assistance Grants 2006 |
|---|---|---|
| **Archuleta County** | $6887 | $500,000 |
| Town of Pagosa Springs | $6887 | $40,000 |
| Upper San Juan Health Service District | $0 | $500,000 |
| **La Plata County** | $363,036 | $2,850,000 |
| Town of Bayfield<br>Bayfield School District | $55,581 | $460,000 |
| City of Durango | $143,041 | $1,500,000 |
| Town of Ignacio | $13,775 | $500,000 |
| **Montezuma County** | $64,392 | $476,000 |
| City of Cortez | $22,587 | $53,500 |
| Town of Dolores | $13,775 | $286,300 |
| Town of Mancos | $962 | $950,000 |

Source: Colorado Department of Local Affairs 2007

The COGCC also receives funding for its administration from a conservation levy based on the value of production. This levy is adjusted regularly depending on natural gas production and COGCC budget needs. The structure and funding for COGCC was evaluated by the 2007 legislature and changes are expected.

The Minerals Management Services (MMS) helps the Tribe account for royalties collected by the Tribe from energy producers operating on Tribal lands. In 2000, MMS implemented a final Indian Gas Valuation Rule that made several significant changes to valuation methods. This rule made valuation of Indian gas more efficient for companies and MMS and at the same time fulfilled MMS' trust responsibility to the Indian community. MMS collected $43,507,870 from American Indian leases located within the State of Colorado and disbursed that amount to the BIA to be distributed to the applicable Indian owners including the SUIT (USDI 2003c).

The state of Colorado, as well as county and municipal governments that assess local sales tax, also accrue sales tax revenues. In Colorado, the state sales tax is 2.9% (Colorado Department of Revenue 2007). In Archuleta County, the county sales tax rate is 4.0% and in Montezuma County it is 0.45%. In La Plata County, the county sales tax rate is 2.0%. Table 3-31 shows retail sales and sales tax revenues for the Colorado counties in the area of influence.

**Table 3-31. 2005 Retail Sales and Sales Tax Revenues for Archuleta, La Plata and Montezuma Counties.**

| | Archuleta | La Plata | Montezuma |
|---|---|---|---|
| Retail Sales | $216,516,000 | $1,321,380,000 | $684,010,000 |
| State Sales Tax Collected | $4,500,000 | $11,558,000 | $500,000 |
| County Sales Tax Rate | 4.0% | 2.0% | 0.45% |

Sources: Region 9 2007, Archuleta County 2005, La Plata County 2007b, Montezuma County 2005, Colorado Department of Revenue 2007

In New Mexico the sales tax (called the Gross Receipts Tax) varies among counties and cities. In Farmington (San Juan County, New Mexico) it amounts to 7%; while in the remainder of the county it is 5.6875% (Farmington Chamber of Commerce 2007a).

**TRIBAL FINANCES**

Tribal finances have changed significantly since the 2002 FEIS because the Tribe implemented a new LTFP in 2000. Primarily, the LTFP has reduced the Tribe's total dependence on oil and gas development on the Reservation for operating revenues. The changes in organization and financial results created by the new LTFP are explained below.

Since 1980, the SUIT has implemented an aggressive program to manage its resources, primarily energy resources, in the manner most beneficial to the long-term financial goals of the Tribe. In recent years the Tribe's income, primarily from oil and gas related revenues, has financed a tripling of Tribal government programs, supported the start up of several new business enterprises, built a substantial Capital Reserve Fund, and still produced an annual budget surplus sufficient to make per capita payments to Tribal members. Grants and contracts, primarily funded through various agencies of the federal government, are decreasing in both absolute dollars and importance, although they remain substantial. The Tribal government manages its programs through funds administered by the Tribal Council. The Permanent Fund is the source of funding for Tribal administration and for numerous benefit and cultural programs from Tribal police to home health care. A number of long-term benefit programs and all the business enterprises are managed through individual funds, such as the Elders Per Capita Fund (pension) and the Lake Capote Fund (recreational enterprise). The Severance Tax Fund and Capital Reserve Fund are used to gather and distribute funds for qualifying new programs and for large capital expenditures.

In 1999, the SUIT began implementation of its LTFP to more clearly support the Tribe's goals. The SUIT recognizes that their current level of energy revenues based on production within the Reservation boundaries will inevitably decrease over time with the depletion of reservoirs. The LTFP aims at establishing a sound financial base for the Tribe in the future by managing spending and investing in a balance of conservative and growth oriented opportunities. Under the revised LTFP, Tribal governmental revenues are collected through and from a Revenue Accumulator into three funds:

- Permanent Fund
- Growth Fund
- Restricted Fund

Details about the Permanent Fund and Growth Fund are included below. The Revenue Accumulator Fund collects the Tribes royalty and severance taxes and allocates those according to the LTFP. In 2006, about 50% of these tax revenues were allocated to the Permanent Fund and the remainder to the Growth Fund. The Restricted Fund holds revenues that have restricted uses as well as in which where the Tribe holds a fiduciary for the benefit of individual Tribal members.

## PERMANENT FUND

The Permanent Fund is used to manage governmental services and benefits for Tribal members. The objective of the Permanent Fund is to create a pool of financial resources sufficient to ensure that Tribal Government exists into perpetuity. Table 3-32 shows the percentage of operating revenues from Reservation and energy sources. In four years reliance on energy development on the Reservation for operating revenues was cut from almost more than 9 out of 10 dollars to about one half.

**Table 3-32. Percentage Operating Revenues from Energy Development on Reservation.**

| Year | Percentage of Operating Revenues |
|---|---|
| 2006 | 51% |
| 2005 | 53% |
| 2004 | 75% |
| 2003 | 87% |

Source: SUIT 2007b

Before 1999, most of the Tribal government's programs were budgeted through the General Fund. Many of these accounts are now included in Governmental Expenditures under Permanent Fund. Table 3-33 shows the major categories of spending from the Permanent Fund and the approximate average spending in each category from 2000 to 2006. Spending policy allows for 5% year over year growth in Governmental Spending.

**Table 3-33. Average Governmental Expenditures 2002 though 2006.**

| | Percent 2000-2006 Average |
|---|---|
| General Government | 28% |
| Education Programs | 8% |
| Justice and Regulator | 9% |
| Natural Resource Management | 4% |
| Other Government Services | 9% |
| Tribal Member per Capita Distribution | 19% |
| Capital Projects and Debt Service | 24% |
| Total | 100% |

Source: Brian Zink, SUIT, Personal Communication 3/12/2007

## GROWTH FUND

The SUGF is designed to diversify the Tribe's revenue stream, reduce the Tribe's reliance on its own on-Reservation energy estate, and improve the economic conditions for the membership. The SUGF includes all of the business entities of the Tribe except the Sky Ute Lodge and Casino (which is under the Permanent Fund). The four major groups of the Growth Fund are:

- **Energy Group**, including Red Willow Production Company, Red Cedar Gathering Company, and ka Energy Group, LLC (oil and gas exploration, transportation, and development).
- **Real Estate Group**, including GF Properties Group, LLC, GF Development Group LLC, and Tierra Group, LLC.
- **GF Private Equity Group**, (merchant banking and investment).
- **Building Materials Group**, including Sky Ute Sand and Gravel, LLC (construction aggregate, asphalt and concrete materials supply and processing).

Growth Fund total assets tripled between 2004 and 2006 (SUIT 2007b). This is due to aggressive development and investment strategies as well as a doubling of natural gas prices.

## 3.11 Noise

This section describes the existing noise environment on the Reservation. Information on noise environment from the 2002 FEIS is incorporated by reference.

### 3.11.1 Noise Issues

Land uses on the Reservation include undeveloped forest and grassland areas, rural agricultural and residential areas, the urban area of Ignacio, and areas of oil and gas development. Each of these land use areas has an associated background noise level ranging from very low to non-existent noise levels associated with undeveloped areas on the extreme east and west ends of the Reservation, to urban and oil and gas development environments that have continuous background noise. Background noise levels vary depending on the time of day, weather patterns, amounts of vegetation, and topography.

Noise levels are measured utilizing instruments that are calibrated to measure dBA. The dBA scale is a measure of sound levels that are present at a given location that would be audible to the human ear. The dBA scale does not measure the levels of noise that may be present at a given location that would not be audible to the human ear, generally not measuring extremely low range noise and not measuring high pitched sounds. Some urban noises that represent the range of noise levels that are commonly heard are provided in Table 3-34.

**Table 3-34. Examples of General Noise Levels in Common Activity Areas.**

| Noise Generator | General Noise Level (dBA) |
|---|---|
| Construction Site | 85 |
| Pick-up Truck | 80 |
| Automobile | 65 |
| Residential Area (daytime) | 50 |
| Residential Area (nighttime) | 45 |
| Rural Area (nighttime) | 35 |
| Hearing threshold | 20 |

Refer to Section 3.11.2 in the 2002 FEIS for information on the existing noise environment in the study area. Regulatory and enforcement agencies of the SUIT generally follow appropriate regulatory standards as advisory levels without enforcement authority. These regulations specify maximum daytime (55 dBa) and nighttime (50 dBa) noise levels in residential and rural areas at a specified distances (350 feet) from an existing noise source. Oil and gas development and operational activities outside of the Reservation or on fee lands within the Reservation are regulated by the COGCC, which has a set of rules (800 Series – Aesthetic and Noise Control Regulations) limiting levels of noise that could be generated during construction and operation of oil and gas development facilities. A summary of the types of activities and the associated allowable noise levels are provided in Table 3-35.

**Table 3-35. COGCC Allowable Noise Levels for Oil and Gas Activities.**

| Oil and Gas Facility | Allowable Noise Level (dBA) |
|---|---|
| Residential/Agricultural/Rural (7 a.m. to 7 p.m.) | 55 |
| Residential/Agricultural/Rural (7 p.m. to 7 a.m.) | 50 |
| Industrial (7 a.m. to 7 p.m.) | 80 |
| Industrial (7 p.m. to 7 a.m.) | 75 |
| Short-Term exceedance (15 minutes maximum) | Increase of 10 dBA |

## 3.12 Health and Safety

The following section provides an update to health and safety issues as it relates to oil and gas development, hazardous and solid waste disposal activities and the coal outcrop fires. Information on health and safety from the 2002 FEIS is incorporated by reference.

### 3.12.1 Health and Safety Issues

The following health and safety issues were identified for oil and gas development on the Reservation (USDI 2002a): oil and gas field construction worker safety; public health and safety associated with oil and gas well pad construction and natural gas well operational activities (including increased travel on public roads); hazardous wastes, hazardous materials and non hazardous waste generation, transportation and disposal; potential releases of chemicals and compounds used in well drilling activities, and condensate fluids generated during natural gas well operation; seeps of methane and hydrogen sulfide gas; and coal outcrop fires. Each of these issues is discussed in detail in the 2002 FEIS (USDI 2002a). The following information is provided as an update.

Hazardous and solid waste disposal activities on the Reservation are managed by the USEPA – Region 6 office. A database search of federal permitted facilities for the proposed project area (zip code 81137) was performed through the USEPA web page (USEPA 2008). Facility database searches were performed with the Enforcement and Compliance History Online (ECHO) and Envirofacts search programs. Facilities searched included CAA stationary sources, CWA direct dischargers, and Resource Conservation Recovery Act (RCRA) permitted facilities. Five (5) RCRA permitted facilities were identified in the search. All the facilities were reported to be in compliance for the past 3 years. There are no Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priority List or Superfund sites located within the Reservation.

The coal outcrop fires located in the southwestern section of the study area continue to be monitored by Tribal Staff and their contractors. An additional area of surface burning was exposed in 2005, and the area is being studied to evaluate potential methods of controlling the fires (Bill Flint, personal communication, 5/25/2007). Access to the area is controlled as described in the 2002 FEIS (USDI 2002a).

# 4.0 ENVIRONMENTAL CONSEQUENCES

## 4.1 Introduction

This chapter describes the environmental effects associated with Alternative 1 - No Action and Alternative 2 - Proposed Action which would result from construction, operation and maintenance, and abandonment activities from gas development. Many of the impacts identified as a result of natural gas development occurring under the Alternative 1 also would occur under expanded natural gas activities associated with implementation of Alternative 2. Differences between the alternatives are compared by different levels of effects. As proposed, 80-acre infill would create impacts that overlap those occurring under Alternative 1.

Generally, impacts in this section are analyzed programmatically, by quantitatively estimating impacts without regard to site-specific information that is currently unknown. Ultimately, final well siting and associated impacts will be determined during the APD phase of well development. During this process each well would undergo site-specific environmental and cultural evaluation prior to construction as directed by the BLM and/or BIA. At that time additional design features could be implemented to minimize or avoid impacts to resources. In addition, the cumulative impact of this programmatic action and other past, present, and reasonably foreseeable future developments in and near the study area are considered in this chapter.

A detailed description of the surface disturbance impact analysis methodology is provided in Section 4.1.1. Both direct and indirect impacts are described for each environmental resource. The duration of the impacts are analyzed and described as either short-term (up to five years) or long-term (the life of the project and beyond).

### 4.1.1 Methodology for Impact Analysis

Programmatic environmental documents are written to analyze impacts on a broad scale. Inherently it is difficult to assess impacts in a programmatic document without the exact details of the proposed action (i.e., location of well sites). Although the majority (95%) of proposed 80-acre infill wells analyzed would be co-located, the exact location of those wells cannot be determined at this point due to specific reservoir drainage issues and the number of 160-acre CBM wells that have not yet been developed. Each well under the proposed action would be subject to individual environmental analysis after submittal of an APD. For this analysis, an impact assessment methodology was developed for the proposed action to consistently evaluate surface resource impacts.

In estimating the surface impacts of the proposed action, it is assumed that well locations could occur anywhere within the study area and that every point within the study area would have an equal probability of having a well location. A record of locations for both the entire past history of oil and gas well drilling as well as more recent oil and gas activities approved under the 2002 FEIS has been incorporated into this analysis. Therefore, a statistical test was conducted to determine how well the observed patterns of past oil and gas activities conform to the expectation that the distribution of proposed well drilling will be proportional to the availability of resources. The analysis also considers that conventional wells can be drilled anywhere, but CBM wells would only be drilled on areas overlaying the Fruitland coal formation. Finally, the proposed action and its estimated surface impacts pertain to drilling wells that access Tribal mineral estate.

To determine the suitability of an analysis based on the proportion of area, four statistical tests were performed. Test I analyzed the hypothesis that the recent patterns of conventional well locations (those approved and drilled under the 2002 FEIS) are proportional to the area. For example, if prime farmland occupies 35% of the Tribal mineral estate in the study area it would be expected that 35% of the wells drilled since Nov 1, 2002 would be located on prime farmland. A chi-square analysis was completed comparing the number of observed well locations to the expected number of well locations to determine if the null hypothesis was true. This hypothesis concluded that conventional wells drilled under the 2002 FEIS were not distributed proportional to area ($P = 0.01$). This P value can be interpreted as the probability that, if the hypothesis of proportional use were true, a random sample of 30 well locations (the number of conventional gas wells drilled since Nov 1, 2002) could be chosen that would deviate as much from the expected values and observed locations. Since the probability is very small, it is highly unlikely that wells are distributed proportional to their availability, and the hypothesis is rejected.

Test II analyzed the hypothesis that recent patterns of CBM well drilling are proportional to the area and this hypothesis was also rejected ($P = 0.004$). For this analysis the area used was restricted to calculate proportions to the Tribal mineral estate overlaying the Fruitland coal formation because that is the only part of the study area subject to CBM development.

Due to the fact that 95% of the wells expected to be drilled under the proposed action would be co-located on existing well pads, the hypothesis (theory) that existing well pads were distributed proportional to area was tested (TEST III) and this hypothesis was also rejected ($P < 0.001$).

As a result, the past patterns of oil and gas well development are not proportional to the area, and thus, would be an inappropriate assumption to make. The mechanism behind this conclusion is not known, but it is reasonable that given a choice of locations to drill, an operator will choose the location that can be drilled at the least cost in order to maximize profits. For instance, it appears that well locations are more likely than expected to occur on barren land, desert shrub, and grassland habitats than on montane forest, piñon juniper, or wetland habitats.

The final analysis (Test IV) tested the hypothesis that past development (existing well pads) outside the Fruitland coal outcrop is distributed the same as past development inside the Fruitland coal outcrop. This hypothesis failed to be rejected ($P = 0.65$), thus it was concluded that there is no evidence that past pattern of development of conventional wells outside the Fruitland coal outcrop differs from development inside; therefore, this was not included in the analysis.

On the basis of this analysis it was determined that future development will likely follow existing patterns. In addition, because it is known that 95% of the development proposed under Alternative 2 in this document will occur on existing well pads, it was determined that future impacts would be estimated based on the proportion of existing well pads that currently exist in a particular resource, not on the proportion of area that a resource occupies. For example, if prime farmland occupies 35% of the Tribal mineral estate in the study area, but 50% of the existing well pads on Tribal mineral estate are located on prime farmland it is assumed that 50% of the future development will also occur on prime farmland.

GIS was also used to derive information about the presence of a particular resource and the extent of potential surface impacts to that resource. Quantitative analysis of impacts for surface resources was obtained by proportional analysis, then by multiplying the number of wells by a construction disturbance factor consisting of 1.15 acres for co-located wells and 3.2 acres for new well locations. Impacts of surface disturbance were calculated and presented in two ways: (1) impacts from the development of new well locations, and (2) impacts if available existing pads are developed (co-location). A list of GIS sources is provided in Appendix H.

Alternative 1 would entail drilling 239 conventional wells and 311 CBM wells under the 160-acre spacing unit on Tribal mineral estate (Section 2.1.3). As of December 2007, 30 conventional wells and 56 CBM wells at 160-acre spacing have been drilled as approved in by the 2002 ROD. Under Alternative 1, the maximum short- and long-term disturbance would be approximately 2,035 acres and 1,399 acres, respectively.

Alternative 2 involves the construction of 770 new CBM wells on Tribal mineral estate, including 731 wells co-located on existing locations and 39 new well pads. Estimated maximum short-term surface disturbance under Alternative 2 would be approximately 965 acres, with 3.2 acres of disturbance for new well pads and 1.15 acres of disturbance for co-located wells. Estimated maximum long-term disturbance would be approximately 451 acres and 0.5 acres per well for co-located wells (Refer to Section 2.3.3).

Based on reservoir information and advances in technology, not all 636 wells analyzed in the 2002 FEIS are expected to be drilled. The additional incremental development anticipated under Alternative 2 would include a total of 347 conventional and CBM wells (Section 2.2.3). Previously approved continuing development under Alternative 1 would result in an estimated maximum short-term surface disturbance of approximately 1,239 acres. Estimated maximum long-term disturbance would be approximately 857 acres (Refer to Section 2.2.3). The total estimated disturbance under Alternative 2, including previously approved continuing development, would be 2,208 acres short-term and 1,286 acres long-term. Potential impacts from the anticipated incremental development previously approved are presented here to allow the reader a quantitative comparison of potential impacts of the total amount of development that could occur under Alternative 2.

It was assumed that interim reclamation of disturbed sites would occur following construction, drilling, and completion, reducing the total maximum acres disturbed. Therefore, the long-term disturbance factor was 2.2 acres for new well pad sites, and 0.5 acre for co-located pads.

Impacts for Chapter 4 are described as direct, indirect, short-term and long-term. Direct impacts include those occurring during the implementation of the action. Indirect impacts are caused by the action but occur later in time or farther removed in distance. Short-term impacts include those occurring during construction and drilling activities or those that are mitigated (i.e., reclamation of disturbed areas) within five years following construction. Long-term impacts include those that exist throughout or beyond the life of the project.

## 4.2 Air Quality and Climate

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect air resources within the air quality analysis area. As part of this analysis, an air quality technical support document was prepared to analyze potential impacts of Alternatives 1 and 2, as well as other reasonably foreseeable actions affecting air quality. The document is available in Appendix G. Air quality resources issues discussed include attainment status of the air quality analysis area, proposed minor source program, visibility in PSD Class I Areas, and Comprehensive Air

Quality Model (CAMx) modeling results. Design features specific to air quality are discussed in Section 2.4.2 and Appendix G.

### 4.2.1 Issues, Impact Types, and Criteria

Impacts to air quality would include the generation of fugitive dust and exhaust from construction and drilling activities, along with air pollutants emitted during operation (e.g., well operations, injection wells, compressor engines, etc.). These impacts could result in temporary and localized increases in ambient pollutant concentrations.

The potential for air quality impacts is limited by state-, Tribal-, and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. Those requirements include the NAAQS, which establish maximum limits for several air pollutants ($NO_2$, $SO_2$, CO, $PM_{10}$, $PM_{2.5}$, and $O_3$), and PSD increments, which limit the incremental increase of certain air pollutant concentrations (including $NO_2$, $PM_{10}$, $SO_2$) above legally defined baseline concentration levels.

The BLM uses the best available scientific information to identify thresholds of significant impacts where legal limits or standards have not been established. Refer to Section 3.2 for discussion on NAAQS. Under the FLPMA and the CAA, BLM cannot authorize any activity which does not conform to all applicable local, state, Tribal and federal air quality laws, statutes, regulations, standards, and implementation plans.

Currently, SUIT is developing a minor source permitting program that likely will mirror certain aspects of the proposed Federal Minor Source NSR Program, but which will be tailored towards the specific regulatory needs of the Reservation.

### 4.2.2 Impact Assessment Methodology

This analysis was prepared under the requirements of NEPA in order to provide sufficient evidence to determine whether to prepare an EIS or a Finding of No Significant Impact. Due to the conservative nature of the PEA analysis, the projected environmental consequences should be considered a "reasonable, but conservative" upper estimate of predicted impacts. Actual impacts at the time of development are likely to be less.

The air quality analysis was based on the best available engineering data and assumptions, meteorology data, and USEPA dispersion modeling procedures. Where specific data or procedures were not available, however, "reasonable, but conservative" assumptions were incorporated. Potential direct, indirect, and cumulative air quality impacts were analyzed for the two alternatives in order to predict maximum near field ambient air pollutant concentrations of criteria pollutants (including ozone) and hazardous air pollutants (HAPs). In addition, the maximum far field ambient air pollutant concentrations, visibility and atmospheric deposition (acid rain) impacts were also evaluated.

A modeling analysis of total cumulative air quality impacts was performed using the USEPA dispersion Model AERMOD to demonstrate that the combined effects of Alternatives 1 and 2, including permitted but not operating sources and other reasonably foreseeable sources (RFS), would not violate NAAQS. Total pollutant concentrations were represented by adding the maximum measured background pollutant concentrations for a given averaging period to the maximum predicted concentrations for determining compliance with the NAAQS.

The EPA's proposed guideline dispersion model, AERMOD (version 02222), was used to assess near field impacts of criteria pollutants CO and $NO_2$, as well as to estimate long-term HAP impacts (i.e., formaldehyde). This version of AERMOD utilizes the PRIME building downwash algorithms, which are the most recent "state of science" algorithms for modeling applications where aerodynamic building downwash is a concern. One year of Bloomfield meteorology data (1997) was used with the AERMOD dispersion model to estimate these pollutant impacts. Impacts from construction were previously determined using the EPA ISC model as part of the 2002 EIS. Since estimated construction emissions remained unchanged, the 2002 modeling was not revised and is reported in this document for completeness.

An assessment of potential cumulative ozone and cumulative far field air quality impacts was conducted. The CAMx was used to estimate air quality impacts for ozone over the air quality analysis area as well as $NO_2$, PM, $SO_2$, visibility, and acid deposition in adjacent Class I Areas. The modeling examined the 2005 base case to indicate current air quality impacts as a reference point for estimating the projected changes in air quality and to evaluate the accuracy of the model estimates compared to measured ambient concentrations. The 2005 base case scenario modeling used for this analysis is identical (same emission inventory and same modeling methodology) to the Four Corners modeling analysis. Atmospheric chemistry resulting in ozone and secondary PM formation from directly emitted precursor species is complex and non-linear and, as a result, it is necessary to perform modeling that accounts for the cumulative changes in emissions at all sources within the air quality analysis area.

Incremental and cumulative project impacts were analyzed in reference to the NAAQS for ozone and $PM_{2.5}$. In keeping with USEPA guidance (USEPA 2007), model results were used in a relative manner to evaluate NAAQS attainment in areas where ambient ozone monitoring is conducted. This involved calculating relative reduction factors (RRFs), which are defined as the ratio of concentrations predicted under the year 2018 full 80-acre infill scenario to concentrations predicted under the year 2005 base case. RRFs are then multiplied by *observed* design values (e.g., annual fourth-highest 8-hour average ozone concentration) taken from data collected at ambient monitoring sites to derive the predicted year 2018 design value. The resulting estimated future year design value is then compared with the level of the NAAQS.

The starting point for the analysis was to develop an accurate estimate of existing emissions against which changes in emissions as a result of the proposed alternatives could be compared. The base case was defined as 2005. Compilation of an accurate emission inventory for 2005 was arduous because neither the SUIT nor USEPA currently has a minor source construction or operating permit program. Thus there is no accurate record of emission sources on the Reservation. In order to compile data regarding emissions, the SUIT contacted oil and gas operators within the reservation boundaries and requested data regarding emission sources within the area.

Table 4-1 presents the distribution of engine size and $NO_x$ emissions based on the emission inventory compiled from oil and gas operators and used in the air quality analysis.

**Table 4-1. Distribution of Reciprocating Internal Combustion Engines (RICE) and Associated Production of SUIT CBM Gas Within the SUIT Boundaries in 2005**

| Engine Size (hp) | Number of Engines | Number of Engines (%) | Percentage of Capacity | Average $NO_x$ Emission Factor (g/hp-hour) | Total $NO_x$ Emissions (t/yr) | Emissions (%) |
|---|---|---|---|---|---|---|
| Gt. 500 | 170 | 53.0 | 92 | 1.5 | 2,982 | 71 |
| Lt. 500 Gt. 100 | 76 | 23.7 | 6.1 | 7.7 | 724 | 17 |
| Lt. 100 Gt. 25 | 73 | 22.7 | 1.8 | 12.2 | 510 | 12 |
| Lt. 25 | 2 | 0.6 | 0.0 | 27 | 11 | 0.3 |
| **Total** | **321** | | **100** | | **4,227** | |

Table 4-1 indicates the vast number of engines within the Reservation boundaries have capacities in excess of 500 horsepower and are controlled with non-selective catalytic reduction (NSCR) or are low-emitting, lean-burn engines.

Future year estimates of emissions that could occur with the implementation of the alternatives were calculated on an annual basis starting in 2006 thorough 2027. Future year emission estimates were developed by estimating the amount of natural gas that would be produced with and without any 80-acre infill development. The amount of natural gas produced is a function of new production (which declines over time) as well as existing declining production. The amount of compressor capacity needed for infill production is directly correlated to the total, as well as the incremental amount of gas produced. Estimating emissions for a declining base case and an incremental increase (with no net increase in production) is a very dynamic process. Thus, as existing production declines, the amount of compressor capacity will decrease from current conditions.

A volume forecast for existing conventional wells that exist within the boundaries of the Reservation was also included in the total volume modeled. The conventional wells were predicted to decline at a rate based on historical trends with no planned development. Figure 4-1 presents estimated production volume for existing (Alternative 1) and proposed 80-acre infill production (Alternative 2). It is important to note that for Alternative 1, there is a substantial decrease in production over time, and as a result of the proposed infill development (Alternative 2), there is no increase in production.

Rather, the infill development simply reduces the overall rate of decline. Figure 4-2 presents the estimated well count with and without infill development.

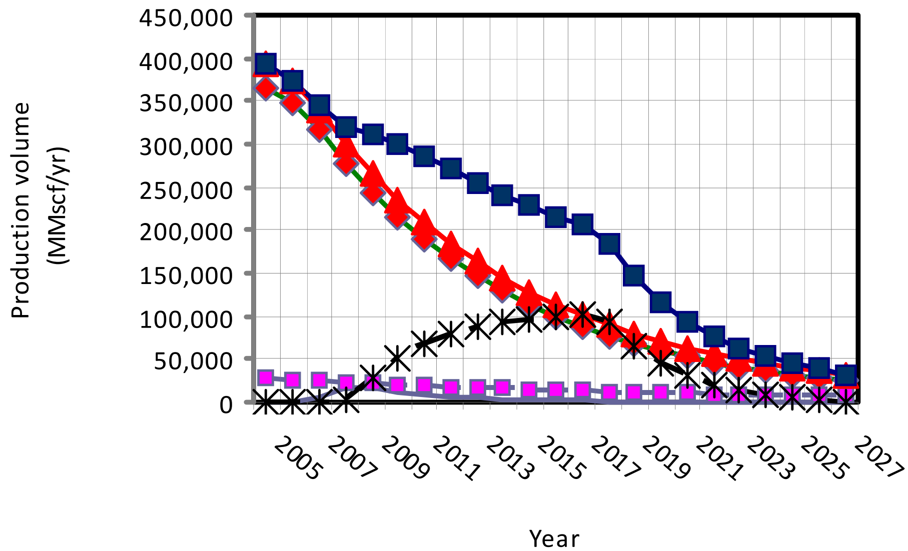



**Figure 4-1. Estimated Production Volume by Year**

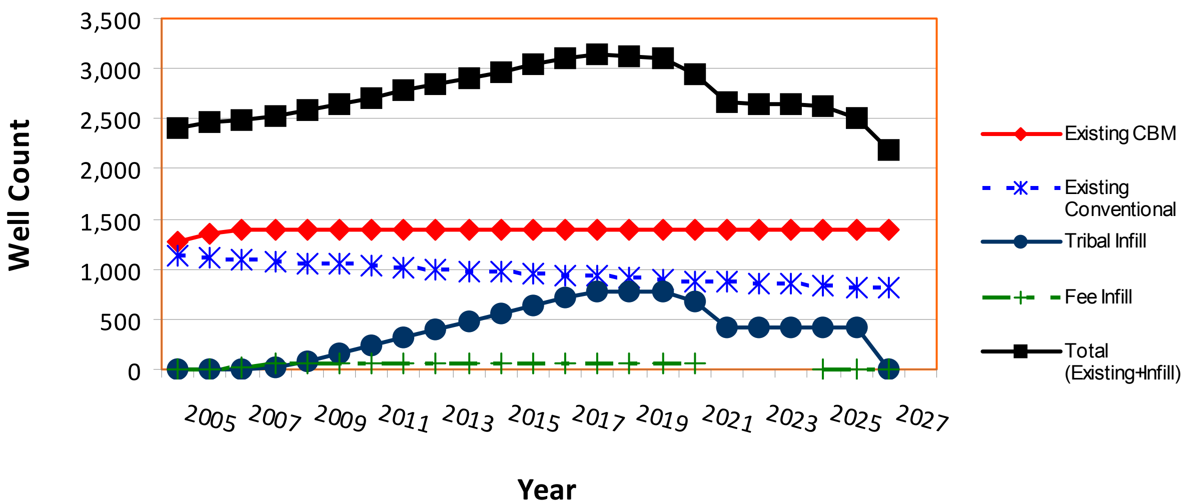



**Figure 4-2. Projected Well Count**

To determine compression horsepower requirements over the life of a gas well, two inputs are required: the gas volume to be compressed and the pressures at which the gas compressor will operate. The specific pressures needed are the compressor suction pressure and the compressor discharge pressure. The compressor suction pressure is determined by the gathering system operating pressure and the discharge pressure is determined by the gathering pipeline operating pressure. The spike that occurs in estimated compression in 2020 is a result of the field entering the declining reservoir pressure dominated phase when the estimated operating pressure is reduced between 2 and 20 psi. Even with this decrease in pressure and the resulting increase in compressor capacity, the total compression is substantially lower for both the existing production and the proposed 80-acre infill production than the compression that was operating in 2005. It is also important to note that this spike in compression capacity is a short-term event and the total amount of compression subsequently decreases. Compressor capacity by year is shown in Figure 4-3.

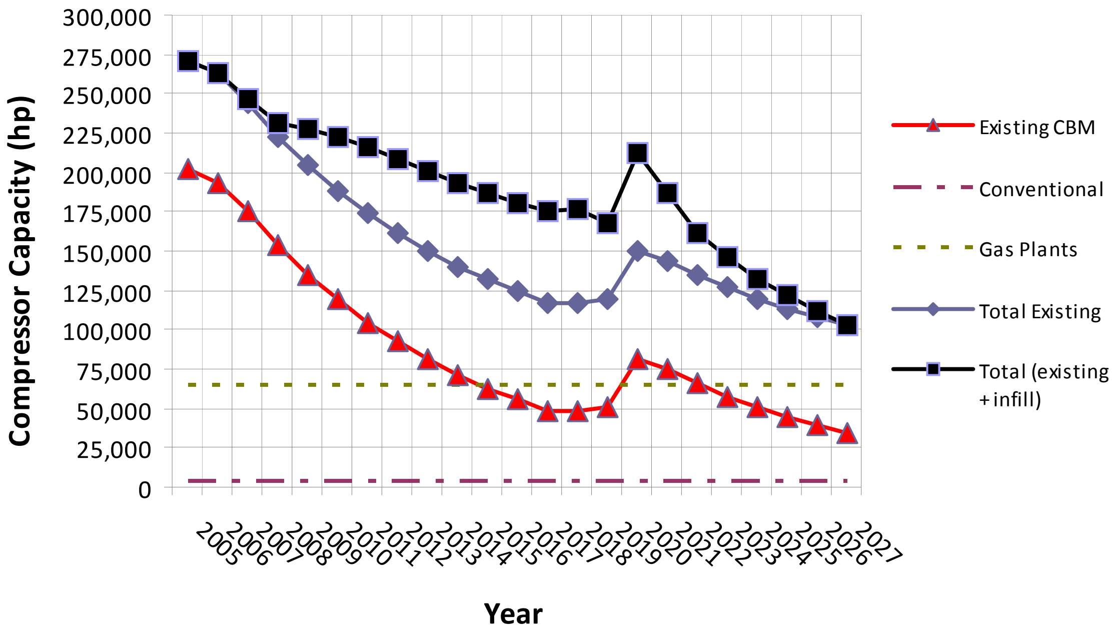



**Figure 4-3. Compressor Capacity by Year**

At present, detailed site-specific engineering data are not available regarding the exact nature of equipment that would be used or the exact locations where the equipment would be installed. For purposes of this air quality analysis, reasonable but conservative assumptions were made regarding cumulative emissions from these potential emission sources. Figure 4-4 presents the total annual emissions for the infill project for $NO_x$. It should be noted that for modeling the projected impacts of the proposed infill project in 2018 it was assumed that the peak that is predicted to occur in 2020 as a result of a reduction in pressure was assumed to occur in 2018.

Greenhouse gas emissions from natural gas fired engines were calculated based the USEPA emission factors. Because the amount of engine capacity is predicted to decrease over time as a result of production decline, the emissions of greenhouse gas emissions ($CO_2$) will also decrease as production decreases. Refer to Appendix G for more information.

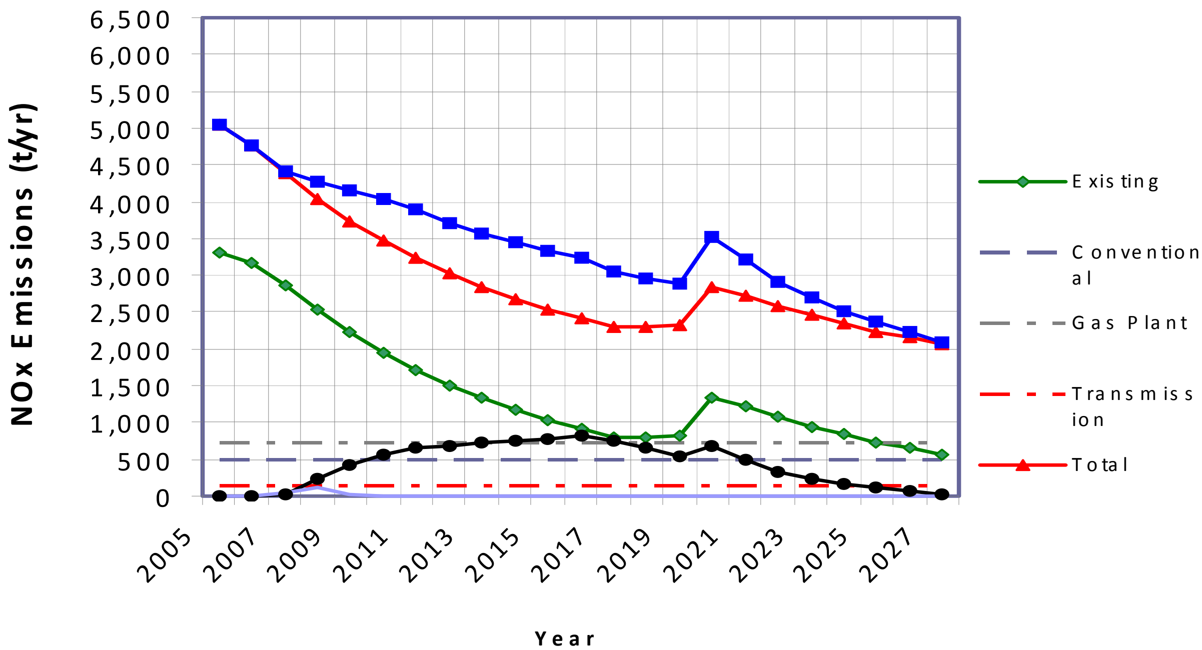



**Figure 4-4. $NO_x$ Emissions from All Sources from Existing and Infill Wells**

### 4.2.3 Impacts Common to Both Alternatives

During construction and drilling, impacts to air quality would result from surface disturbance by earth moving equipment, vehicle traffic fugitive dust, well testing, and drilling rig and vehicle engine exhaust. During production, compressors and other equipment would result in emissions impacting air quality. Actual air quality emissions and potential ambient impacts depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, relative humidity, etc.). The potential impacts from construction would be temporary and very localized and would be minimized by design features.

### 4.2.4 Alternative 1 (No Action) - Impacts to Air Quality

Modeling results for Alternatives 1 and 2, are described under Alternative 2.

### 4.2.5 Alternative 2 (Proposed Action) - Impacts to Air Quality

At present, detailed site-specific engineering data are not available regarding the exact nature of equipment that would be used or the exact locations where the equipment would be installed. For purposes of this air quality analysis, reasonable but conservative assumptions were made regarding cumulative emissions from these potential emission sources.

A modeling analysis of total cumulative air quality impacts was performed using the USEPA dispersion Model AERMOD to demonstrate that the combined effects of the no action and proposed action cases including permitted but not operating sources and other RFS would not violate NAAQS. Total pollutant concentrations were represented by adding the maximum measured background pollutant concentrations for a given averaging period to the maximum predicted concentrations for determining compliance with the NAAQS.

Modeling was conducted to demonstrate compliance with the CO 1-hour NAAQS of 40,000 μg/m$^3$ and the 8-hour NAAQS of 10,000 μg/m$^3$. As indicated in Table 4-2, the maximum predicted CO impacts were 2,136 μg/m$^3$ (approximately 6% of the 40,000 μg/m$^3$ 1-hour standard). Comparison of the 2005 base case and Alternative 1 indicated that there is a 1,035 μg/m$^3$ reduction in peak 1 hour CO impacts. For Alternative 2 the reduction compared to base case is 598 μg/m$^3$.

**Table 4-2. Comparison of the Maximum Predicted CO Impacts Between the 2005 Base Case, Alternative 1, and Alternative 2**

| | 2005 (μg/m$^3$) | Alternative 1 (μg/m$^3$) (2018) | Alternative 2 (μg/m$^3$) (2018) |
|---|---|---|---|
| Maximum Direct 1-hour Impact | 2,136 | 1,101 | 1,537 |
| EPA Cumulative Significance Threshold | 2,000 | 2,000 | 2,000 |
| Maximum 1-hour Background | 2,286 | 2,286 | 2,286 |
| Total 1-hour Impact | 4,422 | 3,387 | 3,823 |
| 1-hour NAAQS | 40,000 | 40,000 | 40,000 |
| Location of Maximum 1-hour Impact<br>UTM Easting (m)<br>UTM Northing (m) | <br>243,350<br>4,108,600 | <br>250,000<br>4,124,900 | <br>250,000<br>4,124,900 |
| Date | 97-10-22-01 | 97-10-22-01 | 97-10-22-01 |
| Maximum Direct 8-hour Impact | 469 | 242 | 338 |
| USEPA Cumulative Significance Threshold | 500 | 500 | 500 |
| Maximum 8-hour Background | 2,286 | 2,286 | 2,286 |
| Total 8-hour Impact | 2,755 | 2,528 | 2,624 |
| 8-hour NAAQS | 10,000 | 10,000 | 10,000 |
| Location of Maximum 8 hour Impact<br>UTM Easting (m)<br>UTM Northing (m) | <br>246,700<br>4,101,900 | <br>246,700<br>4,101,900 | <br>246,700<br>4,101,900 |
| Date | 97-01-19-08 | 97-01-19-08 | 97-01-19-08 |

Notes: UTM - Universal Transverse Mercator

For 8-hour CO, the maximum predicted concentrations for the 2005 base case were 2,755 μg/m$^3$ (approximately 28% of the 10,000 μg/m$^3$ 1-hour standard). Comparison of the 2005 base case under Alternative 1 indicates a 227 μg/m$^3$ reduction in predicted impacts. Comparison of the 2005 base case and the Alternative 2 indicates a reduction in maximum predicted CO concentrations of 131 μg/m$^3$.

As indicated in Table 4-3, the maximum predicted direct and cumulative (including other existing sources, RFS and background) concentrations where Alternative 2 sources would have their maximum impacts are well below the applicable $NO_2$ annual NAAQS (32.2 μg/m$^3$ compared to an air quality standard of 100 μg/m$^3$). There is a 1 μg/m$^3$ reduction in annual $NO_2$ impacts between the 2018 cases and the 2005 baseline. In addition, predicted concentrations are below the PSD Class II $NO_2$ increment. This finding is consistent with the $NO_2$ increment analysis performed by CDPHE (CDPHE-APCD 1999).

**Table 4-3. Comparison of Maximum Predicted $NO_2$ Impacts (µg/m$^3$) Under the 2005 Base Case, Alternative 1, and Alternative 2**

| | 2005 Baseline (µg/m$^3$) | Alternative 1 (µg/m$^3$) (2018) | Alternative 2 (µg/m$^3$) (2018) |
|---|---|---|---|
| Maximum Direct Annual Impact | 23.5 | 22.8 | 22.8 |
| SUIT Source impacts | 9.4 | 5.4 | 6.7 |
| PSD Class II Increment | 25 | 25 | 25 |
| Maximum Annual Background | 9.4 | 9.4 | 9.4 |
| Total Annual Impact | 32.9 | 32.2 | 32.2 |
| Annual NAAQS | 100 | 100 | 100 |
| Location of Maximum Annual Impact<br>UTM Easting (m)<br>UTM Northing (m) | <br>253,000<br>4,112,000 | <br>288,400<br>4,112,800 | <br>288,400<br>4,112,800 |

As indicated in the preceding paragraph, predicted cumulative $NO_2$ impacts are less than the $NO_2$ PSD Class II increment of 25 µg/m$^3$. Given the lack of detailed engineering data available for this PEA analysis, as well as information regarding which existing sources actually consume the increments, a rigorous PSD analysis is not possible. Furthermore, BLM does not have the regulatory authority to conduct such an analysis. This comparison was made to indicate potential significance only and is not intended to be a regulatory PSD increment consumption analysis.

The regulatory authority responsible for administrating the PSD program is also responsible for performing a detailed increment analysis. Such an analysis would be based on established baseline conditions, permit application data and existing increment consuming sources, but not sources that are simply undergoing NEPA review. Because this is not a regulatory PSD increment analysis, these results are presented for disclosure purposes only.

**Hazardous Air Pollutants**

Because the produced gas is CBM, the only HAP that would be emitted from the sources associated with the proposed emission sources is formaldehyde. Maximum cumulative concentrations of formaldehyde in the 2005 base case were used to evaluate incremental health risks. This analysis focused on the potential incremental cancer risk to the most likely exposed (MLE) and the maximum exposed individual (MEI). Long-term (annual average) formaldehyde concentrations were adjusted for the expected project lifetime and were then multiplied by USEPA's formaldehyde unit risk factor to obtain an estimate of incremental cancer risk, which reflects the maximum potential incremental risk but does not represent the total risk to any particular individual.

Estimated incremental risk for the 2005, 2018 Alternative 1, and 2018 Alternative 2 is presented in Table 4-4. The predicted incremental risk is at the lower end of the USEPA risk criteria. It should be noted that the maximum predicted concentrations and incremental risk estimates are very localized at facility boundaries. In addition, the calculated incremental risk shows a reduction in risk over the 2005 baseline conditions.

**Table 4-4. Maximum Predicted Incremental Cancer Risks by Alternative**

| Alternative | Maximum Annual Average Concentration (μg/m$^3$) | Total MEI Risk | Total MLE Risk |
|---|---|---|---|
| 2005 Base Case | 5.1 | $1.9 \times 10^{-5}$ | $6.2 \times 10^{-6}$ |
| Alternative 1 | 2.9 | $1.1 \times 10^{-5}$ | $3.6 \times 10^{-6}$ |
| Alternative 2 | 3.6 | $1.3 \times 10^{-6}$ | $4.4 \times 10^{-6}$ |

## CONSTRUCTION IMPACTS

Construction emissions were unchanged from the 2002 FEIS, and consequently ambient impact modeling was not conducted and is referenced in the following for completeness. Construction emissions would occur during road and well pad construction (three days), well drilling (eight days), and well completion testing (25 days). During well completion testing, natural gas would be burned (flared) for up to seven days. Since orientation of the road and well pad is unknown, several preliminary $PM_{10}$ and $SO_2$ modeling analyses were performed to identify and apply the physical geometry for maximum potential impacts in the final analysis. A summary of construction modeling results is presented in Table 4-5.

Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad construction were used to predict the maximum 24-hour and annual average $PM_{10}$ concentrations. Maximum air pollutant emissions from each well would be temporary (i.e., occurring during a 36-day construction period) and would occur in isolation, with limited interaction of adjacent well locations. Particulate matter emissions from well pad and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was computed at 50% during construction.

The maximum potential particulate matter concentrations at least 650 feet (200 m) from road and 0.5 miles (805 m) from well emission sources (including representative background values) would be nearly 128 μg/m$^3$ (24-hour $PM_{10}$), well below the 24-hour $PM_{10}$ NAAQS of 150 μg/m$^3$. In addition, predicted particulate matter concentrations would decrease rapidly beyond 200 m from the emission source. Since these $PM_{10}$ construction emissions are temporary, PSD increments are not applicable.

The predicted maximum 24-hour concentrations overestimate actual expected $PM_{10}$ concentrations because the maximum modeled concentrations from the proposed activities are assumed to coincide with the first maximum measured background concentrations. However, the meteorological conditions which lead to both situations would be very different, and are not likely to occur at the same location and the same time.

The maximum short-term (3- and 24-hour) $SO_2$ emissions would be generated by drilling rigs and other diesel engines used during rig-up, drilling, and completion operations (sulfur is a trace element in diesel fuel). These $SO_2$ emissions would be temporary, occurring only during the limited 36-day construction period at each well location. The maximum modeled concentrations (including representative background values of 57 and 23 μg/m$^3$, respectively) would be nearly 702 μg/m$^3$ (3-hour) and 133 μg/m$^3$ (24-hour). It should be noted that these modeled estimates do not account for federally mandated sulfur limits in diesel fuel and consequently as a result of these regulations, actual impacts will be less. Therefore, predicted short-term $SO_2$ concentrations are well below primary health-based 24-hour NAAQS of 365 μg/m$^3$ and the secondary (welfare standard) 3-hour $SO_2$ NAAQS of 1,300 μg/m$^3$. Since these $SO_2$ construction emissions are temporary, PSD increments are not applicable.

A direct comparison of the $PM_{2..5}$ impacts with the 24-hour standard is difficult because of the temporary nature of the construction emissions (3 days) and the fact that compliance with the short term standard references the 98$^{th}$ percentile concentration averaged over a 3-year period. Also, comparison with the annual standard is not meaningful.

**Table 4-5. Summary of Predicted Maximum Pollutant Concentrations During Construction and Comparison with NAAQS**

| Pollutant | Averaging Period | SUIT Source (*ug*/m$^3$) | Background (*ug*/m$^3$) | Total Concen. (*ug*/m$^3$) | NAAQS (*ug*/m$^3$) | % of Standard | Location of Maximum | | Time (MM/DAY/ HR) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | X (m) | Y(m) | |
| $PM_{2.5}$ | 24-hour | 7.9 | 8.75 | 16.6 | 35 | 48 | 804.44 | 674.82 | 1/25/2024 |
| $PM_{10}$ | 24-hour | 51.38 | 50.2 | 101.58 | 150 | 67.72 | 804.44 | 674.82 | 1/25/2024 |
| $SO_2$ | 3-hour | 130.6 | 58.57 | 189.17 | 1300 | 14.55 | 0 | 250 | 12/11/2006 |
| $SO_2$ | 24-hour | 30.14 | 23.96 | 54.1 | 365 | 14.82 | 170.84 | 115.39 | 12/14/2024 |

Note: The projected $SO_2$ impacts do not reflect the use of low sulfur diesel.

### 4.2.6 Impacts Summary

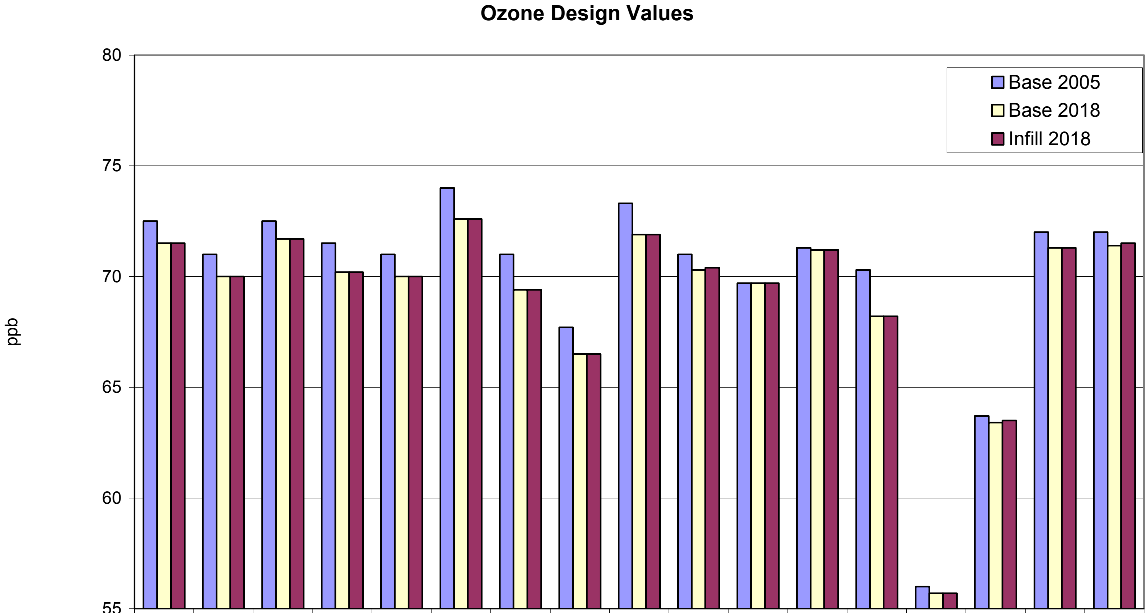
Alternatives 1 and 2 are well below the CO 1-hour NAAQS of 40,000 μg/m$^3$ and the 8-hour NAAQS of 10,000 μg/m$^3$. Alternatives 1 and 2 are also well below the 8-hour CO maximum standard, the applicable $NO_2$ annual NAAQS standard and the PSD Class II $NO_2$ increment. Under Alternatives 1 and 2 HAP concentrations would below risk criteria established by the USEPA. Any construction impacts under Alternatives 1 and 2 would be below the 24-hour and annual average $PM_{10}$ concentrations and the 24-hour $PM_{10}$ NAAQS of 150 μg/m$^3$. Alternatives 1 and 2 would be well below primary health based 24-hour NAAQS of 365 ug/m$^3$ and the secondary (welfare standard) 3-hour $SO_2$ NAAQS of 1,300 μg/m$^3$.

### 4.2.7 Cumulative Impacts

An assessment of potential cumulative ozone and cumulative far field air quality impacts was conducted. For this analysis it is important to note that oil and gas emissions within the SUIT boundaries for Alternative 1 (No Action) scenario are less than SUIT emissions under the 2005 base case scenario. By contrast, it was estimated that total regional emissions would increase based on economic growth and other forecast indicators such as reasonably foreseeable actions.

**OZONE**

Ozone design values were predicted under the 2018 Alternative 1 scenario and the 2018 Alternative 2 scenario (Figure 4-5). Design values are predicted to be lower under both the 2018 Alternative 1 and the 2018 Alternative 2 scenarios as compared to 2005 at all locations except at the Bloomfield monitor (site 35-045-0009) where it is unchanged. In addition, there is almost no difference in predicted ozone design values between the 2018 Alternative 1 and 2 scenarios. In addition, there is no change in design value between the Alternative 1 and the Alternative 2 scenarios. Thus, model results show no significant impact on ozone design values from the proposed Alternative 2 and no new violations of the ozone NAAQS are expected under Alternative 2.




| | 35001 0019 | 35001 0023 | 35001 0024 | 35001 0027 | 35001 1012 | 35001 1013 | 35001 1014 | 35043 1001 | 35043 1003 | 35043 9004 | 35045 0009 | 35045 1005 | 40170 119 | 80677 001 | 80677 003 | 8067S HAM | 80830 101 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Base 2005 | 73 | 71 | 73 | 72 | 71 | 74 | 71 | 68 | 73 | 71 | 70 | 71 | 70 | 56 | 64 | 72 | 72 |
| Base 2018 | 72 | 70 | 72 | 70 | 70 | 73 | 69 | 67 | 72 | 70 | 70 | 71 | 68 | 56 | 63 | 71 | 71 |
| Infill 2018 | 72 | 70 | 72 | 70 | 70 | 73 | 69 | 67 | 72 | 70 | 70 | 71 | 68 | 56 | 64 | 71 | 72 |

Site ID

Note: Concentrations in the Table are in ppb; see Table 4-6 below for a site legend.

**Figure 4-5. Ozone 8-Hour Design Values as of 2005 (Observed) and as Predicted Under the 2018 Alternative 1 (Base 2018) and 2018 Alternative 2 (Infill) Scenarios**

**Table 4-6. Ozone Monitoring Sites within the 4 Km Domain Used in the Calculation of Predicted 2018 Ozone Design Values**

| Site ID | Site Name | County | State |
|---|---|---|---|
| 04-017-0119 | Petrified Forest | Navajo | CO |
| 08-067-SHAM | Shamrock | La Plata | CO |
| 08-067-7001 | Ignacio | La Plata | CO |
| 08-067-7003 | Bondad | La Plata | CO |
| 08-083-0101 | Mesa Verde | Montezuma | CO |
| 35-001-1012 | Double Eagle School | Bernalillo | NM |
| 35-001-1013 | Second St. NW | Bernalillo | NM |
| 35-001-1014 | Coors Rd NW | Bernalillo | NM |
| 35-001-0019 | Mesilla Ave | Bernalillo | NM |
| 35-001-0023 | San Mateo NE | Bernalillo | NM |
| 35-001-0024 | Anderson Ave | Bernalillo | NM |
| 35-001-0027 | Montano Blvd | Bernalillo | NM |
| 35-043-1001 | Bernalillo | Sandoval | NM |
| 35-043-1003 | Rio Rancho | Sandoval | NM |
| 35-043-9004 | Trading Post Rd. | Sandoval | NM |
| 35-045-0009 | Bloomfield | San Juan | NM |

| Site ID | Site Name | County | State |
|---|---|---|---|
| 35-045-0018 | Navajo Lake | San Juan | NM |
| 35-045-1005 | Farmington | San Juan | NM |

Note: Highlighted rows indicate monitors located in relatively close proximity to the proposed action emission sources.

The following figures present predicted ozone design values (annual fourth highest daily maximum 8-hour average concentration) in *each* 4 x 4 km model surface grid cell over the 4 km modeling domain (NM, CO, AZ, UT state and county boundaries are shown in each map). Figure 4-6 presents design values for the 2005 base case, the 2018 base case (no action) and the 2018 full infill scenario (proposed action).

Figure 4-7 presents the difference in design values between the 2018 base case (no action) and the 2005 base case, the 2018 full infill scenario and the 2005 base case and the difference between no action and full infill scenario. The difference plots are not paired in time.[6] Several important conclusions can be reached from the difference plots. First, for the 2018 minus 2005 base case there is a general reduction in predicted ozone design values over the region. The same trend is observed for the difference between the 2018 infill development and the 2005 base case. The maximum predicted increase in design value for the 2018 infill case minus the 2018 no action is 0.03 ppb as indicted by the dark brown shaded cells just north of the AZ – CO border. In addition, over the majority of the modeling domain differences in predicted ozone design values between these two scenarios are negligible (less than ± 0.08 ppb).

[6] Day on which design values shown in top two figures occurs varies from one grid cell to the next, thus these maps represent a composite of many days. As a result, design values from which the differences shown in Figure 2 are computed are not matched in time. For example, the 2018 full infill scenario design value may occur on a different date than the 2018 base case design value in any given grid cell and the two dates can differ from one grid cell to the next.

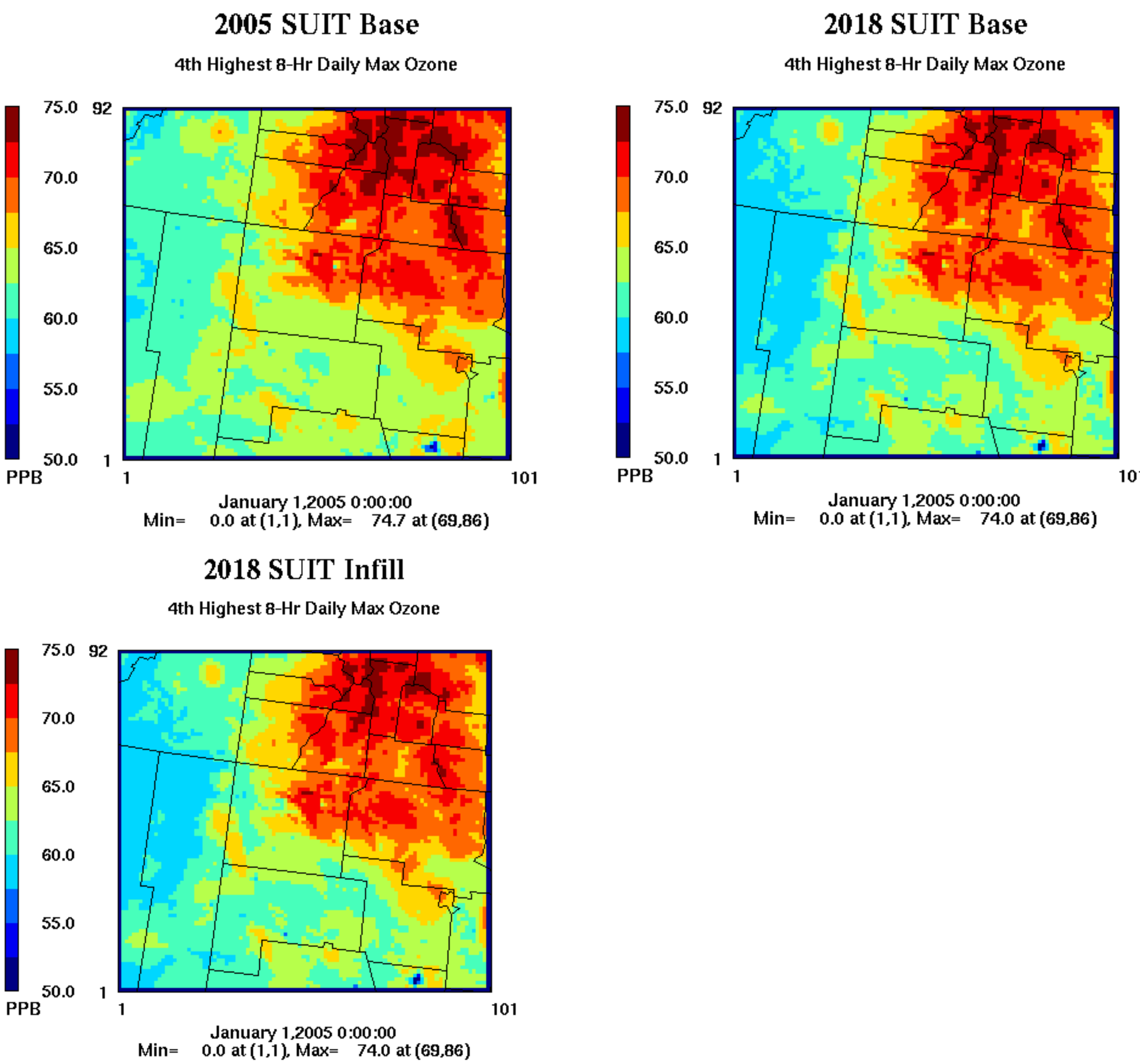



**Figure 4-6. Ozone Design Values in the Four Corners Area for Difference Emission Scenarios as Part of the SUIT PEA**

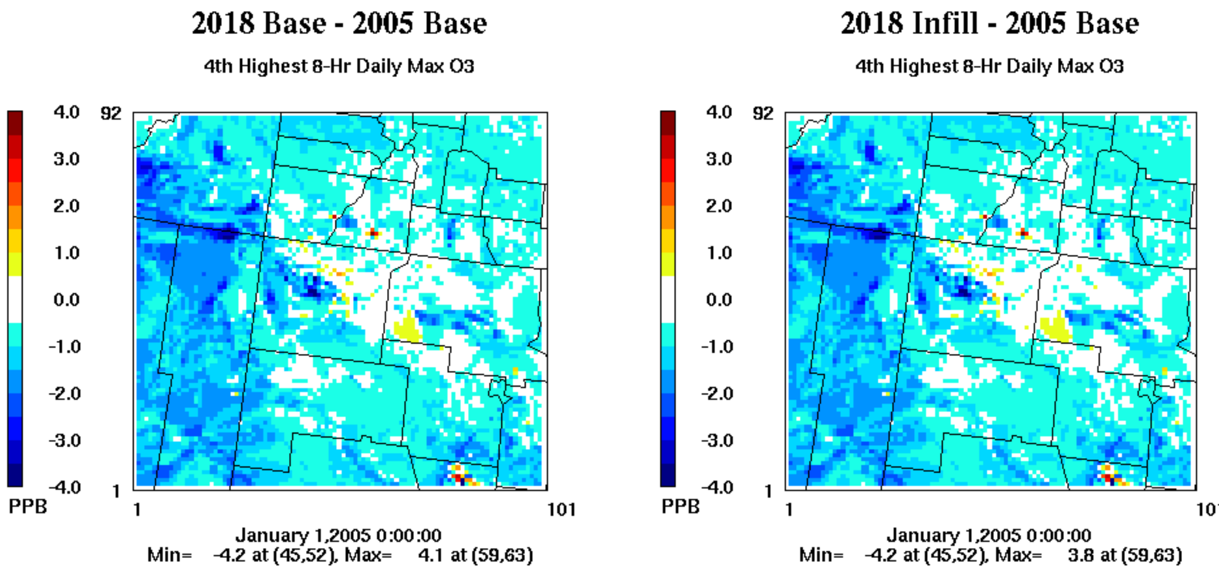
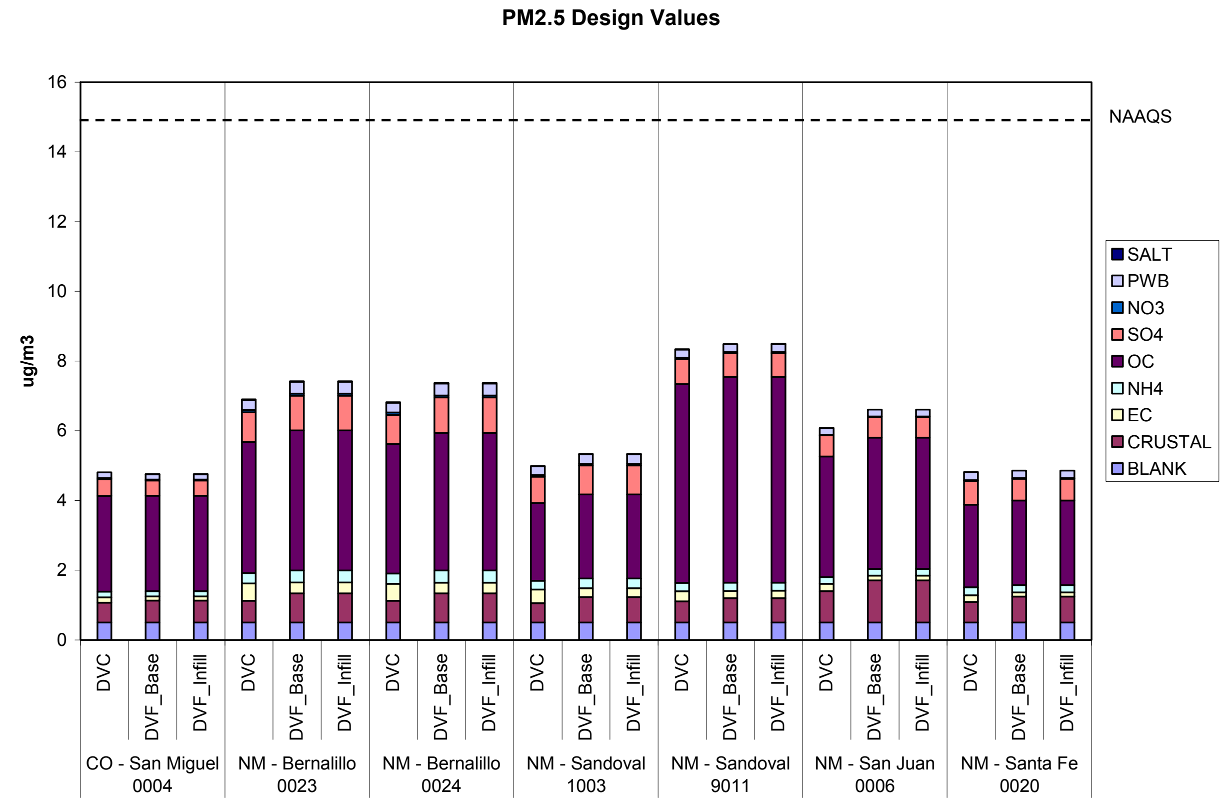



**Figure 4-7. Difference in Ozone Design Values in the Four Corners Area for Different Emission Scenarios as Part of the SUIT PEA**

**$PM_{2.5}$**

Future year (2018) $PM_{2.5}$ design values for both Alternative 1 and 2 scenarios were estimated by applying RRFs to observed $PM_{2.5}$ design values. Current 2005 base case $PM_{2.5}$ annual design values (DVC) and projected future design values under the 2018 Alternative 1 (DVF base) and Alternative 2 scenario (DVF infill) are presented in Figure 4-8. All values are well below the 15 µg/m$^3$ NAAQS with relatively small changes between the 2005 base case, Alternative 1, and Alternative 2 scenarios.




Note: This figure presents the species contribution to total $PM_{2.5}$.

**Figure 4-8. $PM_{2.5}$ Annual Design Values at Monitoring Sites in the air quality analysis area for the 2005 Base Case**

## PSD INCREMENTS

For the 2005 base case, 2018 Alternative 1 and 2018 Alternative 2, PSD Class I Area increments are not likely to be exceeded. Because of the regional nature of the emission inventories used in the modeling and the fact that these inventories do not indicate if emissions are increment consuming sources (i.e., built after the baseline was set) it is not possible to compare model predictions to PSD increments. However, what can be concluded is that because the incremental changes in predicted levels are small (2018 Alternative 2 minus the 2018 Alternative 1 as well as 2018 Alternative 1 minus the 2005 baseline), the likelihood of the proposed action exceeding the PSD increments is unlikely. Further, a $NO_2$ increment consumption analysis conducted by CDPHE (CDPHE-APCD 1999) concluded that PSD increments were not exceeded.

## VISIBILITY

The CAMx model was also used to estimate cumulative incremental impacts and project incremental impacts on visibility levels in Class I Areas for Alternative 2. Visibility impacts were not computed for Alternative 1 because of the small incremental changes compared to the 2005 base case.

The eight-highest predicted daily changes in visibility (which corresponds to the annual 98th percentile deciview [dV] change) resulting from the cumulative incremental impact of Alternative 2 are summarized in Table 4-7. Also listed in Table 4-7 are the project visibility increments on days corresponding to these eight highest cumulative increment days.

For all cases at Mesa Verde National Park and Weminuche Wilderness Area, the Alternative 2 impact is a small fraction of the maximum cumulative impact.

**Table 4-7. Predicted Cumulative Visibility Impacts on the Eight Highest Days at Mesa Verde National Park and Weminuche Wilderness Area**

| Class I Area | Date (month/day) | Deciview Change | |
|---|---|---|---|
| | | Cumulative Increment [a] | Project Increment [b] |
| Mesa Verde | 5/05 | 0.2 | <0.05 |
| | 11/10 | 0.1 | <0.05 |
| | 6/21 | 0.1 | <0.05 |
| | 7/22 | <0.05 | <0.05 |
| | 9/03 | <0.05 | <0.05 |
| | 10/02 | <0.05 | <0.05 |
| | 11/11 | <0.05 | <0.05 |
| | 2/23 | <0.05 | <0.05 |
| Weminuche | 1/04 | 0.7 | <0.05 |
| | 6/17 | 0.7 | <0.05 |
| | 6/16 | 0.4 | <0.05 |
| | 11/10 | 0.4 | <0.05 |
| | 1/11 | 0.2 | <0.05 |
| | 6/21 | 0.1 | <0.05 |
| | 11/09 | 0.1 | <0.05 |
| | 2/22 | 0.1 | <0.05 |

[a] Cumulative Increment = 2018 Alternative 2 scenario visibility minus 2005 base case visibility

[b] Project Increment = 2018 Alternative 2 scenario visibility minus 2018 Alternative 1 scenario visibility

Maximum daily visibility impacts from the project increments (which in general occur on different days than the maximum cumulative impacts) are listed in Table 4-8. The maximum project impact of 0.3 dV is predicted to occur at Mesa Verde National Park..

**Table 4-8. Maximum Predicted Daily Project Visibility Impacts (on the Same Days)**

| Class I Area | Date (Month/Day) | Project Impact (deciview) [a] |
|---|---|---|
| Mesa Verde National Park | 12/25 | 0.3 |
| Weminuche Wilderness Area | 10/24 | 0.1 |

[a] Project Impacts = 2018 Infill scenario visibility minus 2018 Alternative 1 scenario visibility

## ACID DEPOSITION

Releases of certain nitrogen and sulfur pollutant species into the air can result in the deposition of acidic species to the earth's surface at downwind locations. This acid deposition can produce undesirable changes to water chemistry in certain water bodies that lack sufficient acid neutralizing capacity (ANC). Eleven lakes in Class I Areas within the 4 km modeling domain have been identified as being sensitive to acid deposition (BLM 2009); all of these lakes are located within the Weminuche Wilderness Area. The potential for increased acidification of these sensitive lakes was evaluated by computing changes in total annual deposition of nitrogen (N) and sulfur (S) for a) cumulative impacts (2018 infill – 2005 base case) and b) project incremental impacts (2018 infill – 2018 no action). ANC changes were calculated using U.S. Forest Service (USFS) procedures (USDAFS, 2000). Since deposition is calculated by CAMx for a full set of nitrogen and sulfur species, all applicable acidic species were included in the deposition calculation rather than the more limited set of species included in acid deposition calculations based on CALPUFF model results. This results in a somewhat more conservative estimate of acid deposition as compared to a standard CALPUFF analysis.

Predicted changes in ANC were compared to acceptable limits established by the USFS (Blett, 1999) for the Weminuche Wilderness Area (no more than a 10% change in ANC for those water bodies where the existing ANC is at or above 25 microequivalents per liter (µeq/l) and no more than a 1 µeq/l change for those extremely sensitive water bodies where the existing ANC is below 25 µeq/l. Results are shown for the cumulative impacts in Table 4-9 and for the project incremental impacts in Table 4-10. Cumulative changes (Table 4-9) are all negative (i.e., less than zero) indicating that emission reductions between the 2005 base case and the 2018 infill scenario are predicted to result in a *decrease* in the deposition of acidic species to the sensitive lakes. For the project incremental impacts (Table 4-10), the small emission increases associated with the proposed action are predicted to result in only minor decreases in ANC, all of which are well below the applicable significance thresholds.

**Table 4-9. Predicted Change in Acid Neutralizing Capacity of Sensitive Lakes due to Cumulative Impacts (2018 Infill – 2005 Base Case)**

| Sensitive Lake | Minimum Background ANC (µeq/l) | Predicted Change[b] (%) | Applicable Threshold (%) |
|---|---|---|---|
| Big Eldorado | 0.885 | -442.25 | 113.0%[a] |
| Four Mile Pothole | 124.76 | -3.15 | 10.0% |
| Lake Due South of Ute Lake | 14.26 | -27.73 | 7.0%[a] |
| Little Eldorado Lake | 0.05 | -7827.78 | 2000.0%[a] |
| Little Granite Lake | 76.2 | -6.29 | 10.0% |
| Lower Sunlight | 4.55 | -84.81 | 22.0%[a] |
| Middle Ute Lake | 42.45 | -8.11 | 10.0% |
| Small Pond Above Trout Lake | 24.56 | -15.37 | 4.1%[a] |
| Upper Grizzly | 1.7 | -229.47 | 58.8%[a] |
| Upper Sunlight | 1.661 | -235.87 | 60.2%[a] |
| White Dome Lake | 0.144 | -2684.06 | 694.4%[a] |

[a] For sensitive lakes with minimum background ANC values less than 25 µeq/l, the threshold of concern is less than a 1 µeq/l reduction below the minimum background ANC value (e.g.; for Big Eldorado Lake, 1.13 x 0.885 µeq/l equals 1 µeq/l).

[b] A negative change indicates a net decrease in deposition of acidic nitrogen and sulfur species.

**Table 4-10. Predicted Change in Acid Neutralizing Capacity of Sensitive Lakes Due to Project Incremental Impacts (2018 Infill – 2018 No Action)**

| Sensitive Lake | Minimum Background ANC (μeq/l) | Predicted Change (%) | Applicable Threshold (%) |
|---|---|---|---|
| Big Eldorado | 0.885 | 4.01 | 113.0%[a] |
| Four Mile Pothole | 124.76 | 0.05 | 10.0% |
| Lake Due South of Ute Lake | 14.26 | 0.44 | 7.0%[a] |
| Little Eldorado Lake | 0.05 | 71.04 | 2000.0%[a] |
| Little Granite Lake | 76.2 | 0.10 | 10.0% |
| Lower Sunlight | 4.55 | 0.90 | 22.0%[a] |
| Middle Ute Lake | 42.45 | 0.11 | 10.0% |
| Small Pond Above Trout Lake | 24.56 | 0.27 | 4.1%[a] |
| Upper Grizzly | 1.7 | 2.57 | 58.8%[a] |
| Upper Sunlight | 1.661 | 2.64 | 60.2%[a] |
| White Dome Lake | 0.144 | 24.36 | 694.4%[a] |

[a] For sensitive lakes with minimum background ANC values less than 25 μeq/l, the threshold of concern is less than a 1 μeq/l reduction below the minimum background ANC value (e.g.; for Big Eldorado Lake, 1.13 x 0.885 μeq/l equals 1 μeq/l).

### 4.2.8 Design Feature Feasibility and Efficiency

**ENGINES**

On January 18, 2008, USEPA promulgated a New Source Performance Standard (NSPS) for spark-ignited engines (Federal Register 2008a). This regulation established minimum emission standards for new, modified and reconstructed stationary natural gas fired (and other fuels) engines. As a result of the regulation, emissions from applicable engines (especially engines less than 300 horsepower) will be substantially lower than in the past.

A recent analysis by the FCAQTF provided a detailed analysis of emission reduction options for oil and gas engine mitigation (NMED 2007). With respect to the Alternative 2 (Proposed Action), design features (mitigation) is defined as additional emission controls beyond NSPS (assuming that engines used as part of the infill project will be new and subject to NSPS).

That analysis examined the effect of the following control technologies:

- Electrification;
- Lean burn technology;
- Non-selective catalytic reduction (NSCR);
- Selective catalytic reduction (SCR); and
- Oxidation catalyst

## ELECTRIFICATION

In analyzing converting natural gas fired compressor engines to electric engines it was assumed that electricity would come from the existing electrical grid where the majority of the base load electricity is produced from coal-fired electrical generation.

The starting assumption of this mitigation is that all new engines associated with Alternative 2 would be required to meet NSPS emission limits and the $NO_x$ emission limits that are 2 g/hp-hour or less (depending on the year). The FCAQTF analysis concluded that shifting to electric motors in place of natural gas engines at an emission limit of 2g/hp-hr or less would result in no additional reduction in $NO_x$ emissions. In addition, greenhouse gas emissions would increase by shifting compressors from natural gas to electric.

## LEAN BURN TECHNOLOGY

Currently lean burn engines are the main prime mover in gas compression and generator set applications in the Four Corners Area. A lean burn engine has an oxygen level at the exhaust outlet of about 7% to 8% and has corresponding $NO_x$ emissions of 2 g/hp-hour or less. This level of $NO_x$ emission control is achieved thorough combustion modification as opposed to end of pipe control and can achieve the emission levels required as part of the NSPS regulation. Some lean burn engines incorporate an air fuel ratio (AFR) control installed at the engine to ensure a proper fuel mixture.

Lean burn technology has already been implemented as a mitigation strategy for many engines greater than 500 hp that are located within the exterior boundaries of the Reservation.

## NON SELECTIVE CATALYTIC REDUCTION

A process which results in a reduction of several pollutants ($NO_x$, CO and total hydrocarbon [THC]) is referred to as a NSCR and is applicable only to stoichiometric (rich burn) engines. This technology employs a catalyst that is placed on the engine exhaust. Currently, NSCR is a commonly used control method for rich burn engines. For this control to be effective, engines must operate in a very narrow or regulated AFR operating range in order to maintain the catalyst efficiency. Without an AFR controller, emission reduction efficiencies will vary.

An AFR controller will only maintain an operator-determined set point. For this set point to be at the lowest possible emission setting, an exhaust gas analyzer must be utilized and frequently checked. Some issues associated with current practice NSCR retrofits on existing small engines operating at reduced or variable loads are:

- There are problems maintaining a sufficient flue gas temperature for correct oxygen sensor operation and the resulting effectiveness of the catalysts.
- On engines with carburetors, there is difficulty maintaining the AFR at a proper setting.
- On older engines, the linkage and fuel control may not provide an accurate air/fuel mixture.
- If the AFR drifts low (i.e., richer), ammonia formation will increase in proportion to the $NO_x$ reduction but not necessarily in equal amounts.

In a recent paper that examined the reliability of currently available NSCR/AFR solutions for field gas-fired engines, it was found that emissions were not consistent from day to day or even over a few hours (Nuss-Warren et al. 2008). It was found that the raw emissions varied significantly within a short period of time and data indicate a fairly tight operating window for simultaneous control of both $NO_x$ and CO to low levels (i.e., < 500 ppm). A major finding was that the NSCR/AFR systems were able to simultaneously control both species to low levels for a small fraction of the time; however, for the majority of the operation one species was much more effectively controlled than the other, suggesting that AFR was not able to consistently control the air fuel ratio.

Characterization of NSCR performance control is very effective until the pre-catalyst oxygen concentration surpasses a certain level after which $NO_x$ emissions increase rapidly. Concentration of THCs follows the same trend as CO, as does ammonia ($NH_3$). The result is that a tradeoff relationship exists not only between $NO_x$ and CO but also between $NO_x$ and $NH_3$ and between $NO_x$ and THC. The potentially negative impacts of increased CO, $NH_3$ and THC must all be considered as $NO_x$ is limited to lower levels.

Application of NSCR cannot be reliably used to continuously reduce $NO_x$ emissions to levels less than what is specified in the NSPS regulation.

## SELECTIVE CATALYTIC REDUCTION

Selective catalytic reduction is an end of pipe control on lean burn engines that uses excess oxygen in a catalytic reduction system. Reactant injection of industrial grade urea, anhydrous ammonia, or aqueous ammonia is used to facilitate $NO_x$ removal. A programmable logic controller (PLC) is used to control the SCR system (for engine mapping/reactant injection requirements). Sampling cells are used to determine the amount of ammonia injected, which depends on the amount of NO measured downstream of the catalyst bed.

In the proposed standards for Stationary Spark Ignition Internal Combustion Engines, USEPA stated the following with respect to the installation of SCR on natural gas fired engines: "For SI lean burn engines, USEPA considered SCR. The technology is effective in reducing $NO_x$ emissions as well as other pollutant emissions, if an oxidation catalyst is included. However, the technology has not been widely applied to stationary SI engines and has mostly been used with diesel engines and larger applications of thousands of horsepower in size. This technology requires a significant understanding of its operation and maintenance requirements and is not a simple process to manage. Installation can be complex and requires experienced operators. Costs of SCR are high, and have been rejected by States for this reason. USEPA does not believe that SCR is a reasonable option for stationary SI lean burn engines." (Federal Register 2006). Consequently, this technology is not readily applicable to unattended oil and gas operations that do not have electricity.

Because there have been very limited installations of this technology for oil and gas compressor engines, there is very little information in the literature regarding the incremental $NO_x$ emission reduction of SCR beyond lean burn technology for remote unattended oil and gas operations. Thus SCR is not a proven technology that can be used to reduce $NO_x$ emissions from natural gas fired engines in oil and gas operations below NSPS levels.

**OXIDATION CATALYST**

Oxidation catalyst can be used to reduce volatile organic compounds (VOC) and formaldehyde emissions on lean burn natural gas fired internal combustion engines. This technology converts formaldehyde and VOC emissions to $CO_2$ through the use of an oxidation catalyst and requires the use of an AFR in conjunction with the catalyst.

This technology can obtain a 90% reduction in hydrocarbons and an 80% reduction in formaldehyde. Facilities that are major sources for HAPs (10 tons per year any one HAP or 25 tons per year for total HAPs) are required to install MACT (oxidation catalyst) on engines manufactured after December 12, 2002, to control HAPs.

**DRILLING RIG ENGINES**

In Wyoming both natural gas fired drilling rigs and SCR retrofit of diesel drilling engines have been tested. To date, neither Wyoming operators nor the Wyoming Department of Environmental Quality have published any data regarding the operability, level of control or the cost (capital and cost to control) for the implementation of natural gas drilling rigs or second generation SCR control of emissions from drilling engines. It is important to note in Sublet County, WY drilling rigs are the largest source of $NO_x$ emissions. This is because the type of rock formation as well as the depth of the wells require more drilling time and engine capacity than is required for CBM wells in the northern San Juan Basin. By contrast, the largest $NO_x$ emission source in the northern San Juan Basin is natural gas fired engines associated with natural gas production (engines 91 percent and drilling rigs 6 percent). In examining emission control strategies, it is important to consider the unique properties of each basin.

Initial testing of SCR controls on drilling engines resulted in significant operational problems and very large capital and operating costs (ENSR 2006).

Given the uncertainty in the application natural gas fired and SCR for drilling rigs, the relative contribution of drilling rig emissions to the overall $NO_x$ emission inventory, and the turnover rate of drilling rig engines associated with the installation of new engines with current federal emission standards, it may be prudent not to require additional mitigation beyond what is currently mandated. If additional mitigation is contemplated, additional analyses are required.

Since the air quality analysis was completed, the SUIT has decided to implement a mitigation strategy requiring all prime mover diesel drilling rig engines to achieve Tier 2 emission standards or better.[7]

There is very little opportunity to reduce emissions from natural gas fired engines below NSPS levels. At the present time, proven technology does not exist to reduce emissions below the federally mandated limits.

### 4.2.9 Unavoidable Adverse Impacts

Some minimal increase in air pollutant emissions would occur as a result of Alternative 2 as compared to Alternative 1; however, based on the "reasonable, but conservative" modeling assumptions, these impacts are predicted to be below applicable significance

7 Drilling rig engines for new wells, not workovers or recompletion rigs.

thresholds. Both alternatives result in air quality improvements over the base case; however, the rate of improvement is somewhat slowed under Alternative 2.

## 4.3 Biological Resources

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect biological resources within the study area. Biological resources include vegetative resources, and wildlife and fisheries. Design features specific to biological resources are discussed in Section 2.4.

A Biological Assessment (BA) is required by law (Endangered Species Act [ESA] of 1973, 16 U.S.C. 1531 et seq.) for projects on Tribal or federally managed lands. A BA is the means to review, analyze, and document the direct, indirect, interrelated, interdependent and cumulative effects on U.S. Fish and Wildlife Service (USFWS) federally listed endangered and threatened species, and designated critical habitats thereof, as a result of development actions on federally managed lands. The project BA is provided in Appendix I. The BLM and BIA informally consulted with the USFWS requesting concurrence on the effects determinations analyzed and presented in the project BA. The USFWS letter of concurrence is provided in Appendix I. The consultation was programmatic; therefore site specific consultation would need to be conducted at the project phase for any elements of the project that may affect listed species.

### 4.3.1 Vegetative Resources

**ISSUES, IMPACT TYPES, AND CRITERIA**

Vegetative resource issues include: appreciable changes to, or substantial loss of, vegetative communities, wetlands, and culturally important plants; the establishment or proliferation of noxious weeds; impacts adversely affecting the recovery of threatened, endangered and sensitive species; or impacts that would cause rare or sensitive species to become federally listed as threatened or endangered.

Impacts to vegetation would be considered significant if the action were to result in serious, long-term affects to the resource. Examples could include:

- Disturbance and/or contamination of vegetation, such that suitable vegetative species could not be re-established through reclamation;
- Increased spread of root disease in piñon pine due to the removal of trees;
- Removal of potential habitat for current federally listed species to the extent that such populations could not be established on the Reservation;
- Loss of any federally listed species, or loss of critical habitat of such species, that would be considered a take under the ESA;
- High-quality riparian habitat (e.g., multi-structured willow or mature cottonwood) is affected to a degree that the function of the habitat is compromised;
- Impacts to wetlands to a degree that the function of the wetland is compromised;
- Loss of culturally important plant species occurs to the extent that they are no longer available for cultural activities; and/or
- As determined by SUIT DNR representatives, widespread, uncontrolled new infestations of noxious weeds occur.

The SUIT Range Division will be involved in site-specific planning and mitigation for each well location on Tribal lands to facilitate the avoidance of significant impacts to vegetation resources. Therefore, SUIT Range personnel could, at their discretion, impose site specific design features on a case-by-case basis.

## IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology for vegetative resources evaluates impacts common to both alternatives and those impacts specific to Alternatives 1 and 2. The vegetation resources categories evaluated include the following: vegetative communities, wetlands, culturally important plants, noxious weeds, federally listed threatened and endangered plants, and CNHP sensitive plants.

For this analysis, an impact assessment methodology was developed to consistently evaluate surface resource impacts for the alternatives. For example, potential impacts to Knowlton's cactus were quantified using GIS by determining the amount of potential habitat within the study area and then the number of existing well pads within that habitat. The number of potential wells that could occur in that habitat was then extrapolated using a proportional analysis based on the assumption that future development will follow the same pattern as past development. Refer to Section 4.1.1 for a detailed discussion on impacts assessment methodology. Estimates of disturbance acreages are approximate based on GIS polygon calculations. Therefore, total acreages calculated to quantify vegetative resource impacts could be greater to or less than those provided in Chapter 2 in the alternatives discussion. Impacts to threatened and endangered species were determined by examining the locations of new and co-located wells to determine the extent of potential habitat that could be disturbed for these species.

## IMPACTS COMMON TO BOTH ALTERNATIVES

*General Impacts to Vegetation* - Most impacts to vegetative resources during construction and drilling operations are considered direct impacts; that is, impacts that occur at the time of the proposed action is implemented. These impacts could be short- or long-term, depending on the impact and potential design features. Some impacts, however, would be realized later in time and are therefore categorized as indirect impacts. Such indirect impacts would be considered long-term.

The most prevalent direct impact to vegetative communities during the construction and drilling phase would be the loss of vegetation resulting from the clearing of well pads, pipeline ROWs, roads, and other associated infrastructure. Although a portion of new and co-located well pads would be reclaimed, more than half of the disturbed acreage would result in long-term vegetation loss.

During the production phase, a portion of the cleared areas at each new and co-located well pad will be reclaimed and reseeded. For new well pads, approximately 1 acre of previously cleared land will be reclaimed, thus reducing the long-term disturbance from 3.2 acres to 2.2 acres (refer to Section 2.1.3). For co-located well pads, 0.65 acre of previously cleared surface will be reclaimed, thereby reducing long-term disturbance from 1.15 acres to 0.5 acre (refer to Section 2.1.3). Access roads would not be fully reclaimed during the production phase, but rather upon completion of the project. By following the design features outlined in Section 2.4, impacts to vegetation would be minimized.

During the abandonment phase, all well pad sites and associated access roads will be reclaimed and re-vegetated. All well pad infrastructure above the surface would be removed as would gravel. Well pads and access roads would be re-contoured to previous topography to the extent feasible and would be reseeded with an appropriate native seed mix. No new surface disturbances are anticipated during this phase.

*Vegetative Communities* – Reclaimed areas in forest and woodland vegetative communities would require decades (i.e., >50 years) to return to pre-construction conditions. Thus, these vegetative communities would likely not be fully reclaimed during the production phase. Initially, disturbed forest and woodland areas would be established by herbaceous vegetation, representing a shift in plant species composition. Over time, it is anticipated that the native woody species would also become established and eventually grow to pre-construction conditions. Disturbed shrubland and grassland communities would also initially be established by herbaceous vegetation and would likely exhibit a change in species composition. These areas would be expected to return to pre-construction conditions much faster than forested and woodland communities (i.e., within five years for grasslands and ten years for shrublands).

Other direct impacts to vegetative communities could include contamination of vegetation from spills/leaks of petroleum or other environmental contaminants from vehicles, drill rigs, or heavy equipment. Potential spills or leaks of produced water could also impact vegetation due to its high salinity. Additionally, die-offs could occur if enough produced water is spilled or leaked onto the surface. These impacts could be short- or long-term depending on the amount of contaminant introduced into the environment.

Indirect impacts to vegetative communities may include the loss of vegetation (e.g., plant die-off) from methane seepage and/or subsurface coal fires in areas where the Fruitland Formation approaches the land surface (USDI 2002a). Impacts from methane seepage could be short or long-term, depending on the amount and duration of seepage. Die-offs from coal fires could result in damage to roots or other subsurface plant structures from the heat and toxic fumes of the fires (USDI 2002a). These impacts would likely be short-term with vegetation re-establishing after the fire has become suppressed. A subsurface coal fire may ignite a surface fire, which could result in more significant vegetation loss.

By following the design features outlined in Section 2.4 impacts to vegetative communities would be minimized.

*Wetlands* – Direct impacts to wetlands during construction could include filling, excavating, clearing, and grading existing wetlands. These impacts would be short-term if areas are to be reclaimed during the production phase or long-term if disturbed wetlands were located in the non-reclaimed portion of well pads or access road/pipeline ROW. Impacts to wetlands would be greater where roads/pipelines are constructed parallel to wetlands rather than crossing at right angles, which would decrease the area of disturbance.

Disturbed herbaceous wetlands reclaimed during the production phase would be expected to re-vegetate within several growing seasons; however, shrub-dominated wetlands could require at least 10 years to return to pre-construction conditions. Filled wetlands would likely not be reclaimed during production; however, operators would be required by the USACE to mitigate any long-term wetland loss by creating wetlands elsewhere.

Other direct impacts to wetlands could include short-term contamination from spills/leaks of petroleum or other environmental contaminants from vehicles, drill rigs, and other construction equipment.

Indirect impacts to wetlands occurring during the construction and drilling phase could include potential alterations to wetland drainage systems, which could result in changes to the water supply to a wetland. These impacts could be long-term. Indirect impacts to wetlands during production could include lowering of the water table, particularly near the Fruitland outcrop. These impacts are expected to be long-term. By following the design features outlined in Section 2.4, impacts to wetlands would be minimized.

*Culturally Important Plants* – Clearing of well pads, pipelines, roads, and other associated infrastructure during the construction phase would result in the removal of culturally important plants. Some culturally important plants are common and widespread on the Reservation, such as piñon pine, Rocky Mountain juniper, wild banana yucca, and yarrow. Avoidance of these species would therefore be difficult, especially for piñon pine. Riparian communities would be particularly vulnerable because of the abundance of several culturally important plants including narrowleaf cottonwood, cattail, and willow. Impacts to these species would be minimized by avoiding wooded riparian habitats to the extent possible (refer to Section 2.4). Final reclamation of disturbed areas would promote the re-establishment of culturally important plant species naturally occurring in native plant communities on the Reservation. Some of the more rare species, however, could not return as readily. Such species could require special re-vegetation techniques for their re-establishment.

Other impacts to culturally important plants during construction and drilling could include contamination of from spills/leaks of petroleum or other environmental contaminants from vehicles, drill rigs, and other equipment. These impacts are expected to be short-term, but by following the design features outlined in Section 2.4, impacts to culturally important plants would be minimized.

*Noxious weeds* - Noxious weeds could be introduced into the study area during all phases of development. Seeds of noxious species could be carried to construction areas via vehicles/heavy equipment (on tires) and clothing/shoes of construction and drilling personnel. In addition, soil disturbances in construction areas could allow seeds of noxious species already present in the soil to germinate and grow in the absence of competition from native plant species. These impacts would be long-term, but by following the design features outlined in Section 2.4 impacts due to noxious weeds would be minimized.

*Threatened, Endangered, and Sensitive Species* – Of the three federally listed threatened and endangered plant species listed as potentially occurring in La Plata County, only two have the potential to occur within the study area: Mancos milkvetch and Knowlton's cactus. Clearing of well pads, pipelines, roads, and other associated infrastructure during the construction phase could result in the removal of threatened, endangered, and sensitive plant species. In addition, clearing activities would result in the loss of potential habitat for threatened, endangered, and sensitive plant species.

Direct impacts to threatened, endangered, and sensitive plant species could include contamination and possible die-offs due to accidental spills or leaks of petroleum products or other environmental contaminants from maintenance or production vehicles and equipment, or from saline in produced water. These impacts could affect not only individuals but also reduce the quality of potential habitat for these species. These impacts would be long-term, but by following the design features outlined in Section 2.4, impacts to threatened, endangered, and sensitive species would be minimized or avoided.

## ALTERNATIVE 1 (NO ACTION) – IMPACTS TO VEGETATIVE RESOURCES

Estimated short- and long-term disturbance of vegetative communities in the study area under Alternative 1 are presented in Table 4–11. Piñon-juniper/juniper savanna communities would be expected to be most impacted by this alternative, with greater than half (54%) of the surface disturbance occurring in these community types. Semi-desert and salt desert communities would also be heavily impacted, with 20% of the expected surface disturbance occurring in these communities. The proportion of surface disturbance in barren, montane shrubland/grassland, and disturbed communities under Alternative 1 would be roughly 4%, 8%, 5%, respectively. Approximately 1% of surface disturbance would occur in montane forest communities, while less than 1% would be expected in wetland/riparian communities. The percentage of long-term vegetative loss would be less than 1% for each community, except barren where loss would be 2% of existing undisturbed acreage (Table 4–11).

**Table 4-11. Estimated Short- and Long-Term Loss of Vegetative Communities in the Study Area Under Alternative 1.**

| Vegetative Community | Existing Acreage[a] | Number of Wells[b] | | Short-Term Loss (Acres)[c] | Long-Term Loss (Acres)[d] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Co-located | New | | | |
| Montane Forest | 14,716 | 3 | 5 | 26 | 18 | <1 |
| Montane Shrubland/ Grassland | 24,863 | 20 | 33 | 170 | 117 | <1 |
| Piñon-Juniper/Juniper Savanna | 208,770 | 147 | 195 | 1,094 | 752 | <1 |
| Semi-Desert and Salt Desert | 71,916 | 56 | 69 | 400 | 275 | <1 |
| Barren | 8,056 | 26 | 31 | 182 | 125 | 2 |
| Wetland and Riparian | 8,087 | 2 | 3 | 16 | 11 | <1 |
| Disturbed | 84,856 | 15 | 31 | 147 | 101 | <1 |
| **TOTAL** | **421,264** | **269** | **367** | **2,035** | **1,399** | **–** |

[a] Based on undisturbed acreage (Refer to Table 3–6 in Section 3.3.1).
[b] Based on Alternative 1 (includes 86 existing wells and 550 approved but not drilled wells) (Section 2.2.1).
[c] Based on a short-term disturbance of 3.2 acres.
[d] Based on a long-term disturbance of 2.2 acres.

Potential impacts to vegetation as a result of spills/leaks of environmental contaminants and/or produced water would likely be greatest in piñon-juniper/juniper savanna communities, coinciding with the highest number of wells expected in this community type. Impacts would decrease accordingly in semi-desert/salt desert, barren, montane shrubland/grassland, and disturbed communities. Expected impacts to montane forest and riparian and wetland communities would be minimal.

Under Alternative 1, there would be minimal disturbance to wetlands in the study area (Table 4–11). An estimated 29 AF/yr of fresh water use would result from implementation of Alternative 1 for well construction and stimulation, based on an average number of 20 wells drilled per year. Additionally, CBM producing wells would intercept about 37 AF/yr of

Fruitland Formation water that would normally discharge in to the Animas River. This amount of water depletion is not expected to impact area wetlands.

Under Alternative 1, impacts to Knowlton's cactus could include a reduction of potential habitat. However, the potential for these impacts would be minimal, as only four wells would be expected to occur within potential habitat for this species (based on GIS analysis; refer to Section 4.1.1) and this analysis is not based on site-specific evaluations. During the site-specific environmental evaluation, pre-construction surveys for Knowlton's cactus will avoid or minimize impacts to this species and its potential habitat (Refer to Section 2.4).

Alternative 1 would have no potential to impact Mancos milkvetch, as no well locations would be expected to occur within potential habitat for this species (based on GIS analysis of expected well locations; refer to Section 4.1.1 and Map 3-4 in Appendix A).

## ALTERNATIVE 2 (PROPOSED ACTION) – IMPACTS TO VEGETATIVE RESOURCES

Estimated short- and long-term loss of vegetative communities in the study area under Alternative 2 are presented in Table 4-12.

**Table 4-12. Estimated Short- and Long-Term Loss of Vegetative Communities in the Study Area Under Alternative 2.**

| Vegetative Community | Existing Acreage[a] | Number of Wells[b] | | Short-Term Loss (Acres)[c] | Long-Term Loss (Acres)[d] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Co-located | New | | | |
| Montane Forest | 14,716 | 8 | 0 | 9 | 4 | <1 |
| Montane Shrubland/ Grassland | 24,863 | 63 | 3 | 82 | 38 | <1 |
| Piñon-Juniper/Juniper Savanna | 208,770 | 398 | 22 | 528 | 247 | <1 |
| Semi-Desert and Salt Desert | 71,916 | 139 | 8 | 186 | 87 | <1 |
| Barren | 8,056 | 74 | 4 | 98 | 46 | <1 |
| Wetland and Riparian | 8,087 | 5 | 0 | 6 | 3 | <1 |
| Disturbed | 84,856 | 44 | 2 | 57 | 26 | <1 |
| **TOTAL** | **421,264** | **731** | **39** | **966[e]** | **451** | **–** |

[a] Based on undisturbed acreage (Refer to Table 3-6 in Section 3.3.1).
[b] Based on 80-acre infill under Alternative 2.
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.
[e] Acreage estimates may be marginally more or less than those described in Section 2.2 due to GIS polygon analysis.

Table 4-13 presents the estimated short- and long-term loss potentially resulting from the additional anticipated incremental development.

**Table 4-13. Estimated Short- and Long-Term Loss of Vegetative Communities in the Study Area Resulting from Additional Anticipated Incremental Development Under Alternative 2.**

| Vegetative Community | Existing Acreage[a] | Number of Wells[b] | | Short-Term Loss (Acres)[c] | Long-Term Loss (Acres)[d] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Co-located | New | | | |
| Montane Forest | 14,716 | 1 | 4 | 14 | 9 | <1 |
| Montane Shrubland/ Grassland | 24,863 | 10 | 26 | 102 | 69 | <1 |
| Piñon-Juniper/Juniper Savanna | 208,770 | 79 | 154 | 666 | 446 | <1 |
| Semi-Desert and Salt Desert | 71,916 | 32 | 55 | 250 | 168 | <1 |
| Barren | 8,056 | 13 | 24 | 104 | 94 | 1 |
| Wetland and Riparian | 8,087 | 1 | 1 | 6 | 4 | <1 |
| Disturbed | 84,856 | 7 | 26 | 97 | 66 | <1 |
| **TOTAL** | **421,264** | **143** | **290** | **1,239[e]** | **856** | **–** |

[a] Based on undisturbed acreage (Refer to Table 3-6 in Section 3.3.1).
[b] Based on 347 approved but not drilled wells with 20% co-located, and 86 approved and drilled wells (Section 2.2).
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.
[e] Acreage estimates may be marginally more or less than those described in Section 2.3 due to GIS polygon analysis.

The proportion of surface disturbance expected in each vegetative community under Alternative 2 would be similar to Alternative 1 (piñon-juniper/juniper savanna = 54%, semi-desert and salt desert = 20%, barren = 9%, montane shrubland/grassland = 8%, disturbed = 7%, montane forest = 1%, and wetland/riparian <1%). The percentage of long-term vegetative loss combined would be less than 1% for each community (Tables 4-12 and 4-13).

Under Alternative 2, there would be minimal loss of wetlands in the study area (Tables 4-12 and 4-13). By locating well pads, roads, and pipeline outside of wetlands and by maintaining buffer zones between wetlands and construction areas, the potential for impacts from accidental spills/leaks of petroleum or other environmental contaminants would be minimal. By following the design features outlined in Section 2.4, impacts to wetlands would be minimized.

An estimated 34.6 AF/yr of fresh water would be required for well construction and stimulation under Alternative 2. Additionally, producing CBM wells would intercept about 18 AF/yr (peaking in 2025) of Fruitland Formation water that would normally discharge in to the Animas River. This depletion would not adversely affect study area wetlands.

Under Alternative 2, impacts to Knowlton's cactus could include a reduction of potential habitat. However, the potential for these impacts would be minimal, as only six wells, each a co-location, would be expected to occur within potential habitat for this species. In addition, pre-construction surveys for Knowlton's cactus will minimize or avoid impacts to this species (refer to Section 2.4). Alternative 2 has no potential to impact Mancos milkvetch, as no well locations would be expected to occur within potential habitat for this species (based on GIS analysis of expected well locations; refer to Section 4.1.1 and Map 3-4 in Appendix A). The proposed action may affect, is not likely to adversely affect Knowlton's cactus and Mancos milkvetch.

## IMPACTS SUMMARY

Overall impacts to vegetation for both alternatives would be similar. Under Alternative 1 surface disturbances occurring during the construction and drilling phase would result in the greatest impacts to vegetative communities, specifically in long-term vegetation loss. Piñon-juniper/juniper savanna communities would sustain the greatest loss of acreage under both alternatives, followed by semi-desert/salt desert, barren, montane shrubland/grassland, disturbed, montane forest, and riparian/wetland. Vegetative communities would realize greater short-term losses of acreage under Alternative 2 compared with Alternative 1 (Table 4-14). However, Alternative 2 would result in slightly less long-term impact than Alternative 1 (Table 4-14). There would be minimal impact to riparian and wetland communities under both alternatives. Accidental spills/leaks of petroleum products, produced water, or other environmental contaminants could occur under both alternatives.

**Table 4-14. Alternative Summary Comparison of Short- and Long-Term Disturbance to Vegetative Communities in the Study Area.**

| Vegetative Community | Alternative 1[a] | | Alternative 2[b] | |
|---|---|---|---|---|
| | Short-Term[c] | Long-Term[d] | Short-Term | Long-Term |
| Montane Forest | 26 | 18 | 23 | 13 |
| Montane Shrubland/Grassland | 170 | 117 | 184 | 107 |
| Piñon-Juniper/Juniper Savanna | 1,094 | 752 | 1,194 | 694 |
| Semi-Desert and Salt Desert | 400 | 275 | 435 | 255 |
| Barren | 182 | 125 | 202 | 140 |
| Wetland and Riparian | 16 | 11 | 12 | 7 |
| Disturbed | 147 | 101 | 154 | 92 |
| **TOTAL (acres)** | **2,035[e]** | **1,399** | **2,204** | **1,308** |

[a] Based on Alternative 1 (Section 2.2)
[b] Based on Alternative 2 (Section 2.2) and anticipated incremental development.
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.
[e] Acreage estimates may be more or less than those described in Section 2.2 due to GIS polygon analysis.

Potential impacts to threatened and endangered species under both alternatives would be limited to loss of potential habitat for Knowlton's cactus. By implementing pre-construction surveys for Knowlton's cactus, direct impacts to this species would be minimized or avoided. Although some habitat loss for Knowlton's cactus could occur, it would not be extensive enough to preclude establishment of populations on the Reservation.

**UNAVOIDABLE ADVERSE IMPACTS**

Unavoidable adverse impacts to vegetation resources in the study area include those that would remain for the life of the project (25 to 40 years). Wetlands and riparian woodlands are of the greatest concern due to their rarity within the study area and value as wildlife habitat (riparian woodlands), and because they are a source of several culturally important plants.

### 4.3.2 Wildlife and Fisheries

**ISSUES, IMPACT TYPES AND CRITERIA**

The study area provides habitat for a wide variety of wildlife and fish species, including several federal and state threatened and endangered species. Impacts to wildlife and fisheries resources may vary based on species' habitat requirements and sensitivity to project-related disturbances.

Most impacts to wildlife resources during construction and drilling operations are considered direct impacts; that is, impacts that occur at the time the proposed action is implemented. These impacts could be short- or long-term, depending on the impact and potential design features. Some impacts, however, would be realized later in time and are therefore categorized as indirect impacts. Such indirect impacts would be considered long-term. Impacts during construction and drilling, operation, and reclamation would be minimized by the implementation of design features as described in Section 2.4.

Impacts to wildlife and fisheries would be considered significant if the action were to result in serious, long-term affects to the resource. Examples include:

- Habitat loss or fragmentation to the extent that wildlife could not maintain viable populations on the Reservation;
- Water depletion in study area aquatic habitats such that fisheries could not maintain viable populations;
- Disturbance to or removal of potential habitat for current federally listed and candidate species to the extent that such populations could not exist or become established on the Reservation;
- Loss of any federally listed species, or loss of critical habitat of such species, that would be considered a take under the ESA;
- Disturbance (e.g., habitat loss/fragmentation, human presence) to big game migration corridors such that big game are precluded from moving between wintering and summer habitats;
- Decline of game species or fisheries to the extent that they are no longer available for hunting and/or fishing on the Reservation; and/or
- Loss of or disturbance to (i.e., human presence, noise) habitats identified by the SUIT DWRM as sensitive, such that wildlife are precluded from utilizing their resources during critical life stages (e.g., critical wintering grounds or parturition areas for big game).

The SUIT DWRM will be involved in site specific planning and mitigation for each well location to facilitate the avoidance of significant impacts to wildlife and fisheries resources. Therefore, SUIT DWRM may, at their discretion, impose site specific mitigation measures on a per well basis, such as but not limited to avoidance of sensitive habitats or seasonal restrictions on construction activities in sensitive habitats.

## IMPACT ASSESSMENT METHODOLOGY

The impact assessment methodology for wildlife and fisheries resources evaluates impacts common to both alternatives as well as impacts specific to Alternative 1 and Alternative 2. Under the "Impacts Common to Both Alternatives" section, impacts to wildlife and fisheries are separated into the following categories: game species, non-game species, fisheries, federally listed threatened and endangered species, and state threatened and endangered species.

The assessment of impacts to wildlife and fisheries was based on projected habitat losses and activities described under Alternatives 1 and 2 (Chapter 2.0). As site-specific locations cannot be determined at this time, a quantitative analysis of impacts was calculated for surface resources by a proportional analysis using GIS (refer to Section 4.3.1). In addition to analyzing impacts to wildlife and fisheries in this PEA, a BA was also prepared to determine the effects of each Alternative on USFWS threatened, endangered, and candidate species. The BA was submitted to USFWS in March of 2008, and is on file with the SUIT DWRM.

## IMPACTS COMMON TO BOTH ALTERNATIVES

### BIG GAME

*Habitat loss and fragmentation* - The greatest direct impact to big game under both alternatives would be habitat loss and fragmentation as big game have relatively large home ranges and some (deer, elk, and wild turkey) migrate between winter and summer habitats. Proposed new well locations located in previously undisturbed habitat would require the construction of new access roads that would increase habitat fragmentation in an already disturbed landscape. Big game species would realize a reduction in foraging, breeding, and denning grounds, and their migration routes could be dissected by roads and well pads. Of particular concern for mule deer and elk is the loss/fragmentation of winter concentration areas, calving/fawning grounds, and migration corridors. Vegetation removal in winter and calving/fawning areas would result in reduced forage availability, thermal cover, and hiding cover. Disturbance of migration corridors could preclude deer and elk from accessing habitats specific to their winter and summer life cycles and could decrease production or fitness. Merriam's wild turkeys also occupy habitat specific to breeding, brood-rearing, and winter foraging, migrating between habitats sometimes over long distances. This species would also sustain loss and fragmentation of habitats specific to their life cycles. Of particular concern for mountain lions and black bears is the loss of, or disturbance to, denning habitats from increased noise and human presence, which could impact local productivity for these species.

The development of new well pad locations and roads would particularly impact deer and elk, not only in terms of habitat loss, but also in relation to habitat use and selection. Ground disturbance can also introduce invasive non-native plant species that can alter habitat use. Numerous studies have consistently shown that elk avoid roads; although, the response may vary due to traffic volume, extent of cover adjacent to roads, topography, and the type of road (Rowland et al. 2005). Elk also exhibit high levels of stress and increased movement rates in areas of higher road density (Millspaugh et al. 2001), while Rost and Bailey (1979) found that mule deer avoid roads. Furthermore, in a recent study in Wyoming, mule deer were less likely to occupy areas in close proximity to new well pads (and roads) than those farther away (Sawyer et al. 2006). This study, however, concerns the progression from an undeveloped to a developed gas field, while habitat on the Reservation has been previously impacted by gas well development.

Some studies have also reported that black bears and mountain lions may exhibit some road avoidance behavior. In a North Carolina study, some black bears avoided crossing roads; however, increased avoidance was correlated with increased traffic level (Brody and Pelton 1989). In Arizona, mountain lions crossed unimproved dirt roads more frequently than improved dirt and paved roads; and, the latter two road types were less likely to occur within lion home ranges (Van Dyke et al. 1986). In California, mountain lions crossed dirt roads but avoided paved roads (Dickson et al. 2005). While no specific data are reported, Hoffman et al. (1993) suggest that Merriam's wild turkeys may abandon their habitats if road density is too high.

Disturbed habitats not required for well production would be reclaimed and reseeded with appropriate native seed mixes, reducing the amount of long-term habitat loss, particularly forage loss for deer and elk. By following the design features outlined in Section 2.4 impacts to big game would be minimized.

*Human disturbance and noise* - Increased human and vehicle/heavy equipment presence and associated noise during construction, maintenance, and reclamation activities would likely cause some big game to alter their daily movements to avoid these areas. Numerous studies have shown that elk normally prefer to use areas at least 0.5 mile from humans engaged in out-of-vehicle activities (Toweill and Thomas 2000). Other studies have reported alterations in habitat use by elk (Rost and Bailey 1979, Wisdon et al. 2004) and mule deer (Rost and Bailey 1979, Taylor and Knight 2003) in response to human recreation. Hoffman et al. (1993) suggest that Merriam's wild turkeys may also avoid habitats where human presence occurs frequently. These impacts would be expected to increase as well density in the study area increases.

*Human-wildlife encounters* - As new wells and roads are developed and human activities increase in the study area, the potential for human-wildlife encounters and conflicts increases. Possible conflicts could include human encounters with large predators, such as black bears and mountain lions, which could result in injury or death to individuals. There could also be an increase in illegal harvest by humans (i.e., poaching) resulting from new roads within the study area, particularly in remote areas where there is little law enforcement presence.

*Injury and mortality* - Big game species could be injured or killed from vehicle collisions during construction and drilling, production, and reclamation, and these risks could increase as new roads are constructed in the study area. These impacts would be minimized by maintaining appropriate speed limits on oil-and-gas access roads. By following the design features outlined in Section 2.4, impacts to big game would be minimized.

**SMALL GAME**

*Habitat loss and fragmentation* - Most small game species have relatively small home ranges and could readily move to adjacent habitats to compensate for habitat loss and fragmentation. However, long-term habitat loss and fragmentation under both alternatives would impact small game. Therefore, small game species would experience a reduction in foraging and breeding habitat. Ground disturbance can also introduce invasive non-native plant species that can alter wildlife habitat use. Of particular concern for small game mammals is the removal of denning habitat, which could impact local breeding populations. Although upland game birds are highly mobile and could easily move to adjacent or other alternative habitats, these species would also be impacted by long-term loss of foraging, nesting, and roosting habitats. By following the design features outlined in Section 2.4, impacts to small game would be minimized.

*Human disturbance and noise* - Small game could temporarily avoid habitats adjacent to construction areas when human and vehicle/heavy equipment are present but could return to the area after construction is complete. Others could be permanently displaced, moving to areas farther removed from disturbances. Game birds are highly mobile and would likely move to adjacent or alternative habitats in response to human disturbance. Human and vehicle presence during production and reclamation activities could also cause short-term movements or displacement to small game. By following the design features outlined in Section 2.4, impacts to small game would be minimized.

*Injury and Mortality* – Small game mammals could be vulnerable to injuries or mortalities from vehicle collisions during all phases under both alternatives. The potential for game bird injuries or deaths from vehicle collisions or construction activities is less likely, due to their mobility; however, game birds could be injured or killed from several other activities associated with both alternatives. Other injuries/mortalities to game birds may occur during construction, if vegetation containing active bird nests (i.e., with eggs or young) are removed during clearing and blading activities. Finally, game birds have the potential to be injured or killed if they are able to enter either reserve pits containing toxic substances, or heater-treaters (separators). Additionally, small game, specifically burrowing mammals, could be killed through contact with the methane and hydrogen sulfide ($H_2S$). By following the design features outlined in Section 2.4, impacts to small game would be minimized.

**NON-GAME SPECIES**

*Habitat Loss and Fragmentation* - Most non-game species have relatively small home ranges and could readily move to adjacent habitats to compensate for habitat loss and fragmentation. Nonetheless, non-game wildlife would experience long-term habitat loss and fragmentation under both alternatives. Roads fragment habitats, acting as a movement barrier to some species and disrupting natal dispersal, migration patterns, and gene flow among populations potentially leading to inbreeding and reduction in genetic variation. However, some wildlife species have a high tolerance for human and vehicle presence and could occupy habitats adjacent to roads and well pads.

Of particular concern for mammals is the loss of denning or nesting habitat (terrestrial mammals) and roosting or maternity colonies (bats), which could impact local breeding populations. For birds, there is particular concern for the loss of large trees suitable for raptor perching, roosting, and nesting substrates. Potential removal of large cottonwood trees in wooded riparian habitats would reduce potential perching, roosting, and nesting habitat for bald and golden eagle, red-tailed hawk, Cooper's hawk, and several owl species. Similarly, loss of mature ponderosa pine, Douglas-fir, or other conifers would reduce the available perching, roosting, and nesting trees for the forest dwelling birds of prey and numerous owl species. In addition, the removal of snags would reduce available nesting habitat for primary (e.g., woodpeckers) and secondary (e.g., chickadees) cavity nesting birds.

Loss of wetland and riparian habitats would have the greatest impact on amphibians; however, by following the design features in Section 2.4, impacts to riparian and wetland habitats would be minimized. Amphibians also utilize upland habitats for migration and overwintering, and recent studies have shown that fragmentation of terrestrial habitats occurring between amphibian breeding sites has reduced local amphibian populations (Ash 1997, Hecnar and McCloskey 1996). Thus, upland habitat loss and fragmentation in the study area could also negatively impact local amphibian populations.

Of all wildlife, habitat fragmentation could have the greatest impact on birds. Fragmentation creates habitat edges, which can be an ecological trap for many bird species, as edges attract predators and the brood parasitic brown-headed cowbird (*Molothrus ater*). Some research suggests that nesting success decreases near edges due to higher rates of nest predation and/or cowbird parasitism (Whitcomb et al. 1981, Yahner and Wright 1985, Andren and Angelstam 1988, Brittingham and Temple 1983, Ortega 1998).

*Human Disturbance and Noise* - Many non-game wildlife species have the potential to be impacted from human related disturbances. Some individuals could be temporarily displaced during construction, maintenance, or reclamation activities or when vehicles are in construction areas, but would likely return when humans and vehicles have left the area. Others could be permanently displaced, moving to areas farther removed from disturbances. Birds are probably the most mobile and would likely move to adjacent or alternative habitats in response to human disturbance. However, human disturbance could cause some nest abandonment in birds (Fort 2002, Ralph et al. 1993). Some nesting raptors have exhibited reduced nesting success (i.e., nest abandonment/failure, reduced productivity) as a response to human disturbance from recreational or industrial activities. Examples include bald eagle (Fraser at al. 1985, Anthony et al. 1994), golden eagle (Watson 1997), ferruginous hawk (White and Thurow 1985, Olendorff 1993), northern goshawk (Speiser 1992, Boal and Mannan 1994), sharp-shinned hawk (Delannoy and Cruz 1988), and prairie falcon (Boyce 1982, Steenhoff 1998).

*Injury and Mortality* - Injuries or deaths of non-game wildlife could result from vehicle collisions during all phases of development under both alternatives. Some animals could be injured or killed due to vehicle collisions. The potential for bird injuries or deaths from vehicle collisions or construction activities are less likely, due to their mobility.

During construction activities, bird mortalities could occur if vegetation containing active bird nests (i.e., with eggs or young) are cleared during construction. Small, burrowing mammals, reptiles, or amphibians could also be injured or killed during blading and leveling of well pads and access road/pipeline ROWs.

Plant die-offs occur in some areas of the Fruitland outcrop zone as a result of methane seeps. Burrowing animals, such as small mammals, reptiles, and amphibians, could be killed through contact with the methane and $H_2S$. By following the design features outlined in Section 2.4, impacts to non-game species would be minimized.

**FISHERIES**

*Reduction in water quality* – Fisheries in the study area could be impacted by water contamination or petroleum product accidental spills or leaks from vehicles and heavy equipment during all phases under both alternatives. During production, accidental spills of produced water could also have the potential to negatively impact water quality and fisheries. Water contamination could result in the reduction of food resources (e.g., aquatic invertebrates) or direct mortality.

Impacts to fisheries could include the alteration of habitats from erosion and sedimentation, resulting from increased surface disturbances associated with well pads and ROWs. Fish could be impacted directly from sedimentation of gravel spawning beds, as well as indirectly by depletion of food sources (e.g., invertebrates) that inhabit the interstitial spaces of streambeds.

*Reduction in water quantity* - Surface water depletion in the study area could occur during drilling activities; however, drilling water requirements would be met by appropriated sources. Under both alternatives, water depletion would occur during production as the CBM gas wells could intercept groundwater that would normally discharge from the Fruitland Formation into area rivers. Substantial ground water depletions could lower stream flow levels impacting aquatic species by changing channel morphology and reducing the amount of backwater habitats. However, neither alternative is expected to result in substantial ground water depletions. By following the design features outlined in Section 2.4, impacts to fisheries would be minimized.

## FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

*Southwestern Willow Flycatcher* - Riparian habitats in the study area would be minimally impacted under both alternatives; therefore habitat loss for southwestern willow flycatcher would be minimal. If a well location were proposed in habitat with potential to support southwestern willow flycatcher, pre-construction surveys for flycatchers would be required during the breeding season prior to construction activities (Refer to Section 2.4).

Southwestern willow flycatchers present in the study area could avoid habitats adjacent to areas where construction, production, and abandonment/reclamation activities are being conducted. If southwestern willow flycatchers were to nest adjacent to these areas, human disturbance could cause nest abandonment. However, by conducting pre-construction surveys for flycatcher in habitats immediately adjacent to proposed well locations (refer to Section 2.4), these impacts would be avoided.

Like other birds in the study area, southwestern willow flycatchers could be injured or killed by a variety of causes. The most probable cause of death or injury would be reserve pits or heater-treaters, if such structures were not lined or screened properly with protective materials. Vehicle collisions during all phases under both alternatives are possible but unlikely due to flycatchers' high mobility. It is also unlikely that flycatchers would be killed by potential coal fires occurring near the Fruitland outcrop, because they are highly mobile. However, coal fires that ignite surface fires could destroy flycatcher nests if fires spread to suitable nesting habitats. By following the design features outlined in Section 2.4, impacts to southwestern willow flycatchers would be minimized.

*Colorado Pikeminnow and Razorback Sucker* – Potential impacts to the Colorado pikeminnow and razorback sucker would be similar; therefore, the impacts discussion has been combined for these two species. No direct impacts to either fish species are anticipated under either alternative due to the absence of populations on the Reservation. Indirect impacts could include contamination of water downstream in the San Juan River, where known populations occur, from accidental spills or leaks of petroleum products, produced water, or other environmental contaminants.

Both of the alternatives would result in minor depletions to the San Juan River. As part of the SJRBRIP, on September 21, 1999, the USFWS issued an *Intra-Service Section 7 Consultation for Minor Depletions of 100 Acre-feet or Less from the San Juan River Basin*. This opinion provides for a cumulative total of 3,000 AF/yr of new minor depletions in the basin. The minor depletion allowance increases the efficiency of and streamlines the section 7 process, benefiting water development and water management activities, while protecting the endangered and native fish community. A minor depletion is defined as a depletion of 100 AF/yr or less under the guidelines.

Other indirect impacts would include alteration of potential habitats from erosion and sedimentation, resulting from increased surface disturbances associated with well pads and ROWs. Habitats could be impacted directly from sedimentation of gravel spawning beds, as well as indirectly by depletion of food sources (e.g., invertebrates) that inhabit the interstitial spaces of streambeds. Potential water depletions to rivers feeding into habitat for these species could result in indirect impacts. By following the design features outlined in Section 2.4, impacts to the Colorado pikeminnow and razorback sucker would be minimized.

*Yellow-billed cuckoo -* Wooded riparian habitats in the study area would be minimally impacted under both alternatives; therefore, any potential habitat loss for yellow-billed cuckoo would be minimal. Although never confirmed within the study area, cuckoos could avoid construction, production, or reclamation areas. If cuckoos were to nest adjacent to construction areas, human disturbance could cause nest abandonment.

Yellow-billed cuckoos could be injured or killed by a variety of causes. Reserve pits or heater-treaters would be the most probable cause of death or injury if such structures were not lined or screened properly with protective materials. Vehicle collisions during all phases of both alternatives are possible but unlikely due to cuckoos' high mobility. By locating wells outside of riparian habitats, to the extent possible, and by following the design features in Section 2.4, these impacts would be minimized. It is also unlikely that cuckoos would be killed by potential coal fires occurring near the Fruitland outcrop because they are highly mobile. However, coal fires that ignite surface fires could destroy cuckoo nests, if fires spread to suitable nesting habitats. Because there have been no yellow-billed cuckoos documented within the study area in recent years, impacts to this species are expected to be negligible.

**State Threatened and Endangered Species**

State threatened and endangered species with the potential to occur in the study area include river otter, bald eagle, and burrowing owl. The loss of large trees suitable for bald eagle perching, roosting, and nesting, would likely be the greatest potential impact. Loss of riparian habitats would also have the greatest impact on bald eagle and river otter; however, by following the design features in Section 2.4, impacts to riparian and wetland habitats would be minimized. Burrowing owls, if present, could realize the greatest impacts due to habitat fragmentation and the number of wells expected to be drilled in semi-desert/salt desert habitats.

There are only a very small number of known, active bald eagle nests within the study area, and none on SUIT land. Wintering concentrations of bald eagles occur on the Los Piños River, Animas, Florida, and La Plata River within the study area. There are likely several active golden eagle nests within the study area, but available data on these are sparse to non-existent. SUIT DWRM is currently working to conduct surveys on Reservation lands to obtain an accurate database on the occurrence of nesting raptors within the study area (Steve Whiteman, personal communication 4/6/09). Gunnison prairie dogs are a source of prey for bald and golden eagles. Prairie dog colonies do occur within the study area and are assumed to be random and widespread in distribution. The occurrence of prairie dog colonies near active bald or golden eagle nests is currently unknown given available data. It is possible, but unlikely, that the alternatives would result in ground disturbance and appreciable impacts to prairie dog colonies and subsequently the prey base. Pre-construction surveys to evaluate the presence of prairie dog colonies and raptor nests would minimize or avoid any potential effects to raptor prey base.

Human and vehicle presence and the associated noise would also likely directly impact bald eagle, burrowing owl, and river otter, if present, resulting in temporarily avoidance of habitats adjacent to construction areas where human and vehicle/heavy equipment are present. Some individuals could return to the area after construction is complete while others could be permanently displaced. Additionally, human disturbance could cause some nest abandonment or reduced nesting success for burrowing owl (Milsap and Bear 1988, in Haug et al. 1993) or bald eagle (Fraser et al. 1985, Anthony et al. 1994), if construction activities occur adjacent to active nests.

Injuries or deaths of bald eagle, river otter, or burrowing owl could result from vehicle collisions during all phases under both alternatives. Burrowing owls would be the most susceptible, if flying over study area roads to forage. Some could be injured or killed due to vehicle collisions. Additional eagle or burrowing owl mortalities would occur if vegetation containing active nests (i.e., with eggs or young) are cleared during construction. Spring-season pre-construction biological surveys of well pad locations would identify potential burrowing owl nesting sites, and SUIT DWRM personnel would provide site-specific design features to avoid impacting this species, if necessary. By following the design features for raptors in Section 2.4, these impacts would be minimized to this species.

**ALTERNATIVE 1 (NO ACTION) – IMPACTS TO WILDLIFE AND FISHERIES**

Impacts to wildlife, including sensitive species, under Alternative 1 include habitat loss and fragmentation, human disturbance and noise, and injury and mortality including illegal harvest. A detailed description of wildlife and fisheries impacts common to both alternatives is provided in above. Expected habitat loss in the study area per vegetative community is shown in Table 4–11 (Section 4.3.1). Impacts to big game habitat types and long-term loss under Alternative 1 are estimated in Table 4-15. The remaining development under Alternative 1 would include the potential long-term disturbance of 183 acres in elk calving and deer fawning areas, 1,038 acres in elk and deer winter habitat, 194 acres in elk and deer migration corridors, and 972 acres in big game year round habitat (Table 4-15). Design features in Section 2.4 would minimize impacts to study area wildlife.

Fisheries in the study area could be impacted by water contamination and by accidental spills or leaks of petroleum products. During production, accidental spills of produced water could also have the potential to negatively impact water quality and fisheries. Water contamination could result in the reduction of food resources or direct mortality. Impacts to fisheries could include the alteration of habitats from erosion and sedimentation, resulting from increased surface disturbance. Fish could be impacted directly from sedimentation of gravel spawning beds, as well as indirectly by depletion of food sources. By following the design features outlined in Section 2.4, these potential impacts would be minimized.

**Table 4-15. Estimated Short- and Long-Term Loss or Modification of Big Game Habitat Types in the Study Area Under Alternative 1.**

| Big Game Habitat Type | Existing Acreage[a] | Conventional Wells[b] | CBM[b] | Total Short-Term Disturbance[c] (Acres) | Total Long-Term Disturbance[d] (Acres) | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| Calving/Fawning | 34,138 | 42 | 41 | 266 | 183 | <0.5 |
| Winter | 156,113 | 200 | 272 | 1,510 | 1,038 | <1 |
| Migration | 32,980 | 44 | 44 | 282 | 194 | <0.5 |
| Year-round | 132,812 | 194 | 248 | 1,414 | 972 | <0.5 |

[a] Based on undisturbed acreage of the habitat type in the study area, refer to maps 3-5 and 3-6.
[b] Based on Alternative 1 (includes 86 existing wells and 550 approved but not drilled wells) (Section 2.2).
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

No direct impacts to either Colorado pikeminnow or razorback sucker are anticipated due to the absence of populations on the Reservation. Indirect impacts could include contamination of water downstream in the San Juan River and water depletions. Producing CBM wells would intercept about 37 AF/yr of Fruitland Formation water that would normally discharge into the Animas River (USDI 2002a). Other indirect impacts would include alteration of potential habitats from erosion and sedimentation, resulting from increased surface disturbances associated with the construction of well pads and ROWs.

Under Alternative 1, potential impacts to southwestern willow flycatcher and yellow-billed cuckoo would be minimal as wells would be located outside of riparian habitats to the extent possible and by following the design features outlined in Section 2.4.

## ALTERNATIVE 2 – (PROPOSED ACTION) – IMPACTS TO WILDLIFE AND FISHERIES

Expected habitat loss in the study area per vegetative community is shown in Table 4–12 (Section 4.3.1). Under Alternative 2 impacts to wildlife and sensitive species, include habitat loss and fragmentation, human disturbance and noise, and injury and mortality including illegal harvest. Impacts to big game habitat types and long-term loss under Alternative 2 are estimated in Table 4-16. Modifications to big game habitat types under Alternative 2 would include long-term impacts to an estimated 209 acres of elk calving and deer fawning habitat, 579 acres of elk and deer winter habitat, 101 acres of big game migration habitat, and 562 acres of big game year round habitat (Table 4-16). A detailed description of wildlife and fisheries impacts common to both alternatives is provided above. By co-locating the majority of wells under Alternative 2, human related disturbances would be largely limited to existing well locations and access roads rather than previously undisturbed habitats.

**Table 4-16. Estimated Short- and Long-Term Loss or Modification of Big Game Habitat Types in the Study Area Under Alternative 2.**

| Big Game Habitat Type | Existing Acreage[a] | Co-Located Wells[b] | New Locations[b] | Total Short-Term Disturbance[c] (Acres) | Total Long-Term Disturbance[d] (Acres) | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| **Calving/Fawning** | 34,138 | 92 | 5 | 122 | 168 | <1 |
| **Winter** | 156,113 | 540 | 30 | 717 | 336 | <0.5 |
| **Migration** | 32,980 | 94 | 5 | 119 | 58 | <0.5 |
| **Year-round** | 132,812 | 525 | 29 | 697 | 326 | <0.5 |

[a] Based on undisturbed acreage of the habitat type in the study area, refer to maps 3-5 and 3-6.
[b] Based on 80-acre infill (Section 2.2).
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

No direct impacts to either Colorado pikeminnow or razorback sucker are anticipated due to the absence of populations on the Reservation. Indirect impacts could include contamination of water downstream in the San Juan River, and water depletions. Producing CBM wells would intercept an additional 18 AF/yr (peaking in 2025) of Fruitland Formation water that would normally discharge in to the Animas River. Other indirect impacts would include alteration of potential habitats from erosion and sedimentation, resulting from increased surface disturbances associated with well pads and ROWs. Due to water depletions, the proposed action may affect, is likely to adversely affect Colorado pikeminnow and razorback sucker.

Potential impacts to southwestern willow flycatcher and yellow-billed cuckoo would be minimal as wells would be located outside of riparian habitats to the greatest extent possible and by following the design features outlined in Section 2.4. The proposed action may affect, is not likely to adversely affect southwestern willow flycatcher and yellow-billed cuckoo.

## IMPACTS SUMMARY

Under either alternative there would be no significant impacts to wildlife. Impacts to game and non-game wildlife under both alternatives include habitat loss and fragmentation. Although the amount of wildlife habitat lost under Alternative 1 and 2 would be similar in most circumstances, the impacts from habitat fragmentation would be less under Alternative 2 because a substantial number of wells would be co-located and would not require new access roads, and development would be consolidated. Table 4-17 summarizes the total short- and long- term disturbance to wildlife habitat in the study area.

**Table 4-17. Alternative Summary Comparison of Short- and Long-Term Disturbance to Big Game Habitat Types in the Study Area.**

| Big Game Habitat Types | Alternative 1[a] | | Alternative 2[b] | |
|---|---|---|---|---|
| | Short-Term[c] (Acres) | Long-Term[d] (Acres) | Short-Term (Acres) | Long-Term (Acres) |
| **Calving/Fawning** | 266 | 183 | 195 | 209 |
| **Winter** | 1,510 | 1,038 | 1,152 | 579 |
| **Migration** | 282 | 194 | 195 | 101 |
| **Year-round** | 1,414 | 972 | 1,118 | 562 |

[a] Based on Alternative 1 (Section 2.2)
[b] Based on Alternative 2 (Section 2.2) and anticipated incremental development.
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

The potential for wildlife injuries and mortalities under both alternatives could occur from: (1) construction activities, (2) vehicle collisions, (3) methane seeps, (4) illegal harvest, and (5) coal fires. Impacts as a direct result of construction activities would be similar under both alternatives and could include injury or death to small mammals, reptiles, or amphibians during blading and loss of bird nests during clearing and blading. Fewer nests would be impacted under Alternative 2 because a substantial number of wells would be co-located on existing well pads. The potential for vehicle-wildlife collisions would be greater under Alternative 1, as more new access roads would be built than under Alternative 2. The potential for injuries or deaths to wildlife as a result of methane seeps and coal fires near the Fruitland outcrop would be greater under Alternative 2.

Impacts to fisheries under both alternatives are similar and include a reduction in water quality and quantity as well as habitat alteration. These impacts would be similar under both alternatives. Drilling and production activities under both alternatives would result in water depletion, which would impact area fisheries. Water depletion resulting from fresh water use for drilling and completion would be greater under Alternative 2 than Alternative 1, because of the increased number of CBM wells. Habitat alteration impacts to fisheries habitats would be similar under both alternatives.

Impacts to southwestern willow flycatcher and yellow-billed cuckoo would be similar under Alternatives 1 and 2. Habitat loss and fragmentation under both alternatives would be minimal, as riparian habitats would be almost entirely avoided. Impacts to Colorado pikeminnow and razorback sucker and State listed threatened and endangered species would be minimal and similar under both alternatives.

## UNAVOIDABLE ADVERSE IMPACTS

Wildlife habitat losses that would occur for the life of the project (about 25 to 50 years) such as well pads and new roads would be unavoidable adverse impact. Of greatest concern is the loss of winter concentration areas and calving/fawning grounds for mule deer and elk, loss of riparian habitats supporting birds (including raptors), amphibians, and aquatic mammals, loss of trees for nesting birds, and loss of denning habitat for mammals.

## 4.4 Geology, Minerals, and Soils

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect geology, soil and minerals within the study area. Design features specific to geology, soil and minerals are discussed in Section 2.4.

### 4.4.1 Geology and Minerals

**ISSUES, IMPACT TYPES, AND CRITERIA**

Geologic resource issues include changes in geology, a potential for methane seeps and the presence of coal bed fires. The only anticipated impacts would be the deliberate removal of natural gas resources for economic production. Impacts from the depletion of natural gas reserves were analyzed in the 2002 FEIS (USDI 2002a). Other impacts to geological or mineral resources would be considered significant if the action were to result in serious, long-term impact to the resource. Examples include:

- Changes in geology such as fracturing or structural instability;
- If the activities and restrictions associated with the proposed project prohibited reasonable opportunity to explore for or to produce resources such as solid coal, which otherwise would be economically recoverable; and/or
- Methane seeps and coal fires in the Fruitland outcrop naturally occur. An appreciable increase in either phenomenon that could represent a loss of potential economic resources and significant health and safety issues.

**IMPACT ASSESSMENT METHODS**

Impacts to natural gas resources are assessed according to the number and type of wells proposed under each alternative and the total predicted production of conventional natural gas and methane. A gas volume forecast was developed by CG&A (2007). CG&A used its extensive SJB well database to gather information on wells in the study area. This includes coal thickness, gas content, coal isotherm properties, ash content, permeability, initial reservoir pressure, current reservoir pressure, and historical production data from existing 320, 160, and 80-acre infill wells. These data were used to calculate the initial gas-in-place, the gas recovery to date and the remaining gas to be recovered in a section. Type curves were then forecast for the 80-acre wells in the section based on the above referenced variables. These type curves were then cross checked with historical production of existing similar wells or, in the absence of historical data, reservoir simulation models were used as a reference.

CG&A created a unique 80-acre well decline curve representative of each 80-acre well in a township based upon the reservoir properties and production histories of the wells in that township. Each of the 770 wells was assigned a type curve based upon its location within a specific township. The 770 curves were then combined into a single average curve for the program by volume weighting the curves and combining them. This average curve was used for production scheduling because the specific timing of the drilling of each well cannot be predicted. Production from the new wells was forecast to begin in spring of 2009, with 80 wells per year being put on production. The forecast was carried out for 20 years until September 2028. The impacts on gas seeps and coalbed fires cannot be quantified due to the complex nature of the Fruitland Formation. Modeling studies and site research have been done to better understand the role of CBM development and potential effects of infill development.

## IMPACTS COMMON TO BOTH ALTERNATIVES

The potential impacts discussed below would occur under either alternative; however, the level or degree of these impacts may vary between the alternatives.

*Subsurface geologic integrity* - Subsurface geology and minerals would not be affected by the surface construction of wells and infrastructure. The well bores which penetrate Quaternary and Tertiary geologic units are drilled under strict guidelines. Drilling fluids and materials are not expected to extend beyond a small circulation zone (a few feet in diameter). Therefore, geologic formations other than the Fruitland Formation would not be impacted by CBM development. Impacts to the Fruitland Formation would include removal of natural gas resources and dewatering. Production of water from the Fruitland Formation would not affect the strength of the geologic unit due to the structure of the coalbeds and inherent geology.

*Coal and other mineral resources* - Most coal resources in the Fruitland Formation are too deep to be economically mined. There are no active coal mines in the study area. The only coal beds with potential for mining development are very near or at the Fruitland outcrop. There are no anticipated impacts to other mineral, or sand and gravel resources.

*Coal bed fires* - Dewatering and degassing of coal beds during CBM production near the Fruitland outcrop could contribute to the occurrence of coal bed fires resulting in an indirect and long-term impact. The SUIT, with the assistance from the Global Climate and Energy Project at Stanford University, is monitoring three coalbed fires on the Reservation to better understand their dynamics and origins. These monitoring programs are also aimed at identifying any potential hazards to the public and mitigating potential impacts. The future development of features that would capture methane seeps would also, in theory, decrease the effects of CBM on coalbed fires.

*Groundwater* - In the Fruitland Formation, except within a limited area (which will be determined on a case-by-case basis) adjacent to the outcrop, produced water is of low quality and has very limited potential uses. Some produced water could be used to mix in drilling fluids and to drill new wells resulting in a long-term and indirect impact. The disposal of produced water into geologic units at depth (below the Fruitland Formation) would not impact any viable groundwater resources and is carefully calibrated (according to USEPA regulations) so as not to damage the geologic strength of the disposal formation.

*Methane seeps* - Methane gas released by lower pressures near the outcrop could migrate to the surface, infiltrating soils or emanating at seeps and springs. The 3M modeling study (Cox et al. 2001) found that methane seeps could have increased in relation to CBM development and that they could continue to increase in the near future. The study also noted that infill development (and the associated increase in CBM recovery) could reduce the amount of methane that escapes to seeps or springs. LT Environmental has attempted to observe changes in methane seepage over time and space, but has never attempted to correlate seeps to CBM production. Recent work by public, government and Tribal entities has focused on how to mitigate methane seeps. This impact would be an indirect and long-term impact.

**ALTERNATIVE 1 (NO ACTION) – IMPACTS TO GEOLOGY AND MINERALS**

Under the 160-acre infill development plan, approximately 795,076 MMcf would be produced from the Fruitland Formation. This would result in a direct geological impact to the Fruitland Formation resulting in a long-term impact.

**ALTERNATIVE 2 (PROPOSED ACTION) – IMPACTS TO GEOLOGY AND MINERALS**

Alternative 2 would entail 80-acre infill well spacing of 770 CBM wells within the study area. Alternative 2 would be more efficient at recovering methane resources from the Fruitland Formation; an estimated 1,320,024 MMcf of methane gas resources would be produced resulting in a direct, long-term geological impact to the Fruitland Formation.

**IMPACTS SUMMARY**

Alternative 2 would increase the efficiency of methane gas recovery and overall economic benefit to the Tribe from its natural resources by 66% compared to Alternative 1 resulting in a direct and long-term impact. No design features have been developed for geology and minerals.

**UNAVOIDABLE ADVERSE IMPACTS**

The production of non-renewable natural gases would be an unavoidable adverse impact under Alternatives 1 and 2. An increase in the loss of methane resources through surface seeps and springs and loss of coal resources through increased coalbed fires would also result in an unavoidable adverse impact under Alternatives 1 and 2. No design features are proposed for geology and minerals.

### 4.4.2 Soils

**ISSUES, IMPACT TYPES, AND CRITERIA**

Impacts to native soil during each phase of natural gas development include: increase in soil erosion, increase in runoff, changes in soil drainage patterns, loss of topsoil, difficulty in re-vegetation, loss of prime farmland, and elevated methane concentrations in soils.

Impacts to soils would be considered significant if the action were to result in long-term effects to soil stability or productivity. Examples would include:

- Loss of soil productivity after full reclamation has occurred (estimated five years) on appreciable acreage,
- Potential for damage to manmade facilities or endangerment of public safety due to increased erosion,
- Violation of water quality standards due to sedimentation from increased erosion, and/or
- Uncontrolled accelerated erosion.

**IMPACT ASSESSMENT METHODOLOGY**

For this analysis, an impact assessment methodology was developed to consistently evaluate surface resource impacts for both the alternatives. Impacts to soil types were based on estimates of surface disturbance for Alternatives 1 and 2. As site-specific locations cannot be determined at this time, a quantitative analysis of impacts was calculated for surface resources by a proportional analysis using GIS. The acres of disturbance calculated were based on the number of new and/or co-located wells plotted in each soil type. Estimates of disturbance acreages are approximate based on GIS polygon calculations. Therefore, total acreages calculated to quantify soil impacts could be greater or less than those provided in Chapter 2 in the alternatives discussion. Refer to Section 4.1.1 for further details.

**IMPACTS COMMON TO BOTH ALTERNATIVES**

*General impacts* - Native soil impacts would occur during each phase of development under both alternatives. These impacts would include: increased soil erosion, increased runoff, changes in soil drainage patterns, loss of topsoil, difficulty in re-vegetation, loss of prime farmland and elevated methane concentrations in soils. Some soil loss would also occur. Since the 2002 FEIS was published, the SUIT has introduced additional design features for the protection of soils within the study area. These new design features include the submittal of annual reports to the SUIT on reclamation efforts within the SUIT boundary (refer to Appendix E and Section 2.4).

The majority of potential soil impacts occur during the construction phase of gas well pads and access roads and in the setup of heavy equipment. Direct impacts would occur during cut and fill operations to level the well pad and/or ROWs, compaction by heavy machinery, soil disturbance and mixing, loss of vegetated surface, and difficulty in re-vegetation. These impacts would result in an increase in soil erosion, decreased permeability, high sedimentation in runoff, immediate changes to natural drainage patterns, and the loss of farmland. Increased sedimentation in local waterways could affect aquatic habitats, fisheries, domestic drinking water supplies, riparian vegetation, and irrigation systems.

Once construction impacts are mitigated and remediated through the interim reclamation process, minor long-term impacts could continue to occur in the production phase of oil and gas development. Wind erosion and sedimentation from rainfall and snowmelt runoff would occur around well pads and access roads, which could impact the water quality of receiving waters.

During abandonment, the well location would be re-contoured and revegetated to return the area to its previous use, such as grazing or agriculture. Access roads would also be abandoned if not needed for access to an operational well or other facility. The roadway would be scarified to loosen soil, reseeded, and mulched. To facilitate reclamation, travel along the access would be restricted by the construction of earthen berms or other barriers. Initially, final reclamation of a well pad or access road could result in increased erosion from wind and water due to soil disturbance. This impact would be short-term until the area is successfully revegetated. BMPs will be implemented according to the COAs to minimize this impact. Acreage could be returned to its previous use upon final reclamation.

Oil and gas production requires the use of potential contaminants such as produced oil or gas, produced water of low quality, and construction materials. Careful management throughout the process will reduce the potential for any spills or contamination.

Methane concentrations in soils will continue to be monitored according to methods required in existing policy and regulations. It is not expected that newly constructed wells would increase the occurrence of methane in soils near the outcrop. Appropriate design features and safety precautions will be employed in any areas that are identified as having elevated methane concentration in soils.

By following the design features outlined in Section 2.4, impacts to soils would be minimized.

*Prime farmland* – Construction of well locations would impact prime farmland and convert agricultural production areas to well pads, access roads, and pipeline ROWs resulting in a long-term and direct impact. No design features have been developed for prime farmland.

*Highly erodible soils* – These soils are particularly vulnerable to erosion due to the soil type, slope, vegetation, or other factors. Development often leads to de-vegetation and changes in drainage that could exacerbate erosion. Highly erodible soils occur across the study area, particularly in regions with steeper topography. Development on soils with a high erosion potential and slope of greater than 30% should be avoided. By following the design features outlined in Section 2.4, impacts to highly erodible soils would be minimized.

## ALTERNATIVE 1 (NO ACTION) – IMPACTS TO SOILS

During construction and drilling a total of 2,035 acres is estimated to be directly impacted in the short-term under this alternative. Of this acreage, an estimated 410 acres of prime farmland and 810 acres of highly erodible soils could be impacted in the short-term (Table 4-18). During operation, interim reclamation would restore a portion of the impacted area to a functional condition. The long-term disturbance under this alternative is estimated to be 1,400 acres. Of this disturbance, an estimated 282 acres could be prime farmland and an estimated 557 acres could be highly erodible soils (Table 4-18). By following the design features outlined in Section 2.4, impacts to soils would be minimized.

**Table 4-18. Predicted Short- and Long-Term Disturbance to Prime Farmland and High Erosion Potential Soils Under Alternative 1.**

| Soil Type | Current Development [a] | | | Remaining Development | | | Total - Alternative 1 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Wells | Short-Term [b] (Acres) | Long-Term [c] (Acres) | Number of Wells | Short Term (Acres) | Long-Term (Acres) | Number of Wells | Short-Term (Acres) | Long-Term (Acres) |
| Prime Farmland | 22 | 70 | 48 | 106 | 339 | 233 | 128 | 410 | 282 |
| High Erosion Potential | 25 | 80 | 55 | 228 | 730 | 502 | 253 | 810 | 557 |

[a] Known locations.
[b] Based on a short-term disturbance of 3.2 acres.
[c] Based on a long-term disturbance of 2.2 acres.

## ALTERNATIVE 2 (PROPOSED ACTION) – IMPACTS TO SOILS

During construction and drilling, approximately 966 acres would be directly disturbed in the short-term under Alternative 2 (Table 2-5). Of this short-term disturbance, an estimated 187 acres of prime farmland and an estimated 404 acres of highly erodible soils would be disturbed (Table 4-19). During operation, interim reclamation would restore a portion of the impacted area to a functional condition. The total long-term disturbance of wells under Alternative 2 would be 451 acres (Table 2-5). Of this long-term disturbance, an estimated 88 acres would be prime farmland and 189 acres would be highly erodible soils (Table 4-19).

**Table 4-19. Predicted Short- and Long-Term Disturbance to Prime Farmland and High Erosion Potential Soils Under Alternative 2.**

| Soil Type | Co-Located Wells[a] | | | New Wells[b] | | | Total - Alternative 2 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Wells | Short-Term (Acres) | Long-Term (Acres) | Number of Wells | Short-Term (Acres) | Long-Term (Acres) | Number of Wells | Short-Term (Acres) | Long-Term (Acres) |
| Prime Farmland | 140 | 161 | 70 | 8 | 26 | 18 | 148 | 187 | 88 |
| High Erosion Potential | 304 | 350 | 152 | 17 | 54 | 37 | 321 | 404 | 189 |

[a] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[b] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

The short- and long-term disturbance to prime farmland and highly erodible soils from the anticipated additional incremental development is provided in Table 4-20.

**Table 4-20. Predicted Short- and Long-Term Disturbance to Prime Farmland and High Erosion Potential Soils from Additional Anticipated Incremental Development Under Alternative 2.**

| Soil Type | Existing Wells[a] | | | Anticipated Wells | | | Total – Additional Incremental Development | |
|---|---|---|---|---|---|---|---|---|
| | Number of Wells | Short-Term (Acres) | Long-Term (Acres) | Number of Wells | Short-Term (Acres) | Long-Term (Acres) | Short-Term (Acres) | Long-Term (Acres) |
| Prime Farmland | 22 | 70 | 48 | 66 | 184 | 123 | 255 | 171 |
| High Erosion Potential | 25 | 80 | 55 | 144 | 401 | 268 | 481 | 322 |

[a] Known locations.

Additional anticipated incremental development could result in an estimated 442 acres of disturbance to prime farmland and an estimated 885 acres to highly erodible soils during construction and drilling (Table 4-21). During operation, following interim reclamation, long-term disturbance would be 259 acres of prime farmland and approximately 512 acres of highly erodible soils. By following the design features outlined in Section 2.4, impacts to soils would be minimized. No design features were developed for prime farmland.

**Table 4-21. Summary of Predicted Short and Long-Term Disturbance in Acres to Prime Farmland and High Erosion Potential Soils.**

| Soil Type | Alternative 1 | | | Alternative 2 | | |
|---|---|---|---|---|---|---|
| | Number of Wells | Short-Term (Acres) | Long-Term (Acres) | Number of Wells | Short-Term (Acres) | Long-Term (Acres) |
| Prime Farmland | 128 | 410 | 282 | 236 | 442 | 259 |
| High Erosion Potential | 253 | 810 | 557 | 490 | 885 | 512 |

**IMPACTS SUMMARY**

The total long-term, direct disturbance of prime farmlands and highly erodible soils, under both alternatives, is less 1% of the total acreage of these soil types in the study area. As shown in Table 4-21, Alternative 2 would result in a greater short-term impact to prime farmland than Alternative 1. The increased impacts to prime farmland under Alternative 2 would be approximately 32 more acres, or 7%, than Alternative 1. However, Alternative 2 is estimated to result in 23 acres less of long-term impacts to prime farmland than Alternative 1. Under Alternative 2 a greater acreage amount of soils with high erosion potential would be impacted in the short-term, while a lesser amount would be impacted in the long-term than Alternative 1.

Specific development plans are required to avoid highly erodible soils and prime farmland (where feasible) to minimize impacts. Proper implementation of BMPs in all phases of development also will reduce the potential impacts to soils in the study area. Re-vegetation with native species will restore disturbed areas after development and reduce long-term impacts. Impacts under both alternatives would be similar; however, Alternative 2 would provide greater resource recovery and a greater level of consolidated development due to co-location.

**UNAVOIDABLE ADVERSE IMPACTS**

Short-term increases in soil erosion rates, especially in areas where development would occur on highly erodible soils, would result in unavoidable adverse impacts. The impacts would be short in duration and would be minimized by the implementation of design features. Less than 1% of prime farmland within the study area would be removed from agricultural production resulting in unavoidable adverse impacts.

## 4.5 Water Resources

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect ground and surface water resources within the study area. Design features specific to ground and surface waters are discussed in Section 2.4.

### 4.5.1 Groundwater

**ISSUES, IMPACT TYPES, AND CRITERIA**

Groundwater resources that could be impacted by CBM production include deep groundwater (in the Fruitland Formation and other deeper formations), relatively shallow groundwater (tertiary and quaternary aquifers that are utilized for water supply in the area) and the near-surface groundwater table that interacts with surface water flows. The potential for contamination of surface water, vegetation, and soils from groundwater produced in CBM extraction is addressed in the Surface Water Section 4.5.2.

The potential impacts of concern include:

- A change in the groundwater aquifer that affects the established use of the aquifer,
- Degradation of viable groundwater resources by contamination from lesser quality groundwater or migration of methane, and/or
- Appreciable depletion of usable surface water or groundwater supply due to dewatering of the Fruitland Formation.

Several regulatory agencies, including the BLM, COGCC, and SUIT, have enacted policies to protect groundwater resources through well construction and production practices. Monitoring programs aimed at preventing, minimizing, and mitigating potential impacts of oil and gas production have been implemented.

## IMPACT ASSESSMENT METHODS

For the purposes of this PEA, it is assumed that viable shallow groundwater resources are present throughout the study area. This assumption means that every proposed well would be drilled through a viable potable aquifer, and therefore could have the potential to impact the groundwater supply. In reality, the location of groundwater wells and their depths varies across the study area, as does the hydraulic conductivity and other hydrologic properties that influence groundwater supplies.

## IMPACTS COMMON TO BOTH ALTERNATIVES

The hydrogeology of the study area is affected by many variables, including: heterogeneous and anisotropic aquifer properties, topography, stratigraphy, formation depth, hydraulic pressure, fracturing, hydraulic conductivity, shallow aquifers, existing groundwater wells, and existing oil and gas development. In general, the likelihood for impacts and the extent of the potential impacts increases with the amount of proposed development.

*Groundwater contamination* – Methods used to enhance CBM production through increased permeability include acidizing, hydrofracturing, and cavitation. These processes are regulated by the BLM and COGCC to prevent groundwater contamination. Acidizing, the use of acids to dissolve minerals and increase permeability, is localized to the well bore within the producing unit, and therefore would not impact overall groundwater quality. Hydrofracturing uses a fluid mixture of water and gels to increase pressure within the formation thereby increasing permeability. This process only affects the targeted production horizon. Fluids are removed after use and disposed of in an injection well. Only the Fruitland Formation is affected by the hydrofracturing injection process; it does not constitute an impact to groundwater of adjacent units. Cavitation is an injection of air and/or produced water into the target horizon to increase pressures and fracturing. Because the only water used is derived from the Fruitland Formation and it is isolated to the target horizon, this process does not have an impact on other aquifers.

While increased formation permeability is important to well productivity, it increases the possibility of stimulating migration of gases and groundwater between geologic units.

Increased permeability could allow previously non-mobile gases and groundwater to move to existing conduits, such as old wells, which could contaminate other formations resulting in indirect and long-term impacts. By following the design features outlined in Section 2.4, impacts to ground water would be minimized.

Cathodic protection wells could impact groundwater through contamination. If COGCC construction regulations are adhered to, there should be no commingling of waters and no contamination of groundwater. Overall, the potential impact of contamination to groundwater from acidizing, hydrofracturing, cavitation, or cathodic protection wells would be indirect and long-term.

Groundwater aquifers that currently serve as a water supply source would not be impacted by produced water injection. Non-potable groundwater aquifers would not be negatively impacted. Most of the Fruitland Formation and all deeper geologic units receiving produced water from injection are not viable groundwater sources at distance from the outcrop because of their depth and poor water quality. There are no groundwater supply wells completed in the Fruitland Formation known to be used for domestic purposes in the study area.

*Shallow aquifer depletion* – Dewatering the Fruitland Formation would not have a measurable effect on the water levels or the viability of potable groundwater in overlying aquifers. The one exception could be near the Fruitland outcrop zone. Direct, but small to immeasurable long-term impacts would occur as water levels could decrease in seeps or springs fed by the Fruitland Formation near the outcrop (Cox et al. 2001, SSPA 2006b). See Section 4.5.2 for a discussion of impacts to surface water from groundwater depletions.

*Methane contamination of shallow aquifers* – CBM production techniques for lowering the pressure and allowing for gas flow could include temporarily increasing the formation pressure during the hydrofracturing or cavitation process. These changes to Fruitland Formation pressures from CBM development could affect the migration of methane to overlying geologic formations and to surface seeps particularly if substantial fracturing occurred beyond areas of designed impact. The nearly impermeable Kirtland shale, which overlies the Fruitland Formation, typically prevents activity in the Fruitland Formation from impacting shallower Quaternary and Tertiary geologic formations. As production of groundwater reduces the pressure in the Fruitland Formation, the existing confining pressure levels would decrease and the tendency for upward migration of groundwater would be reduced.

Methane migration from the Fruitland Formation could impact overlying aquifers if new wells are not properly constructed or are constructed in the vicinity of old wells that were not properly constructed. These potential impacts would be indirect and long-term. By following the design features outlined in Section 2.4, impacts to groundwater would be minimized.

*Produced water injection* – it is unlikely that any new CBM wells drilled near the Fruitland outcrop would produce water that is usable. The poor water quality of most of the Fruitland Formation prevents this produced water from being a viable water resource. The formations in which the produced water is to be re-injected (mostly the Entrada Sandstone) are also not considered viable groundwater supply sources in this area. Producing water from the Fruitland Formation and disposing of it in deeper, poor quality aquifers would not impact usable groundwater resources in shallow aquifers.

### ALTERNATIVE 1 (NO ACTION) – IMPACTS TO GROUNDWATER RESOURCES

Proper well construction and monitoring should prevent any impacts due to cross-flow between geologic formations. Dewatering from the Fruitland Formation would continue to occur but would not affect the availability or quality of water in overlying aquifers used for groundwater supply. Water levels could decrease in seeps or springs fed by the Fruitland Formation near the outcrop resulting in direct, but small to immeasurable, long-term impacts. By following the design features outlined in Section 2.4, impacts to ground water would be minimized under Alternative 1.

### ALTERNATIVE 2 (PROPOSED ACTION) – IMPACTS TO GROUNDWATER RESOURCES

Under Alternative 2, proper well construction and monitoring should prevent impacts due to cross-flow between geologic formations. Dewatering from the Fruitland Formation would continue to occur, but would not have an appreciable impact on the availability or quality of groundwater in overlying aquifers. Water levels could decrease in seeps or springs fed by the Fruitland Formation near the outcrop resulting in direct, but small to immeasurable, long-term impacts. By following the design features outlined in Section 2.4 impacts to ground water would be minimized under Alternative 2.

### IMPACTS SUMMARY

Although Alternative 2 proposes a greater development level, dewatering from the Fruitland Formation would not increase substantially compared to Alternative 1 (SSPA 2006a, Cox et al. 2001). CBM development under both alternatives would impact groundwater in the Fruitland aquifer in the zones of CBM production and would impact water quality in the disposal formation aquifers, which are not viable groundwater resources. Disposal formation water quality would not be negatively impacted.

The potential for contamination of shallow groundwater aquifers from inadequate well construction exists under both alternatives. However, it is unlikely that new production wells would serve as a conduit given the construction guidelines and thorough monitoring programs currently in place. Surface methane seeps and springs could be related to the dewatering of the Fruitland Formation, though no studies have found a direct relationship.

### UNAVOIDABLE ADVERSE IMPACTS

No unavoidable adverse impacts on groundwater have been identified. Extensive monitoring and permitting requirements are aimed at preventing methane seep contamination, which would most likely occur from existing, poorly constructed, or improperly abandoned wells.

## 4.5.2 Surface Water

### ISSUES, IMPACT TYPES, AND CRITERIA

The potential impacts to surface water quantity and quality on the Reservation, as well as in the larger watershed, are assessed based on known impacts and modeling research. Impacts to surface waters could be direct (immediate) or indirect (not occurring at the same time or place as the activity causing the impact).

The threshold for significant impacts to water quality would be:

- Any violation of water quality standards due to project activities,
- Changes in streamflows that exceed maximum or minimum flows over the past 30 years of record, and/or
- If any surface water that is tributary to ground water resources is adversely affected.

## IMPACT ASSESSMENT METHODS

The potential impacts of the proposed development were assessed based on the known impacts of oil and gas development to date. Ongoing research, groundwater modeling and monitoring findings were incorporated in the estimates of potential impacts to surface water depletions and methane contamination to determine impacts from the implementation of Alternatives 1 and 2.

## IMPACTS COMMON TO BOTH ALTERNATIVES

*Surface water quality* – Surface disturbance during construction, operation, reclamation, and abandonment of wells has the potential to directly impact surface waters through pollution and increased erosion and sedimentation. Short-term impacts would be greater during construction and drilling and would subsequently decrease following interim reclamation. Disturbance denudes soils and makes areas susceptible to erosion. Proximity to surface waters, topography, ground cover, weather, and soil types all influence the amount of erosion and sedimentation that could occur from well and infrastructure construction. These site-specific parameters are addressed in the issuance of APDs. Development including roads, culverts, ROWS, and well pads would potentially change surface drainage patterns. Impacts to surface drainage patterns would be localized and long-term. Following the design features outlined in Section 2.4 would minimize short-term and long-term impacts to surface water quality.

Hazardous materials used during construction, drilling and operation, if spilled, could contaminate surface waters. BLM regulations detail the measures necessary to contain and remediate any pollution. Any spills that occur would be handled by the BIA, SUIT, and BLM, according to protocol set out in the APDs, Tribal policy, and other regulations. Potential impacts from accidental spills to surface water quality would be direct and long-term.

*Surface water streamflows* – It is estimated that each CBM well would require approximately 165,900 gallons (0.5 acre feet) while each conventional well would use approximately 378,000 gallons (1.2 acre feet) of fresh water for drilling and completion (USDI 2002a). Operators are required to obtain a legal supply of water from commercial sources for the drilling and completion of wells. Because water is purchased from decreed commercial sources, depletions do not injure senior water rights holders.

As shown in Table 4-22, full CBM development in SJB in Colorado will result in additional depletions of 336 AF/yr more than depletions from existing wells in 2005 (500 AF/yr minus 164 AF/yr). The full development condition, evaluated by SSPA (2006a), includes 1,516 future CBM wells. If no drilling occurs within 1.5 miles of the Fruitland outcrop, the additional depletions are 6 AF/yr (170 AF/yr minus 164 AF/yr) more than depletions from existing wells in 2005. Therefore, drilling within the buffer accounts for the vast majority (estimated at 98%) of the incremental depletions.

**Table 4-22. Surface Water Depletions from CBM Wells (SSPA 2006a)**

| | Existing Wells (2005 Conditions) [a] | Future Wells | | |
|---|---|---|---|---|
| | | Full Development Condition in San Juan Basin [b] | | Estimated Depletions from Wells in the Reservation [d] |
| | | No Wells within (1.5-mile) Buffer [c] | Wells Allowed in (1.5-mile) Buffer | |
| **Maximum Depletions (Year of Occurrence)** | 164 AF/yr (2020) | 170 AF/yr (2035) | 500 AF/yr (2025) | 18 AF/yr (2025) |

Source: SSPA 2006a

[a] 2005 conditions represent the wells that were operational in Colorado in the year 2005.

[b] Full development conditions (1,516 total wells = 1.15 wells outside buffer + 361 wells in buffer) represent the maximum number of wells that can be drilled based on spacing assumptions within the Colorado portion of the San Juan Basin. See Section 1.3 for a description of the full development.

[c] Fruitland Formation outcrop buffer is measured 1.5 miles from center line of outcrop. Total wells outside buffer equals 1,155.

[d] Incremental depletions based on pro-rata share of future wells in buffer zone in the Reservation study area. Up to 22 future buffer wells out of the total 361 will be drilled on the Reservation. This equals 6% of the total.

According to the SSPA study, there are up to 22 wells in the study area proposed within the Fruitland Formation buffer (SSPA 2006a). This represents 6% of the 361 future wells in the entire SJB buffer zone. Incremental depletions due to full development of future CBM wells on the Reservation will peak at around 18 AF/yr in 2025. The hydrologic modeling of stream depletions conducted for CBM development estimate that maximum basin-wide depletions are less than 0.02% of the total streamflow of affected rivers in the study area (Cox et al. 2001, SSPA 2006a). Direct impacts to streamflows resulting from dewatering of the Fruitland Formation would be long-term.

*Methane Gas Migration* - Methane migrates into surface waters at the outcrop where the Fruitland Formation is in direct contact with river beds, north of the study area. While the possibility for methane migration to surface waters exists at other locations within the study area, it is considered unlikely. Monitored seeps of methane into surface waters have not significantly increased in relation to CBM development within La Plata County over the past 10 years (LTE 2007). Indirect impacts resulting from methane migration to surface waters would be long-term.

## ALTERNATIVE 1 (NO ACTION) – IMPACTS TO SURFACE WATER

Under Alternative 1, approximately 436 acre-feet (3.4 million bbls) of water would be used to drill and complete the wells over the lifetime of the project. An average of 29 AF/yr of fresh water resources would be utilized under Alternative 1, based on a 15-year development period. Maximum annual surface water depletions to the Animas, Los Piños, Piedra, and Florida rivers for all CBM wells in the SJB in Colorado are conservatively estimated to be 170 AF/yr (SSPA 2006a). CBM wells on the Reservation likely have a more tempered effect on surface water depletions due to their distance from the Fruitland outcrop. The magnitude of the surface water depletion associated with this alternative is small when compared to the average annual streamflow of the major rivers in the study area. Impacts to surface water quantity would be direct and long-term. By following the design features outlined in Section 2.4, impacts to surface water would be minimized under Alternative 1.

**ALTERNATIVE 2 (PROPOSED ACTION) – IMPACTS TO SURFACE WATER**

Under Alternative 2, approximately 693 acre-feet (5.3 million bbls) of water would be used to drill and complete the wells over the lifetime of the project. An average of 34.6 AF/yr of fresh water resources would be utilized under Alternative 2 based on a 20-year development period. Depletions due to the proposed 80-acre infill development within the study area were estimated to peak in 2025 at 18 AF/yr (Cox et al. 2001, SSPA 2006a). The magnitude of the surface water depletion associated with this alternative is small when compared to the average annual streamflow of the major rivers in the study area. Impacts to surface water quantity would be direct and long-term. By following the design features outlined in Section 2.4, impacts to surface water would be minimized under Alternative 2.

**IMPACTS SUMMARY**

Alternative 1 would require approximately 29 AF/year of fresh water for drilling and completion activities, compared to Alternative 2 which would require approximately 34.6 AF/year of fresh water. Alternative 2 may capture slightly more discharge to surface water in the basin (peaking at 18 AF/year in 2025). Impacts to surface water quality resulting from increased erosion, minor changes in drainage patterns, and the potential for spill contamination would be similar under both alternatives.

**UNAVOIDABLE ADVERSE IMPACTS**

No unavoidable adverse impacts to surface water have been identified.

## 4.6 Land Use and Ownership

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect land use and ownership within the study area. Design features specific to land use and ownership is discussed in Section 2.4.

### 4.6.1 Issues, Impact Types, and Criteria

The greatest land use issues related to oil and natural gas development are the effects to residential, recreational, and agricultural uses, which are generally the subject of heightened concern where ownership of the surface and subsurface estates has been severed through the original land patents, subsequent conveyances and reservations, and oil and gas leasing. In split estate situations, the surface owner does not own the underlying minerals. Approximately 7% of the study area has a split estate of Tribal/allotted subsurface mineral estate overlain by private held surface. An increased density of wells could result in an increase in conflicts arising over split estate situations.

Impacts on land use are mainly related to physical restrictions and loss of agriculture, livestock grazing and recreational areas. Direct impacts to surface owners could include visual and noise impacts, and depreciation of land value. Noise, dust, and increased traffic could indirectly impact residential areas. Other indirect impacts could be decreased water quality or contamination affecting residential or agricultural water sources.

Impacts to land use would be considered significant if project activities permanently altered or removed continuation of use. Examples of significant impacts on land use include the following:

- Loss of irrigated agricultural areas including cropland and inability to develop or reclaim potential farmland or agricultural uses, or removal of an appreciable amount of productive land such that a Tribal member's assignment or allotment would no longer support a commercially viable operation;
- Loss of grazing areas and/or stock ponds or removal of an appreciable amount of rangeland such that commercially viable livestock grazing would not be supported in a given area;
- Loss of recreation opportunities, especially if such loss affected the viability of commercial recreational activities;
- Reduced or restricted housing availability where suitable surface acreage could not be developed;
- Loss of potential economic or revenue opportunities where suitable commercial acreage cannot be developed; and/or
- Loss of surfaces necessary for tribal facilities development for residential, government, public or commercial uses.

### 4.6.2 Impact Assessment Methodology

Land use concerns were identified through discussion with representatives in the SUIT DOE and DNR. Other information was obtained from La Plata County, CDOW, and Navajo Reservoir State Park.

For this analysis, an impact assessment methodology was developed to consistently evaluate surface resource impacts for the alternatives. Refer to Section 4.1.1 for further details.

**IMPACTS COMMON TO BOTH ALTERNATIVES**

*Split estate* – Private land owners would be impacted by development occurring in split estate situations. Typically, private land owners are monetarily compensated for development occurring on their lands. The amount of compensation is variable depending upon the level of development, the land use type, and the operator. Impacts to private land owners would include loss of land and potential decreased land values, modifications to future development plans due to well pad and access road and/or pipeline corridor locations in the center of, or bisecting, land parcels. Periodic increases in noise and dust levels from increased traffic, continuous noise from compressors or pump jacks, and changes to visual aesthetics could directly impact private land owners. These impacts would be long-term. By following the design features outlined in Section 2.4, impacts to private land owners would be minimized under Alternative 2.

*Agriculture* – Direct impacts to agricultural land use could occur during construction through the reduction in production and crop value. Short-term impacts could include disruption to farming practices, seasonal crop loss, changes to irrigation patterns, and the introduction of noxious weeds. Direct long-term impacts could include loss of cropland from the operation of well pads and access roads, changes to irrigation patterns, modification of farming patterns near or around wells pads and access roads resulting in increased farming efforts, soil compaction and erosion, the establishment or proliferation of noxious weeds, and economic losses. The implementation of design features outlined in Section 2.4 would minimize impacts to agriculture. Impacts to prime farmland are discussed in Section 4.4 - Geology, Minerals, and Soils.

*Grazing* – Grazing impacts are identified on SUIT-designated grazing units although grazing impacts could occur outside these areas. Direct impacts on rangeland would include the short- and long-term loss of forage, possibly resulting in a reduced grazing capacity, and disruption or changes to grazing practices. Direct short-term impacts would occur from the temporary displacement or removal of fences and cattle guards in grazing areas. The loss of stock ponds in instances when facilities cannot be located elsewhere could result in changes in grazing rotations, over utilization in areas with sufficient water availability, and under utilization in drier rangeland areas. Indirect impacts would include the introduction of noxious weeds which could decrease rangeland values by displacing preferred forage species, or reducing grazing capacity. Some noxious weed species are poisonous when ingested by livestock resulting in illness, injury or death. By following the design features outlined in Section 2.4, impacts to grazing and rangeland would be minimized under both Alternatives.

*Forest Resources* – The study area contains medium to high-density piñon-juniper commercial woodlands on approximately 64% of the area (Prior-Magee et al. 2007). Commercial timber resources are limited to less than 6% of the study area. Direct impacts would include removal of forest resources for development. Road, ROW, and well pad development in undisturbed areas would result in fragmentation of forested areas which could alter wildlife use and movement or migration corridors, increase public access, and decrease visual aesthetics. A corresponding increase in forest insect or disease could result from natural gas development and operation. Other direct impacts would be increased soil erosion, changes in surface water runoff patterns, and the introduction or proliferation of noxious weeds. These impacts would be long-term, as it could take decades for reclaimed areas to return to previous conditions. Indirect impacts would include a change in vegetative species composition and density in areas reclaimed, which would result in altered wildlife use in those areas and the immediate surroundings.

*Residential and commercial use* – Increased truck traffic, noise, dust, and visual impacts would indirectly impact residential and commercial areas for the short- and long-term. These impacts would be greater during construction and drilling activities. Impacts to residential and commercial areas would be minimized by design features outlined in Section 2.4. Access roads and pipeline crossing land parcels could directly impact future development and current land use. SUIT regulations require a 200-foot setback from any building, therefore residential and commercial structures would not be directly impacted.

*Designated recreation areas* – There would be no development in designated recreation areas under either alternative unless changes to the designation or conditions on use where imposed by the SUIT. However, increased truck traffic, noise, dust, and visual impacts could indirectly impact a designated recreation area users' quality of experience. These indirect impacts would be short- to long-term. Design features described in Section 2.4 would minimize these impacts.

### 4.6.3 Alternative 1 (No Action) - Impacts to Land Use

Estimated impacts from surface disturbances on land use types within the study area for Alternative 1 are provided in Table 4-23.

**Table 4-23. Estimated Short- and Long-term Loss to Land Use Types in the Study Area Under Alternative 1.**

| Land Use Type | Existing Acreage | Number of Wells[a] | | Short-Term Loss (Acres)[b] | Long-Term Loss (Acres)[c] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Conventional | CBM | | | |
| Split Estate (Private surface/SUIT mineral | 28,856 | 24 | 44 | 150 | 77 | <1 |
| Agricultural Land | 8,686 | 12 | 26 | 52 | 45 | <1 |
| Coyote Gulch Grazing Unit | 5,073 | 5 | 10 | 48 | 33 | <1 |
| Soda Springs Grazing Unit | 9,320 | 9 | 11 | 64 | 44 | <1 |
| Picnic Flats Grazing Unit | 18,167 | 44 | 38 | 262 | 180 | <1 |
| Trail Canyon Grazing Unit | 12,871 | 34 | 46 | 256 | 176 | 1 |
| Beef Canyon Grazing Unit | 4,159 | 9 | 12 | 67 | 46 | 1 |
| Pump Canyon Grazing Unit | 8,261 | 19 | 24 | 138 | 95 | 1 |
| Cinder Buttes Grazing Unit | 6,612 | 0 | 0 | 0 | 0 | 0 |
| All Grazing Units Combined | 64,463 | 120 | 141 | 835 | 574 | <1 |
| Forest Resources | 139,010 | 150 | 200 | 1,120 | 770 | <1 |
| Residential and Commercial | 4,824 | 4 | 6 | 32 | 22 | <1 |

[a] Based on Alternative 1 (includes 86 existing wells and 550 approved but not drilled wells) (Section 2.2).
[b] Based on a short-term disturbance of 3.2 acres.
[c] Based on a long-term disturbance of 2.2 acres.

Split estate lands, where the surface is privately owned and the underlying minerals are owned by the SUIT, encompass approximately 28,856 acres, or about 7%, of the study area. As of December 15, 2007, three conventional wells and 16 CBM wells have been drilled on split estate lands in the study area, as approved in 2002 (USDI 2002a). Under Alternative 1, over the next 20 years an estimated 49 additional wells could be drilled on split estate, for a total of approximately 68 wells. The resulting short-term disturbance would be an estimated 150 acres with a long-term disturbance of 77 acres. Less than 1% of split estate lands would be affected by Alternative 1 (Table 4-23).

It is estimated that a total of 38 wells could be drilled on agricultural lands under Alternative 1 resulting in 44 acres of long-term disturbance (Table 4-23).

Seven SUIT grazing units are located within the study area. Under Alternative 1, an estimated 161 conventional and CBM wells could be drilled in these grazing units resulting in long-term impacts to 574 acres (Table 4-23).

Approximately 770 acres of long-term impacts would be realized to forest resources from an estimated 350 wells drilled under Alternative 1. An estimated 10 wells could impact residential and commercial areas under this alternative resulting in 22 acres of long-term disturbance (Table 4-23).

### 4.6.4 Alternative 2 (Proposed Action) - Impacts to Land Use

Estimated impacts from surface disturbances on land use types within the study area for Alternative 2 were calculated and are provided in Table 4-24.

**Table 4-24. Estimated Short- and Long-Term Loss to Land Use Types in the Study Area Under Alternative 2.**

| Land Use Type | Existing Acreage | Number of Wells[a] | | Short-Term Loss (Acres)[b] | Long-Term Loss (Acres)[c] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Co-Located | New | | | |
| Split Estate (Private surface/SUIT mineral | 28,856 | 65 | 4 | 88 | 41 | <1 |
| Agricultural Land | 8,686 | 37 | 1 | 64 | 44 | <1 |
| Coyote Gulch Grazing Unit | 5,073 | 16 | 1 | 22 | 10 | <1 |
| Soda Springs Grazing Unit | 9,320 | 27 | 1 | 34 | 16 | <1 |
| Picnic Flats Grazing Unit | 18,167 | 89 | 5 | 118 | 56 | 1 |
| Trail Canyon Grazing Unit | 12,871 | 96 | 5 | 126 | 59 | 1 |
| Beef Canyon Grazing Unit | 4,159 | 28 | 2 | 39 | 18 | 1 |
| Pump Canyon Grazing Unit | 8,261 | 57 | 3 | 75 | 35 | 2 |
| Cinder Buttes Grazing Unit | 6,612 | 0 | 0 | 0 | 0 | 0 |
| All Grazing Units Combined | 64,463 | 313 | 17 | 414 | 194 | 1 |
| Forest Resources | 139,010 | 406 | 22 | 537 | 251 | <1 |
| Residential and Commercial | 4,824 | 12 | 1 | 17 | 8 | <1 |

[a] Based on Alternative 2 (Section 2.2.2).
[b] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[c] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

An estimated 65 co-located and 4 new CBM wells could be drilled on split estate under Alternative 2 resulting in long-term impacts to 41 acres. Approximately 44 acres of agricultural land would be impacted for the long-term from the drilling of an estimated 38 CBM wells. Long-term impacts to grazing units would total approximately 194 acres under this Alternative. Under Alternative 2, 428 wells are estimated to impact forest resources resulting in 537 acres of short-term and 251 acres of long-term disturbance. An estimated 13 wells could impact approximately 8 acres of residential and commercial real estate resulting in long-term impacts (Table 4-24).

Potential impacts from the anticipated level of development previously approved are presented in Table 4-25 to allow for a quantitative comparison of potential impacts of the total amount of development that could occur under Alternative 2.

**Table 4-25. Estimated Short- and Long-Term Loss in Land Use Types in the Study Area Resulting from Additional Anticipated Incremental Development Continuing Under Alternative 2.**

| Land Use Type | Existing Acreage | Number of Wells[a] | | Short-Term Loss (Acres)[b] | Long-Term Loss (Acres)[c] | Long-Term Loss (%) |
|---|---|---|---|---|---|---|
| | | Conventional | CBM | | | |
| Split Estate (Private surface/SUIT mineral | 28,856 | 10 | 21 | 87 | 58 | <1 |
| Agricultural Land | 8,686 | 3 | 6 | 29 | 20 | <1 |
| Coyote Gulch Grazing Unit | 5,073 | 3 | 5 | 26 | 18 | <1 |
| Soda Springs Grazing Unit | 9,320 | 6 | 9 | 42 | 29 | <1 |
| Picnic Flats Grazing Unit | 18,167 | 14 | 29 | 138 | 95 | <1 |
| Trail Canyon Grazing Unit | 12,871 | 15 | 31 | 147 | 101 | <1 |
| Beef Canyon Grazing Unit | 4,159 | 4 | 9 | 42 | 29 | <1 |
| Pump Canyon Grazing Unit | 8,261 | 19 | 19 | 90 | 62 | <1 |
| Cinder Buttes Grazing Unit | 6,612 | 0 | 0 | 0 | 0 | 0 |
| All Grazing Units Combined | 64,463 | 61 | 102 | 485 | 334 | <1 |
| Forest Resources | 139,010 | 63 | 131 | 539 | 359 | <1 |
| Residential and Commercial | 4,824 | 1 | 4 | 14 | 9 | <1 |

[a] Based on the additional incremental development anticipated under Alternative 2 (Section 2.2.2).
[b] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[c] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

Continuing development under Alternative 1 could result in 31 wells located on split estate for a long-term loss of approximately 58 acres. An estimated nine wells could impact 20 acres of agricultural land over the long-term. Long-term impacts to approximately 334 acres within SUIT grazing units could occur. Approximately 194 wells could impact 539 acres of forest resources in the short-term and 359 acres in the long-term. A total of five wells is estimated to impact residential and commercial lands within the study area resulting in 9 acres of long-term impacts (Table 4-25).

### 4.6.5 Impacts Summary

Overall impacts to land use types within the study area would be similar under both alternatives (Table 4-26). Approximately 13% more split estate land could be impacted over the long-term under Alternative 2. Approximately 100 wells would be drilled on split estate under Alternative 2 in comparison to 68 under Alternative 1. Under both alternatives less than 1% of split estate lands would be impacted in the study area.

**Table 4-26. Comparison of Land Use Type Short- and Long-Term Impacts Between Alternative 1 and Alternative 2.**

| Land Use Type | Alternative 1[a] | | Alternative 2[b] | |
|---|---|---|---|---|
| | Short-Term[c] (Acres) | Long-Term[d] (Acres) | Short-Term (Acres) | Long-Term (Acres) |
| Split Estate (Private surface/SUIT minerals) | 150 | 77 | 175 | 99 |
| Agricultural Land | 52 | 45 | 93 | 64 |
| Coyote Gulch Grazing Unit | 48 | 33 | 48 | 28 |
| Soda Springs Grazing Unit | 64 | 44 | 76 | 45 |
| Picnic Flats Grazing Unit | 262 | 180 | 256 | 151 |
| Trail Canyon Grazing Unit | 256 | 176 | 273 | 160 |
| Beef Canyon Grazing Unit | 67 | 46 | 81 | 47 |
| Pump Canyon Grazing Unit | 138 | 95 | 165 | 97 |
| Cinder Buttes Grazing Unit | 0 | 0 | 0 | 0 |
| All Grazing Units Combined | 835 | 574 | 899 | 528 |
| Forest Resources | 1,120 | 770 | 1,076 | 610 |
| Residential and Commercial | 32 | 22 | 31 | 17 |

[a] Based on Alternative 1 (Section 2.2)
[b] Based on Alternative 2 (Section 2.2) and the additional anticipated incremental development (Section 2.2.3).
[c] Based on a short-term disturbance of 1.15 acres for co-located wells and 3.2 acres for new well locations.
[d] Based on a long-term disturbance of 0.5 acres for co-located wells and 2.2 acres for new well locations.

Approximately 30% more agricultural land could be impacted for the long-term under Alternative 2 resulting from development of an estimated 47 wells as compared to 38 wells under Alternative 1. Less than 1% of agricultural land within the study area would be impacted under either alternative. Overall, Alternative 2 would result in an estimated 8% more long-term impact to grazing units on the Reservation; however less than 1% of grazing resources would be impacted in the study area in the long-term under either alternative. Alternative 2 is estimated to result in 21% more long-term impacts to forest resources in the study area, while Alternative 1 would result in approximately 4% greater short-term impacts. Less than 1% of forest resources would be impacted under either alternative. Alternative 1 would result in approximately 23% greater long-term impacts than Alternative 2 to residential and commercial land use in the study area (Table 4-26).

Overall, Alternative 2 would result in greater impacts to split estate, agricultural lands, forest resources, and grazing resources than Alternative 1. However, the co-location of wells under Alternative 2 would help to minimize impacts to land use types through the consolidation of natural gas development and would result in greater resource recovery.

### 4.6.6 Unavoidable Adverse Impacts

Long-term, unavoidable adverse impacts to private land owners, residential and commercial areas, and recreation users would result from increased noise, dust, traffic, and changes to visual aesthetics from natural gas well facilities, access roads, and pipelines. The long-term removal of agricultural, grazing resource, and forest resource lands from their current use would result in unavoidable adverse impacts. Continued natural gas resource development in rural residential areas would further modify the undeveloped landscape character to a more industrial environment.

## 4.7 Traffic and Transportation

This section analyzes environmental impacts attributable to traffic and transportation in the study area resulting from the proposed alternatives. No design features were developed for traffic and transportation.

### 4.7.1 Issues, Impact Types, and Criteria

Issues related to traffic and transportation focus on the impacts of additional traffic volume on residents and communities, impacts on existing roadway congestion, and the potential for increases in accident rates due to increased traffic volumes. Impacts associated with the proposed action from increases in traffic volume are measured through the Level of Service (LOS) rating. The LOS for a given transportation route is a rating based on the capacity of the route and the traffic volume on the route, which generates an overall rating for the route. The ratings range from LOS A, which is characterized as having minimal traffic and there are no interferences with safe and efficient travel. The lowest ranking for LOS is level E, in which the roadway begins to fail to provide adequate capacity, due to one or more of the following factors: traffic congestion, lack of travel lanes, or degraded road surface and infrastructure. A LOS impact would be one in which a change in LOS for a given route were to be reduced as a result of implementation of the proposed action.

An impact would occur if the proposed action was to cause a 10% or more increase in daily vehicle trips over the current number of vehicle trips (Section 3.7.1). If the proposed action was to cause a 25% or more increase in daily vehicle trips over the current traffic levels, then the impact would be considered significant. If the proposed action was to cause less than a 10% increase in daily vehicle trips, then the impact would be described as less than perceivable (i.e., no impact).

An increase in the overall rate of traffic accidents would also be considered an impact. The rate of traffic accidents is measured as the number of accidents that occur per motor vehicle mile usage on a given traffic route.

### 4.7.2 Impact Assessment Methodology

The impact assessment methodology for traffic and transportation included assessment of current traffic volumes on federal, state, and county roads within the study area, and comparing the volumes with the anticipated increase in traffic associated with implementation of the proposed action. The current traffic volumes on study area roads was generated by reviewing CDOT and La Plata County Road and Bridge Department AADT counts for roads within the study area. The most current data from each agency was reviewed, and the results were summarized in Section 3.7 of this PEA.

The estimated vehicle trips that would be generated by the alternatives were developed utilizing the same methodology performed in the 2002 FEIS. The addition of a total of 39 daily vehicle trips to each federal, state and county road was estimated to represent the maximum possible impact associated under Alternatives 1 and 2.

The potential impacts associated with the increase in traffic were evaluated in relation to the following transportation elements: the impact of the additional traffic volume on the current LOS associated with each road, roadway congestion, and increase accident rates and or conflicts with other transportation uses within the study area.

### 4.7.3 Impacts Common to Both Alternatives

*Construction and drilling phase* – Increases in traffic levels would primarily occur during the construction and drilling phase for any given well location. Traffic level increases for compressor stations would be highest during the construction phase for any given compressor station.

Heavy truck traffic represents the largest impact to road infrastructure due to the weight of the trucks causing wear on existing road and bridge infrastructure. Heavy truck traffic also represents a major impact to congestion and specific road LOS due to increases in congestion due to potentially slower travel velocities for heavy and wide loads. Heavy truck traffic for any given well location typically occurs over a two- to three-day period prior to and following drilling activities. Depending on the size of the access road, well pad and pipeline construction project, additional heavy truck traffic for hauling in gravel and additional construction equipment could result in direct, short-term increased impacts.

Light truck traffic to a given location is also highest during the construction and drilling phase. Depending on the given location, if multiple simultaneous construction and drilling activities are occurring, up to a dozen light truck trips to a given location may occur. As with heavy truck traffic, these impacts are direct and short-term (approximately two-week period for a given location).

*Production phase* – Production phase traffic volumes are associated with on-going routine maintenance activities and include monitoring of well operations, removal of condensation liquids from collection tanks, and routine maintenance activities that could be required for well site equipment and facilities. The majority of the traffic volume during this phase is light truck traffic with some liquid hauling trucks required for emptying condensate collection tanks. For compressor station operations, the production phase traffic volumes are generally associated with daily operational travel that utilize light trucks. There are maintenance and disposal activities that require large trucks, but these are generally infrequent, compared to the construction phase.

*Abandonment and reclamation phase* - Traffic associated with abandonment and reclamation phase would increase over the levels that occur during the operation phase, but would generally not reach the levels of traffic associated with the construction and drilling phase. Heavy equipment traffic would occur to remove all surface equipment from a given location and to bring in heavy equipment for re-contouring of the well pad surface. To remove all gravel from a location, gravel trucks and excavation equipment would be transported to the location. To provide for final contouring and seeding, heavy equipment and tractors would also be transported to each location. Average reclamation time for a well pad would be approximately one week, with approximately eight vehicle trips per day for any given location.

### 4.7.4 Alternative 1 – (No Action) – Impacts to Traffic and Transportation

Using the LOS analysis provided in the 2002 FEIS, the increase in the number of daily vehicle trips could be compared to the current AADT to determine the level of impact associated with Alternative 1.

Based on the 550 new wells proposed under Alternative 1, there could be an additional 66 daily vehicle trips for well drilling and long-term operations. The associated compressor station construction and operation activities (five new compressors on Tribal surface) would require an additional one daily vehicle trip for construction and operation of the proposed compressor stations over the life of the project (20 years). Therefore, the increase in daily vehicle trips for all activities associated with Alternative 1 would be 67.

These additional 67 daily vehicle trips would be proportionally spread across the study area based on the current levels of development, and assuming the additional wells and compressors would be constructed in similar proportions. The 2002 FEIS estimated that U.S. Highway 550 would receive 34% of the trips, SH 140 would receive approximately 32% of the trips, SH 172 would receive 23% of the trips, and SH 151 would receive the remaining (11%). The increase in daily vehicle trips associated with Alternative 1 would not increase any of the AADTs for these transportation routes by greater than 10%, and therefore the impacts to traffic would be less than perceivable (i.e., no impact).

### 4.7.5 Alternative 2 (Proposed Action) – Impacts to Traffic and Transportation

Alternative 2 involves the construction of 770 new CBM wells on Tribal mineral estate, including 731 wells co-located on existing locations and 39 new well pads. These 770 new wells would be drilled over the next 20 years. It is assumed that the wells would be drilled at a steady pace throughout the productive lifetime of the CBM resource. In addition, to evaluate the impacts to specific roadways and areas, it is assumed that the wells will be uniformly spread across the study area in the proportions that were described in the 2002 FEIS. The same number of new compressor stations (five) as analyzed for Alternative 1, are assumed to be constructed for Alternative 2.

Under Alternative 2, there be an additional 92 daily vehicle trips for well drilling and long-term operations. The associated compressor station construction and operation activities (five new compressors) would require an additional one daily vehicle trip for construction and operation of the proposed compressor stations, over the life of the project (20 years). Therefore, the increase in daily vehicle trips for all activities associated with Alternative 2 would be 93.

These additional 93 daily vehicle trips would be proportionally spread across the study area based on the current levels of development, and assuming the additional wells and compressors would be constructed in similar proportions. The same proportions for each transportation route as provided in the Alternative 1 analysis were used in the analysis for Alternative 2. The increase in daily vehicle trips associated with Alternative 2 would not increase any of the AADTs for these transportation routes by greater than 10%, and therefore the impacts to traffic would be less than perceivable (no impact).

The additional anticipated incremental development approved in 2002 continuing under Alternative 2, would include construction of an additional 113 conventional wells and an additional 234 CBM wells, for a total of 347 wells (Table 2-4). These wells would be constructed at the same time as the 770 CBM wells considered in Alternative 2. In terms of impacts to traffic and transportations, the on-going development activities are represented in the current level of traffic volumes that are included in the state and county AADTs summarized in Section 3.7. As such, these traffic volumes are part of the baseline volumes. Therefore, the traffic volumes would not create any additional impacts to the current transportation network, roadway congestion or accident rates.

### 4.7.6 Impacts Summary

Implementation of either Alternative 1 or Alternative 2 would cause an increase in vehicle traffic on federal, state, and county roads within the study area. The increase in traffic volumes would also cause an increase in roadway congestion, wear on road surface and infrastructure, and increases in accident rates and conflicts. Based on the current volumes of vehicle travel within the study area (which include on-going oil and gas development activities), the proposed increases in traffic are not anticipated to cause any specific roadway traffic volumes to increase by greater than 10%. This analysis was completed on a worst-case scenario, and so actual increases in traffic volumes could be less than the proposed amount. With any increase in traffic volumes not anticipated to exceed a 10% increase, impacts to associated levels of service would be less than perceivable resulting in no impact.

### 4.7.7 Unavoidable Adverse Impacts

No unavoidable adverse impacts to the study area transportation network are anticipated as a result of implementation of Alternatives 1 or 2.

## 4.8 Cultural Resources

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect cultural resources within the study area. Design features specific to cultural resources are provided in Section 2.4.

The following, partially synthesized from the 2002 FEIS (USDI 2002a), discusses the intensity of potential impacts to cultural resources with respect to guidance provided by federal laws.

### 4.8.1 Issues, Impact Types, and Criteria

The principal laws that provide guidance for identifying significant impacts on properties eligible for the National Register and other types of cultural resources include the following:

- National Historic Preservation Act (NHPA),
- Archaeological Resources Protection Act (ARPA),
- American Indian Religious Freedom Act (AIRFA), and
- Native American Graves Protection and Repatriation Act (NAGPRA)

Each of these laws is discussed in detail in Section 4.8.1 of the 2002 FEIS (USDI 2002a). Regulations for Protection of Historic Properties, which primarily implement Section 106 of the NHPA, require that federal agencies consult with SHPO, the Federal Advisory Council on Historic Preservation, and other interested parties to make one of three possible determinations of effect:

- No historic properties
- No adverse effect
- Adverse effect

The available inventory data indicate that no cultural resources within the study area have actually been listed on the National Register, though many are considered eligible or potentially eligible for nomination to the register. Although few of these sites have been formally evaluated, many have the potential to yield important information and therefore are National Register eligible. The regulations for Protection of Historic Properties acknowledge that such informational values often can be substantially preserved through appropriate research conducted in accordance with applicable professional standards and guidelines. However, the alteration of archaeological sites through excavation and removal of archaeological resources from their contexts is considered to be an adverse effect (Federal Register, Vol. 64, No. 95, Page 27064).

Although the compiled inventory data indicate that potentially National Register eligible properties are relatively dense within the study area, most drilling locations and associated facilities would have small impact zones that could be adjusted and modified, based on pre-construction surveys. Therefore, the potential to avoid direct impacts on cultural or historic properties is high, and determinations of no properties or no effect are likely to be the case for most 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, though such needs have been rare during past development.

### 4.8.2 Project Specific Assessments

Detailed cultural resource inventory data would be compiled for specific projects pursued after approval of the proposed action, as required by NHPA regulations noted earlier. Thus, the impact assessment conducted for this PEA is a projection of the probable outcomes of subsequent Section 106 consultations. Consultations, inventories, and evaluations can be conducted only after the impact zones of specific projects are identified. Previous Section 106 consultations for oil and gas developments on the Reservation have usually resulted in determinations of no historic properties or no effect. Given the small size of the proposed projects and the options available in their locations, the majority of new oil and gas projects would result in similar such determinations of no historic properties affected. Determinations of adverse effect are expected to continue to be rare, and measures to avoid or satisfactorily mitigate such effects should continue to be developed through Section 106 consultations.

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 ways to avoid or mitigate impacts are usually identified through these consultations.

### 4.8.3 Impact Assessment Methodology

As described in Chapter 3 (Section 3.8), the cultural resource sensitivity models presented in the 2002 FEIS (USDI 2002a) were necessarily coarse and probably not that meaningful. In place, a working model was presented that treated the entire study area as one zone with an estimated 24 archaeological or historic sites per square mile, with local variation in density from low to high, based on fine-grained local variables including topography, soils, growing season, aspect and availability of water. Of the sites that do exist in any portion of the study area, the average size was projected in Chapter 3 to be 100 feet (30 meters) in diameter, covering 0.18 acre per site. At an average of 24 sites per acre, total acreage or sites within each 640 acre section would be about 4.32 acres, or less than 1% of the area. Using these estimates, within the 421,000 acre study area, approximately 16,450 archaeological or historical sites would be present, covering a total of only 2,961 acres.

As will be shown later in this section, with the low number of acres to be affected under either alternative, the probability of encountering unavoidable significant cultural resources is very low.

### 4.8.4 Impacts Common to Both Alternatives

#### ARCHAEOLOGICAL AND HISTORICAL SITES

Perhaps 16,000 thousand archaeological or historical sites could be present within the study area, as estimated in Section 4.8.3, though an estimated 2,000 or fewer sites have actually been recorded in the study area during previous surveys. Existing regulatory review procedures are routinely followed to identify and address impacts for specific projects proposed for development on the Reservation. These procedures ensure that cultural resources are carefully considered before any project is authorized for development. The analysis for this PEA only generally addresses the types and extent of impacts that could be expected on archaeological and historical sites, and would be supplemented by subsequent project-specific reviews.

The majority of direct and indirect impacts are projected to occur in association with construction activities. Ground disturbance activities associated with construction of drill pads, pipelines, central delivery points, access roads, and other facilities have the greatest potential for adverse impacts on archaeological and historical sites. The increase in human presence associated with construction and operation also is likely to have some degree of impact. Members of work crews could inadvertently damage or intentionally vandalize archaeological and historical sites. The assessment of these direct impacts was based on description of the proposed alternatives, estimated extent of ground disturbance of each alternative within projected cultural resource sensitivity zones, and consideration of standard procedures for development and production.

Indirect impacts are more difficult to quantify. Identified potential indirect impacts include (1) soil erosion due to construction of new facilities, and (2) ground subsidence. Evaluation of the potential extent of these various types of indirect impacts was based on analyses of erosion and subsidence potential. Archaeological and historical sites within the study area are very susceptible to most direct and indirect types of impacts. The resources are of moderate to high quality but are highly fragile, and most impacts would be of permanent duration. Archaeological and historical sites are relatively abundant within the study area; some parts of the study area are documented to have densities in excess of 40 sites per square mile, though an average of 24 per square mile is projected for the entire area. Because the actual areas of potential effect are relatively small, the number of resources that could be disturbed or destroyed by oil and gas developments are expected to be small. Given the potential for avoiding or satisfactorily mitigating adverse impacts that might be identified during review of specific projects, the intensity of impacts on archaeological and historical sites, considered within the regional context of the study area, is not expected to be significant.

**TRADITIONAL CULTURAL RESOURCES**

Traditional cultural concerns about proposed oil and gas development focus primarily on protection of archaeological sites, disturbance of traditionally used plants, and preservation of aspects of traditional Southern Ute Indian culture. Most traditionally used plants occur east of the Piedra River (Byron Frost, personal communication, 2/23/2007), which is beyond the boundary of the study area and should not be a concern in this analysis. Other Tribes in New Mexico, Arizona, and Colorado could also have traditional ties to resources in the study area, including archaeological sites, and would be consulted on a project-by-project basis as warranted.

The direct ground disturbance resulting from construction activities is the source of greatest potential damage to traditional cultural resources.

### 4.8.5 Alternative 1 (No Action) – Impacts to Cultural Resources

Under Alternative 1, the remainder of the oil and gas development analyzed and approved in the 2002 FEIS would be completed. This includes an additional 239 conventional natural gas wells and 311 CBM wells. During construction and drilling for these wells (Table 4-27), a total of 2,035 acres is estimated to be directly impacted in the short-term under this alternative. This would directly affect only 0.48% of the study area. Using an estimated density of 24 sites per square mile, an average of six sites may be found within any single drilling window, with the six sites covering an estimated 1.1 total acres. Without having exact site locations or actual well location information, it is impossible to accurately predict the probability of encountering a site during the planning of any single well project, but it is anticipated to be very low. Those sites that are encountered would be, in most cases, easily avoided by project design features (Section 2.4).

**Table 4-27. Alternative 1 Predicted Disturbance and Probability of Encountering Cultural or Archaeological Sites.**

| Well Type | Total wells Authorized[a] | Total Short-Term Disturbance (Acres)[b] | Percent of Study Area[c] | Average Sites per 160-Acre Windows [d] | Average Acreage of Sites in Windows[e] | Probability of Encountering Sites[f] |
|---|---|---|---|---|---|---|
| **Conventional** | 269 | 861 | 0.2 | 6 | 1.1 | Very low |
| **CBM** | 367 | 1,174 | 0.28 | 6 | 1.1 | Very low |
| **Total** | 636 | 2,035 | 0.48 | 6 | 2.2 | Very low |

[a] Includes wells drilled since 2002.
[b] Based on average of 3.2 acres per well short-term disturbance (see Section 2.2), though some percentage of future wells could be co-located.
[c] Short-term disturbance as a percentage of 421,000 acre study area.
[d] Based on mean of 24 sites per square mile (see Section 3.8).
[e] Based on mean size of 0.18 acres per site (see Section 3.8).
[f] Additionally, most sites encountered can be avoided by subsequent project modification.

### 4.8.6 Alternative 2 (Proposed Action) – Impacts to Cultural Resources

Alternative 2 involves the construction of 770 new CBM wells on Tribal mineral estate, including 731 wells co-located on existing locations and 39 new well pads. During construction and drilling, a total of 966 acres is estimated to be disturbed in the short-term under Alternative 2, covering about 0.22% of the study area (Table 4-28). Using an estimated density of 24 sites per square mile, an average of three sites may be found within any single 80-acre drilling window, with the three sites covering an estimated 0.54 total acres. Without having exact site locations or actual well location information, it is impossible to accurately predict the probability of encountering a site during the planning of any single well project, but it is anticipated to be very low. As with Alternative 1, those sites that are encountered would be in most cases easily avoided by project design features (refer to Section 2.4).

**Table 4-28. Alternative 2 Predicted Disturbance and Probability of Encountering Sites.**

| CBM Well Pad Type | Total Wells Estimated | Total Short-Term Disturbance (Acres)[a] | Percent of Study Area[b] | Mean Sites per 80-Acre Windows[c] | Mean Acreage of Sites in Windows[d] | Probability of Encountering Sites[e] |
|---|---|---|---|---|---|---|
| **New pad** | 39 | 125 | 0.02 | 3 | 0.54 | Very low |
| **Co-located** | 731 | 841 | 0.2 | 3 | 0.54 | Very low |
| **Total** | 770 | 966 | 0.22 | 3 | 0.54 | Very Low |

[a] Based on short-term disturbance of 1.15 acre per co-located well and 3.2 acres for new well pad.
[b] Short-term disturbance as a percentage of 421,000 acre study area.
[c] Based on mean of 24 sites per square mile (see Section 3.8).
[d] Based on mean size of 0.18 acres per site (see Section 3.8).
[e] Additionally, most sites encountered can be avoided by subsequent project modification.

### 4.8.7 Impacts on Traditional Cultural Resources Common to Both Alternatives

As stated in Section 4.8.7 of the 2002 FEIS (USDI 2002a), there is no documentation of prior oil and gas development on the Reservation having disturbed human burials, funerary objects, sacred objects, or objects of cultural patrimony within archaeological sites. This current impact analysis indicates there is a low potential for encountering archaeological sites and a high potential for continued avoidance of direct impacts on those sites that are encountered.

No direct conflicts with preservation of traditionally used native species and oil and gas development have been documented, as most traditional plant use occurs east of the Piedra River. If use of native plants for traditional purposes was found in the study area, standard development procedures that seek to minimize the extent of ground disturbance would also lessen impact on any traditionally used plants.

No direct linkage has been identified between the existing and 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 have the potential to promote self determination and promote preservation of Southern Ute heritage. Thus, heritage preservation issues do not appear to be appreciably related to differences among the alternatives.

### 4.8.8 Impacts Summary

The total short-term disturbance of the study area, under either alternative, is less than 0.5% of the total acreage and the probability of encountering sites is thought to be very low under either alternative.

Given the requirements for pre-construction surveys and existence of SUIT and BIA review procedures, there is great potential for avoiding many direct impacts on sites that might be identified within disturbance zones of site-specific projects, regardless of which alternative is selected. There also is good potential to recover and preserve scientific information from the archaeological sites that might not be avoidable in rare circumstances. Given the potential to primarily avoid or alternatively mitigate impacts, cultural resources should not be a crucial factor in choosing among the alternatives. The potential for avoiding most significant archaeological sites is high, so the potential for avoiding direct impacts on human remains and other items of special concern also is high.

### 4.8.9 Unavoidable Adverse Impacts

The potential to avoid or mitigate impacts to archaeological and historical sites is high. The greatest potential for impacts that would be considered adverse would stem from unplanned events related to increases in study area traffic or human presence. Increased development activity also increases the probability that unrecognized (i.e., buried) cultural resources may be unknowingly impacted by construction operations. Though unlikely, in some situations it could be impossible to avoid archaeological sites that could contain human burials and associated funerary objects, sacred objects, or objects of cultural patrimony. In such instances, it is likely that the SUIT DOE or SUIT DNR would seek or compel the cessation of such activities based upon applicable legal authority.

## 4.9 Visual Resources

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect visual resources within the study area. Design features specific to visual resources is discussed in Section 2.4.

### 4.9.1 Issues, Impact Types, and Criteria

Issues related to potential effects to visual resources could include:

- Changes to unique landscape features or the scenic quality of a landscape;
- Impacts to sensitive viewsheds, such as foreground and middleground views from residences and communities, recreational areas, and key travel routes; and/or
- Impacts to public or Tribal lands that have specific visual designations established for those areas, such as BLM-managed lands with Visual Resource Management designations.

Impacts to visual resources would be considered significant if:

- Changes in the existing landscape from the proposed action resulted in changes in established visual resource designations on public and Tribal lands, substantially altering the scenic values identified for the landscape;
- The introduction of project elements of form, color, and texture into the landscape contrasted strongly with existing conditions and dominated views from sensitive viewpoints;
- Changes to sensitive viewsheds (Level II or Scenic Quality Ranking A areas as identified on Maps 3-10 and 3-11) and unique features resulted in long-term effects that contrasted strongly with the existing surrounding environment; and/or
- Visual contrast resulting from construction disturbances and the presence of oil and gas facilities substantially altered the scenic quality of the landscape and dominated views from sensitive viewpoints. This may be the case in areas where oil and gas facilities would be in the immediate foreground views from sensitive viewpoints or where the facilities would be seen in the foreground to middleground distance zones within previously undisturbed landscapes.

### 4.9.2 Impact Assessment Methods

Impacts to visual resources from project activities were identified based on estimates of proposed well locations for Alternatives 1 and 2. As site-specific locations cannot be determined at this time, a quantitative analysis of impacts was calculated using a proportional GIS analysis (refer to Section 4.1.1).

Visual contrast is a measure of the degree of perceptible change to the form, line, color, and texture of the landscape as a result of project construction and operation. This assessment focused on the visual contrast between the current setting and project changes that could occur within visually sensitive areas of the study area as identified on Map 3-11 (Appendix A).

Contrast levels can be identified as follows:

- Strong contrast—occurs where project activities would attract attention and dominate the landscape.
- Moderate contrast—occurs where project activities would be noticeable and start to dominate the landscape.
- Weak contrast—occurs where project activities would be noticeable but would not attract attention, and would be subordinate to the setting.

The greatest changes to landscapes in the study area would generally be expected to result from the addition of project structures into a landscape and the removal/clearing of vegetation to accommodate project facilities, such as well pads, roads and pipeline ROWs. The proximity of the changes to sensitive vantage points as identified in Maps 3-10 and 3-11 (Appendix A) would also contribute to the perception of the project activities' contrast with the landscape and, therefore, the "impact" to visual resources.

The degree of potential contrast from construction and operation of wells was calculated based on the number of new or co-located wells that could potentially be located in each visual sensitivity level in the study area. Wells located in Level II visual resource value areas, where change to the landscape should be low, would be expected to create higher degrees of contrast and be seen more frequently from sensitive viewpoints. New well locations were expected to create a higher degree of contrast than co-located wells. Estimates of well locations are approximate based on GIS polygon calculations. Therefore, total numbers of wells calculated to quantify visual resource impacts could be greater to or less than those provided in Chapter 2 in the alternatives discussion.

### 4.9.3 Impacts Common to Both Alternatives

The visual quality of the land within the immediate vicinity (visual foreground) of proposed well locations, access roads, and ROWS would be altered during the short-term by actions proposed under both alternatives. Typical structures associated with CBM and conventional wells are most dominant in the immediate foreground (0 to 300 feet) and foreground views (300 feet to 0.25 mile). Depending upon vegetative and topographic screening, facilities can become subordinate to the landscape in middleground views (0.25 to 1 mile) and barely noticeable to the casual observer in background views (1 to 5 miles).

With implementation of either alternative, direct and indirect impacts on visual resources would result in short- and long-term adverse effects on the character of sensitive landscapes and views. Components of the project with the highest potential to adversely affect visual resources include the well pad and pipeline ROW clearing, as well as large solid components associated with well development, such as on-site water storage tanks and compressor stations.

High visual contrast impacts could occur in Level II visual resource value areas, including residential and recreation areas, and key travel routes where new well pads could be cleared within immediate foreground or foreground distance zones. Viewed within the immediate foreground, well pads and associated facilities would be visually dominant and could appreciably alter settings. Moderate impacts would potentially result from the clearing of new well pads within middleground views in sensitive areas. If available topographic and vegetative screening and other design features are used as indicated in Section 2.4, impacts to visual resources in high sensitivity areas could be reduced.

Moderate to high visual impacts resulting from construction of co-located wells could occur if the facility is located within foreground distance zones of sensitive viewers or is located in Level II visual resource value areas. The addition of new well facilities on an existing well pad could result in an incremental change in an already disturbed area. Low impacts would result where the wells are placed on existing well pads within background or seldom seen views.

Over the long-term, successful interim reclamation such as reduction in pad size could lessen effects to visual resources. If reclamation is not successful, project effects to visual resources could continue indefinitely, dependent upon facility location and available topographic screening.

### 4.9.4 Alternative 1 (No Action) - Impacts to Visual Resources

Under Alternative 1, 239 conventional wells and 311 CBM wells would be drilled as analyzed under the 2002 FEIS (USDI 2002a) under the 160-acre spacing unit on Tribal mineral estate (Section 2.2.1).

Estimated direct short- and long-term impacts to visual resources from continued development of the approved 160-acre infill could include construction of an estimated additional 24 new conventional and 31 new CBM wells within Level II visual resource value areas, where change to the landscape should be low or minimally noticeable. Approximately 35 conventional and 45 CBM wells and their associated facilities could be placed within Level III areas, where change should be moderate. An estimated 413 new conventional and CBM wells could be placed in Level IV areas, where change could be high.

### 4.9.5 Alternative 2 (Proposed Action) - Impacts to Visual Resources

Approximately 95% of wells planned for development under Alternative 2 are anticipated to be co-located on existing well pads. Under Alternative 2, only CBM wells would be developed with approximately 74 wells proposed for co-location on SUIT lands in Level II visual resource value areas. Approximately 107 wells could be co-located with existing sites in Level III visual resource value areas. It is assumed that existing infrastructure, such as access roads and pipelines, would be used in these locations and that no new ROW construction would be associated with co-located sites. The addition of these CBM wells would result in incremental increases in impacts to visual resources if appropriate design features are not implemented at the sites. About 4 new wells could be constructed within Level II visual resource value areas; 6 new CBM wells would be constructed in Level III areas. Strong visual contrasts could occur at these locations if they were constructed within foreground views of visually sensitive locations, such as residential areas or high traffic routes.

Although Level IV areas could experience strong changes in the visual landscape, the addition of the proposed 551 co-located CBM wells and 30 new CBM and associated facilities in these areas could incrementally increase potential impacts to visual resources if appropriate design features are not applied, particularly if these locations lie adjacent to sensitive visual areas.

Under Alternative 2, the additional anticipated incremental development (refer to Section 2.1.3) could result in an additional five co-located conventional wells in Levels II and III visual resource value areas, and 22 new conventional wells in Levels II and III visual resource value areas. The additional incremental development could also result in 12 co-located CBM wells and 46 new CBM well locations in Levels II and III resulting in a direct long-term impact.

### 4.9.6 Impacts Summary

Impacts from oil and gas activity would result in the introduction of form, line, color, and textures not found in the existing landscape. Without implementation of design features, these modifications to the existing landscape from oil and gas activity could potentially alter the scenic quality of the area and/or impacts on views from sensitive viewpoints. Alternative 2 has the greatest potential for impacts because it involves a larger numbers of wells. Both of the alternatives would affect views from a variety of sensitive viewpoints associated with Level II visual resource value areas, including residential areas, recreational lands, and key travel routes. Implementation of appropriate design features should reduce the level of contrast between project activities and existing conditions.

### 4.9.7 Unavoidable Adverse Impacts

Unavoidable adverse impacts to visual resources in the study area include those that would remain for the life of the project (25 to 40 years), including well pads, access roads, and pipelines. Unavoidable adverse impacts on viewers would result from both alternatives. Unavoidable impacts on sensitive viewsheds from the development of well facilities include the introduction of new form, line, color, and texture elements that are not characteristic of the natural landscape.

## 4.10 Socioeconomics

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect socioeconomics in the study area. No design features were developed for socioeconomics.

Since the completion of the 2002 FEIS, both the SUIT and La Plata County have experienced significant population and revenue growth. Both governments have made major adjustments to their fiscal planning to reduce their exposure to fluctuations in natural gas production and pricing. Some of the key changes and results include:

- **Increased revenue from natural gas production payments, royalties, and taxes.** Since 2002, natural gas prices in the SJB have tripled (from $2.00 per Mcf [thousand cubic feet] to over $6.00 per Mcf), and new CBM wells are being drilled at a faster rate than expected, increasing the amount of taxable equipment operating in La Plata County. Both the SUIT and La Plata County collected record revenues from natural gas production and property taxes in 2003 through 2006.

- **Revenue diversification**. In 1999, the SUIT implemented an aggressive financial plan to reduce its dependence on natural gas royalties and severance taxes for Tribal government operating revenues. Since then operating revenues derived directly from oil and gas have dropped from 87% in 2003 to 51% in 2006. While natural gas produced on the Reservation provides the bulk of SUIT operating revenues, the SUIT has diversified into other ventures such as real estate and off-reservation oil and gas development.

- **Local impact assessment results.** Two assessments of the impacts related to oil and gas development on La Plata County have been completed. La Plata County evaluated the impacts of proposed development in La Plata County Impact Report

2002 and Fort Lewis College completed a study for the La Plata County Energy Council. Both assessments found that there would not be measurable economic and social impacts associated with oil and gas development planned between 2005 and 2025 because the population and economy in La Plata County has grown and diversified (La Plata County 2002; La Plata County Energy Council 2005).

- **Production peak.** A peak in natural gas production from the SJB was noted by the Durango Herald in July 2006 and has been publicly confirmed by CG&A an independent reservoir engineering firm that has tracked SJB production levels for both La Plata County and the SUIT. Despite an increase in the number of wells, annual natural gas production in the SJB field was lower in 2004, 2005, and 2006, than in 2003. This is attributed to the maturity of the SJB field and the inevitable depletion of the natural gas resource. Higher prices have offset the reduced production, so overall revenue from natural gas production has increased since 2003 in La Plata County and on the Reservation.

### 4.10.1 Issues, Impact Types, and Criteria

This economic analysis measures impacts in the same terms as the 2002 FEIS. Direct economic effects include changes in employment, salaries, and wages paid to oil and gas workers, purchases of equipment, supplies, and services from local area vendors; lease, royalty, and production payments to the Tribe and La Plata County; and taxes and other government levies. Indirect economic effects include economic activity from local purchases of equipment, supplies, and services; induced economic activity from purchases of goods and services by project workers; and changes in sources of income for Tribal and local governments.

The economic analysis focuses on net changes in employment and earnings and the "multiplier" effect of increased earnings and sales in the local economy. All estimates are in 2005 dollars. Employment, royalty, and sales effects are based on typical figures in the SJB oil and gas industry and on estimates and projections made by the SUIT. Employment, earnings, royalties, and local purchases were scaled to each action based on the number of new wells developed or volume of natural gas produced.

The assessment of fiscal impacts primarily considers how local government and Tribal expenditures and revenues would be affected by each of the actions. Unlike the 2002 FEIS, this evaluation focuses exclusively on the Tribal mineral estate. Under the general authority reflected in the U.S. Supreme Court decision of *Cotton Petroluem v. New Mexico*, 490 U.S. 163 (1989), La Plata County is allowed to collect *ad valorem* property taxes on wells and equipment located on Tribal lands within the Reservation. However, La Plata County is not eligible to assess *ad valorem* tax on the value of production attributable to Tribal royalties under Tribal leases and may not impose such taxes on the value of production attributable to the Tribe's operating company, Red Willow Production Company (La Plata County 2007a). The natural gas production is generally more than 90% of the total *ad valorem* tax assessment. As a result of a taxation compact negotiated among the SUIT, La Plata County, and the State of Colorado in 1996, SUIT makes annual voluntary PILTs related to private fee lands within the Reservation that are acquired by the SUIT in its own name until such lands are placed in trust status. Recent annual PILTs have amounted to about $250,000 (La Plata County 2007a).

The State of Colorado collects severance taxes calculated from the value of production from non-Tribal lessees operating on SUIT lands. A portion of these taxes is distributed to local governments in energy producing areas. However, since the actions being analyzed in this PEA affect only the Tribal mineral estate, State severance taxes will not be measurably affected. To the extent that incremental increases in production from tribal minerals will result from the increased number of wells proposed under Alternative 2, impacts to the State of Colorado would be positive.

The analysis of social impacts explores the potential effects of the alternatives on local communities, lifestyles, and quality of life. Boom and bust cycles as well as the associated population changes are key drivers. The estimated changes in the local population are compared with the ability of the area to accommodate the changes.

### 4.10.2 Assumptions Common to Both Alternatives

The foundation for the socioeconomic impacts assessment is the annual volume of natural gas that would be produced under the alternatives. A gas volume forecast was developed by CG&A (2007), a reservoir engineering firm of registered professional engineers with significant experience analyzing CBM reservoirs, including the Fruitland. To determine the future gas production volumes associated with the proposed action, GC&A used a map to identify specific well spacing units that would require federal permitting. A total of 570 CBM wells were identified from the map in areas currently spaced for 80-acre drilling in the study area. An additional possible 200 CBM wells were added in areas that might be viable for 80-acre drilling in the future. A total of 770 wells were then evaluated by CG&A.

CG&A used its extensive SJB well database to gather information on existing wells in the study area. This included coal thickness, gas content, coal isotherm properties, ash content, permeability, initial reservoir pressure, current reservoir pressure, and historical production data from existing 320-acre, 160-acre, and 80-acre infill wells. These data were used to calculate the initial gas-in-place, the gas recovery to date and the remaining gas to be recovered in a section. Type curves were developed for the possible future 80-acre wells in each section based on the above referenced variables. These type curves were calibrated with historical production of existing similar wells or, in the absence of historical data, by using reservoir simulation models.

For both alternatives, CBM and associated gas volumes were estimated from the CG&A forecast; shown in Table 4-29.

Gas volumes for CBM wells proposed for each alternative were estimated using the assumption that each well would start with an average annual output of 162 MMcf. This volume rate would decrease by 15% each year of operation. Gas volumes for conventional wells were estimated with the assumption that each well would start with an average annual output of 146 MMcf. It is assumed that this production rate would decrease by 5% each year of operation.

To estimate the revenues associated with the forecasted gas volumes for each action, a price of $5.64 per Mcf is used to be consistent with assumptions used in the CG&A model. The actual gas price will likely fluctuate around this price, but this average forecast price is used to capture the long-term price level. In addition to revenues, expenditures and employment are included in the economic analysis. The assumptions used for these estimates are included in Tables 4-30 and 4-31.

**Table 4-29. Estimated Annual Well and Natural Gas Production in MMcf for Alternative 1 and Alternative 2.**

| | Alternative 1 No Action | | | Alternative 2[a] Proposed Action | | |
|---|---|---|---|---|---|---|
| Year | New Wells Conventional | New CBM Infill Wells | Annual Total MMcf[b] | New Wells Conventional | New CBM Infill Wells | Annual Total MMcf |
| Pre-2008 | 30 | 56 | 13,500 | 30 | 56 | 13,500 |
| 2009 | 20 | 30 | 7,800 | 20 | 70 | 14,300 |
| 2010 | 20 | 30 | 28,700 | 20 | 110 | 48,200 |
| 2011 | 20 | 30 | 33,200 | 20 | 110 | 62,700 |
| 2012 | 20 | 30 | 37,200 | 20 | 110 | 75,300 |
| 2013 | 20 | 30 | 40,900 | 20 | 110 | 83,400 |
| 2014 | 20 | 30 | 44,200 | 13 | 110 | 90,100 |
| 2015 | 20 | 30 | 47,300 | | 110 | 90,900 |
| 2016 | 20 | 30 | 50,100 | | 104 | 91,500 |
| 2017 | 20 | 30 | 52,600 | | 80 | 92,000 |
| 2018 | 20 | 30 | 55,000 | | 90 | 93,900 |
| 2019 | 20 | 11 | 54,000 | | | 80,900 |
| 2020 | 19 | | 51,500 | | | 69,800 |
| 2021 | | | 46,700 | | | 60,300 |
| 2022 | | | 42,500 | | | 52,200 |
| 2023 | | | 38,700 | | | 45,200 |
| 2024 | | | 35,400 | | | 39,300 |
| 2025 | | | 32,500 | | | 34,200 |
| 2026 | | | 29,900 | | | 29,800 |
| 2027 | | | 27,500 | | | 26,000 |
| 2028 | | | 25,400 | | | 22,800 |
| TOTAL | 269 | 367 | 794,546 | 143 | 1060 | 1,216,334 |

[a] Includes the 234 CBM and 143 conventional wells approved in 2002 and anticipated to be developed under the proposed action.
[b] MMcf = million cubic feet or thousand Mcf

**Table 4-30. Assumptions Used in Economic Analysis.**

| Assumption | |
|---|---|
| Price for SJB natural gas | $5.64 per mcf |
| Conventional Well total cost | $1,075,000 |
| CBM In-fill Well total cost | $850,000 |

**Table 4-31. Employment for Typical Drilling and Operations Activities.**

| | Number of Employees Per Well/Site | Number of Days Per Site Per Year | Total Number of Employee Days Per Site Per Year |
|---|---|---|---|
| **80-acre Infill CBM Well Construction** | | | |
| Well Drilling and Casing | 20 | 4 | 80 |
| Completion | 14 | 1 | 15 |
| Surface Equipment | 4 | 7 | 28 |
| **Conventional Well Construction** | | | |
| Well Drilling and Casing | 20 | 10 | 200 |
| Completion | 15 | 1 | 15 |
| Surface Equipment | 4 | 7 | 28 |
| **Compressor Move** | | | |
| Deconstruct | 12 | 3 | 36 |
| Move | 6 | 2 | 12 |
| Setup | 12 | 5 | 60 |
| **Well Pad and Road Construction** | | | |
| New Road per ¼ Mile | 3 | 1 | 3 |
| New Pad per Site | 3 | 2 | 6 |
| Road and Pad for Recompletion | 3 | 1 | 3 |
| New Flowline per ¼ Mile | 4 | 1.25 | 5 |
| **Operations** | | | |
| Well Operations | 1 | 1 hour/day | 46 |
| Workover conventional well | 4 | 1 day/4 yrs 2.5 | 1 |
| Workover CBM well with pump | 4 | 0.75 | 10 |
| Workover CBM well, flowing | 4 | 3 | 3 |
| Road and Pad Maintenance | 3 | | 9 |
| Compressor Maintenance | | | 131 |
| **Reclamation** | | | |
| Plug and Abandon | 5 | 5 | 25 |
| Well pad Reclamation | 2 | 6 | 12 |
| Compressor Removal | 4 | 6 | 24 |
| Road Reclamation per ¼ Mile | 4 | 1 | 4 |

The SUIT NRMP (2000) guided analysis of the social impacts of the actions; the NRMP is a planning guidance document for mineral-resource development on the Reservation. The NRMP has three general resource management goals:

1. Expand the economic base of the Tribe and improve quality of life and standard of living on the Reservation through balanced development of renewable and nonrenewable resources in a culturally and environmentally appropriate manner.

2. Enhance the beneficial use, productivity, and viability of Tribal natural resources while preserving and protecting important resource values for future generations through integrated multiple-use management and planning.

3. Promote the protection of wild and pristine resources to preserve their unique and irreplaceable values.

These goals were used to measure whether or not the alternatives had a positive or negative impact on the social resources of the SUIT. If the action supported or enhanced these goals, the social impacts were considered to be positive. If the action did not support or reduced the possibility of achieving these goals, it was considered to have negative social impacts.

### 4.10.3 Alternative 1 (No Action)

*Employment and Personal Income* – Under Alternative 1, it is estimated that employment equivalent to about 30 full-time positions would be added during 2009 to develop and operate the proposed new wells for the next 10 years. Activities for these new jobs would include drilling and completing or recompleting well bores; installing roads, compressors, and flow lines; and operating wells and moving compressors. Current compressor capacity is sufficient to meet future compression needs, so no new compressors would be installed. However, as production shifts from the west side to the east side of the Reservation, existing compressors might be moved. Table 4-31 shows the average labor requirements of typical construction, operation, and reclamation activities. The overall employment effect associated with the Alternative 1 is a one-time hire of 30 full-time positions because the number of new wells and associated labor requirements remains generally constant through 2019. After that, it is assumed that these employees would be shifted to operation and decommissioning activities.

The population estimate for the census tracts encompassed by the Reservation boundaries was 11,160 in 2000 (Graves 2003). Total employment on the Reservation in 2000 was estimated to be about 5,500 jobs with the majority of these jobs in services (40%), construction (14%), and retail trade (12%). Unemployment on the Reservation averaged 5% in 2000 (Graves 2003). Therefore, the 30 full-time positions associated with this action would not have a measurable impact on employment on the Reservation.

However, there could be an impact on employment of SUIT members. Because the Reservation is a “checkerboard” of Tribal and non-Tribal land ownership, SUIT members comprise about one-tenth of the population living within the Reservation boundaries. Current estimates of SUIT membership is about 1,400 with about 75% living on the Reservation. More than half of the current membership is under the age of 30. According to the Tribal Rights Employment Office (TERO), the SUIT had about 1,500 employees in 2006 and about 15% were Southern Ute Tribal members. The SUIT is the largest employer of Tribal members. Employment of Tribal members is one of the goals of natural resource development on the Reservation. Therefore, if most of the 30 jobs associated with the Alternative 1 were filled by SUIT members, there could be a short-term impact on employment of Tribal members.

There would be long-term income impacts on the SUIT from Alternative 1, especially in the later years of the study period when natural gas production drops considerably. Tribal members generally have two major sources of income: wages and dividend payments from the Tribe. Between 2003 and 2006, dividend payments increased substantially. Therefore, as on-Reservation natural gas production decreases, earnings from both Tribal enterprises and dividend payments could also decrease, unless such revenue were replaced by off-Reservation oil and gas production or revenues from non-energy diversification. For instance, between 2003 and 2006, the portion of enterprise earnings from on-reservation natural gas resources dropped from 83% to 51%. If this trend continues, reductions in natural gas production would have a smaller impact on total SUIT enterprise earnings and dividend payments in the future.

The number of new jobs created by the No Action Alternative would be small compared to overall employment in La Plata County (Table 4-32). However, the impact to personal income would be larger. Average annual wage for workers in La Plata County in 2005 was about $32,000. In the natural gas industry, the average annual wage in 2005 was over $85,000 in La Plata County. A recent impact analysis found that the natural gas industry comprises only about 4% of employment, but 22% of personal income in La Plata County (La Plata County Energy Council 2005). This is because of the high wages paid to natural gas workers and the contribution of royalty payments to personal income. Therefore, there would be long-term impacts to income in La Plata County under Alternative 1.

**Table 4-32. Natural Gas Employment and Income Statistics for La Plata County.**

| Year | Total County Employment | Number of Producing Wells | Natural Gas Employment | Percent of Total Employment | Average Annual Wage Paid to Gas Workers |
|---|---|---|---|---|---|
| 1999 | 20,800 | 2200 | 125 | 0.6% | $56,000 |
| 2000 | 21,600 | 2275 | 145 | 0.67% | $58,000 |
| 2001 | 22,200 | 2375 | 100 | 0.45% | $79,000 |
| 2002 | 22,800 | 2242 | 135 | 0.62% | $81,000 |
| 2003 | 23,000 | 2332 | 165 | 0.72% | $84,000 |
| 2004 | 24,000 | 2409 | n/a | n/a | n/a |
| 2005 | 25,000 | 2501 | n/a | n/a | n/a |

Source: La Plata County Energy Council 2005

*Direct Spending* – The sustained development program projected for Alternative 1 (50 new wells per year) would not have a measurable impact on spending in the local economy because it is simply an extension of the activity that has occurred in recent years. The 636 new wells that would be developed under Alternative 1 would require an investment totaling about $600 million. Based on industry estimates used in the FEIS, approximately two-thirds of the direct spending ($400 million) would include costs such as casing and equipment that would pass out of the local economy to suppliers and manufacturers elsewhere. The remaining third ($200 million) is assumed to be primarily labor and would enter the local economy. The highest annual level of direct spending in La Plata County is estimated to be $47 million. By comparison, industry survey data compiled by the La Plata County Energy Council estimate that local spending by primary natural gas producers (excluding payroll) in 2003 amounted to over $215 million in La Plata County. (La Plata County Energy Council 2005).

*SUIT Government Fiscal Impacts* – The revenues collected by the SUIT government that would be associated with Alternative 1 are primarily severance tax and royalty payments paid by producers according to natural gas production value. For this analysis it is assumed that royalty payments are paid at 5.7% of natural gas production value (production multiplied by gas price) and severance taxes are 3% of production value. Actual royalty payments and severance taxes vary by producer and lease agreement, but these values are approximate averages. The highest annual revenues realized by the SUIT government for Alternative 1 is estimated to be about $27 million collected in 2018. By comparison, this amounts to about 10% of total energy-related revenues collected by the SUIT government in 2006. Total revenue to the SUIT government from royalty payments and severance taxes over the 20-year study period are estimated to be about $390 million.

## ALTERNATIVE 1 (NO ACTION) – INDIRECT ECONOMIC IMPACTS

This subsection describes indirect economic impacts from Alternative 1 on La Plata County.

The $200 million in direct spending that would enter the local economy as result of investment in new natural gas development in La Plata County would have additional indirect impacts supporting jobs and services that serve the natural gas industry and its workers. Using an output multiplier of 1.43 to account for spending driven by this investment, the natural gas development under the Alternative 1 would add about $290 million to the local economy over 20 years. (La Plata County Energy Council 2005). In the years of highest direct spending, indirect spending would amount to $67 million per year.

## ALTERNATIVE 1 (NO ACTION) – SOCIAL IMPACTS

*Lifestyle* – Social concerns identified during the initial scoping for the proposed action evaluated in the 2002 FEIS included impacts on quality of life for rural residents from increased traffic and industrial activity, and the effects of boom-bust economies on local communities (USDI 2002a). Specific issues concerning quality of life such as water quality, traffic, and other topics are addressed elsewhere in this document.

Oil and gas extraction activities have coexisted with ranching and farming in La Plata County since the 1940s. The Ignacio Blanco Field, which lies almost entirely within La Plata County, already contains more than 1,500 wells (La Plata County 2002). The Fruitland pool is currently spaced at 320-acres, but producers have obtained orders from the COGCC allowing the development of an optional second well, or infill well, on many of these units. Most of the Fruitland wells were drilled around 1990 due to federal tax credit legislation, which resulted in a peak of over 380 new wells permitted in one year. Recent increases in gas prices and improved understanding of the CBM reservoir have coincided with an increased number of APDs. APDs doubled from about 100 in 2000 to 2005 to over 230 in 2006 (COGCC 2007). The addition of 50 new wells per year on Tribal land is about one-fifth of the rate of other recent developments in the region.

The rural lifestyle that characterizes most of the Reservation would be minimally impacted by the development activities under Alternative 1 because of the relatively low levels of industrial activity. The Tribal population density is relatively low, with little likelihood of any significant growth. Even unexpected growth in Tribal population would be balanced by the Tribe’s aggressive reconsolidation and purchases of Tribal land, especially in the eastern undeveloped part of the Reservation. Therefore, there is no shortage of habitable land anticipated under Alternative 1.

*Population* – Direct employment under Alternative 1 is expected increased by about 30 full-time equivalent positions during the life of the project. This magnitude of employment growth is insignificant in a County with a workforce of about 25,000 and with population forecast to increase in La Plata County by 20,000 persons between 2005 and 2020 (refer to Section 3.10).

*Housing* – The increase in employment associated with Alternative 1 is not expected to strain the availability of local housing. The addition of oil and gas jobs that have annual salaries twice the County average would provide more persons in the area with the income required to purchase adequate housing.

### 4.10.4 Alternative 2 (Proposed Action)

**SUMMARY OF ALTERNATIVE 2**

Natural gas development under Alternative 2 includes about twice the number of wells that would be drilled under Alternative 1 as shown in Table 4-29. There would be increased drilling, completion, and pipeline construction activities that would raise employment and spending on equipment and services in the area of interest. Widespread infill development would not defer the start of plugging and-abandonment and reclamation work, but it would increase the number of wells that eventually need to be plugged as well as spending and employment associated with plugging and abandonment and reclamation work. Cumulative incremental gas produced under Alternative 2 would be approximately 530,000 MMcf higher during the project period than Alternative 1.

**ALTERNATIVE 2 (PROPOSED ACTION) – DIRECT ECONOMIC IMPACTS**

*Employment and Personal Income* – Direct employment under Alternative 2 would be about 60 full-time-equivalent jobs added in 2009 and remaining through the life of the project. However, as shown in Table 4-32, relative to total employment and personal income in La Plata County these jobs would amount to less than 1% increase in employment and income in La Plata County. Conversely, if a majority of these positions were filled by Tribal members it could have a measurable impact on employment for the SUIT.

*SUIT Revenues* – Alternative 2 is estimated to have about 530,000 MMcf more natural gas production over the study period than Alternative 1 resulting in higher royalty and severance tax payments to the SUIT. It is estimated that the SUIT would receive royalty payments and severances taxes totaling about $650 million over the study period. In the peak production year, 2018, royalty payments and severance taxes would amount to over $50 million; about 20% of total energy revenues for the SUIT Government in 2006.

In addition to royalty payments and severance taxes, the SUIT government would realize income derived from revenue generated from a working interest in natural gas production under Alternative 2. A conservative estimate of the Tribal working interest net revenue estimated by CG&A staff is $195 million over the life of the project. Total revenue to the SUIT government from royalty payments, severance taxes, and a working interest over the study period for Alternative 2 are estimated to be about $845 million.

*Direct Spending* – The development program for Alternative 2 (1203 wells) would provide an incremental direct spending over $1.05 billion over the 20-year project life. Approximately two-thirds, $700 million, is assumed to be costs such as equipment that would pass directly out of the local economy to suppliers and manufacturers elsewhere.

The remaining $350 million would be spent in the local economy. In the years with highest spending, it is estimated that about $115 million would enter the local economy annually.

**ALTERNATIVE 2 (PROPOSED ACTION) – INDIRECT ECONOMIC IMPACTS**

The $350 million in direct spending that would enter the local economy as result of investment in new natural gas development in La Plata County would have additional indirect impacts supporting jobs and services that serve the natural gas industry and its workers. Using an output multiplier of 1.43 to account for spending driven by this investment, the natural gas development under the Alternative 1 would add about $500 million to the local economy over 20 years. (La Plata County Energy Council 2005). In the years of highest direct spending, indirect spending would amount to $165 million per year.

**ALTERNATIVE 2 (PROPOSED ACTION) – SOCIAL IMPACTS**

*Lifestyle* – Social concerns raised during scoping of the 2002 FEIS include disruption of neighborhoods and properties by site workers, effects on quality of life for rural residents, and the effects of boom-bust economies on local communities (USDI 2002a). Specific issues concerning quality of life related to water quality, traffic, and other topics are addressed elsewhere in this PEA.

The rural lifestyle that characterizes most of the Reservation would have negligible impacts from the drilling and related activities under Alternative 2. Oil and gas extraction activities have coexisted with ranching and farming in La Plata County since the 1940s. However, demographic changes in these counties have brought about new community awareness regarding the impact of drilling activity. Grass roots organizations have been established to both investigate and litigate on behalf of these communities. The SUIT has an environmental division within its governmental structure to monitor and manage the impact of oil and gas extraction on the Reservation.

With respect to the boom-bust economic cycle, the decline in the oil and gas economy would be less severe under Alternative 2 because of greater activity in the industry for more years than under existing production.

*Population* – Direct employment under Alternative 2 is expected to be steady, adding 60 full-time equivalent positions at the start of the project and maintaining them during the 20-year period. This magnitude of employment growth is insignificant in a county with a workforce of about 25,000 and with population forecast to increase in La Plata County by 20,000 persons between 2005 and 2020 (refer to Section 3.10).

*Housing* – The increase in employment associated with Alternative 2 is not expected to strain the availability of local housing. Adding relatively high-paying oil and gas jobs would provide more persons in the area with the income required to purchase adequate housing.

### 4.10.5 Summary of Economic Impacts

Table 4-33 provides a summary comparison of economic impacts for Alternative 1 and Alternative 2.

**Table 4-33. Summary of Economic Impacts Over 20-year Study Period.**

| | Alternative 1 No Action | Alternative 2 Proposed Action |
|---|---|---|
| Total Number of Wells | 636 | 1203 |
| Total Gas Production (MMcf) | 800,000 | 1,300,000 |
| Total Employment | 30 new jobs | 60 new jobs |
| Total Spending | $600 million | $1,050 million |
| Total Local Direct Spending | $200 million | $350 million |
| Total Local Indirect Spending | $290 million | $500 million |
| Total Severance Tax and Royalty Revenue to SUIT | $390 million | $650 million |
| Incremental Working Interest Net Revenue to SUIT | n/a | $195 million |

The SUIT would receive incremental revenues from royalties and severance tax revenues on the Tribal acreage of $390 million over existing production under Alternative 1, and $650 million over Alternative 2. In comparison to Alternative 1, under Alternative 2, the SUIT would realize a cumulative incremental benefit estimated at $195 million from net revenues from Tribal working interest d/b/a Red Willow Production Company. The hundreds of millions of dollars of incremental revenues that the SUIT would receive under Alternative 2 would not be enough to stem the overall decline of energy-related revenues from Tribal land with declining production, but would allow Tribal government to adjust more slowly than it would under Alternative 1. Therefore, under Alternative 2, social and cultural bonds in the SUIT community are better supported as an indirect effect of increased revenues to the SUIT than under Alternative 1. Neither alternative would have a substantial effect to employment within the SJB given the magnitude of the existing job market. There would be no strain to the local availability of housing under either alternative.

### 4.10.6 Unavoidable Adverse Impacts

The inevitable decline of oil and gas production from the SJB would have unavoidable, adverse, direct and indirect socioeconomic impacts. Direct economic impacts would include losses of jobs and declines in sales of equipment and services. Direct fiscal impacts would include loss of revenues to the SUIT government, La Plata County, and other taxing entities. Indirect economic impacts would include loss of employment financed by the SUIT and by industry contractors and loss of spending in the local economy due to lower employment and lower spending by the SUIT. Other social impacts could include loss of cultural programs and basic services previously financed by the SUIT and possibly loss of services in the county or in the school districts.

The losses of employment and spending that would accompany natural gas production declines under either alternative and would be modestly buffered by a temporary increase in well plugging and reclamation services. Employment, sales, and services would shift from development and maintenance areas to reclamation maintaining some of the employment and spending required for new development.

## 4.11 Noise

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect ambient noise levels within the study area. Design features specific to noise generated during construction and operation activities are discussed in Section 2.4.

### 4.11.1 Impacts Common to Both Alternatives

Ambient noise levels in any given area are a combined total of all sources of noise that may be audible at a given location. Although oil and gas construction and compressor operation activities generally represent the highest noise sources in a given area, other potential sources include normal traffic activities, home construction activities, and air transportation. The levels of any of these sources could increase or decrease depending on the location, the time of day, and the number of sources that are near to any noise receptor.

Noise impacts to residents within the study area would be location specific depending on the amount of oil and gas development activities and amount of background noise present in an area. For isolated rural locations, oil and gas construction and long-term pump jack and compressor operations could represent long-term nuisance impacts. Impacts from both alternatives from noise would be direct and long-term. By following the design features outlined in Section 2.4 impacts from noise would be minimized.

### 4.11.2 Alternative 1 (No Action) – Noise Impacts

Noise impacts associated with the additional wells drilled under Alternative 1 would vary depending on the location of the wells and the existing infrastructure and activity levels at a given location. Impacts would be the same as those described in Section 4.11.1 and would be direct and long-term.

### 4.11.3 Alternative 2 (Proposed Action) – Noise Impacts

The additional anticipated incremental development occurring under Alternative 2 would include the drilling of up to 770 CBM wells. Noise impacts associated with the additional wells drilled under Alternative 2 would also vary depending on the location of the wells and the existing infrastructure and activity levels at a given location. The additional number of wells considered in Alternative 2 would increase noise levels in specific areas, and would also cause additional site-specific impacts to residents within the study area. Impacts would be the same as those described in Section 4.11.1 and would be direct and long-term.

### 4.11.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be caused by the increase in noise levels associated with construction and long term operation of the proposed well locations and compressor stations. The increase in noise levels would vary depending on site conditions and would also vary depending on current meteorological conditions. The impacts would be greater in rural areas, and may be on going based on the operational conditions for given wells (well head compression).

## 4.12 Health and Safety

This section analyzes environmental consequences resulting from the proposed alternatives that have the potential to affect health and safety within the study area. Health and safety design features are discussed in Section 2.4.

### 4.12.1 Issues, Impact Types, and Criteria

Impacts to public health and safety would be considered significant if occupation workers or the general public were to be exposed to serious health risks. Health risks can be either acute, short-term risks such as accidents, fires or toxic exposures, or they can be chronic, such as long term exposure to chemicals. The proposed action does not represent any change in public health and safety risk, other than a potential for increase in worker or public health safety from accidents or fires.

### 4.12.2 Impacts Common to Both Alternatives

Health and safety impacts common to both alternatives include the following: well field construction activities, natural gas pipeline leakage or fires, wildfires created by natural gas well construction, exposure to toxic chemicals, air emissions, methane seep exposure, and coal fire exposure. Each of these impacts is described in detail in the FEIS (USDI 2002a). The site conditions and regulatory oversight relative to health and safety are essentially unchanged since the approval of the 2002 FEIS, with the exception of coal outcrop fires. As described in Section 3.12, an additional area of surface burning was exposed in 2005 and the area is being studied to evaluate potential methods of controlling the fires. Health and safety design features are provided in Section 2.4.

### 4.12.3 Alternative 1 (No Action) – Impacts to Health and Safety

The impacts as described above would continue with the on-going oil and gas development and operation activities. Impacts to health and safety under Alternative 1 would be direct and indirect and long-term.

### 4.12.4 Alternative 2 (Proposed Action) – Impacts to Health and Safety

Construction activities and drilling associated with the proposed action would cause an increase in health and safety risks and potential impacts at levels that are proportionally greater than those associated with Alternative 1. The addition of 770 new wells over a 20-year period would require additional drilling and construction activities, which have associated health and safety risks and potential impacts. With more pipelines installed there would be an increase in risk associated with pipeline ruptures or accidental rupture of pipelines during construction activities. Additional wells also require additional usage and storage of chemicals, produced water and natural gas liquids. With the additional use and storage there is more potential for leaks and spills of these toxic materials that could cause impacts associated with worker or public exposure. Finally, the development of the Fruitland Formation could cause dewatering of the outcrop area, which could potentially increase the risk of coal outcrop fires. The additional construction, well drilling and long-term operation activities are not anticipated to create conditions such that a serious public health risk would occur. Impacts to health and safety under Alternative 2 would be direct and indirect and long-term.

### 4.12.5 Unavoidable Adverse Impacts

During construction, well drilling, and long-term operation of the proposed wells, there would be continuing risks to oil and gas construction workers and the general public. The risks to health and safety would decrease as wells become non-productive and are abandoned. No unavoidable adverse impacts are anticipated under either alternative.

## 4.13 Cumulative Impact Assessment

### 4.13.1 Introduction

The cumulative impacts analysis is important in understanding how multiple actions in a particular time period and space (e.g., geographic boundaries) impact the environment. The Council of Environmental Quality (CEQ) regulations define cumulative effects as "…the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR 1508.7). Whereas the individual impact of one project in a particular area or region may not be considered significant, the result of numerous projects in the same area or region may cumulatively result in significant impacts. Cumulative impact analysis, as applied to NEPA, is subject to interpretation in analyzing the magnitude of impacts to a particular area or region as a result of the proposed action and other actions, including reasonably foreseeable actions.

### 4.13.2 Continuing and Reasonably Foreseeable Actions Included in the Analysis

<u>**OIL AND GAS DEVELOPMENT**</u>

Currently over 30,000 natural gas and oil wells have been drilled within the SJB in New Mexico and Colorado. In 2003, the ROD was issued for the Farmington Resource Management Plan and FEIS approving the development of 9,942 natural gas wells on BLM lands in San Juan, Rio Arriba, and McKinley counties in the New Mexico portion of the SJB. These wells have been approved at a drilling rate of approximately 500 wells per year over a 20-year time frame.

The San Juan Public Lands Center issued the ROD for drilling of up to 127 new CBM wells and 93 new miles of roads and pipelines in a 125,000-acre analysis area north of the Reservation in La Plata and Archuleta counties. Additionally, approximately 100 well pads and 30 miles of road construction were authorized on private lands, outside of federal jurisdiction. The COGCC estimates that in La Plata and Montezuma County, there would be a drilling of 40 to 140 oil and gas wells annually. These would be concentrated on private lands in La Plata County.

Several companies have proposals to drill natural gas wells or carbon dioxide wells within the BLM Canyons of the Ancients National Monument about 15 miles west-northwest of the City of Cortez, Montezuma County, Colorado. These proposals currently include six natural gas wells and 15 carbon dioxide wells. Also, Western Oil and Gas has proposed approximately 600 natural gas wells in eastern Burnham Chapter of Navajo Nation, southwest of the study area.

Western Refining owns and operates the Bloomfield Refinery in Bloomfield, New Mexico. The total approximate refining capacity is 16,600 barrels per day. Crude oil supply to the refinery comes primarily from the regional area and is collected by Western Refining's pipeline network or transported by truck. The San Juan River Gas Plant is a natural gas treatment plant in Kirtland, New Mexico, located approximately 10 miles west of Farmington, New Mexico, and is owned by Western Gas Resources, Inc. The plant consists of several units: a purification plant, a natural gasoline plant, a compressor station and a dehydration unit. The facility includes compression, amine gas treating, liquids stabilization, Claus sulfur recovery plant, dehydration, and a cryogenic liquid recovery plant. The Chaco Plant is one of the nation's largest cryogenic natural gas processing plants including the 5,400-mile San Juan pipeline system that gathers over 1 billion cubic feet (Bcf) of natural gas per day for processing natural gas. The plant is owned and operated by Enterprise Products and is located approximately 10 miles south of Bloomfield, New Mexico. ConocoPhillips and DCP Midstream own and operate a natural gas liquids extraction plant in Bloomfield, New Mexico, with a net plant inlet capacity of 275 MMcf per day. Williams Four Corners, LLC (a subsidiary of Williams Partners) operates the Milagro and Esperanza natural gas treating plants in San Juan County New Mexico, which are designed to remove carbon dioxide from up to 750 million cubic feet of natural gas per day. Williams Four Corners also operates the Ignacio natural gas processing plant in La Plata County Colorado and the Kutz and Lybrook natural gas processing plants in San Juan County, New Mexico, which have a combined processing capacity of 760 MMcf per day. The Ignacio processing plant is located within the study area.

Mid-America Pipeline Company is proposing a natural gas liquids pipeline project. Parallel sections of pipeline would total 202 miles along an 840-mile route between Granger and Wamsutter areas in Wyoming, and Hobbs, New Mexico. The pipelines would be 8 to 16 inches in diameter, buried, steel, and carry natural gas liquids. Existing ancillary facilities, including pump stations, would be expanded to have more capacity. The Phoenix Expansion Project is proposed by Transwestern Pipeline Company (Transwestern). As part of the overall project, Transwestern plans to build approximately 25 miles of pipeline looping parallel to its existing San Juan Lateral, in San Juan County. The San Juan Lateral extends from San Juan County, New Mexico, to connect with Transwestern's mainline in McKinley County, New Mexico, and is located approximately 35 miles or further from the study area.

## POWER GENERATION

Four Corners Generating Station is one of the largest coal-fired generating stations in the United States with the first unit going online in 1963. The plant is located in Fruitland, New Mexico, about 25 miles southwest of the extreme southwestern portion of the study area. The five-unit, 2,040-megawatt (MW) power plant is operated by Arizona Public Service Company and provides power to over 1 million households in New Mexico, Arizona, California and Texas. The plant is fueled by low-sulfur coal from the BHP-Billiton Navajo Mine and was the first mine to mouth generation station to take advantage of the large deposits of sub-bituminous coal in the Four Corners region.

San Juan Generating Station is operated by Public Service Company of New Mexico and consists of four coal-fired, pressurized units that generate about 1,800 gross MW of electricity. The station went online in 1973 and is the seventh-largest coal-fired generating station in the West. The plant is a mine to mouth operation fueled by low-sulfur sub-bituminous coal from the BHP-Billiton San Juan Underground Mine.

Navajo Generating Station is a coal-fired power plant with a capacity of 2,250 MW that serves customers in Arizona, Nevada and California. The plant began operation in 1974 and is located in Page, Arizona, approximately 175 miles west-southwest of the study area. Coal is provided by Peabody's Kayenta mining operations located about 50 miles east of the plant and is hauled by the Black Mesa and Lake Powell Railroad.

The city of Farmington, New Mexico, owns and operates the cogeneration Animas Power Plant which generates 51 MW of energy using natural gas. The city of Farmington's Bluffview Power Plant began commercial operation in 2005. The 60 MW (rated) plant utilizes a combustion turbine and a steam turbine. This facility, like Animas Power Plant, is a "combined cycle" power plant which means it uses waste heat from the combustion turbine generator to produce steam to operate the steam turbine generator. Both plants are located in Farmington approximately 28 miles south of the study area. The city of Farmington also operates the Navajo Reservoir hydro power plant which generates 30 MW and is located approximately 13 miles south of the study area. Milagro Power Plant is a cogeneration power plant whose capacity is 61 MW from two units. The plant is owned and operated by Williams Four Corners and located in Bloomfield, New Mexico.

Desert Rock Energy Project is a proposed 1,500 MW coal-fired power plant which would be owned in partnership by Dine Power Authority, a subsidiary of the Navajo Nation, and Sithe Global. The plant would be a mine to mouth station using sub-bituminous coal mined at the BHP-Billiton Navajo Mine. The proposed power plant would be located near Burnham, New Mexico, approximately 35 miles southwest of the study area.

## COMMUNITY EXPANSION

La Plata County is expected to continue to grow in population at a rate higher than that of most areas in the U.S. Between 2001 and 2002, population growth in La Plata County increased by 2%, outpacing Colorado and the U.S. Between 1991 and 2000, the county population grew at a rate of 2.9%. Total county population in 2000 was 43,941 people, up 36% from 32,284 in 1990 (Sonoran Institute 2005). In 2006, total population in the county was 49,182 (JSI Research and Training Institute 2007). Economically the county is expected to continue to grow, but generally within the same industries. These industries are oil and gas development, tourism, construction, and retail sales (Sonoran Institute 2005).

With continued population and industrial growth the county is expected to expand residential and commercial development. Durango, La Plata County's largest city, is geographically restricted for growth. However, continued development of residential and commercial establishments is expected along the Animas River corridor south and north of the city, along the U.S. Highway 160 corridor, and around the Bayfield area. Several residential areas are currently proposed within the county. On the Florida Mesa approximately 280 acres would be developed as residential home sites (La Plata County 2008). Associated with new home sites would be new roads, electric lines and other infrastructure.

The SUGF is proposing development of a 160-acre and adjoining 320-acre residential development located southwest of Ignacio, Colorado within the next five to 20 years (Trevor Nazzaro, personal communication, 3/13/2008). SUGF has been developing the Three Springs Neighborhood which encompasses 681 acres in Grandview located within the city limits of Durango. The Three Springs Neighborhood currently includes a hospital complex (Mercy Medical Center), commercial businesses, SUGF administrative buildings, and residences. By 2030, Three Springs would be fully built out encompassing a 76-acre park and over 300 acres of open space and trails, a middle school, and approximately 2,000 home sites. The SUGF is proposing the Rock Creek II Subdivision located just east of Ignacio which would encompass 80 acres and 200 home sites. This property would be completely developed by 2011. SUGF is also building Tranquilo Court located in the eastern part of Ignacio which will include 23 home sites on four acres. This property is currently being developed and will be completed by 2009.

The SUIT recently constructed a new casino and hotel on the north side of Ignacio. The hotel and casino occupies 300,000 square feet of usable space including a bowling alley, pool, day-care facilities, administrative offices, fitness center, and four restaurants. The entire casino/hotel complex is approximately 50 acres in size.

## HIGHWAYS

Reasonably foreseeable highway projects in La Plata County include the expansion of U.S. Highway 550 from the New Mexico border north to Durango from two to four lanes in 2008 through 2009. U.S. Highway 550 south of the New Mexico border has previously been upgraded from two to four lanes. The intersection of U.S. Highway 160 at Grandview and U.S. Highway 550 is currently being widened. The first phase of a new interchange with U.S. 550, including building four (4) bridges and ramps east of the current intersection, are currently being constructed. The project is scheduled for completion by September 2010 (CDOT 2008). No other large highway projects are expected within the county.

## GRAVEL MINING

SUSG operates one extraction, mining and wash plant on the Reservation near Weaselskin Bridge, south of Durango. Additionally, SUSG operates a batch plant west of Ignacio within the Reservation boundary. Other SUSG operations include plants in Farmington, New Mexico, and Cortez, Mancos and Montrose, Colorado. Gosney and Sons operates a batch plant east of Ignacio within the Reservation boundary on fee land. SUSG and Gosney and Sons extract gravel, cobbles, and sand which are used for construction and road building activities both on and off the Reservation.

## WATER DEVELOPMENTS

Irrigation water is released at Navajo Dam through diversion headworks for the Navajo Indian Irrigation Project (NIIP). Irrigation water travels through a series of concrete lined open canals, membrane lined open canals, seven tunnels, 15 siphons, and an in-line earth channel and reservoir behind Cutter Dam in San Juan County, New Mexico. Water is distributed to the turnouts at the individual farm units of the Navajo Agricultural Products Industry through about 340 miles of underground pipe lateral systems ranging from 6 to 84 inches in diameter.

The ALP project is located in the central portion of La Plata County. The project is being developed for implementation of the Colorado Ute Settlement Act Amendments of 2000 to fulfill the water rights settlement of the Ute Mountain Ute Tribe and the SUIT. Fulfillment of the settlement obligations, one of which is completing the ALP, would provide non-Indian water users in Southwest Colorado certainty to the continued, historical use of water. Storage would largely be reserved for Indian water users, but would also provide nearly 33% of the storage in Lake Nighthorse for use by non-Indian entities in the Four Corners region. Located on a parcel of land directly across from Santa Rita Park, the Durango Pumping Plant would lift water from the Animas River up through the Ridges Basin Inlet Conduit into Lake Nighthorse.

The Navajo Nation Municipal Pipeline was authorized under ALP. This pipeline is proposed to carry municipal water from Farmington, New Mexico, to the Shiprock, New Mexico area to benefit the Navajo Nation.

The BOR has developed a proposal to construct two pipelines for the Navajo-Gallup Water Supply Project. One pipeline would predominantly parallel U.S. Highway 491 and would transport San Juan River water to the Navajo Nation and the Gallup area in New Mexico. Another spur would run north along Highway 591 to serve Naschitti and Sanostee. The second pipeline would serve the eastern portion of the Navajo Nation south of U.S. Highway 550. This pipeline from the NIIP would be treated and sent along U.S. Highway 550 to Nageezi and then south to Torreon.

### 4.13.3 Impact Assessment Methodology

For this analysis the geographic scope of the project varies by resource. For most resources the geographic scope is the northern portion of the SJB including the study area however, air quality is analyzed in a regional setting. The cumulative impacts analysis analyzes each resource as defined in Chapter 3 by each alternative. The following approach, analytical perspective, and considerations were used to conduct the cumulative impact analysis in accordance with the BLM Manual Handbook 1790-1 (BLM 2008). Information is quantified to the extent practicable; however, the cumulative impacts analysis in this PEA is primarily qualitative. Federal, state, and local government, SUIT, and private activities are considered in the analysis. For some resources, more detailed cumulative analysis in the 2002 FEIS is referenced. Reasonably foreseeable actions are those future actions for which there is a reasonable expectation that the action could occur, a project that has already started, or a future action that has obligated funding.

Activities relevant to the cumulative impacts analysis were identified from reviews of information available from government agencies including FEIS documents, land use and natural resource management plans and private organizations. Relevant activities are based on potential geographical and temporal (space and time) relationships with the proposed action. Some actions identified in this section may not have a cumulative impact on all resources.

The cumulative impacts of Alternative 1 were analyzed in the 2002 EIS and will not be discussed in this section. The following terminology is used in the cumulative impacts analysis to qualify the impacts of implementing Alternative 2 (BLM 2008). These terms are defined as the following:

- **Direct Effects** which are caused by the action and occur at the same time and place (40 CFR 1508.8 (a));
- **Indirect Effects** which are caused by the action and are later in time or farther removed in distance, but are reasonably foreseeable (40 CFR 1508.8 (b));
- **Short-term** - Up to five years;
- **Long-term** - The life of the project and beyond;
- **Additive** - The effects of the action add together to make up cumulative effects;.
- **Countervailing** -The effects of some actions balance or mitigate the effects of other actions; and
- **Synergistic** -The effects of the actions together is greater than the sum of their individual effects.

### 4.13.4 Cumulative Impacts Assessment

The following analysis of potential cumulative impacts associated with the alternatives is organized by resource area in the same order of resource discussions in Chapters 3 and 4. Design features discussed in Section 2.4 would minimize cumulative impacts.

**AIR QUALITY**

The air quality analysis area is the geographic scale used to describe cumulative impacts to air resources.

*Past Development* – Drilling for natural gas and oil has occurred in the air quality analysis area since the 1920s. Currently, over 30,000 CBM and conventional wells have been drilled within the air analysis area. To date, oil and natural gas development has directly impacted air quality resources by increasing fugitive dust emissions from the construction of roads and pipelines, which has resulted in short-term or temporary impacts that are localized. During oil and gas operations, drilling rigs and construction traffic increased the amount of $PM_{10}$, $SO_2$, CO, VOC, $CO_2$ on a short-term and localized basis.

*Present Development* – World energy demand has increased by approximately 60% during the last 25 years, primarily due to a global infrastructure that has expanded on a massive scale. Forecasts for the next 25 years anticipate a similar increase in demand from a larger base. Currently, oil and natural gas provide nearly 60% of the world energy demand (National Petroleum Council 2007). Continuing oil and gas activities within the air analysis area will further increase short-term emissions during construction and operation resulting in short-term direct impacts to air quality within the air quality analysis area.

*Reasonable Foreseeable Development* – Approximately 13,000 natural gas wells are scheduled to be drilled within the air quality analysis area over the next 15 to 20 years. The Desert Rock Energy Project is proposing a 1,500 MW coal-fired power plant located near Burnham, New Mexico. Mid-America Pipeline Company is proposing a natural gas liquids pipeline project totaling 202 miles along an 840-mile route between the Granger and Wamsutter areas in Wyoming, and Hobbs, New Mexico. The Phoenix Expansion Project is proposed by Transwestern Pipeline Company and entails the construction of approximately 25 miles of pipeline looping parallel to its existing San Juan Lateral, in San Juan County, New Mexico. The San Juan Lateral extends from San Juan County, New Mexico, to connect with Transwestern's mainline in McKinley County, New Mexico. To the extent that emissions from these projects have been quantified and estimated emissions are in the public domain, they have been included in the far field and ozone modeling analyses. [8]

*Alternative 2* – The potential cumulative impacts to air quality that could result from Alternative 2 plus forecasted impacts from existing operations that account for changes in production as well as impacts from reasonably foreseeable projects, do not result in projected adverse or significant air quality impacts. The development of 770 wells would not result to a violation of the CO and $NO_2$, NAAQS. The only HAP that would be emitted from the sources under Alternative 2 would be formaldehyde. The maximum annual average formaldehyde concentration under Alternative 2 is at the lower end of the range of USEPA's risk criteria. The maximum 24-hour and annual average $PM_{10}$ concentrations from traffic on unpaved roads and during well pad construction would be temporary (e.g.,

[8] Reasonable Foreseeable Development emissions were developed by Environ as part of the FCAQTF modeling analysis.

occurring during a 36-day construction period) and would occur in isolation, with limited interaction of adjacent well locations. The maximum short-term (3- and 24-hour) $SO_2$ emissions generated by drilling rigs and other diesel engines would be temporary, occurring only during the limited 36-day construction period at each well location. All of the impacts from the above mentioned sources would result in direct and short-term impacts.

The CAMx modeling results demonstrate no major impact to Ozone 8-hour design values, any contribution from Alternative 2 emissions are very small (insignificant) and no new violations under NAAQS were expected under Alternative 2 (refer to Appendix G). Projected project impacts are well below the 1 dV threshold under Alternative 2 at all Class I Areas for visibility. The acid deposition rates would decrease for sensitive lakes within the air quality analysis area (refer to Appendix G).

The impacts from the implementation of Alternative 2 would contribute to air quality impacts from the past, present, and reasonable foreseeable actions mentioned above. Under Alternative 2, impacts to air quality would be direct, short and long-term, and synergistic.

## BIOLOGICAL RESOURCES

This section evaluates cumulative impacts to the following resources: vegetation, (including culturally important plants and noxious weeds), threatened, endangered and sensitive species, wildlife, and fisheries. It is difficult to quantify the amount of oil and gas development that could occur within the SJB over the next 20 years, particularly if New Mexico Oil Conservation Commission or COGCC spacing orders change or new technologies allow for drilling to new formations. Impacts are discussed qualitatively using the northern SJB, including the study area, as the geographic scope. However, a quantitative analysis is included for cumulative impacts from oil and gas development potentially occurring in the study area. The quantitative analysis follows the methodology discussed in Section 4.1.1.

Due to the complexity of natural ecosystems and the large geographical scope, the types of impacts to biological sources that have occurred from past development, reasonable foreseeable development, and cumulatively under either alternative are generalized. The greatest type of impacts to biological resources would be habitat loss, modification, degradation, and fragmentation.

*Past Development* – The primary past development in the study area is from oil and gas development. Currently there are 2,917 active oil and gas wells within La Plata County (COGCC 2008b). Table 4-34 summarizes the estimated amount of past, long-term disturbance to biological resources within the study area resulting from natural gas wells based on an average disturbance amount per well of 2.2 acres. However, Table 4-34 does not include disturbance associated with roads, ROWs, or other infrastructure. Approximately 1,300 miles of federal, state, Tribal, county, private, and oil and gas roads has been constructed within the study area. North of the study area, approximately 290 CBM and conventional wells have been drilled and 58 miles of roads constructed resulting in approximately 500 acres of disturbance to various vegetation communities and wildlife habitats (USDI/USDA 2006a).

**Table 4-34. Past Development Summary of Amount of Disturbance to Biological Resources within the Study Area.**

| Resource | Within Study Area | | | |
|---|---|---|---|---|
| | Acres of Resource in Study Area | Current Number of Well Pads in Resource | Current Disturbance[a] (Acres) | Current Disturbance (%) |
| Calving/Fawning | 41,320 | 195 | 429 | 1.0 |
| Migration | 68,187 | 366 | 805 | 1.2 |
| Winter | 350,503 | 2,052 | 4,514 | 1.3 |
| Year-Round | 201,996 | 1,354 | 2,978 | 1.5 |
| Barren | 8,053 | 144 | 317 | 3.9 |
| Disturbed | 85,423 | 512 | 1,126 | 1.3 |
| Montane Forest | 14,641 | 20 | 44 | 0.3 |
| Montane Shrubland/Grassland | 24,721 | 162 | 356 | 1.4 |
| Pinon-Juniper/Juniper Savanna | 209,130 | 1,131 | 2,488 | 1.2 |
| Semi-Desert and Salt Desert | 71,891 | 567 | 1,247 | 1.7 |
| Wetland and Riparian | 7,924 | 20 | 44 | 0.6 |

[a] Based on long-term disturbance of 2.2 acres per well pad.

Past development in the northern SJB has resulted in both direct and indirect long-term impacts to all vegetative resources, including cultural species. Direct impacts include vegetation removal and modification of vegetation communities. Indirect impacts include the introduction of invasive species and changes in wildlife habitat use. It is unlikely that threatened, endangered or sensitive species would have been adversely affected from past development due to pre-construction on-site surveys and their limited ranges. Past development within the study area has directly and indirectly impacted wildlife from vehicular collisions, habitat degradation and modification, and fragmentation. Direct and indirect long-term impacts to fisheries have resulted from increased soil erosion and decreased streamflows.

*Present Development* – Ongoing activities within the northern SJB are primarily oil and gas development and community expansion. These activities continue to impact biological resources directly and indirectly for the short- and long-term.

*Reasonably Foreseeable Development* - Oil and gas development would continue on fee lands within the northern SJB. Approximately 586 wells could be drilled on fee lands/fee minerals over the next 15 to 20 years in the study area. North of the study area, development in the HD Mountains was recently approved allowing for drilling of up to 227 new CBM wells and 123 new miles of roads and pipelines on 125,000 acres of both federal and private lands (USDI/USDA 2006a). The disturbance from reasonable foreseeable development, in particular from oil and gas development would further disturb vegetation communities and create habitat type conversions. Oil and gas development and community expansion cumulative impacts in this area would result in similar types of wildlife impacts. The HD Mountains contain important big game migration routes, where wildlife moves north to south through the study area (USDI 2002a). Development in the HD Mountains would impact big game and other wildlife by further fragmenting this migration corridor.

Other activities that would disturb vegetation types include community and highway development however, these impacts would be minimal. Wildlife habitat would continue to be fragmented and modified. Some wildlife species could be killed due to vehicle collisions or construction activities. Activities would continue to develop more remote areas where relatively large wildlife habitat areas are still available.

*Alternative 2* - The potential cumulative impacts to biological resources that could result from Alternative 2 are additive to what has occurred from past development and what is reasonably foreseeable. Table 4-35 estimates the cumulative disturbance within the study area resulting from existing oil and gas development, future development on fee lands within the study area, and the impacts from Alternative 2. Associated existing infrastructure such as roads and ROWs, and development north of the study area are not evaluated in Table 4-35. It should be noted that the estimates in Table 4-35 are based on current development patterns and the amount of actual future disturbance within different resources may vary.

**Table 4-35. Estimated Cumulative Disturbance to Biological Resources from Alternative 2 within the Study Area.**

| Resource | Within the Study Area | | |
|---|---|---|---|
| | Acres of Resource in Study Area | Cumulative Disturbance (Acres) | Cumulative Disturbance (%) |
| Montane Forest | 14,641 | 121 | 0.8% |
| Montane Shrubland/Grassland | 24,721 | 984 | 4.0% |
| Pinon-Juniper/Juniper Savanna | 209,130 | 6,818 | 3.3% |
| Semi-Desert and Salt Desert | 71,891 | 3,328 | 4.6% |
| Barren | 8,053 | 1,284 | 15.9% |
| Wetland and Riparian | 7,924 | 113 | 1.4% |
| Disturbed | 85,423 | 2,855 | 3.3% |
| Calving/Fawning | 41,320 | 1,318 | 3.2% |
| Winter | 350,503 | 11,287 | 3.2% |
| Migration | 68,187 | 2,013 | 3.0% |
| Year-Round | 201,996 | 7,568 | 3.7% |

[a] Based on long-term disturbance of 2.2 acres per well pad.
[b] Based on long-term disturbance of 2.2 acres per existing well, 2.2 acres for new well locations, and 0.5 acres for co-located well locations.

Cumulative impacts would result in wildlife habitat loss and conversion. Disturbance could lead to invasion of exotic species or the further the spread of existing populations, which could be more likely to out-compete natives. The density and diversity of vegetation species would be modified in areas reclaimed following construction. Changes to vegetation would subsequently result in altered wildlife use of an area. These impacts would be greater in vegetation types such as riparian areas or wooded areas that are used for wildlife nesting, foraging, and breeding.

Continued population growth would likely concentrate residential and commercial growth within the existing patterns of the study area. Residential and commercial development is expected to expand along river and highway corridors within the study area and in existing communities. Community expansion and oil and gas development would further impact wildlife, especially big game migration corridors. The widening of U.S. Highway 160 would also impact a main migration corridor along the Animas River. The level, or degree, of cumulative impacts on wildlife would vary based on species. Normal wildlife movements, or migration, within the northern SJB could be altered or impeded. Disturbance of migration corridors could preclude deer and elk from accessing habitats specific to their winter and summer life cycles and could decrease production or fitness.

Some wildlife could alter their habitat use and selection in areas based on development levels or consistent vehicular or human activity, creating overuse in some habitats, which may cause changes to sub-population numbers. Restricted movement and dispersal could eventually reduce genetic diversity in a population as a whole, particularly for wildlife species with small ranges or limited mobility. Disturbance would directly and indirectly impact wildlife by removing habitat that is used for foraging, burrowing/nesting, and breeding. These impacts could be greater in habitats used for particular life events such as nesting or breeding. Increased traffic resulting from energy and community development would proportionally increase the likelihood of vehicle/wildlife collisions and mortalities. The potential for human-wildlife encounters and conflicts, as well as poaching, would also increase. Electrical transmission and distribution line expansion for oil and gas development and community growth could have a negative effect on raptors and migratory birds by causing direct mortality and disrupting breeding, nesting, and foraging behaviors.

Methane seeps in some areas of the Fruitland outcrop zone may result in vegetation die-off and mortality to smaller wildlife species that might be killed through contact exposure with the methane and $H_2S$. Increased oil and gas development within and north of the study area could decrease methane seeps along the Fruitland outcrop (LTE 2008).

Impacts to fisheries from water contamination by accidental spills or leaks of hazardous products from energy development or other commercial enterprises could occur. This could result in direct mortality and/or a reduction of food resources. Indirect impacts to fisheries could include habitat alteration or destruction due to increase sedimentation from associated surface disturbance. Threatened and endangered, or otherwise sensitive species would continue to be protected by regulatory oversight and pre-project planning. Overall, the impacts from reasonable foreseeable development would be direct and long-term to biological resources.

The impacts from the implementation of Alternative 2 would contribute to biological resource impacts from the past, present, and reasonably foreseeable actions mentioned above. Under Alternative 2, impacts to biological resources would be direct and indirect, long-term and synergistic.

**GEOLOGY, MINERALS, SOILS**

Cumulative impacts to this resource are analyzed using the SJB as the geographic scale.

*Past Development* – Drilling for natural gas and oil has occurred in the SJB since the 1920s. CBM emerged as a viable source of natural gas in the late 1980s and 1990s. The SJB was the first major CBM producing region, the largest producing basin in the Rockies, and early activity was stimulated by Federal tax credits. The National Petroleum Council (NPC) has estimated undiscovered gas in the SJB at 30.1 Tcf. The conventional undiscovered gas accumulations represent only 3% of the undiscovered gas resource, non-conventional low permeability sandstones represent 52%, and CBM from the Fruitland Formation comprises 29% of the undiscovered gas resource. Production in the SJB rose marginally over the period 1997-2001, from 3.9 Bcf per day to 4.1 Bcf per day (NPC 2007).

Natural gas development to date has directly impacted the mineral resources within the SJB through the depletion of reserves. Localized areas of topography (surface geologic formations) have been permanently altered resulting in long-term direct impacts. Other direct long-term impacts include soil loss, increases in soil erosion, increases in runoff, changes in soil drainage patterns, difficulty in revegetation, and the loss of prime farmland and agricultural land. However, the extraction of natural gas and oil reserves from the Colorado portion of the SJB has had direct and indirect, short-term impacts to the general public as it serves to meet energy needs.

*Present Development* – World energy demand has increased about 60% during the last 25 years, primarily due to a global infrastructure that has expanded on a massive scale. Forecasts for the next 25 years anticipate a similar increase in demand from a larger base. Currently oil and natural gas provide nearly 60% of the world energy demand (NPC 2007). Continuing oil and gas activities within the SJB will further deplete mineral reserves, disturb soils, and alter topography resulting in long-term direct and indirect impacts.

Potential cumulative adverse impacts from natural gas extraction include the indirect impacts from loss of gas from seeps and the loss of potential coal reserves due to fires at the Fruitland outcrop. The SUGF is currently attempting to capture methane escaping from vent wells along the outcrop for processing. In theory, the gas that would escape as a seep would be captured by these vent wells near the outcrop, processed and sold. This would reduce methane pollution and public safety hazards related to the seeps, resulting in beneficial long-term direct impacts.

*Reasonably Foreseeable Development* – Approximately 13,000 natural gas wells are scheduled to be drilled within the SJB over the next 15 to 20 years. Cumulative impacts from reasonable foreseeable development would result in long-term direct and indirect impacts to geology, minerals, and soils in the SJB. Impacts to the mineral sources from the removal of gas would be long-term and direct. This would also result in unavoidable adverse impacts to mineral sources by depleting reserves. Impacts to the general public would be short-term direct and indirect.

*Alternative 2* – The greatest cumulative impact to geology, minerals, and soils in the SJB is the irretrievable extraction of natural gas and oil reserves for human consumption. Alternative 2 would have short-term direct and indirect impacts from meeting energy needs.

Impacts could include a decrease in methane seepage at the outcrop, and the occurrence or magnitude of coal fires at the outcrop resulting from CBM production. Recent studies show a downward trend in methane seepage at the outcrop (LTE 2008). However, monitoring of methane seeps along the outcrop since 1998 has not found any direct correlation with CBM production (LTE 2006).

Disturbance to soils from oil and natural gas development, gravel mining, residential and commercial development, agriculture, and grazing would result in some soil loss, increases in soil erosion, increases in runoff, changes in soil drainage patterns, difficulty in re-vegetation, and the loss of prime farmland. Cumulatively direct and indirect impacts to soils would be long-term.

The impacts from the implementation of Alternative 2 would contribute to geologic, soil, and mineral impacts from past, present, and reasonably foreseeable actions mentioned above. Under Alternative 2, impacts to geology, minerals, and soils would be direct and indirect, long-term and synergistic.

## WATER RESOURCES

The cumulative effects analysis area includes the Animas, Upper San Juan, Middle San Juan, and the Piedra River watersheds.

*Past Development* – The analysis area has grown substantially within the past three decades. As a result, growth has increased demands on water use. Natural gas development, community development, and agriculture require the use of fresh water. The total volume of fresh water required for natural gas drilling in the Colorado portion of the SJB is estimated to be approximately 120 AF/year (USDI 2002a, USDI/USDA 2006a). Surface disturbance from development has resulted in increased sedimentation in local waterways. Receiving waters downstream (San Juan River) are currently impaired for sedimentation, nutrients, dissolved oxygen, and fecal coliform (SWQB 2005).

CBM development within the northern SJB has also resulted in dewatering of the Fruitland Formation. Dewatering from the formation also depletes surface water volumes in the La Plata, Los Piños, Animas, and Piedra rivers where they cross the Fruitland outcrop. Modeled depletions were estimated to be 156 AF/year in 2005 based on existing CBM natural gas development (SSPA 2006a). Past development has resulted in direct and indirect short- and long-term impacts to water resources in the analysis area.

*Present Development* – Present development would continue to impact water quality similar to past development.

*Reasonably Foreseeable Development* – Continued oil and gas development within La Plata County would use approximately the same amount of produced and fresh water for drilling activities. Residential and commercial expansion would increase fresh water demand. Future developments occurring on agricultural lands could result in a decreased use of fresh water for irrigation, since residential and most commercial developments use less water than agriculture. However, agriculture is a source of recharge to the terrace deposits on Florida Mesa (Florida Mesa District Land Use Plan 2001). Fresh water and domestic ground water sources in the Middle San Juan watershed in the western portion of the study area are limited. Further development in that area would likely result in increased demand on limited supplies, which may ultimately restrict development.

According to the SSPA model, maximum annual surface water depletions in the Dewatering from the Fruitland Formation would occur from CBM production in the analysis area. If no wells are installed within 1.5 miles of the outcrop, depletions will peak in approximately 2035 at 171 AF/yr, and will drop below 100 AF/yr by 2150 (SSPA 2006a). Dewatering of the Fruitland Formation would result in long-term direct impacts to the formation and to surface water volumes. Cumulative effects from dewatering of the Fruitland Formation would not adversely impact domestic ground water quantity and quality. However, domestic water wells finished in the Fruitland Formation at the outcrop would likely have decreased quantities. Additionally, seeps and springs along the outcrop would likely be depleted or dry up. There would be no cumulative impacts to other seeps and springs within the analysis area from dewatering of the Fruitland Formation.

Future energy development and community expansion would create greater surface disturbance which would likely result in increased sedimentation in local waterways. Increases in sediment levels, particularly in the La Plata and Animas Rivers could result in continued impairment of the Animas River or exceedance of total maximum daily loads (TMDLs). Direct and indirect cumulative impacts to water quality would be short- to long-term.

Cumulative impacts could also impact water quality and subsequently fish habitat. Decreases in water quality could also occur from spills or leaks of hazardous materials, including household and agricultural products. Typically, these impacts would be localized and would not result in cumulative impacts to water quality unless improperly handled.

*Alternative 2* – Alternative 2 estimates a fresh water demand of 34.6 AF/year for well drilling. This amount of fresh water use is not expected to significantly increase demands on area surface waters or result in restricting community expansion where resource extraction occurs. Under Alternative 2, it can be reasonably interpreted that the incremental increase in depletions due to infill drilling would peak at 18 AF/yr by 2025 (Cox et al. 2001, SSPA 2006a). Water wells drilled into the Fruitland Formation at the outcrop would likely have decreased quantities from additional incremental depletions. Further depletions from other activities could contribute to seeps and springs along the outcrop being depleted or drying up.

Surface disturbance would result in increased sediment levels in local waterways reducing water quality and impacting fish habitat. Increases in sediment levels, particularly in the La Plata and Animas Rivers could result in continued impairment of the Animas River or exceedance of TMDLs for sediment. Under Alternative 2, impacts to water resources would be direct and indirect, long-term and synergistic.

## LAND USE AND OWNERSHIP

Cumulative effects to land use and ownership are analyzed within La Plata County. Community expansion and oil and gas activities are the main development activities in the area.

*Past Development* – Past development has resulted in long-term direct impacts to land use and ownership by displacing land use or restricting land use. Private land owners have been impacted directly by the loss of land or decreased land values, changes to land use, and future development plans from natural gas development. Indirectly short- and long-term impacts have been realized by the general public by increased traffic, noise, and dust levels.

*Present Development* – Present development would continue to impact land use and ownership similar to past development.

*Reasonably Foreseeable Development* – Overall land use and ownership is not expected to change appreciably as a cumulative impact of future oil and gas development. The majority of the county contains moderate oil and gas development. Cumulative impacts to land use would be greater in areas currently undeveloped, or lesser developed, such as north of the study area. Direct long-term impacts on land use would be mainly related to physical restrictions on land use and displacement of land use. Indirect short- to long-term impacts would occur from increased fugitive dust, noise, and traffic levels, and changes to visual aesthetics in populated areas. These impacts would vary in intensity and would be localized. Community expansion would result in direct long-term impacts to land use as agricultural, range, or forested lands are converted to residential areas.

*Alternative 2* – Cumulative oil and gas development would remove approximately 2 acres of land per well pad from other uses, such as residential development, agriculture, grazing, or wildlife habitat. The 2002 FEIS estimated that approximately 2% of each spacing unit (i.e., 160, 320, or 640-acres) would be disturbed within the study area and north of the study area based on a total surface disturbance of 24,300 acres (USDI 2002a). Not enough information or data were available to accurately estimate the cumulative amount of disturbance that could occur in La Plata County from oil and gas, community expansion, or other developments.

The greatest impacts would occur in split estate situations. Impacts to private land owners would include loss of land and decreased land values, modifications to future development plans due to well pad and access road and/or pipeline corridor locations in the center of, or bisecting, private land parcels. These impacts are difficult to quantify and would vary on a case-by-case basis. Direct impacts to surface owners would include visual and noise impacts. Noise, dust, and increased traffic could indirectly impact land owners. Under Alternative 2, impacts to land use and ownership would be direct and indirect, long-term and additive.

## TRAFFIC AND TRANSPORTATION

Cumulative impacts to traffic and transportation are evaluated for La Plata County.

*Past Development* – Oil and gas development, community expansion, and tourism have had the largest impact on traffic and transportation in the county. Increases in all of these variables have resulted in direct long-term impacts to traffic levels, accident occurrences, roadway congestion, and wear and tear on roadways within the county.

*Present Development* – Present development would continue to impact traffic and transportation similar to past development.

*Reasonably Foreseeable Development* – Continued growth within the county would cumulatively impact the level of use for most highways and major arterials. The 2002 FEIS (Refer to Table 4-37 in Section 4.7) conducted a cumulative traffic analysis which showed that the LOS on four of nine highway segments would continue to deteriorate through 2017 without future oil and gas well development (USDI 2002a). Vehicle traffic north of the study area related to oil and gas development would contribute a 1% increase to traffic volumes on U.S. Highway 160 and a 10% increase of daily vehicle trips on county roads. Widening of U.S. Highway 550 would reduce impacts on the level of service from increased daily vehicle trips from increased population growth, oil and gas development, and tourism.

*Alternative 2* – Alternative 2 would result in an increase of 93 daily vehicle trips in the study area. The cumulative direct long-term impacts to traffic volumes resulting from oil and gas development would be less than those of increased population growth and tourism (USDI 2002a). Cumulative impacts are not expected to appreciably impact traffic congestion or vehicle accident rates under Alternative 2. Additional wear and tear on county roads and oil and gas roads would result in cumulative direct long-term impacts within the study area. These impacts would be greater than those of typical passenger vehicles associated with tourism or project residential growth since increased oil and gas traffic would consist of larger, heavier vehicles. Under Alternative 2, impacts to traffic and transportation would be direct, long-term, and additive.

## CULTURAL RESOURCES

Cumulative impacts to cultural resources are analyzed within the study area.

*Past Development* – Past development from community expansion, population growth, tourism, and energy development has resulted in long-term direct impacts to cultural resources in the study area. Prior to the implementation of federal and Tribal regulations an unknown number of cultural resources could have been impacted. Indirect impacts have occurred from increased public access to otherwise remote areas. This increased access has likely resulted in collecting or vandalizing cultural resources within the study area.

*Present Development* – Direct and indirect impacts would likely continue to impact cultural resources. However, federal and Tribal guidelines minimize the potential for these impacts.

*Reasonably Foreseeable Development* – Continued energy development, population growth, tourism, and community expansion would have the potential to directly and indirectly impact cultural resources. The potential for impacts is minimized by federal and Tribal guidelines.

*Alternative 2* – Development of oil and gas would follow federal and Tribal guidelines to protect cultural resources and negative impacts would be avoided to the greatest extent possible. Developments on private land are regulated by SHPO guidelines. The policy of site avoidance during project planning provides protection of archaeological resources regardless of the development. Under Alternative 2, impacts to cultural resources would be direct and indirect, long-term and additive.

## VISUAL RESOURCES

The analysis area for cumulative impacts to visual resources is the study area.

*Past Development* – Past development in the study area has resulted in direct long-term impacts to visual resources. Oil and gas development and community expansion has impacted views from sensitive viewpoints.

*Present Development* – Present development would continue to impact visual resources similar to past development.

*Reasonably Foreseeable Development* – Future development on private lands within the study area and its impacts to visual resources cannot be quantified with available data. Community expansion along river corridors and key travel routes within the study area would also impact visual resources. Impacts to visual resources from continued resource extraction and community development would be direct, long-term, and additive.

*Alternative 2* – Alternative 2 would affect views from a variety of sensitive viewpoints associated with Level II visual sensitivity areas, including residential areas, recreational lands, and key travel routes. Under Alternative 2, impacts to visual resources would be direct, long-term, and additive.

## SOCIOECONOMICS

The socioeconomic area of interest encompasses the northern half of the SJB, the second most productive gas basin in the continental U.S.

*Past Development* – The cumulative economic, fiscal, and social effects of the oil and gas industry on the SJB have been enormous, bringing billions of dollars in taxes and wages while coexisting with much of the pre-existing ranch and agricultural surface uses for more than 20 years. These effects have been no more or less intense on the Reservation than elsewhere in the SJB, but the fiscal and economic aspects have been particularly important to the SUIT. Although oil and gas exploration in the SJB began in the 1920s, the cumulative socioeconomic impacts of the industry were largely dictated in the late 1980s when the development of unconventional gas wells qualified for tax credits. Nearly 700 tax-credit qualified CBM wells were drilled on the Reservation in just four years, forming the base of gas production on the Reservation today.

Oil and gas development in the SJB has had direct and indirect long-term economic and fiscal impacts on the five-county area because the oil and gas industry pays relatively high salaries, as well as substantial royalties and property, severance, and sales taxes. The oil and gas industry injects a relatively large amount of money into communities relative to the increase in population which it brings. Rather than straining basic services, growth in the oil and gas industry can improve the local economy and the services provided in an area. First, both oil and gas workers and the companies they work for pay substantial taxes, which supports publicly provided services. Second, oil and gas workers spend their income primarily in the communities of the region, thus supporting thousands of other local jobs. The oil and gas industry has directly provided hundreds of relatively high-paying, long-term jobs for a broad range of skill levels in the SJB.

Oil and gas development has added to increased economic development for the SUIT. Because Tribal government is the largest employer of Tribal members and provides a broad range of services, the economic and social well-being of the Tribe as a whole is tightly linked to the fiscal health of tribal government. In the past decade, the SUIT General Fund budget has roughly tripled due to oil and gas development has proven itself to be compatible with ranching and agricultural surface uses and would not disrupt the rural culture of the Reservation.

*Present Development* – Ongoing oil and gas development would continue to have positive direct and indirect impacts to socioeconomics within the SJB.

*Reasonably Foreseeable Development* –As natural gas reserves are depleted, drilling and production within the SJB is expected to decline and subsequently decline in its contribution to local economies. Population growth within the five counties is expected to continue to increase resulting in direct and indirect long-term socioeconomic impacts. Population, employment, housing, facilities, services and infrastructure, and total revenues would increase in the future with or without additional CBM development.

*Alternative 2* – The direct and indirect short- and long-term cumulative impacts associated with the Alternative 2 would be negligible within the larger geographic and time scale of oil and gas development in the region. Cumulative incremental gas produced under Alternative 2 would be approximately 1.4 Bcf during the project period compared to existing production forecasts. A cumulative minimum incremental benefit to the Tribe of about $840 million was calculated for the life of the project on natural gas production under Alternative 2, considering only royalty/production payment revenues. Under

Alternative 2, the socioeconomic impacts would be direct and indirect, long-term, and additive.

## NOISE

Cumulative impacts to noise are assessed within the study area. Noise impacts are not necessarily cumulative since the greatest impacts result from local noise.

*Past Development* – Energy development, community expansion, increases in traffic levels, including air traffic have previously been the greatest contributors to cumulative direct, long-term noise impacts within the study area.

*Present Development* – Ongoing oil and gas development would continue to have localized direct and indirect impacts to noise levels in the study area.

*Reasonably Foreseeable Development* – Increased population and other development activities within the study area would increase noise sources and receptors. Outside of communities such as Ignacio, noise is relatively evenly distributed over the study area. Noise from an individual source attenuates with distance and noise from multiple sources in the same area is less than the sum of individual noise sources. As population increases in the study area, residences would be more likely to hear noise sources.

*Alternative 2* – Co-location of wells could result in fewer noise sources, but may also result in higher noise levels at the source. This potential for impacts would be slighter higher under Alternative 2 than Alternative 1 due to the greater number of wells. Under Alternative 2, impacts from noise would be direct, long-term, and additive.

## HEALTH AND SAFETY

The northern SJB represents the analysis area for cumulative impacts to health and safety.

*Past Development* – Past oil and gas development, mining, and power generation in the northern SJB has resulted in direct and indirect long-term impacts to public health and safety.

*Present Development* – Ongoing oil and gas development, mining, power generation, and continued population growth would have the potential for direct long-term impacts to health and safety.

*Reasonably Foreseeable Development* – The increased number of gas wells coupled with an increase in population density would result in increased interactions between the two. There would be an increase in the likelihood of potential accidents involving oil and gas workers and the public. Potential environmental changes at the Fruitland outcrop related to CBM production may impact residents and non-oil and gas facilities. Hazards associated with methane seeps at the outcrop include explosion, ground collapse, fire, and the release of toxic gases. The amount of $H_2S$ gas monitored at methane seeps along the outcrop has shown an upward trend (LTE 2008). As population increases within the basin there is an associated increase in potential impacts to local landowners.

*Alternative 2* – There would be an increase potential for interactions between natural gas wells or related infrastructure and oil and gas workers as well as the general public. Alternative 2 may have an incremental cumulative impact on methane seems along the

Fruitland outcrop. Under Alternative 2, health and impacts would be direct, long-term, and additive.

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GPO Access, Code of Federal Regulations http://www.gpoaccess.gov/CFR/INDEX.HTML

La Plata County – http://co.laplata.co.us

Sky Ute Casino – www.skyutecasino.com

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### Personal Communications

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# 7.0 APPENDICES