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Reasonably Foreseeable Development Scenario for Oil and Gas

Moab Field Office

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MOAB FIELD OFFICE
REASONABLY FORSEEABLE DEVELOPMENT SCENARIO FOR OIL AND GAS

I. Summary

A Reasonably Foreseeable Development Scenario (RFD) for oil and gas is a long term (15 year) projection of oil and gas exploration, development, production, and reclamation activity.

There are approximately 577 wells capable of producing oil and gas in the Moab Field Office (MFO), 724 miles of roads, and 589 miles of pipelines associated with the production of the wells. The 577 wells include producing oil wells, shut-in oil wells, producing gas wells, shut-in gas wells, water injection wells, gas injection wells, and temporarily abandoned wells. The mileage for the roads does not include Highway 191 or Interstate 70. The estimated acreage for the wells, roads, and pipelines used for the existing producing oil and gas operations is 8,500 acres. This amounts to about 15 acres of surface disturbance per well.

Future oil and gas drilling is projected at about 12 to 40 wells per year. It is recognized that there would be some years with less than 12 wells and some years with more than 40 wells. For the purpose of analyzing the impacts of oil and gas leasing, the average of 26 wells per year will be utilized which amounts to a total of about 390 wells over the next 15 years. The surface disturbance for construction of a well pad, road, and associated pipelines is estimated at 15 acres. Therefore, the total projected surface disturbance for oil and gas drilling over the next 15 years is about 5,850 acres. It is assumed that 50 percent of the wells drilled would be productive; and that the remaining 50 percent would be abandoned and reclaimed; and that revegetation would be successful within a scope of ten years. Therefore, over the next 15 years, about 53 wells would be successfully reclaimed making the net surface disturbance (not including current disturbance) about 5,055 acres.

For geophysical exploration, 2,000 linear miles of source lines are projected over the next 15 years. Assuming vibroseis buggies or buggies transporting drills drove over every mile of source line and the path of the buggies was 15 feet wide, the total surface disturbance is estimated at about 3,600 acres. It is assumed that reclamation of disturbance would be successful within a scope of ten years depending on reclamation times related to soils, vegetation, and rainfall.

The baseline RFD scenario for the MFO is summarized as follows:

- Existing surface disturbance for 577 wells and infrastructure is about 8,500 acres. This amounts to about 15 acres of surface disturbance per well.

- Future surface disturbance over the next 15 years for a projected 390 wells and infrastructure amounts to about 5,850 acres. During this period, 53 wells would be successfully reclaimed making the net surface disturbance (not including current disturbance) about 5,055 acres.

• Future surface disturbance over the next 15 years for geophysical exploration (2,000 linear miles) amounts to about 3,600 acres. Reclamation would be successful over the scope of 10 years.

II. Introduction

The following Reasonably Foreseeable Development Scenario (RFD) projects the level of oil and gas activity that can reasonably be expected to occur during the next 15 years in the Moab Field Office (MFO). An RFD for oil and gas is a long-term projection of oil and gas exploration, development, production, and reclamation activity. The RFD is a technical report typically reference in the NEPA document. The RFD is neither a planning decision nor the “No Action Alternative” in the NEPA document. All lands (Federal, State of Utah, Indian and Private) are included in the projection following guidance in BLM Handbook H-1624-1 and Instruction Memorandum No. 2004-089. The baseline projection will assume that all potentially productive areas are open for leasing under standard lease terms and conditions except those areas designated as closed to leasing by law, regulation or executive order.

The largest blocks of excluded lands are wilderness study areas (WSAs) which total approximately 353,606 acres and Arches National Park encompassing 76,397 acres. BLM lands administered by the Vernal Field Office in the northern portion of the MFO are also excluded (28,869 acres). The projection will include the Manti-LaSal National Forest, the Uintah and Ouray Indian Reservation, State land, and private land. Table 1 shows a breakdown of the land status within the MFO and the lands included and excluded in the RFD. The land status within the MFO is also shown on Map 1 (Appendix).

Table 1
Land Status and Lands Included and Excluded in the RFD

Land Status	**Lands Included in the RFD (acres)**	**Lands Excluded in the RFD (acres)**
BLM	1,821,374	
BLM Lands Administered by the Vernal Field Office		28,869
Wilderness Study Areas		353,606
State	346,542	
Indian Reservation	198,106	
Private	156,199	
US Forest Service	141,241	
National Park Service		76,397
Total	2,663,462	458,872

Energy analysts agree that worldwide demand for oil and gas will continue to increase in the near future. At the same time many experts are predicting that world production will soon peak and begin to decline (Deffeyes, 2002; Campbell 2003). These dynamics point to continuing price increases for oil and natural gas. Against this backdrop of increasing demand, activity levels in the MFO will be determined largely by the local geology. Past and present activity levels will provide a starting point for projecting future activities.

III. Description of Geology

The geology of the MFO is described in the Mineral Potential Report for the Moab Resource Management Plan. The northern part of the MFO includes the southwestern portion of the Uinta Basin whereas the southern two thirds includes the Fold and Fault Belt of the Paradox Basin. The two areas have very different geology although both contain areas of high occurrence potential for oil and gas. The oil and gas "Plays" defined by the United States Geological Survey (USGS) in the 1995 National Assessment of United States Oil and Gas Resources (Gautier, 1996) are of special interest relative to future exploration and development activity. The oil and gas plays are shown on Map 2.

The following plays cover the northern part of the planning area (Spencer, 1996):

Play 2002 Uinta Tertiary Oil and Gas Play

Play 2003 Upper Cretaceous Conventional Play

Play 2004 Cretaceous Dakota to Jurassic Play

Play 2051 Uinta Basin Sego Coalbed Methane Play

Play 2002 covers a very small area in the extreme northern part of the MFO and includes oil and gas in stratigraphic traps in the Green River and Wasatch Formations. Source rocks are thought to be organic-rich rocks in the underlying Mesaverde Formation. Play 2003 includes a larger area and refers to accumulations in conventional sandstone reservoirs in the Mesaverde Formation sourced by organic rich shales and coal in the lower Mesaverde.

The Cretaceous Dakota to Jurassic Play (2004) underlies much of the northern half of the field office and includes oil and gas in conventional sandstone reservoirs in the Dakota Sandstone and Cedar Mountain Formation of Cretaceous age and the Morrison and Entrada Formations of Jurassic age. The Cretaceous and Morrison reservoirs are mostly fluvial in origin whereas the Entrada is eolian. Source rocks may be coal in the Dakota and/or organic-rich shales in the overlying Mowry and Mancos Shales. Known coal beds in the Neslen Formation form the basis for the Sego Coalbed Methane Play (2051) which underlies the northeastern portion of the field office.

The following classic Paradox Basin plays underlie the southern and western parts of the MFO (Huffman, 1996):

Play 2101 Buried Fault Blocks, Older Paleozoic

Play 2103 Fractured Interbed

Play 2105 Salt Anticline Flank.

As the name implies, Play 2101 refers to oil and gas in porous dolomitic limestone beds in the Leadville Limestone of Mississippian age and Devonian age sandstones in a faulted anticline (Lisbon Field). Source rocks are probably organic-rich black dolomitic shales in the Pennsylvanian Paradox Formation. These same dolomitic shales serve as both source and reservoir for Play 2103. Only where fractured do they have adequate permeability to produce economic quantities of hydrocarbons. Play 2105 defines hydrocarbons in Permian-Pennsylvanian reservoirs along the flanks of salt anticlines. The only significant production from this play is gas at Andys Mesa Field in Colorado.

IV. Past and Present Oil and Gas Exploration Activity

Geophysical Exploration

Geophysical exploration has occurred in all portions of the MFO in the past. There were geophysical projects throughout most portions of the MFO during the 1980's and eleven have been completed between 1992 and 2004. These are listed and briefly described below in Table 2 to give an indication of the types of surveys that have been conducted in the field office.

Table 2
Geophysical Operations Conducted in the MFO

Year	Geographic Area	Description	Surface Disturbance
1992	Deadman Point	3-D survey using vibroseis trucks	9 square miles
1992	Mineral Point	2-D vibroseis trucks	11 linear miles (3 lines)
1992	Deadman Point, Bull Canyon, Big Draw	2-D shothole using truck mounted drills	21.5 linear miles (7 lines, 2-4 miles long)
1992	Castle Valley, Fisher Valley	2-D shothole using truck mounted and helicopter drills	29.5 linear miles (2 lines)
1992	Lisbon Valley	2-D shothole using truck mounted and helicopter drills	25 linear miles (4 lines)
1993	Salt Wash	2-D shothole using truck mounted drills	3 linear miles (1 line)
1996	Wilson Canyon, Rattlesnake Ranch	3-D project using vibroseis trucks	5 square miles
2000	Island Canyon	2-D project, shothole using buggy and heli-portable drills	8 linear miles in MFO and 12 linear miles in Colorado (3 lines)
2001	The Knoll, Bull Canyon, and Big Flat	3-D project using vibroseis buggy trucks	36 square miles
2002	The Highlands, Owl Draw, and Yellow Jacket Canyon	2-D swath project using vibroseis buggy trucks	36 square miles (7 receiver lines); 18.3 linear miles (3 lines)
2002	Lisbon Valley, Big Indian Valley, East Coyote Wash	3-D project using vibroseis buggy trucks	37 square miles

V. Past and Present Oil and Gas Development Activity

Oil and Gas Leasing Activity

Existing and pending oil and gas leases in the MFO are shown in Map 3. They are concentrated in the southern and southwestern parts, the west central part and in the northeastern corner of the MFO. The extreme northeastern and southeastern parts of the Manti-La Sal National Forest are leased but no leases exist in the western portion of the Forest. Uintah and Ouray Indian Reservation surface areas in the northwestern part of the FO are all unleased.

All 22 parcels in the MFO offered in a September 8, 2004 competitive oil and gas lease sale received bids with bonus values ranging from $3.25/acre to $85.00/acre (average bid per parcel = $29.21/acre). These results indicate that the oil and gas industry continues to have a relatively high degree of interest in obtaining leases in the planning area. Parcels receiving the highest bonus bids are located in T. 22, 23 S., R. 23, 24 E. (Eastern Paradox geographic area).

Six MFO parcels were offered in the December, 2004 competitive sale with five of them being located in the Salt Wash geographic area. All parcels were sold with an average bonus bid of $29.67/ acre.

Historical Drilling Activity

Grand County has been the site of active oil and gas drilling for the past 100 years. The wells listed in Table 3 were compiled from Utah Division of Oil, Gas and Mining data and are current as of March 3, 2005.

Table 3
Grand County Wells in the MFO

Well Status	Number
Producing Oil Wells	28
Producing Gas Wells	267
Shut-in Oil Wells	74
Shut-in Gas Wells	121
Temporarily Abandoned Oil Wells	20
Temporarily Abandoned Gas Wells	22
Water Disposal Well	2
Plugged and Abandoned Oil Wells	43
Plugged and Abandoned Gas Wells	69
Dry Holes	503
Abandoned Locations (Oil)	283
Abandoned Locations (Gas)	131
Approved Permits (Oil)	2
Approved Permits (Gas)	30
Total	**1595**

The MFO includes a part of northern San Juan County in addition to Grand County. Table 4 lists San Juan County wells.

Table 4
San Juan County Wells in the MFO

Well Status	Number

Producing Oil Wells	5
Producing Gas Wells	9
Shut-in Oil Wells	18
Shut-in Gas Wells	3
Temporarily Abandoned Oil Wells	1
Temporarily Abandoned Gas Wells	2
Gas Injection Wells	2
Water Disposal Well	3
Plugged and Abandoned Oil Wells	15
Plugged and Abandoned Gas Wells	4
Dry Holes	63
Abandoned Locations (Oil)	14
Abandoned Locations (Gas)	10
Approved Permits (Oil)	0
Approved Permits (Gas)	0
Total	**149**

Combining the two tables results in a total of 1744 wells and locations in the MFO. The oil and gas wells of the MFO are shown on Map 4. There are currently 577 active wells (534 in Grand County and 43 in San Juan County).

Drilling activity peaked in Grand County in 1981 when 124 wells were spudded. During the period 1990 to 2003 the number of wells spudded each year has averaged six. Figure 1 (Appendix) shows the number of new wells each year from 1970 through 2003 (IHS Energy, 2004).

Utah Division of Oil, Gas and Mining Data (2004) indicate that 33 percent of the wells drilled in Grand County during the period 1991-2004 were dry.

Historical Oil and Gas Production

Both oil and gas production from the MFO have declined in recent years (Utah Division of Oil, Gas and Mining Records). Figures 2 through 11 show production trends during the period 1984-2003 for Grand County and individually for the four largest fields in the MFO.

Greater Cisco, San Arroyo and Bar X Fields are in Grand County and are included in the county production totals. Lisbon Field is in northern San Juan County but largely in the MFO. The oil and gas fields within the MFO are shown on Map 5.

Examination of the graphs in figures 2 -11 indicates that both total production and individual field production for the four largest fields have been declining since the mid 1990s or earlier.

Well Spacing

The majority of the wells in gas fields of the Book Cliffs are being produced with one well per 160 acres or one well per 320 acres. There is one area in T. 16 S., R. 26 E. where gas wells are being produced with one well per 40 acres. Although there are State of Utah spacing orders that would provide for 40 acre spacing of gas wells within portions of the MFO, there are few areas in the MFO with producing gas wells on 40 acre spacing.

Due to the lenticular discontinuous nature of the reservoirs, there are several areas within Cisco and Cisco Dome oil and gas fields with State spacing orders that would allow for more than one well per 40 acres. There are two areas in Nash Wash and two areas in the Danish Flat area where oil and gas wells have been produced with one or more wells per 40 acres. The tight spacing was established to allow for development of the laterally discontinuous nature of the reservoirs.

Infrastructure

The long history of oil and gas activity in the MFO and surrounding areas has resulted in the development of an adequate infrastructure.

1. *Road Systems*

Almost all of the roads providing access to the producing wells in the MFO are on the Grand and San Juan County Class B road systems, and the roads are being maintained by the counties on a regular basis. Class B road systems in the MFO are shown on Map 1.

2. *Pipeline Systems and Gas Plants*

All of the existing gas fields have pipeline systems for gathering production from the wells. There are two interstate pipeline systems running through the MFO, Williams Pipeline (formerly Northwest Pipeline) and the Mid-America Pipeline (MAPCO). The interstate pipelines are within a designated utility corridor that parallels portions of Interstate 70 and Highway 191. Gas production from all of the fields within the MFO can be transported to the Williams Pipeline system. The major pipelines transporting field production and the interstate pipelines are shown on Map 6.

San Arroyo Gas Plant for the Book Cliffs Area

The majority of the natural gas produced from the gas fields in the Book Cliffs is processed through the San Arroyo Gas Plant. The primary function of the gas plant is to provide compression for gathering gas. The plant is stripping some butane and methane from the natural gas. The plant does not extract carbon dioxide (CO_2) or nitrogen. During the past 10 years, gas from wells north of the MFO (Uintah County wells) has been gathered and routed through the San Arroyo Gas Plant. There are numerous field compressors along the pipelines that gather gas to the San Arroyo Gas Plant, and there is a major compressor station in Colorado on the Bar-X pipeline system that is gathering gas from Utah. The San Arroyo Gas Plant is operating at or near its capacity at this time.
The Westwater Pipeline System (and Westwater Compressor Station) gathers gas from the Middle Canyon area and transports gas to Williams Pipeline near Harley Dome. The San Arroyo and Westwater Pipeline Systems have been in place for 30-40 years, and it is likely that the equipment would need to be repaired or replaced during the next 15 years.

In order to gather and process additional gas, facilities at the gas plant would have to be upgraded, facilities at existing compressor stations would have to be upgraded, additional compressor stations would likely be needed along the existing pipelines, and additional pipelines would have to be installed to increase the capacity for gas production. One or more new gas plants and compressor stations may be needed.

Even if no additional wells are ever drilled in the portions of the Book Cliffs managed by the MFO, additional pipelines and a gas plant may be needed to handle gas production from Uintah County. If drilling confirms data gathered during recent geophysical exploration, there is a potential that 10-15 new wells per year could be drilled along the Grand and Uintah County line.

Based on discussions with the owner/operator of the San Arroyo Gas Plant, a new gas plant may be constructed rather than trying to upgrade the existing facilities. In the event that a new gas plant is constructed, it is likely that the new plant would be located along the southern end of the Westwater Pipeline system near the tie-in with Williams Pipeline. At this time, it is not likely that the new gas plant would treat for CO2 or process helium.

The Harley Dome Field is located east of the Greater Cisco oil and gas fields and south of the Bar-X Unit. Currently all of the wells in Harley Dome are low volume, low pressure gas wells. Some of the gas reserves in Harley Dome contain helium. It would not be feasible to produce helium without producing the natural gas from the wells; therefore, any production of helium would be in conjunction with the production of natural gas. The Westwater pipeline which gathers gas from wells in the Book Cliffs gas fields crosses Harley Dome. There are no facilities for separating, transporting, or marketing helium through the Westwater pipeline or the Westwater compressor station. At the present time, the volume of helium would not be adequate to justify facilities for processing or transporting helium. The closest gas plant is the Badger Wash gas plant in Colorado, approximately 15 miles northwest of Mack and approximately 18 miles northeast of Harley Dome. The Badger Wash Gas Plant does not currently process helium.

Grand Gas Gathering System in Cisco

The gas production from the Cisco Dome and Greater Cisco oil and gas fields is transported by the Grand Gas pipeline system. The Grand Gas pipeline system includes a compressor station which has facilities for stripping condensate and drip from the natural gas. The present pipeline system and compressors are adequate to handle the current gas production, and it is likely that the system could handle any increased gas production during the next 15 years.

Some of the natural gas from wells in the Greater Cisco gas fields has a high content of inert gases (low btu). In the future, there may be options for installing amine units at the Grand Gas compressor station or at individual well pads to remove the CO2 from the gas.

Many of the Grand Gas facilities are 30-40 years old. It would be feasible to upgrade the compressor station, to add additional compressors along the existing pipeline system, and to install additional pipelines along the existing pipeline routes. At the present time, economics would be the only factor limiting future repairs or replacement of equipment.

If there were new drilling programs or a new discovery within or adjacent to the Greater Cisco area, an additional pipeline system, compressor station or gas plant may be needed. If additional or newer facilities were required in the future, there would be adequate room for expansion at the existing gas compressor station or the tie-in with Williams Pipeline on the south side of Interstate 70.

Both the Book Cliffs Unit (in Cottonwood Canyon) and the Left Hand Canyon Field (Nash Wash) are within the Book Cliffs area. Both of these areas are immediately north of the Greater Cisco gas fields and are separated from the other Book Cliffs gas fields and pipeline gathering systems. The access routes to the Book Cliffs Unit and Left Hand Field are from the Greater Cisco gas fields. The pipeline from the Book Cliffs Unit wells gathers gas to the Grand Gas pipeline system.

There is one well in the Left Hand Canyon Field. The well is a shut-in gas well (waiting on pipeline). The most logical pipeline route would be down Nash Wash to the pipelines utilized for the wells in the Cunnigham Ranch area. Pipeline installation would not likely be economical until additional production is available. The Left Hand Field is within the Coal Canyon WSA, and options for future drilling in the Left Hand Field are limited at this time.

Lisbon Valley Gas Plant

There is a network of gas gathering pipelines in Lisbon Valley, and the pipelines transport natural gas from wells to the Lisbon Gas Plant. The Lisbon Gas Plant is located on private land in the MFO. The facilities at the Lisbon Gas Plant were upgraded in the early 1990's, and the plant currently produces natural gas, condensate, natural gas liquids, and liquid helium. In addition to the natural gas produced in the Lisbon Valley area, pipelines currently gather natural gas production from wells in San Miguel County, Colorado. There is also a pipeline running south from the plant that would have the capability to gather natural gas from other fields in San Juan County, Utah. The facilities at the Lisbon Gas Plant are adequate to process future gas production, and in the event that additional facilities are needed, there is room for expansion at the existing location.

Many of the pipelines associated with the Lisbon Unit and the Lisbon Gas Plant have been in place for 30-40 years, and would need to be repaired or replaced during the next 15 years. It is also likely that additional pipelines would be needed for gathering additional gas to the plant. In many cases, the installation of new pipelines parallel to the existing pipelines (looping the pipelines) would increase the capacity of the existing gathering system. The most likely locations for looping of pipelines would be the pipeline system in Lisbon Valley that gathers gas from Colorado and the pipelines between the plant and the Mid-America Pipeline. In the event that a new pipeline were needed to gather gas from other areas, it is likely that the majority of the new pipelines could follow an existing road or pipeline route.

In order to continue gathering gas in the pipelines from the wells in the Lisbon Unit, additional compression would be needed in the future. Compressors would be installed at some of the existing well pads, at some of the pipeline headers, or possibly additional compressors would be added at the gas plant.

Gas Pipelines for Big Flat and Bartlett Flat Areas

Natural gas is produced in association with the oil at the Cane Creek/Long Canyon wells. At the present time, there are no pipelines transporting gas from the Big Flat area, and gas is being flared or vented pursuant to the guidelines in NTL-4A.

A pipeline right-of-way was issued for the construction of a buried pipeline in 1991. The pipeline has not been constructed. Due to the high costs involved with buried pipeline construction, it is not likely that the gas production from the existing wells would justify construction of a pipeline. In order for pipeline construction to be an economically viable option, there would need to be additional gas production from either a major gas well or sustained drilling program of 2-3 wells per year.

It may be feasible to find an alternate route for a surface pipeline which would reduce pipeline costs and make installation feasible. A surface pipeline could be installed parallel to SR 313 or parallel to existing roads and trails from Bartlett Flat to Bartlett Wash and Highway 191. Another option may be a surface pipeline from the existing Big Flat wells to the Moab Salt Plant where the gas would be used to run equipment at the plant.

3. *Produced Water and Disposal Facilities*

The volume of produced water at the majority of the oil and gas wells in the Book Cliff and Greater Cisco fields has been 5 barrels or less per day and has been evaporated in pits located at the well sites. A typical pit is approximately 20 feet by 20 feet and 5-10 feet deep. Metal or fiberglass storage tanks are utilized to store produced water at some wells, and the produced water is transported by truck to authorized disposal facilities in Colorado. Although there are a few water injection wells used for enhancing field production, there are no water disposal wells in the Book Cliffs or Greater Cisco oil and gas fields.

During the past 15 years, within the Salt Wash field, water produced at the oil wells has been either hauled by trucks to authorized commercial water disposal sites or injected in one of the two water injection wells located in the Salt Wash area. Both of the water injection wells were authorized by the Utah Division of Oil, Gas, and Mining. One of the wells is on public lands and authorized by a right-of-way. The other well is on state land.

There is one water injection well in the Cane Creek Units, and produced water from all of the Cane Creek Unit wells is being hauled by truck to the injection well.

Produced water from the Lisbon and Big Indian Unit wells is being transported by pipelines and hauled in trucks to injection wells located near the Lisbon Gas Plant. Most of the water produced at the other wells in the Lisbon Valley area has been hauled in tanker trucks to approved disposal sites. There is one water injection well approved for commercial use in the Lisbon Valley area (located in the Monticello FO), and this well would be available for disposal of water production from wells outside of the Lisbon and Big Indian Units.

Hydrogen sulfide gas (H2S) can occur in wells used for water injection. No H2S has been identified at the water injection wells in the Salt Wash field or Cane Creek Unit. In the event that H2S is found at the water injection wells, H2S Public Protection Plans would be implemented. All of the wells are in locations that could be fenced and signed for public safety.

In the past, water produced at the Long Canyon No. 1 and Chevron Fed No. 1 wells has been evaporated at a pond located next to the wells or hauled to an authorized water disposal sites. The water produced at the Long Canyon No. 1 and Chevron Fed No. 1 wells has a high concentration of calcium chloride and magnesium chloride. Calcium chloride and magnesium chloride are the constituents utilized for dust control, road base stabilization, ice and snow melting, and workover fluid at some oil wells. Mining claims were filed on the well sites for the mineral content in the water, and the water produced at the Long Canyon No. 1 and Chevron Fed No. 1 wells is currently being marketed for use as a dust suppressant.

Hydrogen Sulfide Gas (H_2S)

Hydrogen Sulfide (H_2S) is a poisonous gas that can occur in association with oil and gas operations. Wells in the Lisbon Valley area typically produce from the Mississippian age Leadville Limestone and the Devonian age McCracken Sandstone, both of which naturally contain H_2S in high concentration. The Lisbon Gas Plant is equipped to safely extract H_2S from the gas stream. In association with the plant, there are two wells which are used to inject H_2S back into the Leadville Limestone.

Public access is restricted at the gas plant, and warning signs for H_2S have been installed at well sites where H_2S has been identified. In some cases, gates have been installed at the edge of the well pads or along the roads to the wells to further warn the public of the H_2S safety concerns. An H_2S Public Participation Plan is in place for these facilities.

Conflicts with other Mineral Development

No conflicts with other mineral development have been identified. Due to the low potential for commercial development of coal, it is not likely that there would be any conflicts between coal and the development of oil and gas resources.

There is potential for oil and gas drilling in areas with uranium and potash deposits. Historically, uranium mining operations have been small enough that oil and gas exploration and development could occur adjacent to the mining operations. In the past, there were no unresolved conflicts between oil and gas and uranium operations in Lisbon Valley.

The areas identified for potential development of potash do not overlap any existing oil and gas operations. It is likely that any future development of potash would be through solution mining operations. In most cases, there would be adequate latitude in selecting well sites for either solution mining or oil and gas drilling to avoid direct impacts to either resource.

The Lisbon Valley Copper Mining Project is within an area with high development potential for oil and gas. The mining operations would eliminate some opportunities for oil and gas exploration and development. Although it may be feasible to locate a well pad or oil and gas surface facilities in between the pits and soil stockpiles of the mining operations, the nature of the mining operations would preclude the use of some areas. There is potential for encountering hydrogen sulfide gas (H2S) during oil and gas drilling and production operations in Lisbon Valley, and there could be a potential conflict between on-going mining activities and the oil and gas operations involving H2S. In most cases, oil and gas drilling operations could directionally drill from outside the mining properties. Due to the size of the Lisbon Valley Mining Project, future federal oil and gas leases may need to be issued with no surface occupancy stipulations.

There are numerous old copper and uranium mining operations throughout Lisbon Valley. Where the old mining facilities are less than 200 meters wide, it is likely that future oil and gas drilling operations could be moved away from the mining activity. In order to avoid the potential for future oil and gas drilling and production on top of the old tailings or settling ponds, a no surface occupancy stipulation may be warranted at some locations (such as the Keystone-Wallace ponds).

VI. Oil and Gas Occurrence Potential

The oil and gas plays within the MFO are rated as having a high potential for the occurrence of oil and gas (See the Mineral Potential Report for the MFO, 1995).

VII. Oil and Gas Development Potential

All the oil and gas plays are associated with the commercial production of oil and gas and therefore are rated as having a high development potential. The development areas within these plays are discussed in the following text:

As described in the Mineral Potential Report, there are basically two separate geologic provinces within the MFO. The northern portion of the MFO is within the southern flank of the Uinta Basin. The southern two-thirds of the MFO are associated with the Paradox Fold and Fault Belt. The BLM lands within the MFO that are located at the northern end of Grand County, adjacent to the state lands in the Steer Ridge, Moon Ridge, Cedar Camp Ridge, Horse Ridge areas, are administered by the Vernal Field Office and not addressed in this document.

The northern portion of the MFO is being separated into three separate areas for the RFD: Book Cliffs, Greater Cisco, and Roan Cliffs. The Book Cliffs/Greater Cisco area covers the northeastern portion of the MFO. Almost all of the natural gas produced in Grand County comes from the Book Cliffs/Greater Cisco area. The remainder of the northern portion of the MFO that is associated with the southern flank of the Uinta Basin is referenced as the Roan Cliffs. Currently, there is no oil and gas production in the MFO portions of the Roan Cliffs, and the review of the Roan Cliffs was separated from the Book Cliffs/Greater Cisco area.

Although the Book Cliffs and Greater Cisco areas are producing from similar geologic formations and structures, there are major differences in topographic features and potential environmental impacts between the two areas. Topographic features, primarily the steep slopes and canyons of the Book Cliffs, have limited the development of road and pipeline systems. There are separate pipeline gathering systems for the Cisco and Book Cliffs areas. Based on the topography, potential environmental impacts, and pipeline gathering systems, the Book Cliffs and Greater Cisco areas were separated for a more site specific analysis in the RFD.

The remainder of the MFO is within the Paradox Fold and Fault Belt. The Paradox Fold and Fault Belt trends northwest - southeast through the MFO. The northwestern end of the Paradox Fold and Fault Belt within the MFO is located at the mouth of Rattlesnake Canyon on the Green River. The eastern side of the Paradox Fold and Fault Belt reaches the western side of the Greater Cisco Area. All of the southwestern and southern portions of Grand County along with the northern portion of San Juan County administered by the MFO are within the Paradox Fold and Fault Belt.

The western portions of the Paradox Fold and Fault Belt within the MFO encompass several oil and gas fields, including Salt Wash, Ten Mile, Big Flat, Hatch Point and Lisbon Valley. The Ten Mile and Hatch Point Fields are being combined with the Big Flat Field into a single area, Big Flat-Hatch Point, for analysis in the RFD. The Salt Wash, Big Flat-Hatch Point, and Lisbon Valley areas are being addressed separately in this RFD.

The remainder of the Paradox Fold and Fault belt that is east of the producing fields is being considered as a single area and is identified as the Eastern Paradox for this RFD. The area designated as the Eastern Paradox includes; Little Grand Wash, Crescent Junction, The Highlands, Fisher Valley, Beaver Mesa, and other areas south of I-70 (including the LaSal Mountains and the Westwater Canyon area where the development potential is rated low). The Blaze Canyon Field is within the Eastern Paradox. However, there is limited oil and gas production in this area, and the drilling throughout the Eastern Paradox would be exploratory. Therefore, it is logical to treat all of the areas within the Eastern Paradox as a single unit for the RFD.

The following areas are each addressed separately when considering future oil and gas development:

Book Cliffs
Greater Cisco
Roan Cliffs
Salt Wash
Big Flat-Hatch Point
Lisbon Valley
Eastern Paradox

These development areas are shown on Map 7.

VIII. **RFD Baseline Scenario Assumptions**

<u>Assumptions for Coalbed Methane Development</u>

There are no coal bed methane wells in the MFO. Coal seams are present in the Sego coal field throughout the steep canyons of the Greater Cisco, Book Cliffs, and Roan Cliffs areas; and therefore, there is potential for drilling and producing coal bed methane (CBM). However, only the northeastern portion of the coal field is available for CBM development because most of the coal field is within the boundaries of WSAs. The coal seams in the MFO are thin compared to other areas where CBM drilling has occurred during the last 15 years. The coal seams in the MFO crop out in walls of canyons. In order to drill for CBM, the well pads and drilling operations would be located on the points above the canyons.

There are natural gas wells producing from the Dakota Formation in the areas with coal outcrops. Even though it may be feasible to utilize these existing well pads or portions of the existing roads for drilling CBM wells, any drilling for CBM within the MFO would be considered exploratory drilling.

Although there may be options to drill for CBM from an existing well pad or road, access for drilling coal beds in some of the canyons would require construction in canyons and along rocky, steep canyon walls. Assuming an existing well pad and road could not be utilized, the surface disturbance for a well pad and associated soil stockpiles would be approximately 250-300 feet by 450 feet, and access to reach a drilling location would require at least 1-3 miles of new construction with cut and fill roadbeds approximately 40-50 feet wide.

Production facilities would be located at the well site. The anticipated production facilities on the well pad would include a wellhead, separator, dehydrator, gas meter, 2-3 production tanks for storage of oil or produced water, and 1-2 fenced pits. An area of approximately 200 feet by 300 feet would be needed for the production facilities.

Typically water is produced with CBM gas. If large volumes of water were produced at the CBM facilities, typical well site facilities would not be adequate for evaporation; and produced water would have to be hauled by truck to authorized disposal sites (water injection wells, water evaporation ponds). There are currently no commercial disposal sites authorized for accepting produced water in the Book Cliffs, Greater Cisco, or Roan Cliffs areas. Therefore, in the event of CBM drilling, commercial evaporation ponds or injection wells may be needed. It is likely that the evaporation ponds or injection wells would be located at the base of the Book Cliffs. An area of approximately 5 acres would be needed for an evaporation pond, and a facility of approximately 2 acres would be needed for an injection well.

The existing pipeline systems in the Book Cliffs or Greater Cisco areas could be used for CBM gas, or additional pipelines could be installed parallel to the existing pipelines. There are no pipelines in the Roan Cliffs, and pipelines for the transportation of CBM gas would utilize the same pipeline routes identified for gas production under the assumptions for oil and gas activity in the Roan Cliffs area.

The Sego coal-bed methane play has been subdivided into various levels of occurrence potential based on the thickness of coal in the Neslen Formation. The northeast portion of the coal-bed methane play, where the coal seams are greater than eight feet thick, is rated as having a high potential for development. It is anticipated that about 3, five-spot coal-bed methane tests will be conducted in the area in the next 15 years, for a total of 15 new wells. In the western two thirds of the play development is not considered likely due to the thinner coal and because the area is overlain with Wilderness Study Areas (WSAs). The WSAs would preclude future leasing and development.

The La Sal Coal Field underlies the southeastern corner of the Eastern Paradox area as well as the northern part of the Lisbon Valley area. Coal occurs as thin beds in the Dakota Formation which caps a dissected plateau in this area (Doelling and Graham, 1972). As a result the coals are exposed on the flanks of mesas and buttes and are at shallow depths. It is likely that any CBM that might have been contained in the coals has been lost and development is unlikely.

In the event that wells are drilled for CBM; (1) the impacts would be similar to the impacts from other wells in the Book Cliffs area, (2) the administrative processes used for other oil and gas actions would be used to analyze the impacts of the project, and (3) the well numbers projected for drilling in the MFO would be high enough to include future CBM drilling.

Assumptions for Drilling Deep Wells

A few deep wells (10,000 feet or deeper) have been drilled in the MFO in the past, and it is likely that some deep wells would be drilled in the next 15 years. The likelihood of a deep well being drilled is highest in the Eastern Paradox area, but it is also feasible in other areas of the MFO. The drilling of a deep well requires a larger drill rig and a larger drill pad (approximately 400 feet by 450 feet) than used for drilling conventional vertical wells. While the size of a well pad for drilling a deep well would be larger than other well pads, there would not be many deep wells, and the addition of a few deep wells would not substantially affect any long-term projections based on the sizes of smaller well pads.

Assumptions for Horizontal Drilling

Horizontal drilling technology has been used in the Big Flat-Hatch Point and Lisbon Valley areas. All of the horizontal drilling has been in the Paradox formation. It is likely that horizontal drilling would continue when drilling in the Big Flat-Hatch Point, Lisbon Valley, Eastern Paradox, and possibly other areas within the MFO. Information on the dimensions for a typical horizontal drilling well pad and time frames for drilling are included in some of the other sections of the RFD.

Directional drilling technology has been used in MFO when drilling two wells from the same well pad; but, as of 2004, there are no areas within the MFO where horizontal drilling technology has been utilized for (1) drilling two wells from the same well pad, or (2) drilling multiple laterals from a single vertical wellbore. The drilling of multiple horizontal laterals from a single location has occurred in areas outside of the MFO, especially when drilling wells on 10 acre spacing in rough terrain. Although there are no current applications for horizontally drilling multiple laterals from a single location, there is a possibility that the use of horizontal drilling technology could increase throughout the MFO. Increased use of horizontal drilling technology for producing gas wells in the Greater Cisco or Book Cliffs areas would not result in any new types of impacts not already being analyzed.

Projected Level of Oil and Gas Activity

Historical Drilling Trends

Historical drilling activity can be used as an indicator for estimating future drilling activity. Information on the drilling conducted in the MFO over the last 20 years was obtained from the State of Utah website managed by the Utah Division of Oil, Gas and Mining. The information included private, state, and federal mineral actions.

Since 1991, the numbers of APDs approved and wells drilled in Grand County have been cyclic, and the overall trend has been downward. Between 1991 and 2003, the number of drilling permits issued each year in Grand County varied from 2 to 16, and the number of wells drilled each year varied from 1 to 13. There was a boom in oil and gas activity in Grand County in the early 1980's. There were about 50 wells drilled each year in Grand County between 1981 and 1983. During the period of 1984 through 2004, there were about 225 wells drilled on federal, state, and private lands within the Moab Field Office (about 11 wells per year). Although the previous activity can be an indicator of future activity, the reliability of these forecasts is limited by unforeseen factors, such as changes in economic conditions and technology.

In order to utilize the historical information to project future drilling activity, the following assumptions are made:

1. Drilling activity could continue at the same long-term rates during 1984-2004.
2. There could be a boom in oil and gas drilling, similar to the early 1980's.

Based on these assumptions, there would be about 11 wells drilled each year for 15 years (165 wells) and 3 years with about 50 wells drilled each year (150 wells). Therefore, it is feasible for about 315 wells to be drilled on federal, state, and private lands within the MFO during the next 15 years. This amounts to an average of about 21 wells per year. This projection, based on previous drilling, is consistent with the actual number of wells drilled in the MFO during the past 20 years and includes a "boom cycle" with increased exploratory drilling (such as during the early 1980's).

Projected Drilling Activity

The number of wells projected for the development areas is based on previous drilling, knowledge and experience of MFO oil and gas staff with the areas, abundant informal discussions with oil industry personnel (geologists, engineers, managers) over the last 10 years and during preparation of this document, and consideration of current market conditions.

Future drilling is affected by economic situations that are not accurately forecast, therefore, a range of well numbers was utilized to reflect the potential numbers of future wells. It is recognized that future drilling activity and future wells would not be evenly distributed throughout the geologic areas. When new wells are drilled, and especially when new fields are discovered, there could be additional drilling activity concentrated around the new wells.

The following projections are provided as the number of wells that could be drilled yearly in each development area of the MFO:

Book Cliffs	3-15 wells per year
Greater Cisco	3-10 wells per year
Roan Cliffs	0-1 wells per year
Salt Wash	0-2 wells per year
Big Flat-Hatch Point	3-5 wells per year
Lisbon Valley	2-4 wells per year
Eastern Paradox	1-3 wells per year
	12-40 wells per year

These yearly projections provide a range of potential drilling activity and are not thresholds for limiting drilling activity to 40 wells per year. It is recognized that there would be some years with less than 12 wells and some years with more than 40 wells. In the event that more than 50 wells were drilled in one or more years, the years with increased drilling would average out with the years when fewer wells were drilled. Of the 45 to 225 wells projected to be drilled in the Book Cliffs in the next 15 years, it is anticipated that up to 15 of these wells would be drilled for coal-bed methane.

The range of wells projected for the development areas averages about 26 wells per year which is slightly higher than the projection of 21 wells per year based on historical drilling information. Recent developments in the oil and gas industry would favor an increase in drilling activity over historical trends. Prices of both oil and gas have increased substantially and market analysts project the high commodity prices to continue. Local and regional gas pipeline expansion is continually increasing access to markets, thus enhancing the economic incentive to drill. Although these developments have only had a brief term of influence on the industry, they are already being expressed locally in terms of increased interest in oil and gas leasing and an increase in drilling applications.

Therefore, an average of about 26 wells per year is projected for a total of about 390 wells over the next 15 years.

IX. **Surface Disturbance Due to Oil and Gas Activity on All Lands**

Estimated Existing Surface Disturbance

As of March 3, 2005, there are approximately 577 wells in the MFO. The 577 wells include producing oil wells, shut-in oil wells, producing gas wells, shut-in gas wells, water injection wells, gas injection wells and temporarily abandoned wells.

Based on a review of the county road systems, there are at least 724 miles of roads within the MFO that provide access to producing oil and gas wells and other associated oil and gas facilities. None of the state highways were included in the mileage. Portions of some paved county roads near Crescent Junction, Thompson, Harley Dome, Lisbon Valley, and one of the paved roads providing access to the Lisbon Valley Gas Plant were included in the mileage. Almost all of the roads providing access to the producing wells are on the Grand and San Juan County Class B road systems. Some of the paved county roads have a surface disturbance of approximately 150 feet wide. The Class B roads and other roads providing access to wells were constructed 25-66 feet wide.

There are approximately 589 miles of pipelines associated with the oil and gas wells in the MFO. Most of the pipelines are transporting natural gas. More than one-half of the pipelines are surface pipelines. Descriptions of the pipeline systems and associated gas plants are provided in Chapter V. The majority of the main trunk lines within the pipeline gathering systems were authorized by BLM rights-of-way (as opposed to Sundry Notices), and most of the right-of-way widths are 50 feet. In some cases there may be more than one pipeline within the same right-of-way. The estimates include some pipelines where the rights-of-way have been granted, but not constructed (such as the pipeline for the Cane Creek Unit). The pipelines gathering gas from individual wells to the trunk lines were authorized either by rights-of-way or Sundry Notices, and the authorizations were for widths varying from 10-30 feet.

The interstate pipeline systems operated by Williams Pipeline (formerly Northwest Pipeline) and Mid-America Pipeline were not included in the mileages for these pipelines. The interstate pipelines are not direct results from oil and gas production operations in the MFO, acreages were not estimated for interstate pipelines, and the interstate pipeline rights-of-way and utility corridors are addressed in the Moab RMP.

The estimated surface disturbance for the existing wells, roads, and pipelines in the MFO is 8,500 acres.

Estimated Future Surface Disturbance for Development Areas

The potential for surface disturbance from future oil and gas activities was considered in each of the following development areas:

Book Cliffs
Greater Cisco
Roan Cliffs
Salt Wash
Big Flat-Hatch Point
Lisbon Valley
Eastern Paradox

Book Cliffs

Drilling for gas would continue in the Book Cliffs, and the activity would primarily be in-field drilling and development in areas with existing road and pipeline systems. Based on the previous 15 years, most of the drilling would be on leases issued prior to 1980 which are held by production.

The construction of a well pad, reserve pit, blooie pit, cut/fill slopes, and soil stockpiles would cover approximately 250 feet by 350 feet (2 acres) in the flatter areas, such as in the Bar-X Unit, or approximately 300 feet by 450 feet (3.1 acres) in the rougher, steeper terrain of the Book Cliffs. In the areas with steep terrain, there would likely be some cut and fill slopes approximately 20 feet high, and there would occasionally be cut/fill slopes of 30-40 feet high. During drilling for in-field development, new road construction and/or road upgrading would vary from 100 feet to 2 miles. Roads would be constructed with a 15-24 feet travel surface within a construction width of 30-60 feet depending on the terrain.

Although the majority of future drilling would be in areas with producing wells, there is a potential for exploratory wells to be drilled 2-3 miles from existing producing wells, and access to some areas could require 5 miles of new road construction. The combination of topography, environmental constraints, and economics could restrict drilling opportunities in some of the steep canyons of the Book Cliffs.

During the last 15 years, many wells have been located on existing roads in canyons or along ridge-tops, rather than constructing new roads along steep slopes. At least one company has utilized existing well sites for directionally drilling new wells. It is likely that some of the future drilling operations would continue to utilize directional drilling technology, reducing the need for construction of well pads and roads in some areas. However, both cost and risks in drilling increase with directional drilling. Directional drilling increases the likelihood of missing the target or having downhole problems. There are technological constraints in how far a well pad can be shifted from its downhole target, and additional construction for well pads and roads can not be eliminated

Production facilities would be located at the well site. For a typical gas well in the Book Cliffs, an area of approximately 160 feet by 300 feet would be needed for the production facilities. The anticipated production facilities on the well pad would include a wellhead, separator, dehydrator, gas meter, and 1-2 fenced pits (or a metal or fiberglass tank) for water disposal and containment of fluids in emergencies.

Occasionally the production facilities include a pumping unit, 1-2 production tanks (usually 210 barrel capacities) for the storage of oil or produced water. Oil and produced water would be transported by trucks from the wells in the Book Cliffs. The major natural gas gathering systems, compressor stations, and the San Arroyo Gas Plant are in place for the production of natural gas.

Natural gas production would be transported by welded steel, surface pipelines. The pipelines gathering gas from individual wells would follow existing roads or pipelines wherever possible. In order to increase gas production through the pipelines, small field compressors covering an area of approximately 50 feet by 50 feet (or less) would be located at well pads or other areas with easy access along the pipeline rights-of-ways.

When roads or existing pipeline rights-of-way are not available, pipelines would be installed cross-country. In some cases, pipelines would be "pulled-through" areas with steep, rugged terrain without utilizing heavy equipment for removal of vegetation. The pipe would be welded at existing well pads or along existing roads, a cable would be routed through the trees, and the pipe would gradually be pulled through the areas after one or more sections of pipe were welded together.

In addition to the pipelines needed for gathering gas from individual wells, it is likely that 3-5 pipelines would be needed to supplement the existing pipeline systems, and each pipeline would be 20-30 miles long. One or more gas plants (5-10 acres each) and compressor stations (2-5 acres each) may be needed along the pipelines. The steep canyons of the Book Cliffs eliminate some options for developing new pipeline systems; therefore, it is likely that the majority of the new pipelines and pipeline upgrading would occur along the existing pipelines and roads. It is likely that (1) most of the new pipelines would be installed parallel to the existing pipelines, and (2) any new gas plants would be located on or next to one of the existing pipeline gathering systems.

Most of the gas produced in the Book Cliffs is from the Dakota Sandstone. Gas from the Entrada Sandstone contains a high concentration of inert gases. The San Arroyo Gas Plant does not have facilities for processing high concentrations of inert gases, therefore, there has not been much production from the Entrada Sandstone. In 2003, a pipeline was installed from the Entrada gas wells in the Bar-X Unit to the Badger Wash Gas Plant in Colorado which can process Entrada gas. This infrastructure improvement could result in additional drilling, recompleting existing wells in the Entrada Sandstone, and installing additional pipelines in adjacent areas.

When a well is not completed for production or production has been depleted, the well would be plugged and abandoned. After being plugged, the well site would be reclaimed. It is likely that a portion of the road would remain in use for continued access to other existing wells. Reclamation would be adequate for bond release in approximately 2-3 years.

Greater Cisco Area

Future drilling activity would likely be similar to the previous 15 years. Most of the drilling would be in-field drilling and development next to or in between existing wells in the Danish Flat, Agate Gas Field, Cisco Wash, and Nash Wash areas. These areas have existing road and pipeline systems. Much of the drilling would be on leases that are held by production, many of which were issued prior to 1980.

For a typical well in the flatter portions of the Cisco area, the construction of an average well pad, reserve pit/blooie pit, and associated soil stockpiles would cover approximately 150 feet by 260 feet (0.9 acre). The surface disturbance for well pads in the steep terrain would resemble Book Cliffs wells (2-3 acres each).

New road construction and/or road upgrading for in-field development would vary from 100 feet to 1 mile. Roads would be constructed with a 15-18 feet travel surface within a construction width of 20-35 feet (depending on the terrain and type of traffic). Although the majority of the new drilling would be within 1 mile of an existing well, there are opportunities for exploratory drilling where 2-3 miles of road construction would be required.

An area of approximately 150 feet by 200 feet would be needed for the production facilities. The anticipated production facilities on the well pad would include a wellhead, separator, gas meter, and fenced pits for water disposal and containment of fluids in emergencies. There are a couple of wells running on electrical power, but almost all of the well production equipment is run on gas produced on-lease. If oil was produced at the well, there would be a pumping unit, one or two oil production tanks, and possibly a tank for the storage of produced water. Oil and produced water would be hauled from the wells by tanker trucks. Natural gas production would be transported by welded steel surface pipelines.

The Grand Gas pipeline system and compressor station are in place for the production of natural gas. In most cases, the pipelines gathering gas from individual wells would follow existing roads or pipelines.

In the event that (1) additional wells are drilled in Utah and Colorado that produce helium or high concentrations of other inert gases, and (2) facilities are needed for the processing of helium or other inert gases, the processing facilities could be located at a gas plant somewhere between Harley Dome and the Bar-X Unit, or it may be feasible to construct a pipeline from Harley Dome to a gas plant in Colorado. A pipeline from Harley Dome to the Badger Wash gas plant (or any other future processing facilities in Colorado) would likely follow existing roads or pipeline rights-of-way.

When production is depleted, the well would be plugged and abandoned. After plugging, each well site would be reclaimed. It would be likely that a portion of the road would remain in use for continued access to other existing wells. Depending on the soils, existing vegetation and rainfall, reclamation would be adequate for bond release in 3-5 years, but reclamation of some areas could require 10 years. Halogeton is growing throughout most of the Cisco area. In some areas, halogeton would out-complete native plant species and limit reclamation success.

Roan Cliffs

There are no producing wells within the Roan Cliffs. The impacts from well pad or road construction would be similar to the impacts described for the Book Cliffs with well pad construction of approximately 300 feet by 450 feet (3.1 acres). There would be some cut/fill slopes 30-40 feet high.

Due to the topography and locations of WSAs, access to the Roan Cliffs from the south (Thompson or Green River, Utah) would be limited. Access would require over 10 miles of new road construction and/or major road upgrading. Roads would be constructed with a 15-18 feet travel surface within a construction width of 30-50 feet.

In the event that a well produced, the production facilities would be located at the well site. The anticipated production facilities on the well pad would include a wellhead, separator, dehydrator, gas meter, 2-3 production tanks for storage of oil or produced water, and 1-2 fenced pits. An area of approximately 200 feet by 300 feet would be needed for the production facilities.

None of the existing roads are utilized for oil and gas operations, and there are no pipelines for gathering natural gas. Existing roads may need to be upgraded if tanker trucks were hauling oil production. In the event that pipelines were installed for transporting natural gas production, the pipelines would probably be steel pipelines installed on the ground surface. The routes for the pipelines from the wells to Interstate 70 would follow canyons and existing roads.

The closest existing pipeline that would accept and transport natural gas is the Williams Pipeline. Gas produced at wells would have to be piped to the Williams Pipeline tie-ins at Cisco, or new tie-ins would have to be installed at either The Highlands or north of Moab Canyon.

All of these options for a pipeline would require a new pipeline constructed north of Interstate 70 to either Crescent Junction or Thompson. In order to reach the Williams Pipeline north of Moab Canyon, a pipeline would be constructed from Crescent Junction running parallel to the MAPCO Pipeline and Highway 191. There are at least two routes for a pipeline to reach the Williams

Pipeline southeast of Thompson. One route would parallel Grand County Road No. 163 to the Williams Pipeline near The Highlands. Another option for a pipeline route would be parallel to Grand County Road No. 175 for almost the entire pipeline route from Crescent Junction to the Williams Pipeline compressor station south of Cisco (T. 21 S., R. 23 E., section 35). All of these pipeline options would likely require 1-2 compressor sites along the pipeline.

Due to the distance to the Williams Pipeline and costs of pipeline installation, it would not be likely that a single well would justify a pipeline. Therefore, it is likely that gas wells would be shut-in until there are enough wells to supply adequate gas production for construction of a pipeline.

If a well were drilled and not completed for production, the well would be plugged and abandoned, and the well site would be reclaimed. It most cases, all of the road constructed for access to the well would also be reclaimed. Reclamation would be adequate for bond release in approximately 3-5 years.

The combination of topography, environmental constraints, economics, and WSAs would restrict opportunities for drilling and geophysical exploration in the Roan Cliffs.

Salt Wash

Future drilling could be in-field development with the wells within 1 mile of the existing wells or could include exploratory drilling 2-3 miles from the existing wells. It is feasible that a horizontal well or a deep well could be drilled. However, most of the wells previously drilled in the Salt Wash area have been conventional vertical wells less than 10,000 feet deep.

The construction of a typical well pad, reserve pit, blooie pit, and soil stockpiles would cover approximately 250 feet by 350 feet (2 acres). In most cases, new road construction and/or road upgrading would vary from 1/2 mile to 2 miles. Roads would be constructed with a 15-18 feet travel surface within a construction width of 30-40 feet.

The anticipated production facilities on the well pad would include a wellhead, pumping unit, separator, 3-5 production tanks for oil, 1-2 production tanks for storage of produced water, and 1-2 fenced pits. An area of approximately 200 feet by 300 feet would be needed for the production facilities.

Produced water would either be piped to one of the existing water injection wells located in the Salt Wash area or hauled to an authorized disposal site by tanker trucks. Oil would be hauled from the wells by tanker trucks.   The existing county roads accessing the Salt Wash Field and nearby areas are currently utilized and maintained for tanker truck traffic.

Although some of the wells have gas entrained in the oil production, there is not adequate gas production to warrant pipeline construction. If gas production increased during future drilling in Salt Wash, the closest existing pipeline for transporting natural gas would be the Williams Pipeline. In order to reach the Williams Pipeline, a pipeline would be constructed along Grand County Road No. 147 (Ruby Ranch Road) and Grand County Road No. 138 (to the Moab Airport), and south along Highway 191 to the north end of Moab Canyon. One or two compressor sites may be needed on the pipeline.

If a well were drilled and not completed for production, the well would be plugged and abandoned, and the well site would be reclaimed. It most cases, all of the road constructed for access to the well would also be reclaimed. Reclamation would be adequate for bond release in approximately 3-5 years.

Big Flat-Hatch Point

Although future drilling would still be considered exploratory drilling from a geologic standpoint, the number of wells that are likely to be drilled in the Cane Creek Unit could resemble field development. Based on previous interest in drilling in this area, it is feasible that 20-40 wells could be drilled in the Cane Creek Unit during the 15 years following the revision of the RMP. With a 50% success rate in drilling the exploratory wells, there would be an additional 10-20 producing wells. At the present time, the only factor that would be limiting the potential for additional drilling would be the high costs for drilling horizontal wells in this area.

Most of the leases within the Cane Creek Unit were issued prior to 1990, and some of the leases were issued with no lease stipulations. Future drilling would not be constrained by new lease stipulations developed in the revised RMP.

In addition to the future drilling within or adjacent to the Cane Creek Unit, it is very likely that there would be exploratory drilling between Spring Canyon and Eight-Mile Rock. During the last twelve years, suspensions of lease operations have been granted in the Big Flat-Hatch Point area, and there are pending APDs in Shafer Basin and on Hatch Point. It is likely that a portion of these wells and additional wells in these areas would be drilled in the future.

Surface disturbance for a well pad, reserve pits, blooie pit, cut/fill slopes, and soil stockpiles would be approximately 400 feet by 400 feet (3.7 acres). The roads would be constructed with a travel surface of approximately 20-24 feet wide within a construction width of 35-50 feet.

There are roads on many of the points and mesas within the Big Flat-Hatch Point areas that would provide a portion of the access to the wells. However, new road construction and/or upgrading existing roads would be required for over 5 miles to reach some of the areas. In order to keep heavy truck traffic hauling drill rigs off the paved Hatch Point road, drilling operations would be routed along San Juan County Road Nos. 132 and 131 (Looking Glass Rock).

All fluids used during the drilling or testing of the well would be contained in a fenced reserve pit. The reserve pit would be fenced on three sides during drilling operations and the fourth side would be fenced when the rig moves off the location. After the fluids have been removed or evaporated, the reserve pit contents would be stabilized, covered with the subsoil stockpiled during construction of the pit, and reclaimed. Sewage would be contained in a chemical toilet during the drilling operations. Trash would be stored in a portable self-contained trash cage and hauled to an approved sanitary landfill when the drilling is completed.

If commercial production is established, the production facilities would probably be located on the well pad. An area of approximately 400 feet by 300 feet (2.75 acres) would be needed for production operations. The majority of this area would be occupied by production facilities. Typical production facilities would include the wellhead, a pumping unit, a tank battery, heater treater, separator, circulation pump and flare pit. A typical tank battery would include 3-4 tanks (500 barrel capacity per tank) to contain oil, one tank for produced water, and possibly an additional tank for fresh water. The tank battery and production equipment would be surrounded by a berm adequate to contain any fluids lost during production handling or discharged in the event of a spill. The well pad (or certain portions of the tank battery, treater, and flare pit) would probably be fenced to exclude livestock.

Internal combustion engines would be used to run the equipment. The pumping unit would typically be a pump-jack approximately 10 feet wide and 35 feet long. The pivot point of the pump-jack would be approximately 19 feet high, and the top of the horse-head would be approximately 27 feet high at the top of the stroke.

Additional upgrading and maintenance would be needed for drainage control on the new road. Oil production would be hauled from the well site by tanker trucks. Portions of the existing road networks and State Route 313 would be used by tanker trucks in the Big Flat area. In the Hatch Point area, tanker truck traffic would probably be routed along San Juan County Road Nos. 132 and 131 (Looking Glass Rock).

In most cases, salt water produced at the wells would be hauled to an approved disposal site. There is one water injection well in the Cane Creek Unit, and produced water from all of the Cane Creek Unit wells is being hauled by truck to the injection well.

Throughout the year, work would occur at the producing wells to maintain or enhance production. It is anticipated that a wireline truck would be needed monthly at flowing wells to remove paraffin. A rig with a small derrick would be needed 2-3 times a year at the wells with pumping units, for a period of at least 2 days when working on the pumps. At times, well maintenance would require a rig at the well for over a week. The entire well pad would be required during future down-hole maintenance operations.

When a well is not completed for production or production has been depleted, the well would be plugged and abandoned. The well site would be reclaimed. It would be likely that a portion of the road would be reduced in width and left for access to other areas. Reclamation would be adequate for bond release in approximately 3 years.

At the present time, there are no pipelines transporting gas from the Big Flat area, natural gas produced in association with the oil at the wells would be flared or vented pursuant to the guidelines in NTL-4A. In the event that additional gas was produced, a pipeline may be constructed following a route along the Dubinky Well - Blue Hills - Moab Airport roads. There may be other routes where a surface pipeline could be installed parallel to SR 313 or parallel to existing roads and trails from Bartlett Flat to Bartlett Wash and Highway 191. Another option may be a surface pipeline from the existing Big Flat wells to the Moab Salt Plant where the gas would be used to run equipment at the plant.
In the event that natural gas production was established on Hatch Point, the gas would be transported by pipeline to the Lisbon Valley Gas Plant. It is likely that the pipeline would be buried and that portions of a pipeline from Hatch Point would follow the route of San Juan County Road Nos. 132 and 133. If gas production were established at wells in the Ten Mile area north of Spring Canyon, a pipeline could be routed northeasterly towards the Blue Hills Road

and would likely parallel roads authorized for accessing the wells. From the Blue Hills Road, the pipeline would follow the route described for the Salt Wash area.

Lisbon Valley

The majority of the wells in the Lisbon Valley area are within the Lisbon and Big Indian Units, and the boundaries of the Lisbon Field are well defined. Although some of the future drilling could be in-field development, it is likely that future drilling would include exploratory drilling with the wells one or more miles from existing producing wells.

The construction of a typical well pad, reserve pit, blooie pit, and soil stockpiles would cover approximately 300 feet by 400 feet (2.75 acres). In the event that a horizontal well or deep well were proposed, well pad construction would cover approximately 400 feet by 400 feet (3.7 acres).

New road construction and/or road upgrading would vary from 500 feet to 3 miles. Roads would be constructed with a 15-18 feet travel surface within a construction width of 30-40 feet. There is a network of roads surrounding the Lisbon Gas Plant and the areas to the west and north of the gas plant. Future exploratory drilling to the northeast and east of the gas plant would require new road construction and/or upgrading roads for 2-3 miles.

If commercial production is established, the subsequent production facilities would be located at the well site. An area of approximately 250 feet by 250 feet would be needed at each well for typical oil and gas production facilities. The anticipated production facilities on the well pad would include a well head, a pumping unit, dehydrator/separator unit, two 400 barrel production tanks for oil, a 60 barrel water storage tank, and a fenced emergency pit. Oil would be hauled from the wells by tanker trucks. The existing county roads are currently utilized and maintained for tanker truck traffic.

Natural gas would be transported by pipelines, and the majority of the pipeline routes would follow existing roads. Most of the existing pipelines gathering gas from individual wells are surface pipelines, and it is likely that the use of surface pipelines would continue in the Lisbon Valley area.

The pipelines would tie-in with a network of pipelines that transport natural gas to the Lisbon Gas Plant. In order to increase gas production through the pipelines, additional compressors may be needed at individual well pads, on existing pipelines, or at the Lisbon Gas Plant.

A larger area may be needed for production operations if oil were produced from a horizontally drilled well in the Paradox Formation. An area of approximately 400 feet by 300 feet would be needed for production operations. Based on production operations at horizontal wells on Big Flat, production facilities would include the wellhead, a pumping unit, a tank battery, heater treater, separator, circulation pump, and an emergency pit. A typical tank battery would include 3-4 tanks (500 barrel capacity per tank) to contain oil, one tank for produced water, and possibly

an additional tank for fresh water. Produced water would be transported by pipeline to injection wells located near the Lisbon Gas Plant or hauled in tanker trucks to approved disposal sites.

When a well is not completed for production or production has been depleted, the well would be plugged and abandoned. The well site would be reclaimed. In the Lisbon Valley area, it is likely that the majority of the road would remain in use for access to other producing wells. Reclamation would be adequate for bond release in 2-3 years.

Eastern Paradox

Based on the geology of the Paradox Fold and Fault belt, (1) the Eastern Paradox has oil and gas reserves, (2) the reserves are not evenly spread throughout the area, and (3) additional drilling is required to determine where the oil and gas fields are located. At this time, it is difficult to predict how exploratory drilling would proceed. Some of the wells would have shallow targets, and other wells would be either horizontal wells or deep wells. Based on drilling during the last 10 years and previous geophysical projects, it is likely that there would be exploratory drilling around Blaze Canyon, Crescent Junction, Thompson, and The Highlands.

There are existing road systems in many portions of the Eastern Paradox area that could provide access for drilling wells. Most the access for the Eastern Paradox on the northwestern side of the Colorado River would be provided by the Grand County road systems that link to either Interstate 70 or Highway 191. Depending on the location of a well proposed on the southeastern side of the Colorado River, it is likely that a portion of the access would be provided by the existing roads on the points and mesas. Any exploratory drilling in the Dolores Triangle would be accessed from county roads in Colorado. At the southern end of the Eastern Paradox, there are existing road networks connecting to either Highway 191 or State Route 46 that would provide some access for drilling.

For a typical shallow well, the construction of a well pad, reserve pit, blooie pit, and soil stockpiles would cover approximately 200 feet by 300 feet (1.4 acres). New road construction would vary from 500 feet to several miles. New roads would be constructed with a travel surface approximately 15-18 feet wide, with total surface disturbance width of approximately 35 feet.

In the event that a horizontal well or deep well were proposed, the well pad construction would cover approximately 400 feet by 400 feet (3.7 acres) for a horizontal well or 400 feet by 450 feet (4.1 acres) for a deep well. New road construction and/or road upgrading would vary from 0.2 mile to 10 miles. Roads would be constructed with an 18-22 feet travel surface within a construction width of 40-50 feet.

In most cases, exploratory wells have a low success rate and the majority would be plugged and abandoned. If a well encountered oil or gas reserves, the well would be produced. Additional wells would be drilled near the first well to confirm the extent of the oil and gas reserves, and it is likely that these confirmation wells would be within 1 mile of the first well.

Due to the lack of wells within the Eastern Paradox, any predictions for future production or discovery of new fields are speculative. Based on the Blaze Canyon Field, a new field could be relatively small with 1-3 producing wells. A new field could emulate a field in the Greater Cisco area with 3-5 shallow wells spread over 1-2 miles. A new discovery at a greater depth could produce a field with high volumes of oil and gas similar to the Cane Creek Unit or Lisbon Unit. Mapping the oil and gas reservoir boundaries in deep formations could require the drilling of 5 or more wells.

Production facilities for a shallow well would include a wellhead, pumping unit, separator, 3-5 production tanks for oil, 1-2 production tanks for storage of produced water, and 1-2 fenced pits. An area of approximately 200 feet by 300 feet would be needed for the production facilities.

If oil were produced from a horizontally drilled well in the Paradox Formation, an area of approximately 400 feet by 300 feet would be needed for production operations. Production facilities would include the wellhead, a pumping unit, a tank battery, heater treater, separator, circulation pump, and flare pit. A typical tank battery would include 3-4 tanks (500 barrel capacity per tank) to contain oil, one tank for produced water, and possibly an additional tank for fresh water.

If the well is a producer, additional upgrading and maintenance would be needed for drainage control on the new road. Oil production would be hauled from the well site by tanker trucks, and gas would be flared pursuant to the guidelines in NTL-4A. There are no natural gas gathering pipeline systems in place. Due to the costs of pipeline installation, it is not likely that a single well would justify a pipeline. Therefore, it would be likely that gas wells would be shut-in until there are enough wells to supply adequate gas production for construction of a pipeline.

In the event that future drilling in the Eastern Paradox on the northwest side of the Colorado River lead to an adequate volume of natural gas production, a pipeline would be needed to transport the gas to the Williams Pipeline. At the northern end of the Eastern Paradox (Rattlesnake Canyon - Thompson), the pipeline route would be similar to one of the routes described for the Roan Cliffs. If natural gas production were established at wells south and east of Thompson, a gathering pipeline could access the Williams Pipeline with a new hook-up near The Highlands or at one of the existing hook-ups near Cisco. Pipelines would likely be buried but surface steel pipelines would be considered for some of these pipelines.

If natural gas fields are encountered during exploration drilling in the Eastern Paradox on the southeastern side of the Colorado River and on the north side of the LaSal Mountains, there are no readily accessible gas pipelines and it is likely that gas wells would remain shut-in for an extended period.

If natural gas production were established at wells at the southern end of the Eastern Paradox, the gas would be piped to the Lisbon Gas Plant. It is likely that the majority of the pipeline routes would follow existing roads.

If the volume of produced water were 5 barrels or less per day, it may be possible to evaporate the water in a pit at the well site. The pit would be approximately 20 feet by 20 feet and 5-10 feet deep. Metal or fiberglass storage tanks would be utilized to store produced water at some of the wells, and the produced water would be transported by truck to authorized commercial disposal facilities. There are no water injection wells in the Eastern Paradox area. In the event that future drilling leads to the discovery of a new field in the Eastern Paradox, there may be need for a commercial water disposal injection well or water evaporation ponds. The State of

Utah Division of Oil, Gas, and Mining approves all water disposal facilities, and BLM would follow Onshore Order No. 7 for the disposal of produced water.

If a well is not completed for production or production has been depleted, the well would be plugged and abandoned. The well site would be reclaimed. It is likely that the majority of the new road construction would also be reclaimed. In the low rainfall areas with Mancos Shale soils, reclamation would be adequate for bond release in approximately 7-10 years. Reclamation would be adequate for bond release in 2-3 years in some of the areas with higher rainfall.

Total Estimated Future Surface Disturbance for Wells, Roads, and Pads

The surface disturbances from drilling and producing a well in the MFO would be affected by a wide range of variables. The estimates for surface disturbances would be affected by size of the well pad, topography, and length of new road construction. The primary factor affecting the size of the well pad would be the size of the drill rig needed to reach the total depth of the well. Some of the shallow wells drilled within the MFO could be drilled with minimal equipment, and in some cases, the well pad could be less than 1 acre in size. A well pad constructed for drilling a deep well (over 10,000 feet deep) would probably have to be at least 4 acres to provide enough room for the drilling equipment and service trucks. Typically, the well pad for gas production facilities could be smaller than a well pad for a producing oil well where several oil storage tanks would be required. Where tanker trucks are used to haul oil from a producing well, the road would have to be constructed wider than a road for a shallow gas well. Construction in steep terrain would result in higher volumes of cut and fill, and the surface disturbances in the steep terrain would be wider than in flat terrain. When more than 1 mile of new road construction is required to reach the proposed well pad, the acreage for the road would exceed the acreage for the well pad.

As shown in the preceding information, the size of a well pad in MFO would range from 0.9 acre for a shallow well in the Greater Cisco area to over 4 acres for a deep well in the Eastern Paradox area. Although many of the future wells would be drilled within the existing Cisco and Book Cliffs gas fields where new road construction may be minimal, there are also numerous areas throughout the MFO where 2 miles of new road construction would be expected and the surface disturbance for the road would be between 8 and 18 acres (depending on the road width and terrain). There are some areas where the access to new wells would require over 5 miles of new road construction and/or road upgrading. Based on these ranges of variables, the surface disturbance for construction of a well pad, road, and associated pipelines has been estimated at 15 acres per well. The estimate of 15 acres per well would be higher the actual surface disturbance for most gas wells drilled in producing fields with existing road systems, and the estimate of 15 acres per well may be low for exploratory wells in areas where over 2 miles of new road construction was required. Fifteen acres per well is an estimate for the average surface disturbance during future drilling, but it is not a threshold for limiting future exploratory drilling programs to 15 acres per well.

The estimated surface disturbance per well would include acreage for additional pipelines, compressor stations, and gas plants constructed for gathering gas from existing and future gas fields in MFO. The estimate does not include modifications to existing interstate pipelines or new interstate pipelines constructed in the utility corridors.

It would be reasonable to assume that portions of the producing well pads would be reclaimed after the drilling operations and entire well pads would be reclaimed after wells were plugged. As discussed in previous sections of this document, there would be a wide range in the size of the potential well pads, length of new road construction, and time of reclamation prior to release from bonding obligations. Projecting the acreages or percentages of a producing well pad that would be reclaimed or the percentages of the future wells that would be plugged is difficult due to the cyclic nature of drilling programs, the wide range of drilling success rates between drilling in known fields and exploratory drilling in new areas, the variability in well pad sizes, and the variability of reclamation times related to the soils, vegetation, and rainfall. **However, for the purpose of this RFD, it is assumed that 50 percent of the wells drilled would be productive; and that the remaining 50 percent would be abandoned and reclaimed; and that revegetation would be successful within a scope of ten years.**

The estimated surface disturbance for future wells, roads, and pipelines in the MFO is 15 acres per well or a total of 5,850 acres for the 390 wells projected over the next 15 years. During this period about 53 wells would be successfully reclaimed making the net surface disturbance (not including current disturbance) about 5,055 acres. Only the wells drilled during the first 5 years would be successfully reclaimed over the next 15 years (21 wells per year x 5 x 50% = 52.5 or 53).

<u>Total Estimated Future Surface Disturbance for Geophysical Exploration</u>

Although geophysical data may have been collected from an area in the past, previous geophysical activity does not preclude the gathering of additional geophysical data. Old data is continuously being reprocessed, but there are limits to the quality of data that can be interpreted from the older data. It is feasible that geophysical exploration could occur anywhere within the MFO in the future. Based on the geophysical activities during the last 15 years, the majority of the future geophysical projects would probably be within the Big Flat-Hatch Point, Lisbon Valley, and Eastern Paradox areas.

Between 2002 and 2004, there were at least three geophysical projects along the Uintah and Grand County border in the Book Cliffs. The project areas were on state lands and federal lands managed by the Vernal Field Office. If the subsequent exploratory wells confirm oil and gas production, it is likely that additional geophysical projects would be proposed in the Book Cliffs managed by MFO.

Typically, geophysical operations would utilize either two-dimensional (2-D) or three-dimensional (3-D) data acquisition technology. The activities would require spreading cables and geophones for receiver lines and utilizing vibroseis trucks or shotholes along source lines to supply the source of energy for creating seismic reflections (seismic acoustic waves).

Previous 3D seismic projects in MFO have varied from 5 square miles for the Wilson Canyon Project near Rattlesnake Ranch and 37 square miles for the Lisbon Valley Project. On some 3D projects outside of the MFO, the project areas have covered 50-100 square miles. There is little doubt that 3D projects of 30-50 square miles would be proposed within the MFO in the future, and 3D projects covering 100 square miles could occur anywhere in the MFO. Based on previous geophysical projects and current oil and gas production in the MFO, additional 3D geophysical projects would likely be proposed for the following areas; Deadman Point, Bartlett Flat, Mineral Point, The Knoll, Bull Canyon, Big Flat, Lisbon Valley, East Coyote Wash, and LaSal.

The distances between the receiver lines and the distances between the source lines would vary depending upon the depth of the target formations. For shallow formations, such as in the Greater Cisco area, the receiver/source lines for a 3D project would be approximately 660 feet apart, and there would be 8 linear miles of source lines for every 1 square mile of the project. In other areas of the MFO where oil and gas formations would be deeper, the receiver/source lines for a 3D project would be 1320 feet apart, and there would be 4 linear miles of source lines for every 1 square mile of the project.

Based on the previous 3D projects in the MFO and depths of the oil and gas formations in the areas where geophysical projects would be expected, most of the 3D projects in the MFO would likely have receiver/source lines at 1320-1760 feet intervals and at least 4 linear miles of source lines per square mile of the project. A 30 square mile 3D project would then require at least 120 miles of source lines where a vibroseis buggy or drill buggy would be driven. Depending on the network of existing roads and trails in the project area, it may be feasible to move some of the source points to the roads and avoid some cross-country travel with the buggy vehicles.

In addition to 3D projects, 2D projects will continue to occur. Future 2D geophysical projects could vary from 1-2 lines of 1-2 miles each or dozens of lines several miles long. In remote areas with steep slopes and limited access, there would be a potential for a 2D seismic line to be run down a narrow mesa or canyon.

Vibroseis buggies or buggies transporting drills would typically be used to travel cross-country. Buggies transporting drills would likely follow a single route and make a single pass or round trip along the source lines. Vibroseis buggies would probably be run in single file with each buggy following the previous buggy, or the vibroseis buggies could be spread 3-4 abreast and running parallel to each other when recording source lines. The buggy routes would be zig-zagged (weaved) to avoid long, straight visual impacts.

When vehicles travel cross-country, there would be no dozing along vehicle access routes. The surface impacts from the buggies would be the vehicle tracks along the buggy routes and a drill hole if it is a shothole project. Helicopters would be utilized to distribute receiver cables on most big projects and for moving portable drilling equipment in steep rugged terrain that is too steep for buggies.

Some companies and/or geophysicists prefer vibroseis technology for gathering data, because the frequency of the source can be varied and data can be collected at several different frequencies while the vibroseis buggy is on the line. The depths and types of formations may also affect the preference of one type of source equipment over another.

One company in the Greater Cisco area has been exploring the feasibility of using a trailer mounted elastic wave generator (EWG) for collecting geophysical data at shallow depths. The EWG has an accelerated weight drop based on a sling shot technology. A gasoline powered engine would drive a hydraulic system to lift a 600 pound weight in between two large industrial elastic bands. The elastic bands would be stretched as the weight was lifted. An electrically controlled valve would be operated to release the tension on the elastic bands and drop the weight onto the ground. At this time, it is unknown if this type of equipment can be successfully used to collect data for locating well sites.

Geophysical surveys measuring gravity, magnetic, or electrical conductivity, and soil sampling have been completed in the past. It would be likely that these types of geophysical surveys would be utilized during the next 15 years. Typically, the gravity/magnetic/electrical geophysical surveys would be low-impact actions that could be classified as casual use, as long as vehicles stayed on existing roads.

At this time, it is not likely that 4D geophysical technology would be used in the MFO. Typically, the 4D projects would be looking for subtle changes in existing production and changes in the producing reservoirs over time. The rock formations in the MFO would likely affect the collection of the data. Therefore, there would not be much application for 4D technology in the MFO. In the event that 4D technology was used in MFO, the project layout and potential impacts would be similar to a 3D project, and the project could be considered and analyzed with the same administrative processes used for 3D projects.

Geophysical contractors are now experimenting with three-component (3C) technology. A 3C geophysical project would record p waves which are now being recorded on typical projects plus two directions of shear waves. A 3C geophysical project would be laid out like a 3D project, except a different type of geophone would be used for recording the data. Therefore, the use of 3C technology would not likely be a substantial change in impacts from what would be encountered with a 3D project.

A 3C project, or other new technology/equipment, would not be precluded from future use in the MFO. It is likely that (1) any new types of geophysical equipment/projects would use some sort of receiver system and source equipment that would be transported over the ground and (2) the impacts from the transportation and use of the new equipment could be analyzed through NEPA documentation. The geophysical industry is aware of environmental concerns, and they recognize that the implementation of future technology and/or equipment would need to have the same types of impacts or less impact than the equipment being used today. Therefore, it is not likely that the industry would propose methods of data collection that would require an increased level of surface impacts.

Projections for future geophysical exploration projects in the MFO were based on the following assumptions:

1. There would be at least as many geophysical projects as during the previous 15 years.
2. Geophysical exploration would be cyclic and could increase if there was a boom in oil and gas activity, similar to the early 1980's.

3. Data acquisition would involve the use of 2D, 3D, or similar technology.
4. The number and size of 3D projects would increase in the future.
5. Measuring the exploration in linear miles of source lines would be more meaningful than the number of geophysical projects.
6. An estimate of 4 linear miles of source lines for every square mile of 3D project would be representative for the majority of projects in the MFO.
7. Casual use activities would not be included in the projections.
8. With the exception of National Parks and designated wilderness areas, there would be no areas closed to geophysical exploration within the MFO.

Using these assumptions, the potential for future geophysical exploration on federal, state, and private lands within the MFO during the next 15 years could range from 1500 to 3000 linear miles of source lines, or an average of 100-200 linear miles of source lines per year. These projections would include one or two cyclic booms in activity such as during the early 1980's. The yearly averages are not thresholds for limiting geophysical exploration to 200 miles per year. Based on previous trends in geophysical exploration, there would be some years with no projects. It is also likely that there would be at least one year with geophysical exploration projects covering over 400 linear miles of source lines.

Future estimated surface disturbance for geophysical operations within the MFO is based on 2000 linear miles of source lines over a period of 15 years. Assuming vibroseis buggies or buggies transporting drills drove over every mile of source line and the path of the buggies was 15 feet wide, there would be a surface disturbance of approximately 3,600 acres over the next 15 years. It is assumed that reclamation of disturbance would be successful within a scope of ten years depending on reclamation times related to soils, vegetation, and rainfall.

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APPENDIX

(Note to project website visitors: due to their large size, Map files are found separately on project website)

Figures

Figure 1. Grand Co. Wells (1970-2003)

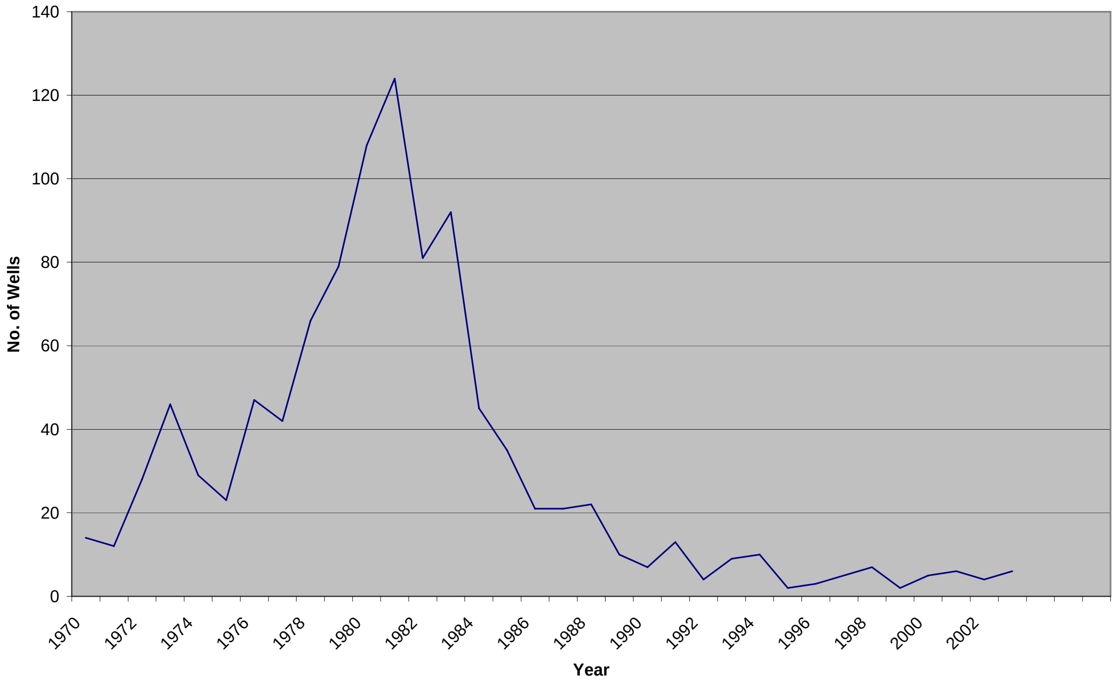


Figure 2. Grand Co. Oil Production (1984-2003)

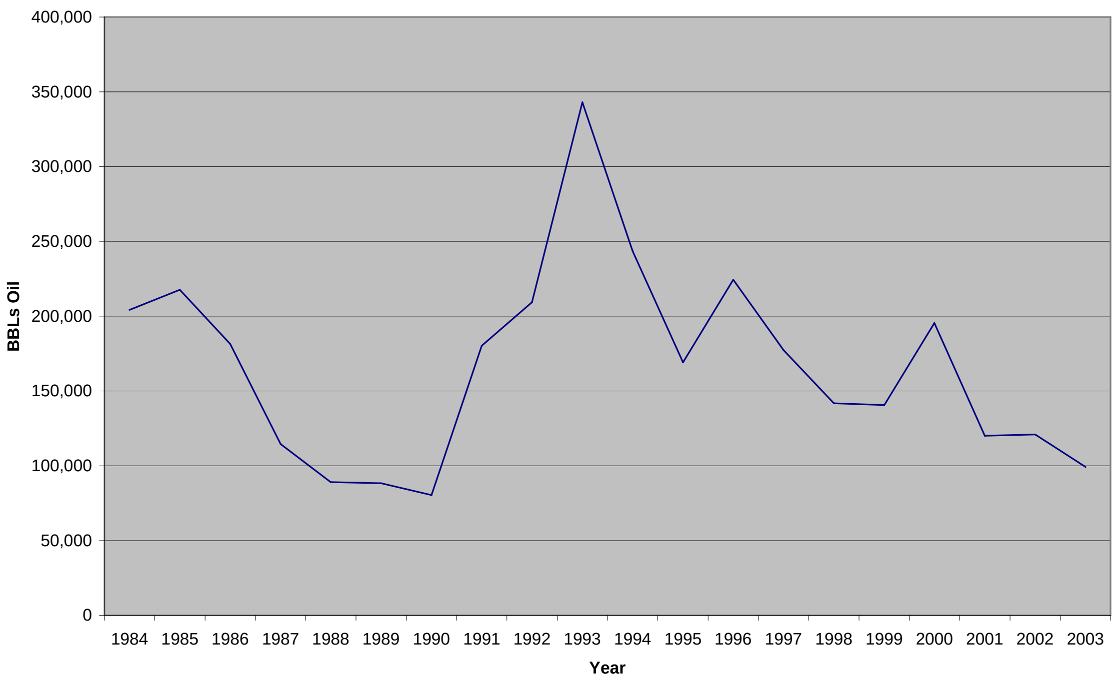


Figure 3. Grand Co. Gas Production (1984-2003)

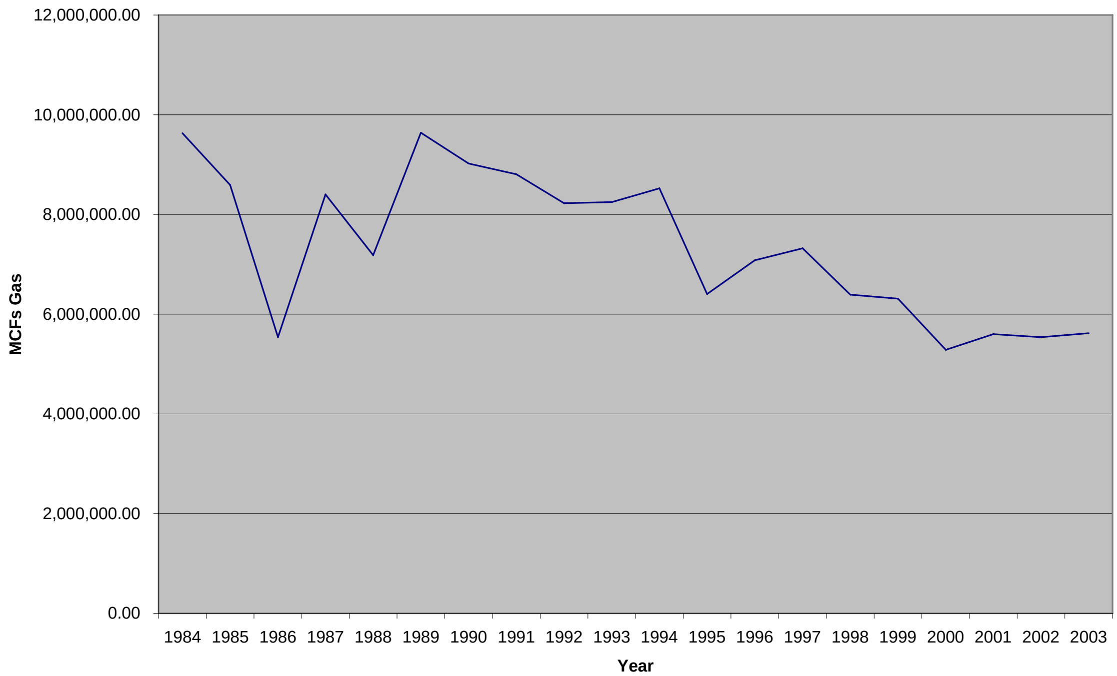


Figure 4. G. Cisco Oil Production (1984-2003)

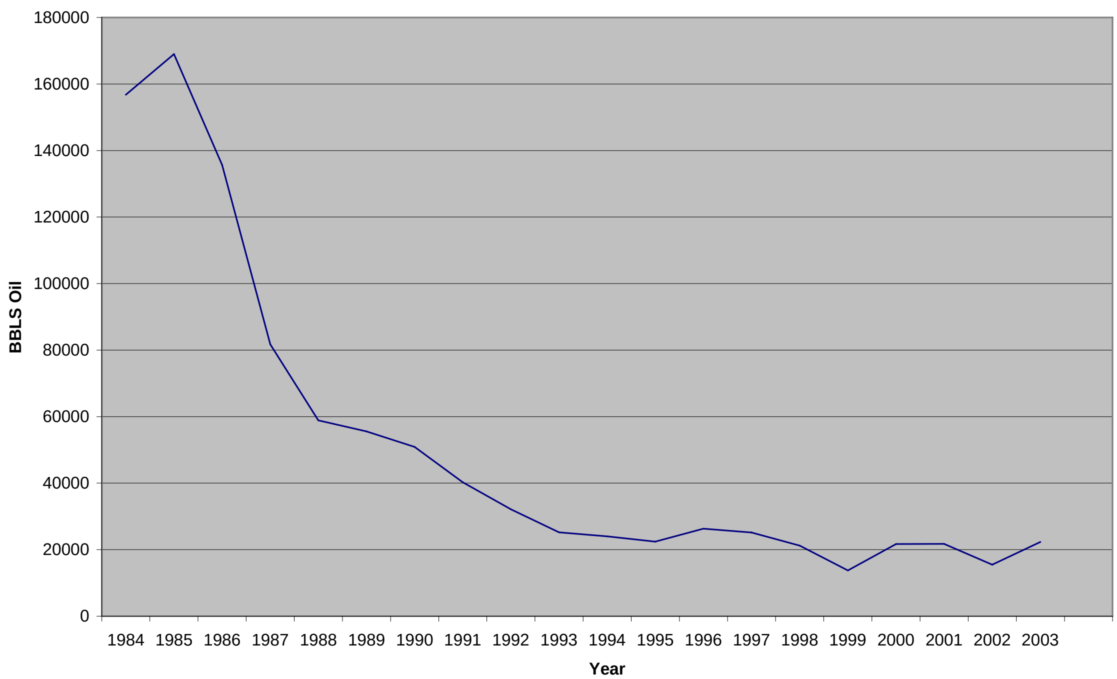


Figure 5. G. Cisco Gas Production (1984-2003)

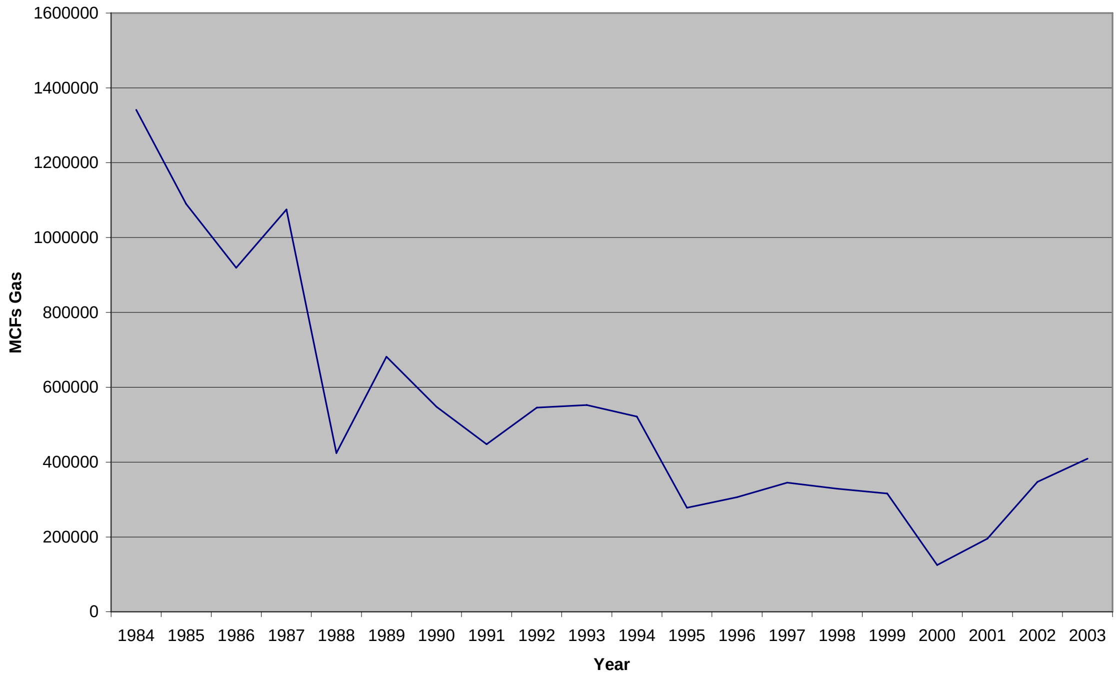


Figure 6. San Arroyo Oil Production (1984-2003)

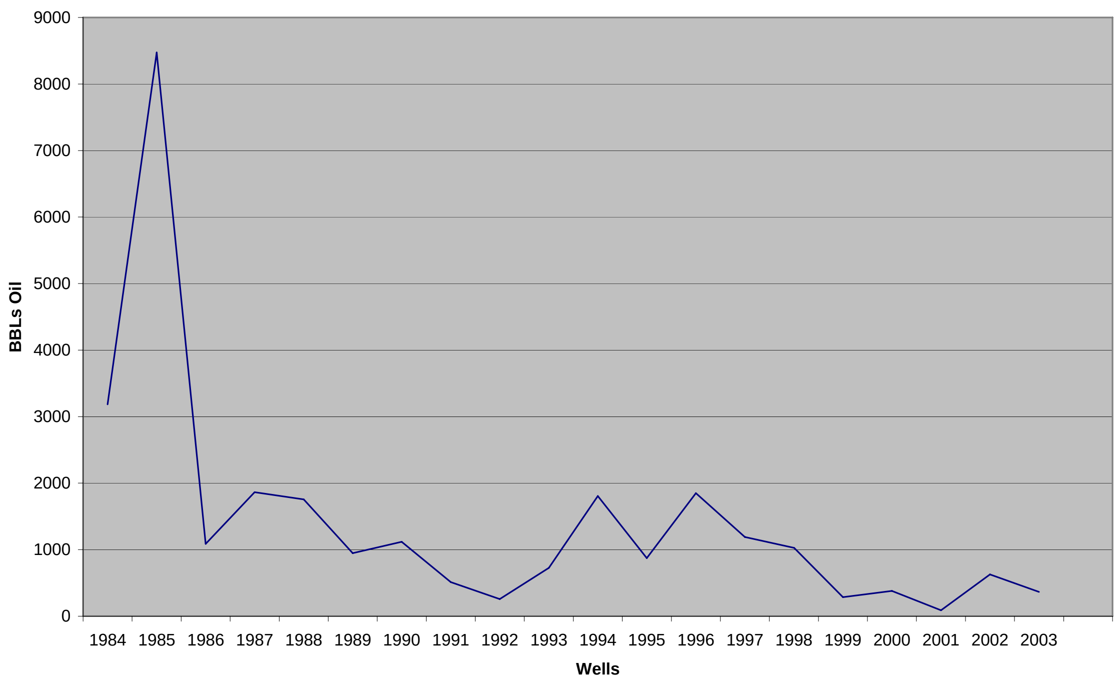


Figure 7. San Arroyo Gas Production (1984-2003)

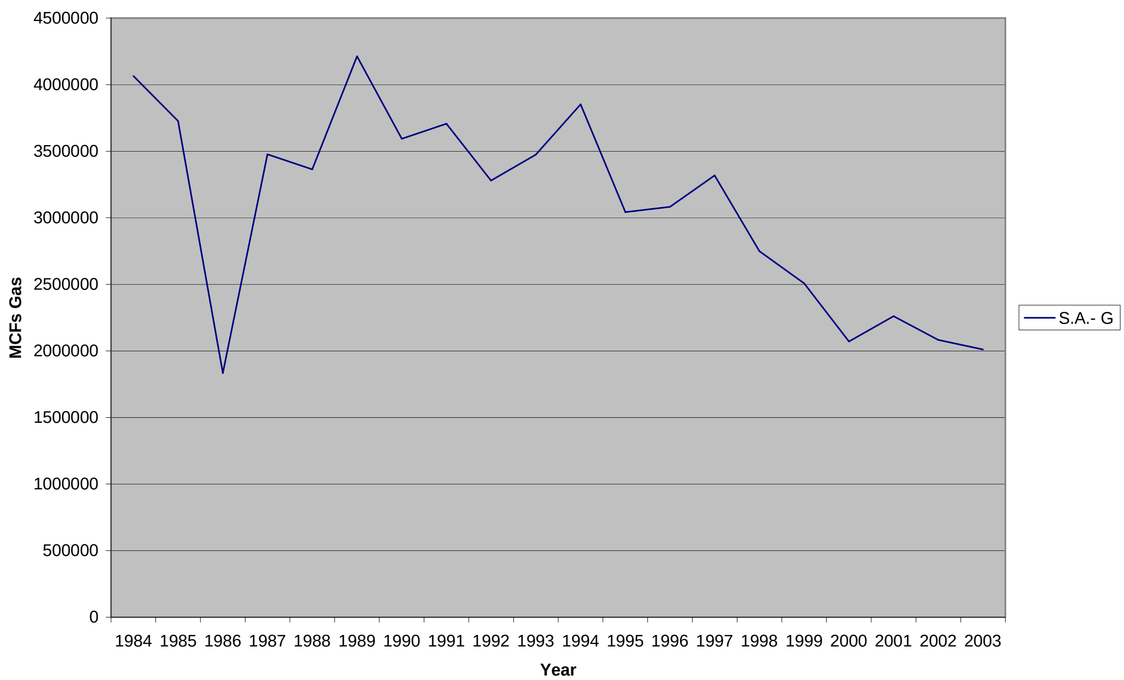


Figure 8. Bar X Oil Production (1984-2003)

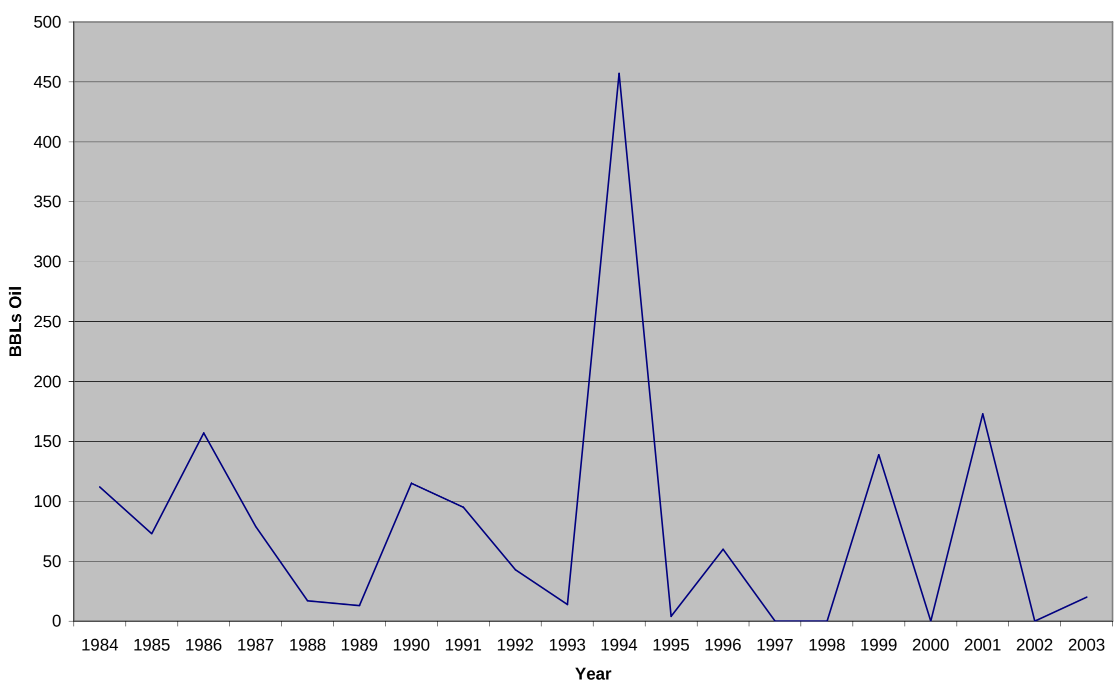


Figure 9. Bar X Gas Production (1984-2003)

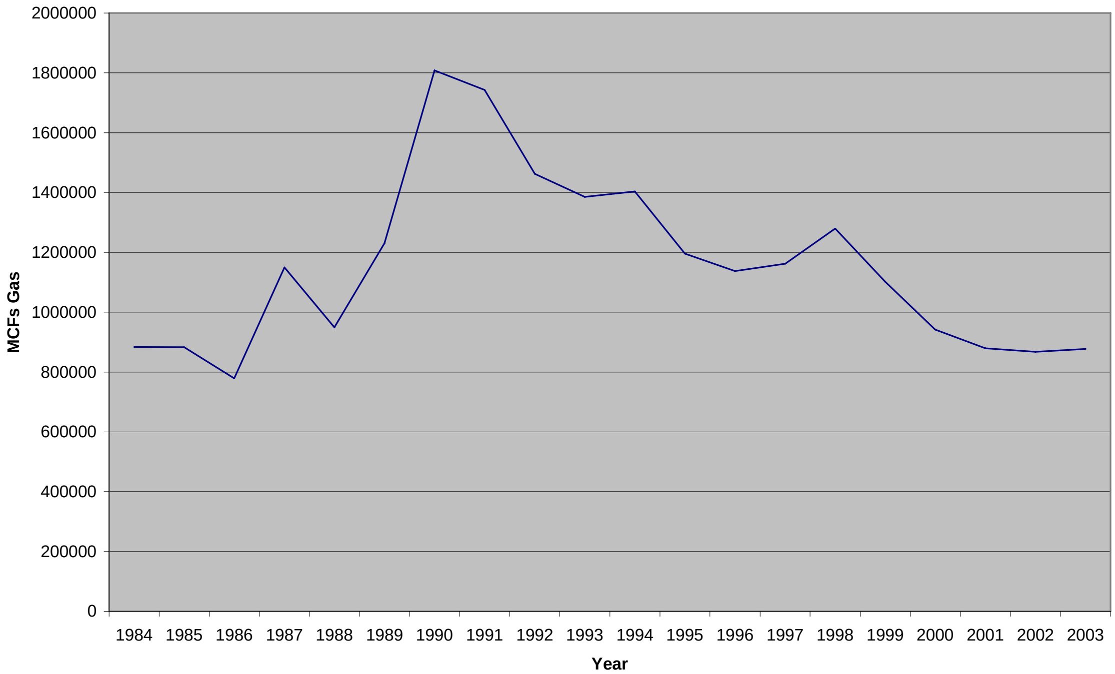


Figure 10. Lisbon Oil Production (1984-2003)

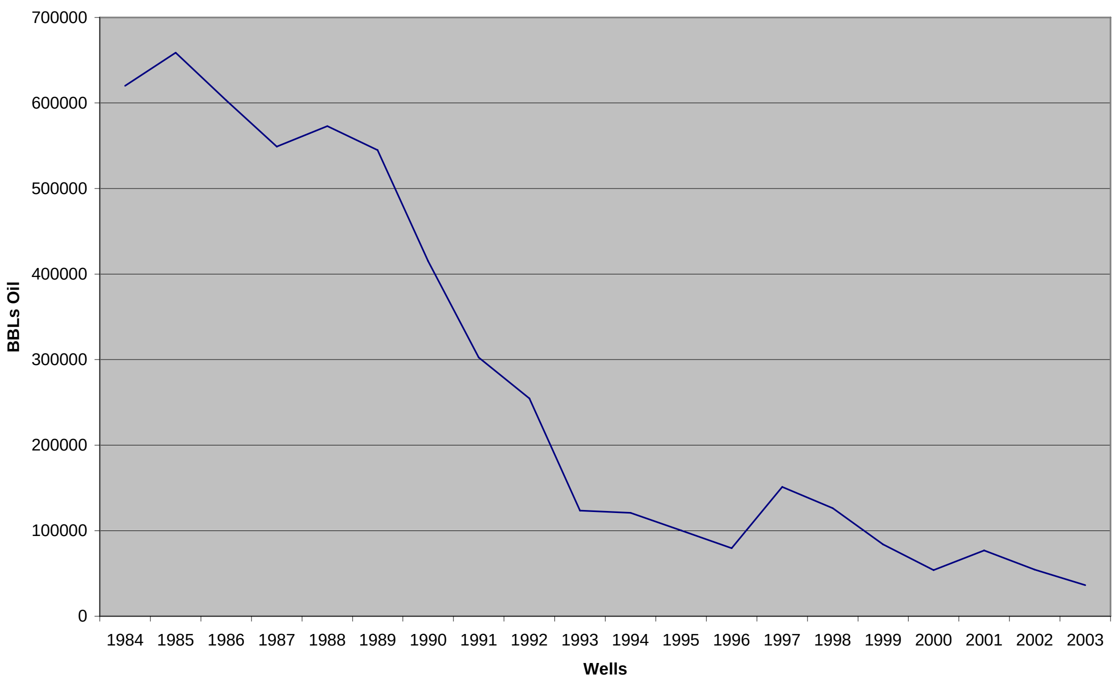
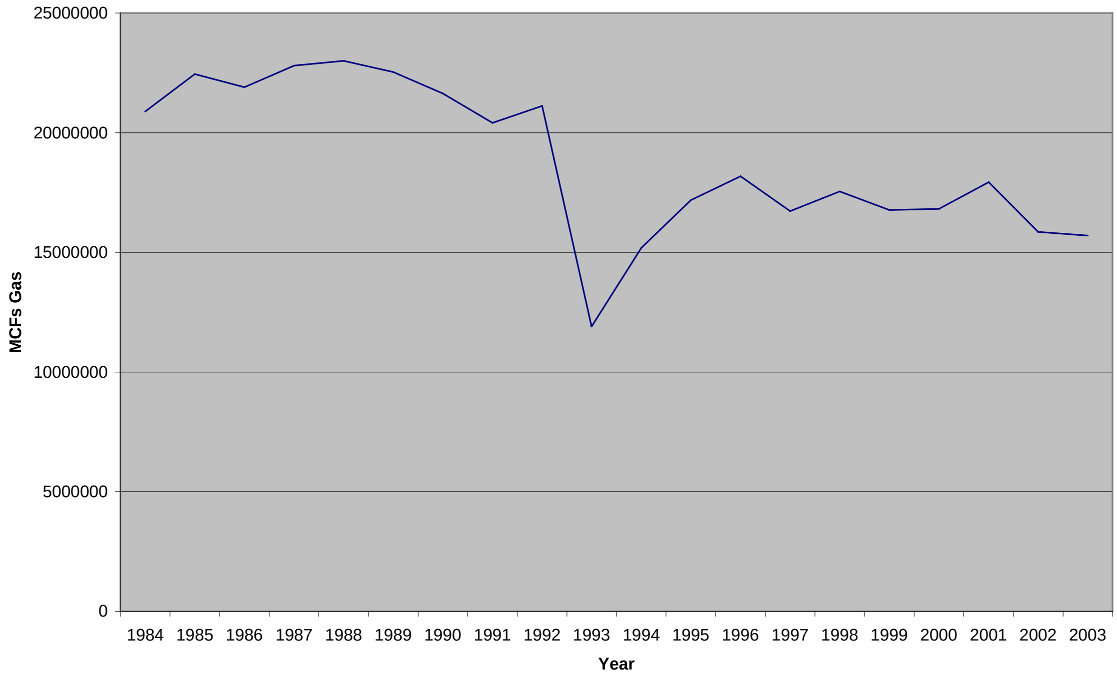
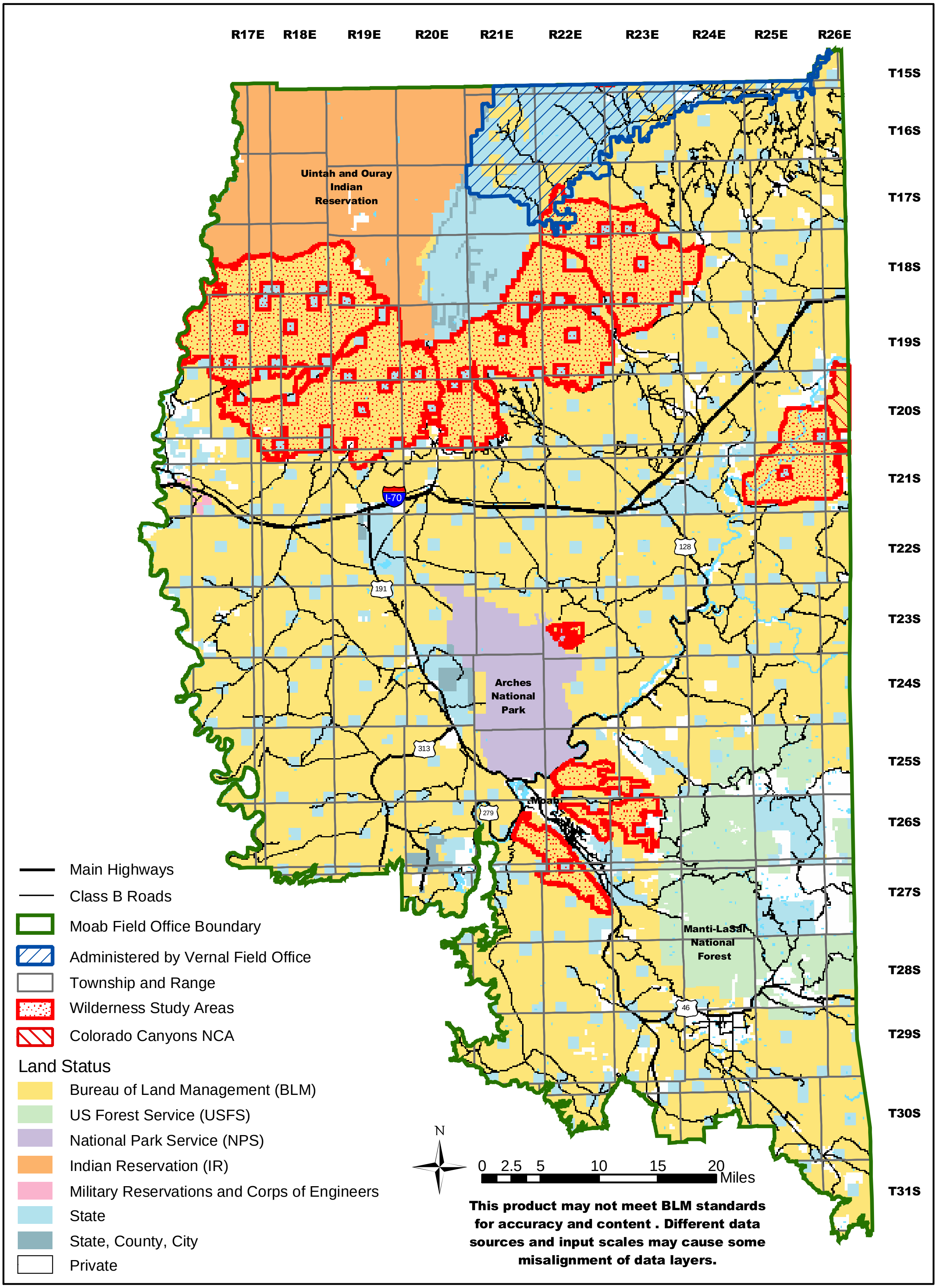


Figure 11. Lisbon Gas Production (1984-2003)



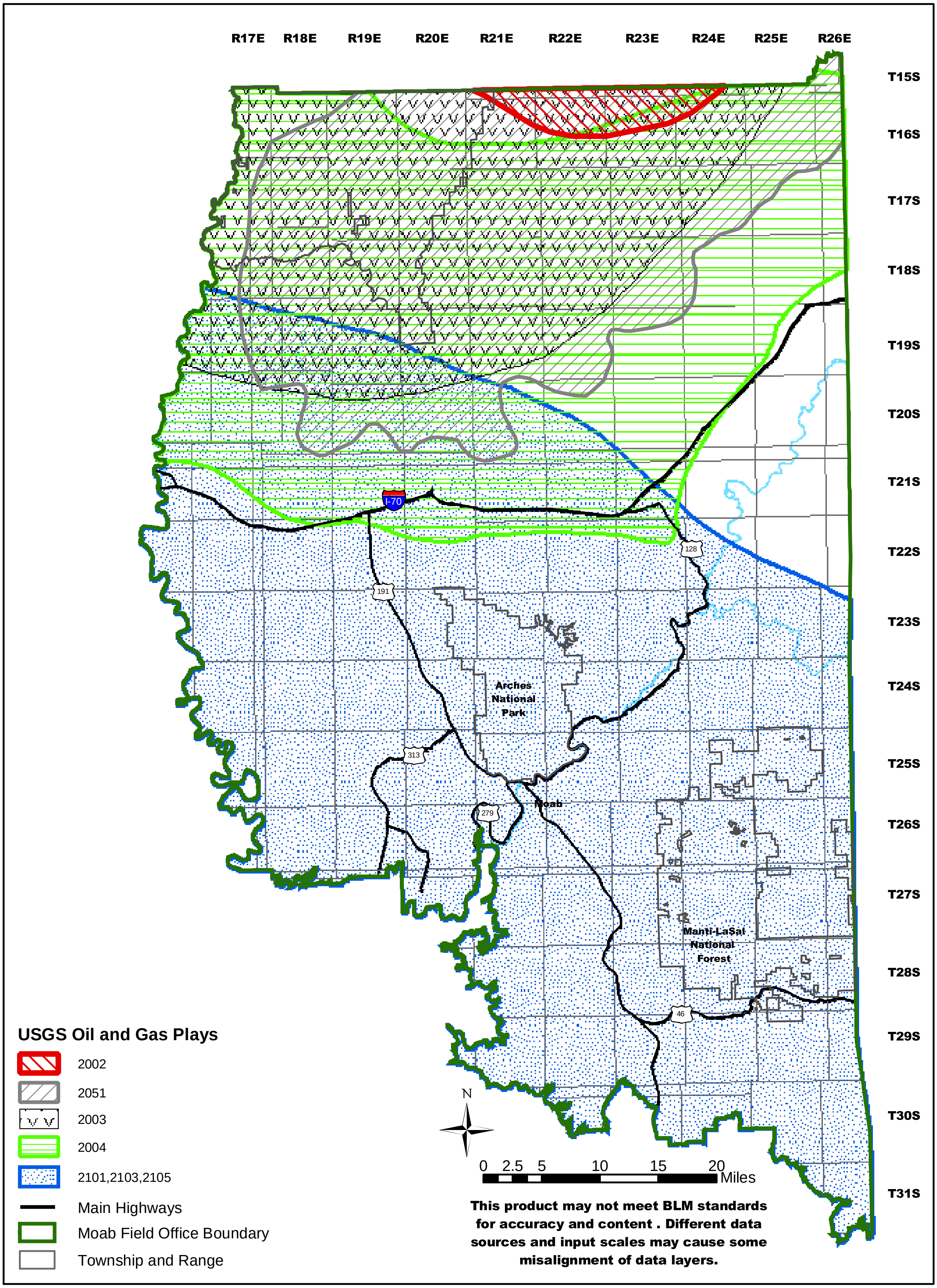
Map 1 - Land Status

Moab Field Office
Bureau of Land Management
March 29, 2005



Map 2 - USGS Oil and Gas Plays

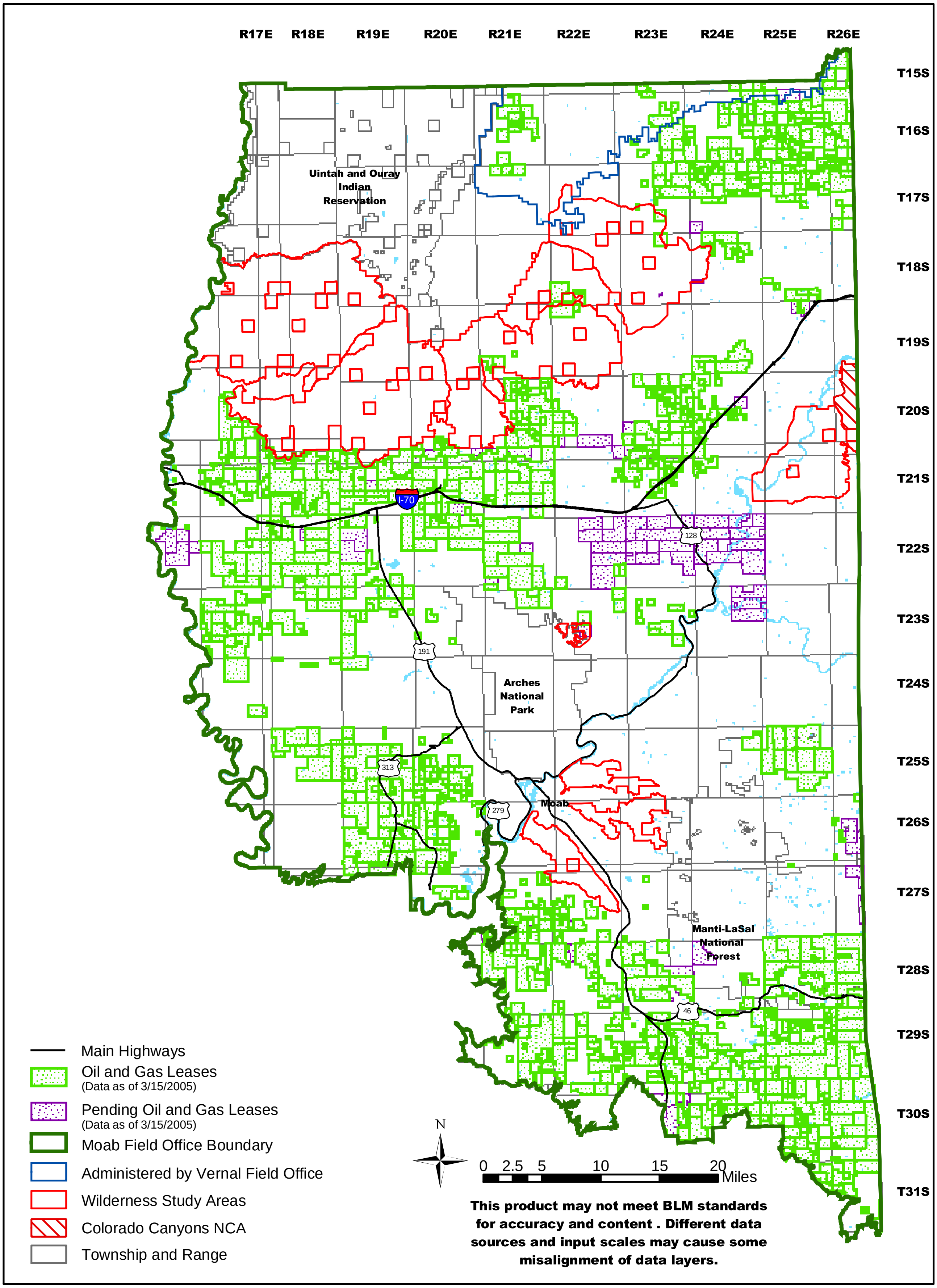
Moab Field Office
Bureau of Land Management
March 29, 2005



This product may not meet BLM standards for accuracy and content . Different data sources and input scales may cause some misalignment of data layers.

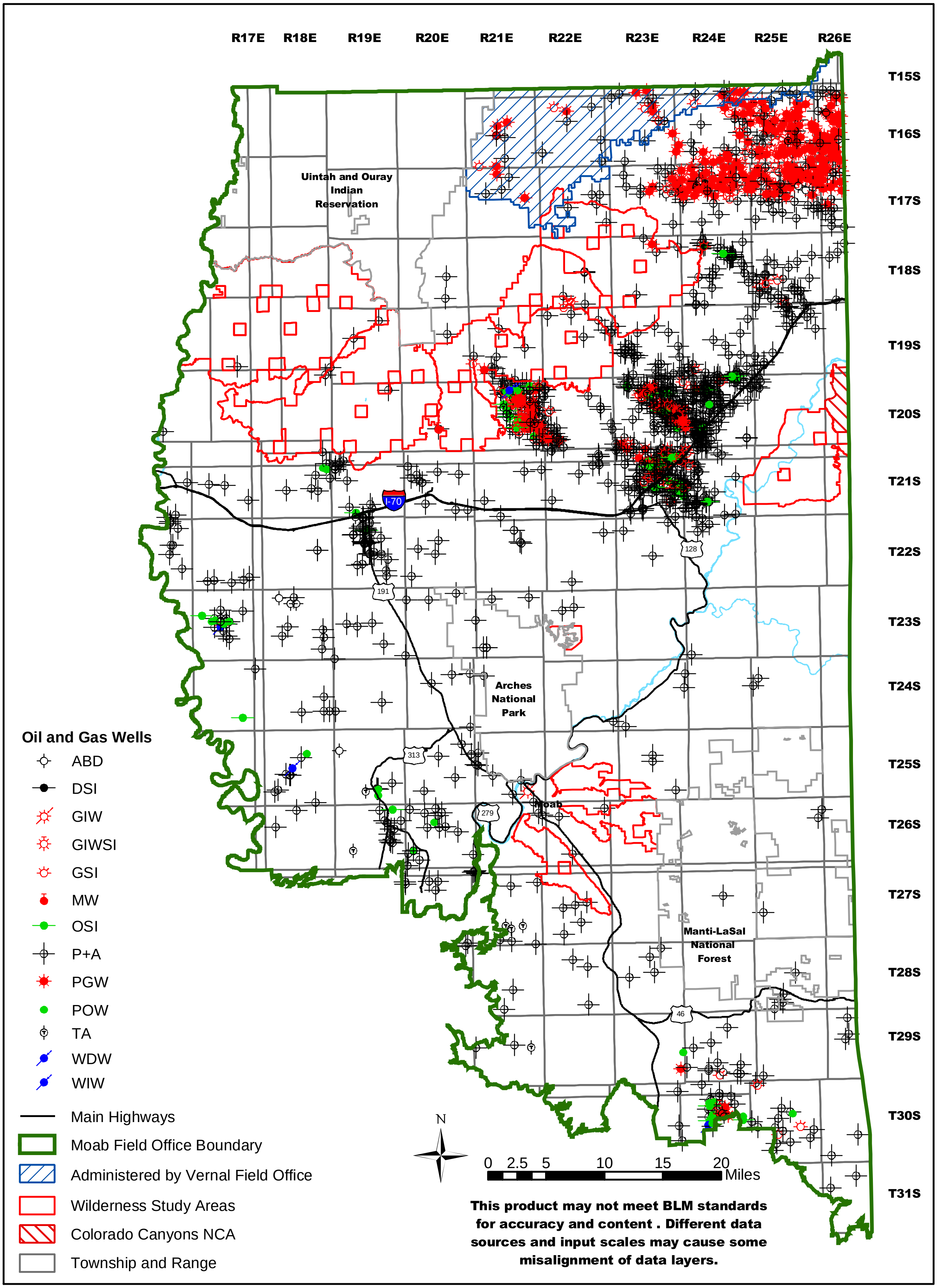
Map 3 - Oil and Gas Leases

Moab Field Office
Bureau of Land Management
March 29, 2005



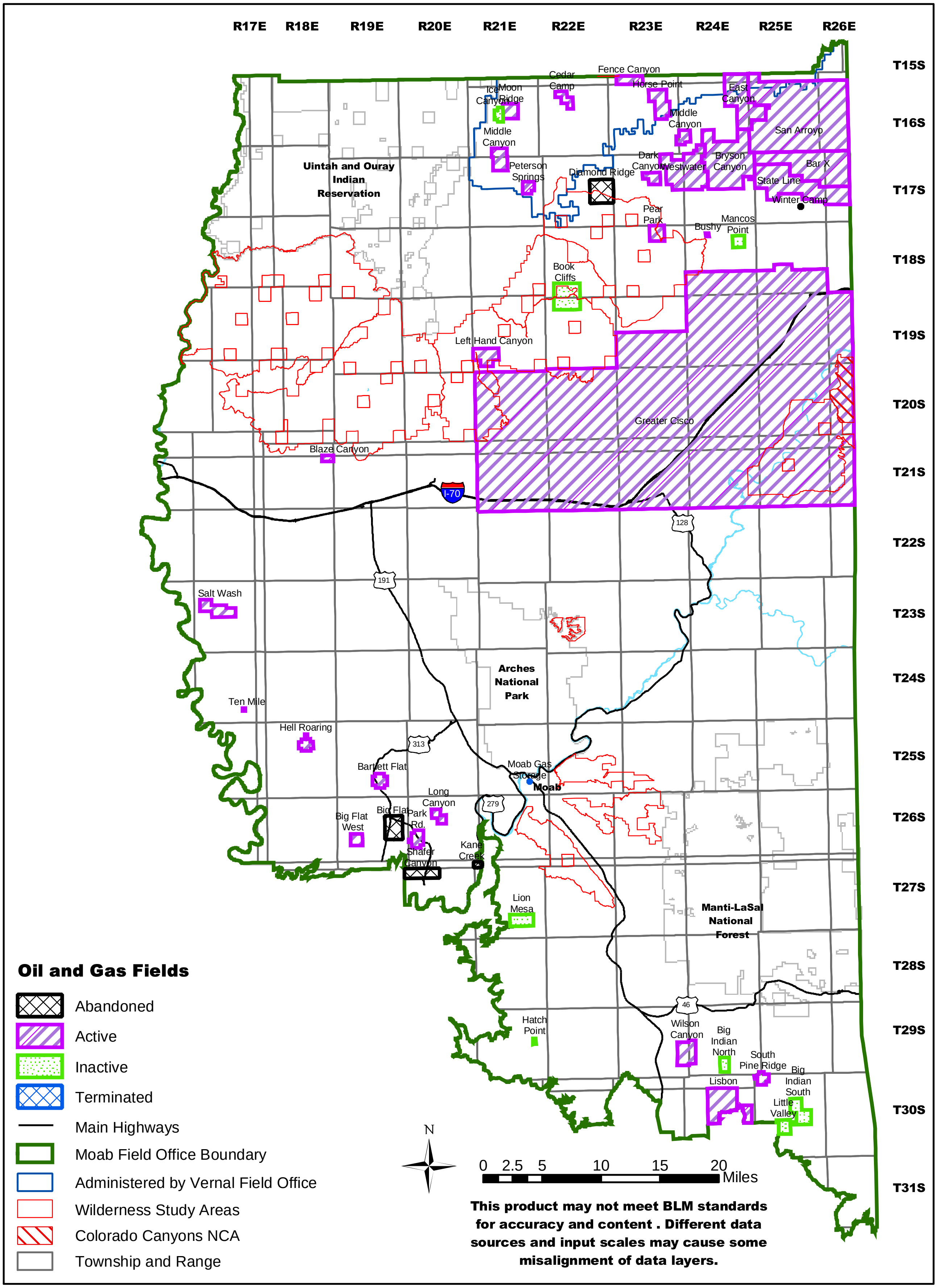
Map 4 - Oil and Gas Wells

Moab Field Office
Bureau of Land Management
March 29, 2005



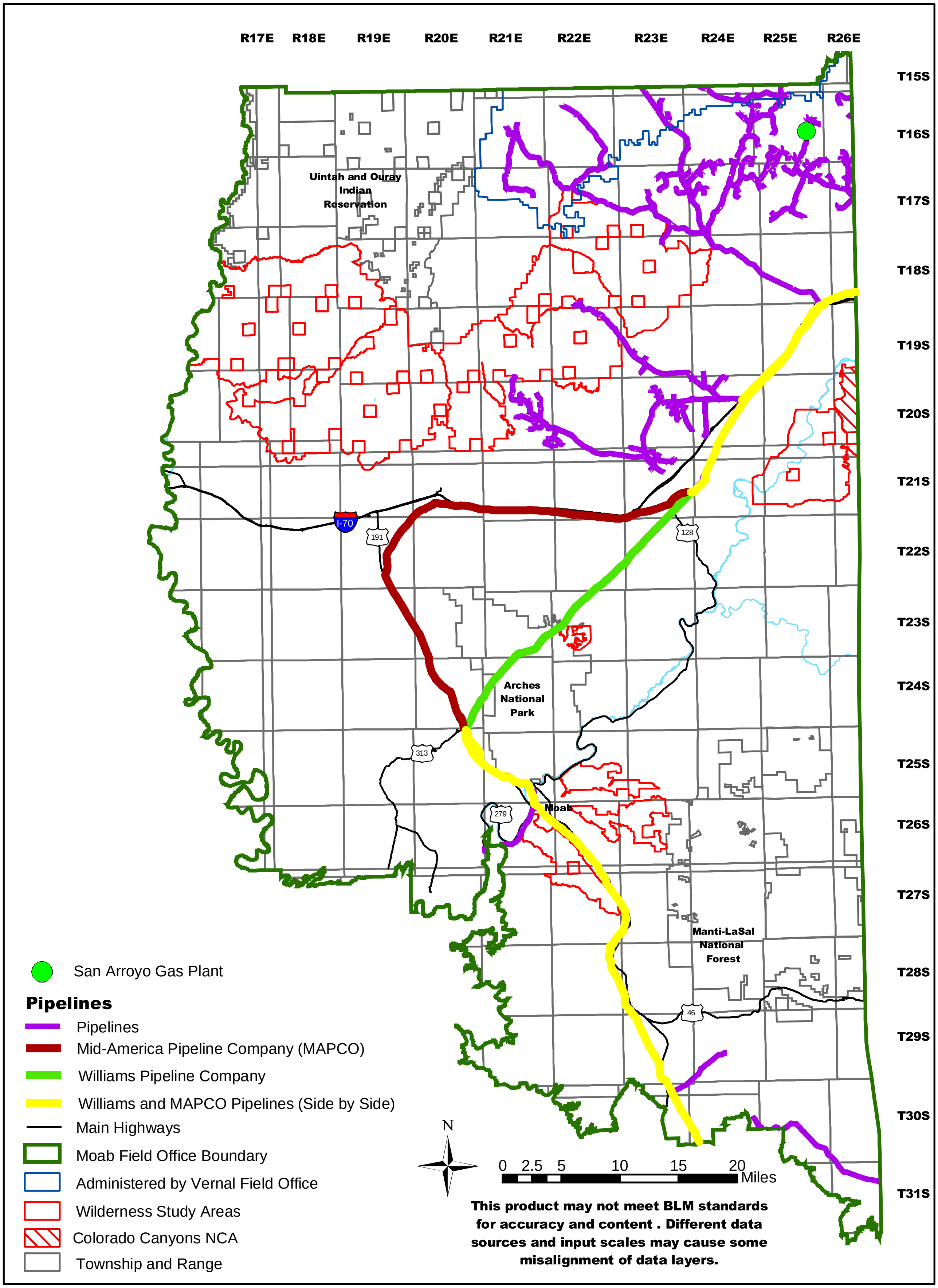
Map 5 - Oil and Gas Fields

Moab Field Office
Bureau of Land Management
March 29, 2005



Map 6 - Oil and Gas Pipelines

Moab Field Office
Bureau of Land Management
March 29, 2005



This product may not meet BLM standards for accuracy and content. Different data sources and input scales may cause some misalignment of data layers.

Map 7 - Moab Planning Area Oil and Gas Fields

Moab Field Office
Bureau of Land Management
May 2, 2005