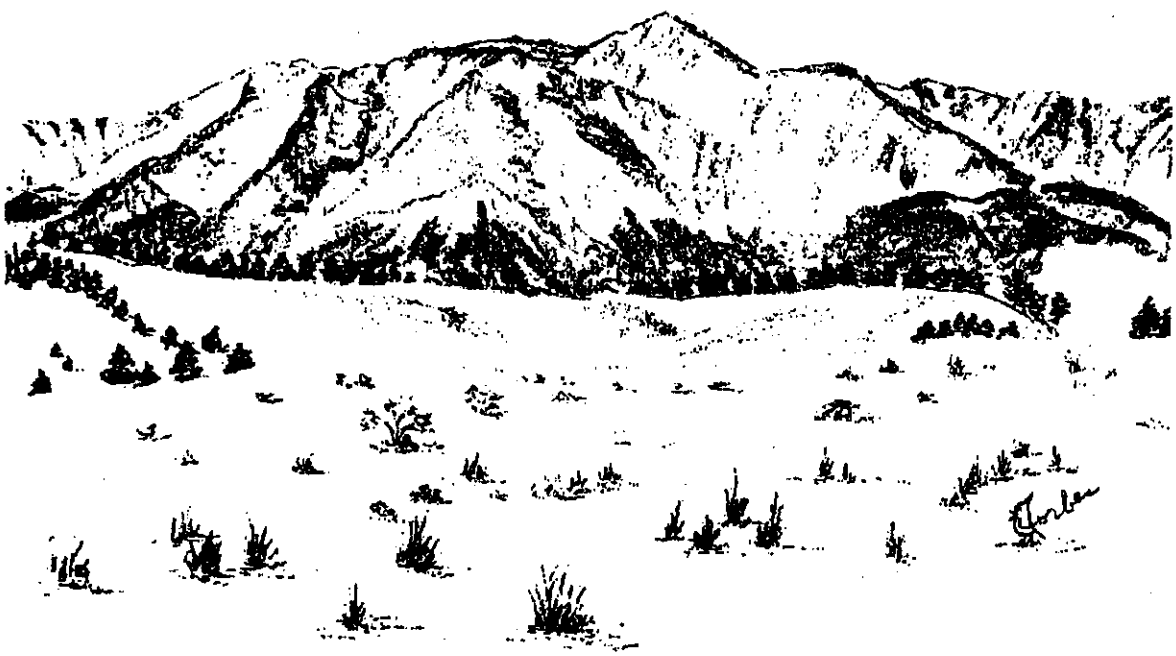
APPENDIX C
FLUID MINERALS MANAGEMENT



Revised March 1991

APPENDIX C

FLUID MINERALS MANAGEMENT

BLM AUTHORITY AND RESPONSIBILITIES FOR OIL AND GAS OPERATIONS

The BLM has responsibility for environmental protection, public health, and safety related to oil and gas operations on BLM-administered lands. There are three pieces of legislation that give primary direction to BLM for these operations: the *Mineral Leasing Act* of 1920, as amended, the *National Environmental Policy Act* of 1969 (NEPA), and the *Federal Land Policy Management Act* of 1976 (FLPMA). There is other legislation that affects various aspects of development. Most notably, these include laws to protect cultural resources and endangered species.

The law that directs BLM to make public land available for development of oil and gas resources is the *Mineral Leasing Act.* This legislation directs BLM to make all public land available for oil and gas development with the exception of specific lands, such as national parks, which are listed in the Act or its amendments.

The *National Environmental Policy Act* of 1969 (NEPA) directs all Federal agencies to analyze and disclose to the public the impacts of major Federal actions. Oil and gas leasing is a major Federal action by definition. The BLM prepares an environmental impact statement (EIS) to fulfill the mandate of NEPA (hence, this document).

The *Federal Land Policy and Management Act* of 1976 (FLPMA) instructs BLM to prepare and disclose to the public its plans for the lands under its jurisdiction. Since the *Mineral Leasing Act* requires availability of public land for leasing and since the leasing could lead to development that may have impacts on the environment, all three pieces of legislation are tied together in a workable process to accomplish the Congressional intent. The primary focus of the process for oil and gas development is the BLM resource management plan/environmental impact statement (RMP/EIS). Within the RMP, plans are disclosed for development/conservation of oil and gas (as well as all other resources and values). The RMP also serves to analyze and disclose the environmental impacts of the projected development.

Once decisions have been reached through the planning process as to what lands are available for leasing and under what conditions, they are offered for sale at auction. Those people interested in purchasing oil and gas leases may nominate a parcel, or BLM may offer parcels of its choosing. In either case, the proposed parcel must conform to the RMP decisions and be offered for sale at a public auction. Those parcels that do not sell at the auction are available for noncompetitive sale for a 2-year period thereafter.

Management decisions are incorporated into the lease document as stipulations and notices before it is issued. Public notice of the sale (which includes the list of parcels offered, their location, and the stipulations to be attached) is given 45 days prior to the sale. Significant change to the stipulations made after the lease is issued is also posted for public notice for 30 days prior to making the change.

The purchaser of a lease at the auction must bid at least 2 dollars per acre. The bonus bid must be paid at the sale, and the rent is due at the beginning of each new year as long as the lease is held and is not producing. Leases purchased at auction may be held for 5 years without production. Leases purchased noncompetitively after the auction may be held in nonproducing status for 10 years. If the lessee establishes production, a royalty of 12 1/2 percent must be paid to the government. Half of that money is returned to the state and county of origin for their use. The other half goes into the Federal treasury earmarked for reclamation projects, the National Forest System, National Park Service, etc.

Separate from leasing actions, geophysical explorationists may explore for oil and gas on public land. Geophysical exploration on public land requires approval of the methods employed and mitigation of impacts. The BLM resource area office must receive a copy of the Notice of Intent to perform geophysical operations. The exploration plan is analyzed for conformance with the resource area resource management plan/EIS and mitigative measures and reclamation requirements are attached to the approval. BLM specialists examine the Notice of Intent (the plan of operations) and the site, or "line," to be explored, as well as the RMP in determining appropriate mitigative measures and reclamation requirements.

The majority of geophysical exploration operations conducted on public lands are done by exploration companies. Some are associated with petroleum producers, many are not. Geophysical exploration operations may also be conducted on a lease held by the lessee with the same requirements for mitigation of impacts and reclamation. (See further discussion of oil and gas exploration below.)

A well must be drilled in order to produce oil and/or gas from the lease. Before drilling a well, the lessee, or an operator for the lessee, must file an Application for Permit to Drill (APD). The operator must file the application with

the district or resource area office in which the action will take place. The application must include a plan for the drilling of the well and a plan for the protection of the surface and environment. The drilling plan contains information as to the depth of the well, how it will be constructed, how groundwater and other mineral resources will be protected, and how blow-outs and other emergencies will be prevented or addressed. The surface use plan covers such concerns as the location and amount of surface disturbance and how that disturbance will be reduced or eliminated. It covers mitigation of impacts to wildlife, cultural resources, vegetation, soil, surface water, and other land uses and values. Each resource/value is evaluated in light of the RMP decisions. The operator is responsible for incorporating all RMP decisions in the proposed APD. If the APD does not have the appropriate information and mitigation incorporated, the application may be modified or rejected. In most APDs in Colorado, the few RMP decisions not incorporated by the operator are attached to the approved application by the BLM as Conditions of Approval (COAs).

At a minimum, each APD is reviewed by a BLM geologist, petroleum engineer, and surface reclamation specialist and by the Authorizing Officer (area or district manager). The geologist evaluates the need for groundwater and other mineral resource protection and the structural competency of casing point formations. The petroleum engineer evaluates the drilling plan, the well construction, and the safety of the operation. The surface reclamation specialist evaluates the surface plan, checks the proposal against the RMP and other guidance, conducts the onsite inspection, analyzes impacts, proposes mitigation, and writes the environmental assessment (EA). The surface reclamation specialist also calls on other expertise as needed in the analysis of impacts and recommendation of mitigation and reclamation requirements. For example, the BLM archaeologist would recommend any needed mitigation for impacts to cultural resources.

APD information is posted in the local authorizing office for a 30-day public notice period. The APD may not be approved until the comment period has expired. Each lease where an APD is proposed is checked to determine if a bond has been posted to cover abandonment of the well should the lessee/operator default on their obligations under the lease. Each application is evaluated as described above, and subjected to a field inspection of all proposed disturbed areas. Appropriate, site-specific mitigation is then attached to the APD as COAs. A cultural resource inventory is conducted for each APD, and a report sent to the district/resource area archaeologist for evaluation. In designated areas, endangered species or other inventories may be conducted. The proposal is subjected to a *National Environmental Policy Act* (NEPA) review (an EA) that checks for conformance with the RMP and determines whether or not there is a need for additional review (i. e., an expanded EA or environmental impact statement). EAs are prepared for all APDs on Federal lands in Colorado. When all impacts are analyzed, all necessary mitigation incorporated, and the public notice period expired, the APD may be approved.

In cases where the proposed well is obviously part of a larger field development, and such development has not already been scrutinized by a NEPA document other than the RMP, a "field development" EA is prepared. This EA looks at conformance of the specific field development with the general development analyzed in the RMP. As with the APD EA, an EIS is prepared if the projected field development does not conform with the analysis of field development in the RMP.

Over the life of a field, other operations, such as construction of power lines, pipelines, use of secondary and tertiary recovery methods, and other production facilities may become necessary. Each new surface disturbance is subjected to the same RMP test. Each is analyzed to determine impacts and mitigation. New ideas and technology are incorporated into new mitigative measures as they become available and when they do not impact the lease rights granted. New ideas and technology may also require amendment or maintenance of the RMP/EIS prior to use as mitigation.

As the well(s) plays out and comes to the end of its usefulness, it is abandoned and the disturbed area reclaimed. The operator must submit an abandonment notice for approval. The notice is evaluated by a geologist and a petroleum engineer to determine that the well will be plugged to protect usable water zones, other mineral resources, and the surface from contamination by any oil or gas that might leak up from the depleted reservoir or other fluids and gases up hole or on the surface that could migrate through the old well bore (and casing if left in place) to harm other resources. The surface reclamation specialist checks the final reclamation proposal to ensure it is in accordance with the original APD requirements, and, in some cases, incorporates the latest methods of reclamation. Reclamation is required to restore the well site, road, and other disturbances to as an original (or better) condition as possible. The surface reclamation specialist also inspects the location once or twice at approximately 1-year intervals to monitor the progress of reclamation. If the reclamation does not meet the requirement set out in the APD, the operator will re-do those portions necessary to complete the goals for the reclaimed area. The well will continue to be monitored until the surface reclamation specialist is satisfied that the reclamation has succeeded and the location is stable.

The BLM authority to require reclamation has only existed since the passage of the *Federal Land Policy Management Act* of 1976. Wells abandoned prior to that time were reclaimed haphazardly at best and primarily as gratis by the companies involved. These older unreclaimed sites are reclaimed by the BLM as the need arises and money is

available. In the majority of cases "natural reclamation" has stabilized and revegetated the site. An attempt to further reclaim the location at this time would do more harm than good. BLM only reclaims such locations when a serious erosional or other problem has developed. Some unreclaimed locations are reclaimed by a new lessee as part of a new lease agreement.

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

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

Operators are required to submit monthly production reports, which go to the Minerals Management Service (MMS) and are available to the BLM inspectors electronically. The BLM verifies the report in the field and the MMS verifies the royalty payment. The two agencies work together to ensure that all production is accounted for and royalty is paid.

Operations within the jurisdiction of other Federal or state and local agencies may also be field inspected by those agencies. The BLM has several agreements with other agencies that specify conditions where the BLM will notify the agency of violations within that agency's jurisdiction and in turn the agency will notify the BLM of violations within its jurisdiction.

Oil and Gas Exploration and Development

Oil and gas exploration and development activities progress through five phases, which are, in part, sequential and may overlap in time: preliminary exploration, exploratory drilling, development, production, and abandonment. Leases are obtained before the second phase (exploratory drilling).

Preliminary Exploration

Petroleum exploration occurs in unexplored portions of areas where petroleum is known or thought to occur in commercial quantities. An area where petroleum is thought to occur in commercial quantities is known as a frontier or rank wildcat area. With declining known oil and gas supplies, it has become profitable to explore for oil and gas in less promising geological provinces and in areas where the climate, terrain, depth of deposits, and other obstacles have discouraged previous efforts. Increasingly sophisticated exploration techniques, improved oil and gas drilling, and transportation technologies have also enhanced prospects for locating, extracting, and marketing petroleum resources.

Geological Exploration

Where the bedrock geology of an area is well exposed, it is often possible to predict where oil might gather. The potential traps (anticlines, faults, or formations with varying porosity) can sometimes be located with the aid of published geologic maps, aerial photos, and landsat imagery. Occasionally, additional data will be gathered by aircraft. Low altitude reconnaissance flights, frequently at elevations of 100 to 500 feet, help identify rock outcrops that can be studied later on the ground. Next, one or more geologists may examine and sample the rock outcrops in the area and map the surface geology. Geological exploration can be performed with little surface damage; four-wheel drive pickups, motorcycles, or all terrain vehicles can be used to cover the area.

Geophysical Exploration

Subsurface geology is not always accurately indicated by surface outcroppings. In such cases, geophysical prospecting methods are used to define subsurface structure. Three geophysical survey techniques can be used to define subsurface characteristics through measurements of the gravitational field, the magnetic field, and seismic reflections.

Gravity and magnetic surveys indirectly measure course subsurface structure. The fieldwork involves small portable units, which are easily transported via light off-highway vehicles, such as four-wheel drive pickups and jeeps, or aircraft. Off-highway vehicle traffic is common in these two types of surveys. Sometimes, small holes (approximately 1 inch by 2 inches by 2 inches) are hand dug for instrument placement at the survey measure points. These two surveys can make measurements along defined lines, but it is more common to have a grid of discrete measurement stations.

Seismic reflection surveys are the most common of the geophysical methods and produce the most detailed subsurface information. The seismic method detects subsurface geologic structural information by producing a source wave

at or near the surface that bounces off subsurface layers. The "echoes" or seismic reflections are recorded as a function of time. The deeper the subsurface reflecting layer, the later in time it is detected. The weak seismic reflections are detected at the surface by arrays (groups) of seismometers or geophones that are very similar to microphones. The geophone electrical signals are sent by a connecting cable to the recorder unit where the signals are amplified and then recorded on a multi-track magnetic tape.

The tape is later sent to a computing center where it is rearranged and computer enhanced to present the subsurface reflections in a graphic picture called a Seismic Section. The seismic reflections are very weak requiring very sensitive geophones. While the geophones can "hear" the desired reflections, they also detect: cars and trucks, people and animals moving about, water wells pumping, airplanes (at tens of thousands of feet in the air), trains (many miles away), the wind blowing, and trees and shrubs moving in the wind.

Any of these other activities can produce a "noise" at the geophone, which often is stronger than the desired seismic reflections.

The seismic reflection method needs the seismic source and geophone arrays along a straight line. Sometimes it is possible to work along existing roads if the roads are straight. Where practical, existing roads are used to facilitate access to the seismic operations. The geophone arrays are normally straight along the line length. In difficult seismic data areas, however, they may have considerable width.

To understand the subsurface structures in three dimensions, it is necessary to have seismic lines recorded in a "cross" or line gridded pattern. The grid spacing between lines can be from a fraction of a mile apart to many miles apart depending on the exploration purpose. The exploration purpose will also determine what latitude, if any, there is in moving these lines.

The work of a seismic crew begins with the permit agent obtaining permits from private landowners and government agencies.

The survey crew next places pin flags and other markers at uniform intervals along the seismic line and carefully measures the markers in relation to precisely known geographic locations. For a shot hole explosive seismic source, drilling rigs will be working on the seismic line. When the complete seismic line is ready, the geophone crew arrives and places the geophones in arrays in precise locations to the flagging and lay connecting cables between the geophone arrays and the recorder unit. After the seismic reflection data is recorded, the geophone crew picks up all the geophones and connecting cables and cleans up the seismic line. Most of these individual steps involve one or more equipment trucks to travel the seismic line if the terrain is driveable.

The seismic reflection method is usually referred to by the type of seismic source. The most common seismic sources are vibrator, shot hole explosive, and surface explosive.

The geophysicist, in determining the seismic exploration program parameters, will pick the most appropriate seismic source based on the depth of exploration interest and the degree of detail needed to define the subsurface structure.
Vibrator Source

The vibrator method uses a 4x4 or 4x6 wheel drive truck or buggy mounted hydraulic vibrator source. Their primary physical feature is a pad (about 4 feet square) that is slowly lowered from the center of the truck or buggy to make contact with the ground. Connected to the pad is the reaction mass. The reaction mass is moved a few inches up and down hydraulically in a carefully controlled manner to send a seismic source wave into the ground.

The vibrator is a weak seismic source and requires two to eight vibrators working together to create detectable reflections. Since it is a weak source, it has been used successfully to gather seismic reflection information in difficult high population areas such as Los Angeles and Paris.

To be able to use the vibrator source method, it is required that the seismic line goes along a straight road, or if cross country, over gentle, rolling driveable terrain.

Conventional Drilled Shot Hole Source

The shot hole explosive source requires the drilling of a hole to a predetermined depth, placing explosives at the bottom of the hole and back filling the hole with cuttings if the hole is air filled, or bentonite chips if the hole is naturally water filled.

Shot hole drilling depths will range normally from 25 to 200 feet. The explosive charge size can range from 5 to 50 pounds. The hole diameter is typically 2 to 6 inches. The drill rigs are most often truck or buggy mounted. Cuttings from drilling the hole are normally scattered by hand near the shot hole or put back in the shot hole after explosive charge placement. Proper preplugging of the shot hole with tamped cuttings or bentonite chips prevent the view commonly shown in the movies of holes "blowing out." There are some special source testing situations that need the detonation of charges in open holes. A shot hole that "blows out" causes a very poor seismic source wave that is very detrimental to the seismic reflection method. Detonation of a properly preplugged shot hole will create the best seismic source wave and cause no surface disturbance.

Portable Drilled Shot Hole Source

Special limited depth drill rigs can be moved in pieces by a helicopter. Helicopter portable drills are used where access limitations or topography restraints prevent use of conventional truck or buggy mounted drill rigs. This is a very expensive option, which also places significant limits on the depth of drilling, and consequently, the size of the explosive charge. These limits can severely restrict the reflection methods ability to define subsurface structures.

Surface Explosive Source

The surface explosive source method involves placing puds (pouches) of explosives on a number of stakes driven into the ground. This is also called the Poulter method, named after its developer.

The explosive puds range in size from 1 to 5 pounds. The stakes are typically 4 to 8 feet in height. The number of stakes used in the source array can range from a few to the more common 10. Occasionally the explosives are placed on the ground or snow, but this is a less effective source wave technique. Use of tall (6-foot) stakes or placing the explosives on the surface of deep snow results in little visible surface disturbance, in contrast to the noise level of the detonations. The surface explosive method is very mobile. Generally 4x4 vehicles are used for transportation, although it can be supported with animal pack teams or helicopters.

Mini-hole Explosive Source

The mini-hole explosive source can be used in favorable conditions. A very small portable unit is use to drill a number (a source array) of small diameter shallow holes. The holes are usually 2 to 3 inches in diameter, drilled to depths of 5 to 15 feet and each hole loaded with a small, 1 pound or less, explosive charge. These holes are detonated simultaneously to produce a seismic source wave. This method, however, is usually limited to defining shallow subsurface structures, and therefore, cannot often be substituted for the significantly more effective deep shot holes.

A given area may be explored several times by the same or different companies over a period of time. Multiple exploration is undertaken for a variety of reasons--first attempts may have been unsuccessful, the depth of exploration interest may have changed, other competitive companies want their own information, or improved techniques and/or equipment are used.

All the work required to obtain exploration seismic data does not guarantee that the data will indicate any necessary subsurface structures--let alone a subsurface structure containing hydrocarbons. For the explorationist, the unfortunate reality is that obtaining seismic data most often leads to the decision that an area does not have adequate subsurface structures or structures containing economic hydrocarbons and therefore no drilling will follow.

TYPES OF OIL AND GAS DRILLING AND PRODUCTION

Oil and gas wells are drilled primarily with rotary drilling rigs. The rigs use mud or compressed air as a medium to cool the drilling tools, carry cuttings to the surface, and, in the case of mud, to stabilize the drilled hole. In the early days of drilling, the "cable tool" rig was the predominant method of drilling. Cable tools were largely replaced by rotary rigs in the 1950s. Some of the oldest wells still producing in Colorado were drilled with cable tool rigs.

The method of drilling is generally the same regardless of the target production. The depth of the target usually has more to do with the method of drilling than the type of production. In general, deeper wells require larger rigs, which in turn require larger drill pads. Because oil is more valuable than gas, gas wells tend to be shallower in depth. The reason is that deeper wells cost more and the lower profitability of gas production means they do not bear the higher cost of deeper wells. The size of the anticipated production also has a bearing on the expense a given production will bear. For example, a very large gas producing reservoir may better bear the cost of deeper drilling than a shallow, low producing oil reservoir. But, all else being the same, deeper reservoirs cost more to develop than shallow ones.

The biggest differences among the various types of oil and gas wells occur in the production phase of operations. The same basic rotary drilling methods are used for drilling all types of oil and gas wells.

Oil and Gas Co-Production

Reservoirs that produce both oil and natural gas require the siting of facilities for the production, clean-up, and storage and/or transportation of the products on location (i. e., the well pad). If the well produces naturally, that is the gas and oil flow to the surface under natural pressures, only a series of pipes and valves at the well "head" are required to regulate the flow of product to the surface. If there is no, or insufficient, natural pressure, a pump is installed to lift the product to the surface. Once the oil and gas comes to the surface, it travels through pipes to separation equipment where water and gases such as carbon dioxide are removed, and the gas and oil are separated. The water and oil are piped to respective storage facilities and the gas put into a transmission pipeline. In a few cases, separation/clean-up and/or storage facilities are located off the well pad for common use by more than one well. But, in the great majority of the wells in the study area, all facilities are located on the same pad on which the well was drilled.

Gas is transported to market through a network of gathering pipelines from each well to a transmission line. The gathering system usually consists of pipe of 2 to-4 inches in diameter, which is laid on the ground or buried several feet below the surface. BLM most often requires that lines be laid near the access road or buried under it to save additional surface disturbance. Measurement of gas is usually through a differential pressure recorder on the well pad.

Oil is produced into tanks either on the well pad or a common tank near the well. The oil is measured for sale from these tanks and transported to distribution points by special truck. In the case of some highly productive fields, oil carrying pipelines may be laid to a distribution point or refinery. In these cases, there is a network of pipelines to each well similar to that for the gas gathering system. The oil gathering lines are usually 4 to 6 inches in diameter, and measurement is either through a sales tank or a sales meter attached to the line.

In some areas, hydrogen sulfide (also known as H2S or sour gas) may be found with the hydrocarbon production. In these cases, special stainless steel pipe is used to contain the production until the hydrogen-sulfide can be separated from the hydrocarbons. The hydrogen sulfide is disposed of by incineration or neutralized by sulfur extraction.

Oil Production

Typically, oil is produced in association with water and gas; however, in some cases oil is produced with almost no water nor associated gas. The facilities to produce such oil are the same as those described above without the equipment for gas cleanup and measurement.

Dry Gas Production

Dry gas is a term applied to any natural gas produced without oil. It usually has some water associated and may have a small amount of light liquid hydrocarbons, called "drip" or condensate. Dry gas wells typically have only a "christmas tree" or valve/gauge assembly, showing above ground. Production facilities may include a pit or tank for the collection of separated produced water and a small tank for the storage of the liquid hydrocarbons. As with oil and gas production, there is a gathering pipeline and sales meter for gas distribution.

Carbon Dioxide Production

Carbon dioxide is produced in a manner similar to dry gas. But, carbon dioxide, in combination with water, may form carbonic acid, which is very corrosive. The produced gas, therefore, must be "cleaned" (impurities removed) as soon as possible after it reaches the surface. For that reason, stainless steel piping is used from well head to separator, and separators are placed as close as possible to the well head. Usually a single large separator is located to service

several wells. The use of some stainless steel pipe and common separators are the two most distinguishing surface features of carbon dioxide production.

Exploratory Drilling

Drilling does not begin until a lease has been acquired by the operator. When preliminary investigations are favorable and warrant further exploration, exploratory drilling may be justified. Stratigraphic tests and wildcat tests are the two types of exploratory drill holes.

"Strat" tests involve drilling relatively shallow holes to supplement seismic data. The holes are usually from 100 to several thousand feet deep, and are drilled primarily by rotary drill rigs. As the rock is drilled, the resulting rock chips are brought to the surface by a high-pressure airflow or circulating drilling mud. Samples of these chips are collected, bagged, and identified as to depth of origin. They are then studied by a geologist to determine such data as rock type, age, and formation.

Truck-mounted drilling equipment for strat tests is fairly mobile; therefore, roads and trails to test sites on level solid ground are temporary and involve minimal construction. In hilly or mountainous areas, more road building is necessary.

Generally, access roads are bladed 12 to 14 feet wide and are not crowned nor ditched. Some roads may simply be surface scraped; i. e. , vegetation is clipped off next to the soil surface. Other roads may require cuts in excess of 20 feet and fills exceeding 10 feet. Strat tests requiring a large amount of construction (i. e. , several acres of cut and fill described previously) are unusual since construction costs may outweigh the information gained.

A space of about one-half acre or less is leveled and cleared of vegetation for the average drill site. If high pressure air is used to remove rock chips or rock cuttings, rock dust may be emitted into the air when samples are not being collected. If mud is used as a drilling fluid, mud pits may be dug; more commonly, portable mud tanks are used. Usually 1 to 3 days are required to drill the test holes, depending on depth to and hardness of the bedrock. In areas with shallow, high-pressure, water bearing zones, casing may be required to keep water out of the hole.

After the surface and subsurface geological studies, the seismic, and other geophysical surveys, comes the evaluation of the prospect. Only by drilling a wildcat well (a well drilled in unproved territory) will the oil company know if the rocks in the prospect they have identified contain oil or gas.

Nationally, about 1 in 16 wildcat wells produces significant amounts of oil or gas. Locally, success ratios may be as high as one in 10. The deeper wells may require several months or more to complete; shallower wells up to a few thousand feet deep may be completed in as little as a few weeks. As a general rule, the deeper the test, the larger the drilling rig and facilities required.

Prior to approval for drilling, onsite inspections are conducted with the proposed drill pad and access road staked out, to assess potential impacts and attach appropriate mitigative conditions to the permit to drill. A drill "pad" (well site) from 1 to 4 acres in size is then cleared of all vegetation, and leveled for the drill rig, mud pumps, mud (or reserve) pit, generators, pipe rack, and tool house. Topsoil and native vegetation are usually removed and stockpiled for use in the reclamation process. The mud pit may be lined with plastic or bentonite to prevent fluid loss or prevent contamination of water resources. Other facilities such as storage tanks for water and fuel are located on the pad or are positioned nearby on a separate cleared area. If the well site is not large enough for the equipment required to rig-up (prepare the drilling rig for operation), a separate staging area may be constructed. Staging areas are usually no larger than 200 by 200 feet and may simply be a wide flat spot along the access road on which vehicles and equipment are parked.

Five thousand to 15,000 gallons of water a day may be needed for mixing drilling mud, cleaning equipment, cooling engines, etc, for each well. A surface pipeline may be laid to a stream or a water well, or the water may be trucked to the site from ponds or streams in the area.

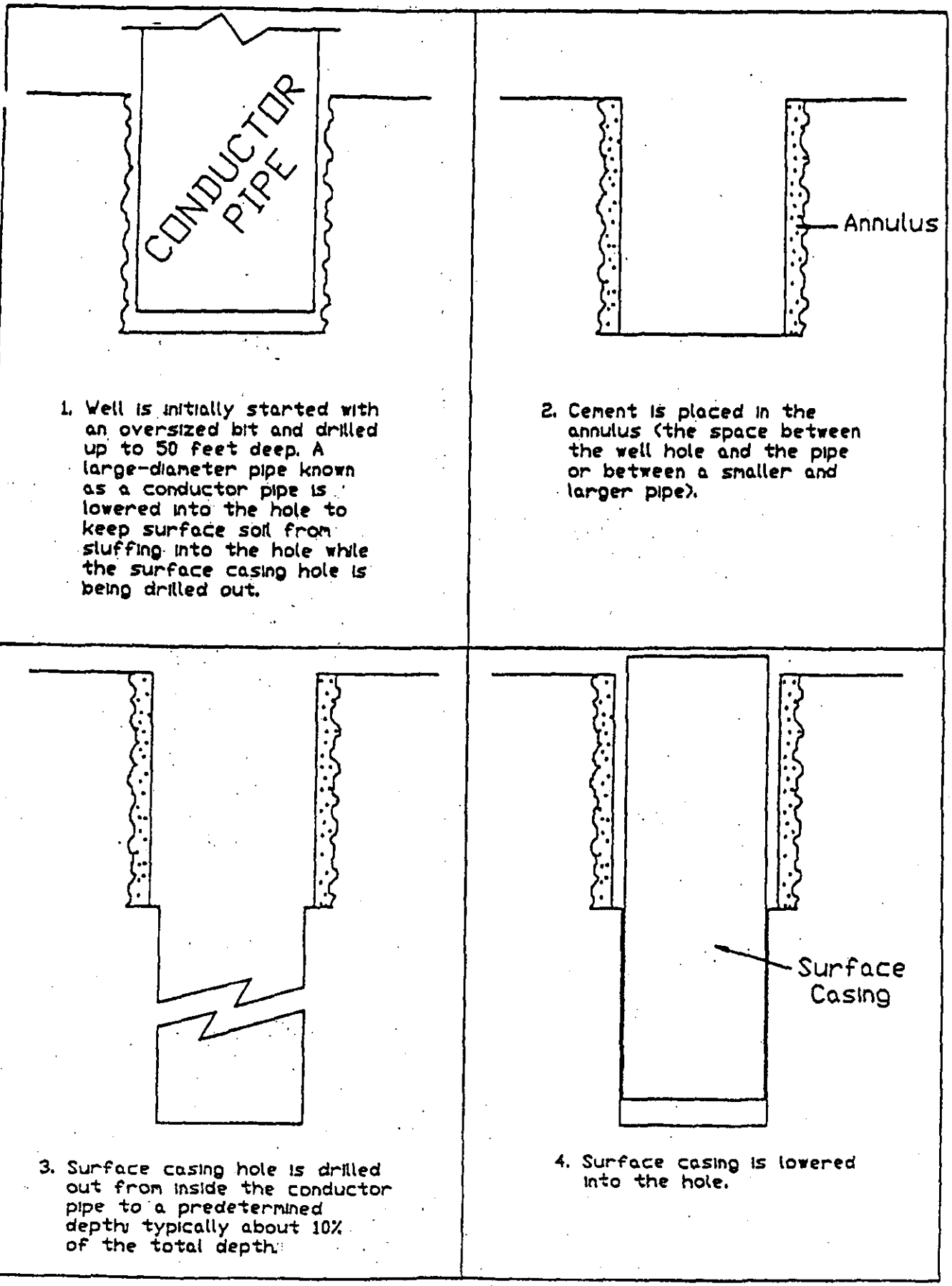
The rigs are very large and may be moved in pieces. In some instances, rigs can be moved short distances on level terrain with little or no dismantling of equipment, which will shorten the tearing-down and rigging-up time. Moving a dismantled rig involves use of heavy trucking equipment for transportation, and crews to erect the rig. Gross weight of vehicles may run in excess of 80,000 pounds.

In order to move a drill rig and well service equipment from one site to another, and to allow access to each site, temporary roads may be built. These roads are generally 16 to 18 feet wide (driving surface) and may be as short as 200 feet or as long as 10 miles or more. Bulldozers, graders, and other types of heavy equipment are used to construct and maintain temporary wildcat roads.

The start of a well is called "spudding in." A short piece of tubing called conductor pipe is forced into the ground (sometimes with a piledriver), and cemented in place. This keeps surface sand and dirt from sloughing into the well hole. Next, the regular drill bit and drill string (the column of drill pipe) take over. These pass vertically through a heavy steel turntable (the rotary table) on the derrick floor and the conductor pipe. The rotary table is geared to one or more engines, and rotates the drill string and bit. As the bit bores deeper into the earth, the drill string is lengthened by adding more pipe to the upper end. (See Figure A-1).

Appendix C

FIGURE A-1

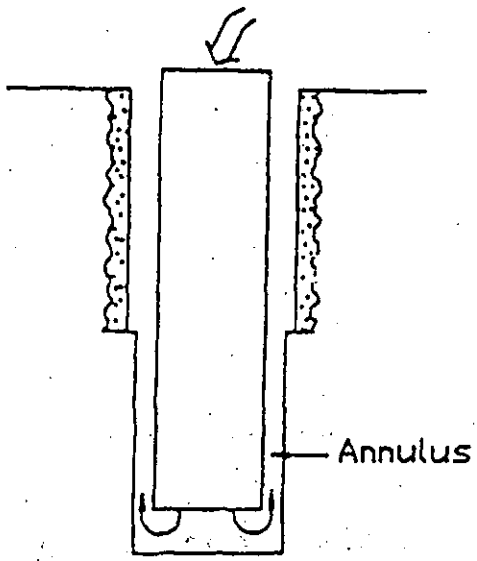


1. Well is initially started with an oversized bit and drilled up to 50 feet deep. A large-diameter pipe known as a conductor pipe is lowered into the hole to keep surface soil from sluffing into the hole while the surface casing hole is being drilled out.

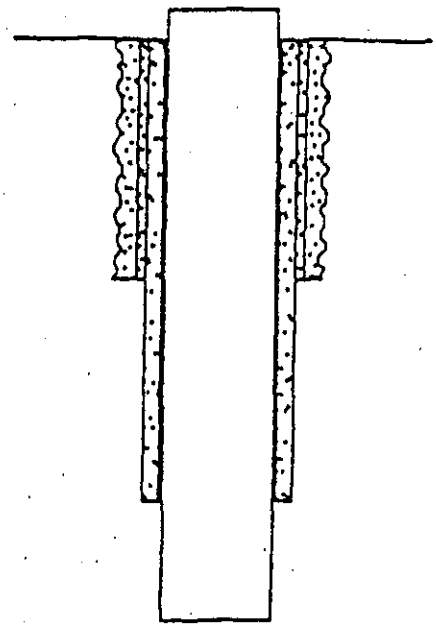
2. Cement is placed in the annulus (the space between the well hole and the pipe or between a smaller and larger pipe).

3. Surface casing hole is drilled out from inside the conductor pipe to a predetermined depth typically about 10% of the total depth.

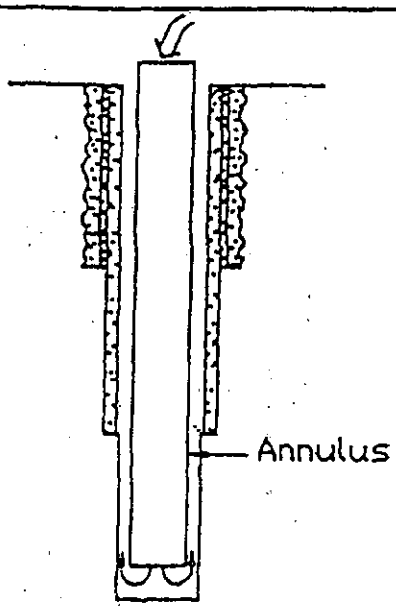
4. Surface casing is lowered into the hole.



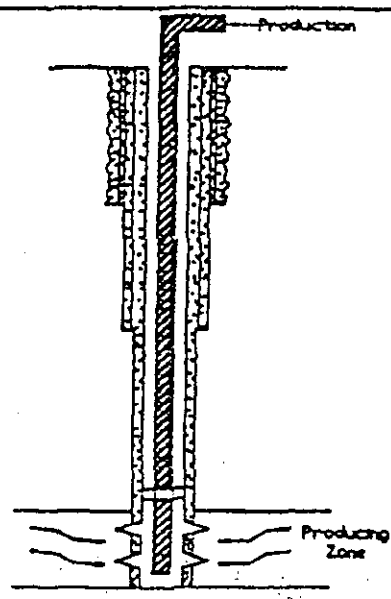
5. Cement is pumped down the surface casing and forced up the outside through the annulus. The cement is used to hold the surface casing in place. It protects shallow fresh water and other mineral zones.



6. The well is deepened using a bit smaller than the surface casing. The well is now drilled to its' final depth. In deep wells, intermediate casing is set before drilling to the final depth.



7. The intermediate casing, or production casing is lowered into the hole. Cement is pumped down the casing and up the outside through the annulus to seal the casing in place. This cement will also isolate and protect all hydrocarbon-bearing zones, fresh water zones, and other zones of interest.



8. Once the production casing is in place, perforations are made through the casing and cement into the producing formation. Techniques are then used to increase the flow of oil and gas into the well. Production tubing is hung down the well to the producing zone. Oil and gas flow into the well and either flow or are pumped up the production tubing to the surface.

Once the hole reaches a depth of several hundred feet, another string of pipe (the surface casing) is set inside the conductor pipe and cemented in place by pumping cement between the casing and hole wall. Surface casing acts as a safety device to protect freshwater zones (aquifers) from drilling fluid contamination. To prevent the well from "blowing out" in the event the drill bit hits a high pressure zone, "blowout preventers" (large metal rams) are installed around the surface casing just below the derrick floor. These rams will close around, crushing the drill string and sealing the well in the event of a blowout.

After setting the surface casing, drilling resumes using a smaller diameter bit. Depending on well conditions, additional strings of casings (intermediate casing) may be run (installed) before the well reaches the objective depth (total depth or "T. D. ").

During drilling, a mixture of water, clay, and chemical additives known as "mud" are continuously pumped down the drill pipe.

It exits through holes in the bit and returns to the surface outside the drill pipe. As the mud circulates, it cleans and cools the bit and carries the rock chips (cuttings) to the surface.

It also helps to seal off the sides of the hole (thus preventing cave-ins), and to control the pressure of any water, gas, or oil encountered by the drill bit.

The mud is the first line of defense against a possible blow-out since it is used to control pressure. It is for this reason that a pit full of "reserve" mud (the reserve pit) is maintained on location. The reserve mud is used in emergencies to restore the proper drilling environment when radical or unexpected changes in down-hole pressure are encountered.

The cuttings are separated from the mud and sampled so that geologists can note and analyze (log) the various strata through which the bit is passing. The rest of the cuttings pass into the reserve pit as waste. Some holes are drilled at least partially with compressed air which serves the same purpose as drilling mud of cooling and cleaning the bit and evacuating the cuttings from the hole.

During or at completion of drilling activity, the well is logged. Logging means measuring with geophysical instruments the physical characteristics of the rock formations and associated fluids through which the borehole passed. These instruments are lowered to the bottom of the well, and slowly raised to the surface while recording data. Other measuring procedures include the drill stem test, in which pressures are recorded and fluid samples taken from zones of interest. After studying the data from those logs and tests, the geologist and/or petroleum engineer decide if the well will produce petroleum.

If the well did not encounter oil and gas, it is plugged with cement and abandoned. The well pad and access road are recontoured and revegetated.

If the well will produce, casing is run to the producing zone and cemented in place. A proper cementing of the production casing string is required to provide coverage and prevent interzonal communication between oil and gas horizons and usable water zones. Initially, this is accomplished by placement of steel casing from the ground surface to a depth generally ranging between 200 and 1,000 feet. The actual length of this "surface casing" is dependent on factors such as depth of freshwater zones, anticipated formation pressures, and the length of the next smaller casing to be set. The annular space between the borehole and the exterior of the surface casing is required to be filled with cement. Cement is pumped down the casing and around the bottom until cement is returned to the surface outside of the casing. This ensures cement completely fills the annular space and precludes interzonal migration of formation fluids (i. e. , groundwater). Following the placement of surface casing, the hole is drilled deeper and more casing is installed. Cement is placed in a similar fashion to the surface pipe, however, a quantity of cement sufficient to cover and isolate only those zones having hydrocarbons, usable water, or other mineral values.

If the determination is made that water monitoring wells are necessary in a given area, a separate borehole specifically designed as a monitoring well should be completed. Logical placement of a monitoring well would be in a protected location at the edge or just off the well pad (generally 100 to 200 feet from producing well bore). It should be noted also that monitoring wells and other relatively shallow boreholes have often had adverse impacts on the most critical groundwater source because of interzonal flows and introduction of bacteria and other contaminants into the system. The drill rig is usually replaced by a smaller rig that is used for the final phase of completing the well.

Development

If a wildcat well becomes a discovery well (a well that yields commercial quantities of oil or gas), development wells will be drilled to confirm the discovery, to establish the extent of the field, and to efficiently drain the reservoir. The procedures for drilling development wells are about the same as for wildcats, except there is usually less subsurface sampling, testing, and evaluation. If formation pressure can raise oil to the surface, the well will be completed as a flowing well. Several downhole acid or fracture treatments may be necessary to enhance the formation permeability to make the well flow.

When a well is "acidized," this refers to the process of placing acid in the well bore across the productive interval that causes the solution of some of the mineral materials (e. g., calicide, dolorite, etc.), which reside around the pore

space. Upon solution and removal of these minerals, porosity and permeability are enhanced. When a well is hydro-fractured, it simply means fluid, usually gelled water, is pumped down the well, through perforations in the casing and into the formation. Pumping pressures are increased to the point where the formation fractures or breaks, and the sand is added to the injection fluid to "prop-open" the crack once the pressure is released. The pressures required to fracture a given formation is generally quite predictable based on rock type and depth. For some formations, especially coals, abnormally high pressures are required to fracture them.

Pressures, volumes, and rates are all measured and monitored during the fracture process. These parameters provide information as to how the formation is behaving and if the fracture is propagating within the desired interval (i. e., staying in zone). This is especially true in coals, as sustained "high" injection pressure indicates the fracture is moving through the coal.

If pressures fall off, it indicates the fracture has extended beyond the coals and the operation can be halted. In addition to using the foregoing parameters to monitor fracture behavior, other methods for fracture geometry and extent available (e.g., tracer and tiltimeter surveys). Control is maintained throughout the fracture operation.

A free-flowing well is simply closed off with an assembly of valves, pipes, and fittings (called a christmas tree) to control the flow of oil and gas to other production facilities. A gas well may be flared for a short period to measure the amount of gas per day the well can produce, then shut in or connected to a gas pipeline.

If the well is not free-flowing, it will be necessary to use artificial lift (pump) methods. These are explained, along with well production equipment and procedures, in the following section on production. After a pump is installed, the well may be tested for days or months to see if it is economically justifiable to produce the well and to drill additional development wells. During this phase, more detailed seismic work may be run to assist in precisely locating the petroleum reservoir and to improve previous seismic work.

As with wildcat wells, field development well locations will be surveyed. A well spacing pattern must be established by the state, with approval of the BLM. (See Figure A-2).

Oil well spacing for production from Federal leases is usually a minimum of 40 acres. Most gas well spacing for production from Federal leases uses units of 160, 320, and 640 acres per well. Spacing for both oil and gas wells is based on the characteristics of the producing formation. If a field is producing from more than one formation, the surface location of the wells may be much closer than one per 40 acres. Once well spacing has been approved, development of the lease proceeds.

During the development stage, the road system of the area is greatly expanded. Once it is known which wells produce and their potential productive life, a permanent road system can be designed and built. Because it often takes several years to develop a field and determine field boundaries, the permanent road system is usually built in segments. Since the roads in an expanding and developing field are built in segments, many temporary roads (built initially for wildcats or development) end up as long-term (in excess of 15 years) main access or haul roads. The planning of temporary roads for wildcats and development wells is done with road conversion to long term in mind.

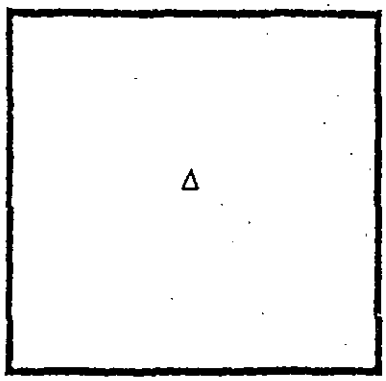
Since development wells have longer life spans than wildcat wells, access roads for development wells are better planned, designed, and constructed. Access roads are normally limited to one main route to serve the lease areas, with a maintained side road to each well. Upgrading of temporary roads may include ditching, draining, installing culverts, graveling, crowning, or capping the roadbed. The amount of surface area needed for roads would be similar to that for temporary roads mentioned earlier, and would also be dependent on topography and loads to be transported over it. Generally, main access roads are 20 to 24 feet wide and side roads are 14 to 18 feet wide. These dimensions are for the driving surface of the road and not the maximum surface disturbance associated with ditches, back cuts, or fills. The difference in disturbance is simply a matter of topography. Surface disturbance in excess of 130 feet is not unusual in steep terrain (slopes exceeding 30 percent).

When an oil field is developed on the current minimum spacing pattern of 40 acres per well, the wells are 1,320 feet apart in both north-south and east-west directions. If a section (1 square mile) is developed with 16 wells, at least 4 miles of access roads are built. In mountainous terrain, the length of access roads may be increased since steep slopes, deep canyons, and unstable soil areas must often be circumvented in order to construct stable access to the wells.

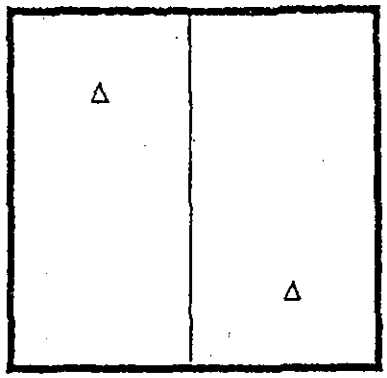
Surface use in a gas field may be similar to an oil field (though usually less) even though the spacing of wells is usually 160 acres. Though a 160-acre spacing requires only four wells per section, the associated pipeline system often has similar initial surface requirements (acreage of surface disturbance).

In addition to roads, other surface uses for development drilling may include flowlines; storage tank batteries; facilities to separate oil, gas and water (separators and treaters); and injection wells for salt water disposal. Some of the facilities may be installed at each producing well site, and others at places situated to serve several wells. These

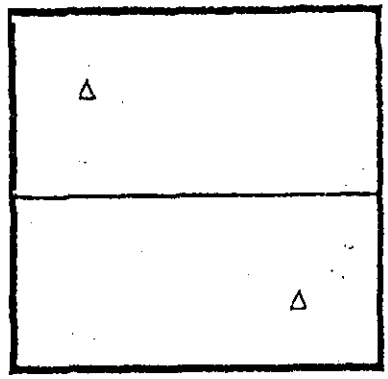
Figure A-2. Oil and Gas Spacing for a Standard 640-Acre Section. Wells must stay at least 200' inside lease boundary line. Δ Ideally spaced well.



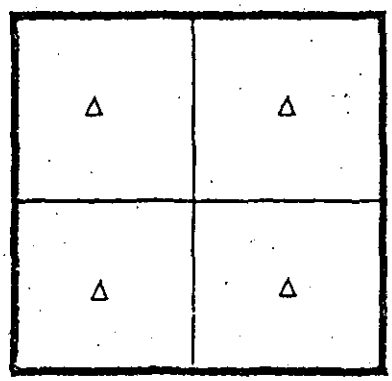
1. 640-acre spacing



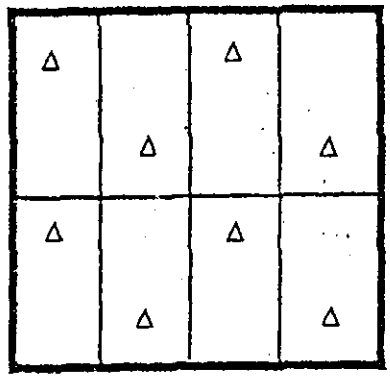
2. 320-acre spacing ("stand-up")



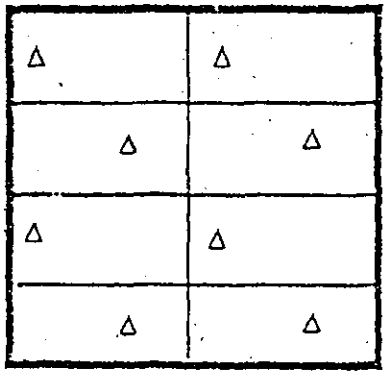
3. 320-acre spacing ("lay-down")



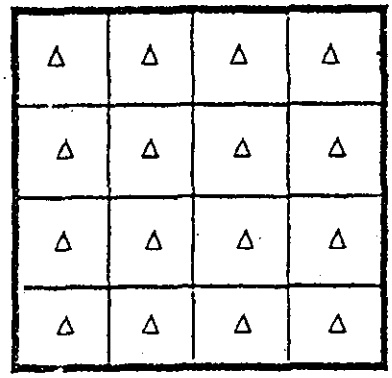
4. 160-acre spacing



5. 80-acre spacing ("stand-up")



6. 80-acre spacing ("lay-down")



7. 40-acre spacing

facilities are discussed more in the following production section.

Surface use in an oil and gas field may be affected by unitization of the leaseholds. In many areas with Federal lands, an exploratory unit is formed before a wildcat is drilled. The boundary of the unit is based on geologic data. The developers unitize the field by entering into an agreement to develop and generate it as a unit, without regard to separate ownerships. Costs and benefits are allocated according to agreed terms.

Unitization reduces the surface-use requirements because all wells are operated as though on a single lease. Duplication of field processing facilities is minimized because development operations are planned and conducted by a single unit operator, often resulting in fewer wells.

The rate of development well drilling depends on whether the field is operated on an individual lease basis or unitized, the probability of profitable production, the availability of drilling equipment, protective drilling requirements (drilling requirements to protect Federal land from subsurface petroleum drainage by off-setting non-Federal wells), and the degree to which limits of the field are known. The most important development rate factor may be the quantity of production. If the discovery well has a high rate of production and substantial reserves, development drilling usually proceeds at a fairly rapid pace. If there is some question whether reserves are sufficient to warrant additional wells, development drilling may occur at a much slower pace. An evaluation period to observe production performance may follow between the drilling of successive wells.

Development on an individual lease basis usually proceeds more rapidly than under unitization, since each lessee must drill his own well to obtain production from the field. On a unitized basis, however, all owners within the participating area share in production of a well regardless of whose lease the well is on. Spacing requirements are not applicable to unit wells. The unit is developed on whatever the operator considers to be the optimal spacing pattern to maximize recovery.

As mentioned earlier, drilling in an undeveloped part of a lease to prevent drainage of petroleum to an offset well on an adjoining lease (protective drilling) is frequently required in fields of intermingled Federal and privately-owned land. The terms of Federal leases require such drilling if the offset well is on non-Federal lands, or on Federal lands leased at a lower royalty rate. Many fields go through several development phases. A field may be considered fully developed and produce for several years, then a well may be drilled to a deeper pay zone. Discovery of a new pay zone in an existing field is a "pool" discovery, as distinguished from a new field discovery. A pool discovery may lead to the drilling of additional wells--often from the same drilling pad as existing wells--with the boreholes separated only by feet or inches. Existing wells may also be drilled deeper.

Usually 4- to 6-inch diameter pipelines transport the petroleum between the well, the treating and separating facilities, and central collection points. These lines can be on the surface, buried, or elevated. Most pipelines in the planning areas are buried.

Trucking and pipelining are the two methods used separately or in conjunction to transport oil out of a lease or unitized area. Trucking is used to transport crude oil from small fields where installation of pipelines is not economical and the natural gas in the field is not economically marketable. It is not practical to truck natural gas.

Pipelines are the most common way to transport oil and gas. If a field has substantial amounts of natural gas, separate pipelines will be necessary for oil and gas. Pipelines move the oil from gathering stations to refineries. As existing fields increase production or new fields begin production, new pipelines may be needed. These new lines usually vary in size from 4 to 16 inches in diameter, and range in length from a few miles to tie into an existing pipeline, to hundreds of miles to supply a refinery. Construction of a pipeline requires excavating and hauling equipment, a temporary and/or permanent road, possibly pumping stations, clearing the right-of-way of vegetation, and possibly blasting.

Natural gas pipelines transport gas from the wells (gathering or flow lines) to a trunk line then to the main transmission line from the area. Flow lines are usually 2 to 4 inches in diameter and may or may not be buried. Trunk lines are generally 6 to 8 inches in diameter and are buried, as are transmission lines which vary in diameter from 10 to 36 inches. The area required to construct a pipeline varies from about 15 inches wide (for a 2- to 4-inch surface line) to greater than 75 feet for the larger diameter transmission lines (24 to 36 inches). Surface disturbance is primarily dependent on size of the line and topography of the area on which the line is being constructed.

Compressor stations may be necessary to increase production pressure to the same level as pipeline pressure. The stations vary in size from approximately 1 acre to as much as 20 acres for a very large compressor system.

Construction techniques for natural gas lines are similar to those used for oil pipelines.

Production

Production in an oil field begins just after the discovery well is completed and is usually concurrent with development operations. Temporary facilities may be used at first, but as development proceeds and reservoir limits are determined, permanent facilities are installed. The extent of such facilities is dictated by the number of producing wells,

expected production, volume of gas and water produced with the oil, the number of leases, and whether the field is to be developed on a unitized basis.

The primary means of removing oil from a well in the planning areas is by pumping jacks (familiar horsehead devices). The pumps are powered by electric motors (powerlines required) or if there is sufficient casinghead gas (natural gas produced with the pumped oil), or another gas source is available, it may be used to fuel internal combustion engines.

Some wells drilled in the area produce sufficient water that must be disposed of during the operation of the well. Although most produced waters are brackish to highly saline, some are fresh enough for beneficial use. If water is to be discharged, it must meet certain water quality standards. Because water may not come from the treating and separating facilities completely free of oil, oil skimmer pits may be established between separating facilities and surface discharge.

Another method of disposing of wastewater is through subsurface injection. In Colorado, injection disposal wells are authorized by the Colorado Oil and Gas Conservation Commission (COGCC) under primacy of the U. S. Environmental Protection Agency. BLM engineers review the proposal for impacts to other minerals and groundwater, but have no approval authority over the well or target zone. When water is disposed of underground, it is always introduced into a formation containing water of equal or poorer quality. It may be injected into the producing zone from which it came or into other producing zones. In some cases, it could reduce productivity of the field and may be prohibited by state regulation or mutual agreement of operators. In some fields, dry holes or depleted producing wells are used for salt water disposal, but occasionally new wells are drilled for disposal purposes. Cement is squeezed between the casing and sides of the well to prevent the salt water from migrating up or down from the injection zone into other formations.

Underground oil is under pressure in practically all reservoirs. This pressure is usually transmitted to the oil through gas or water in the reservoir with the oil. When oil is pumped out of the well, pressure is reduced in the reservoir around the drill hole. This allows the gas or water in the reservoir to push more oil into the space next to the well. A reservoir that has mostly gas pushing the oil is called "gas drive," and one that has mostly water pushing the oil is called "water drive." Oil that is recovered under these natural pressures is considered primary production. Primary production accounts for about 25 percent of the oil in a reservoir.

Methods of increasing recovery from reservoirs generally involve pumping additional water or gas into the reservoir to maintain or increase the reservoir pressure. This process is called secondary recovery. Recently, the trend has been to institute secondary recovery processes very early in the development of a field. Surface disturbance from a water flooding recovery system is similar to drilling and development of an oil and gas well itself; i. e., a drill pad and access road are constructed and water pipelines may be built. Surface use is increased substantially since as many as four injection wells may be used for each oil well in the field (there are many different patterns as well as many other methods of secondary recovery).

Tertiary recovery methods increase recovery rates by lowering the viscosity of the oil either by heating it or by injecting chemicals into the reservoir so that the oil flows more easily. Heating of reservoir oil can be accomplished by injecting steam into the reservoir. Tertiary recovery methods are not yet widely used in this area. By the year 2000, ultimate recovery (including secondary and tertiary recovery) from any given oil reservoir is expected to average 40 percent nationally.

Crude oil is usually transferred from the wells to tank storage facilities (a tank battery) before it is transported from the lease. If it contains gas and water, they are separated before the oil is stored in the tank battery. The treating and separating facilities are usually located at a storage tank battery on or near the well site.

After the oil, gas, and water are separated, the oil is piped to storage tanks located on or near the lease. There are normally at least two tanks; so that one tank can be filling as the contents of the other are measured, sold, and transported. The number and size of tanks vary with the rate of production on the lease, and with the extent of automation in gauging the volume and sampling the quality of the tank contents.

Horizontal Drilling

The recent development of horizontal drilling holds promise of further reductions in disturbance of surface resources and values. Use of directional, horizontal, and multiple-completion drilling technology could further reduce the number of surface locations and provide greater flexibility in siting locations and provide greater flexibility in siting locations. These techniques will also increase production and ultimately lower costs of production.

There are, however, many problems with these techniques yet to be solved before they will come into widespread use. The two most pressing of these problems in Colorado at the moment are interference with spacing patterns and the cost of the opeartions. Most industry experts agree that the latter will be solved through additional experience and some additional technical advances. The problem of spacing patterns for horizontal holes more directly involves Federal and state policy.

Current spacing patterns are based on the most efficient recovery of the resource. Spacing patterns in Colorado are set by the COGCC. Spacing patterns on Federal lands are also set by the COGCC, but with the concurrence of BLM, who has the responsibility for Federal lands. If BLM and state government were to set different spacing patterns, the result would be unsolvable drainage conflicts, lost revenues, and lost resource. It could also mean the drilling of more wells than are necessary as competing companies developed reservoirs under differing jurisdictions.

In Colorado, moset fields are developed on a 40-, 80-, 160-, 320-, or 640-acre pattern (see Figure A-2). Forty acres is the spacing pattern authorized for all unspaced areas. However, most new field operators apply for large spacing based on reservoir characteristics soon after field discovery. The spacing pattern is based on the calculated area of reservoir rock that one well can drain. The calculations are based on conventional (vertical) wells.

Horizontal wells are drilled to the producing formation, or close to it, then proceed horizontally through the producing formation. The advantage of these wells is that much more of the reservoir rock is exposed to the bore hole, and therefore, more product may be produced through one well. In addition, more than one horizontal hole may be extended from the same vertical bore or even from the horizontal portion of the bore, thereby limiting additional surface use. Spacing patterns frequently must be adjusted to permit this type of development.

For example, a field with 40-acre spacing may have one horizontal well drilled in the NW1/4NW1/4 with the horizontal portion running east all the way to the NE1/4NE1/4. This well would penetrate and produce all four of the northern tier of well spaces, thereby eliminating the need to drill three wells. The elimination of the need to drill three wells would require Federal and state approval to circumvent the spacing order. Real life examples may get much more complicated than this one.

In many cases, such as the simple example given above, the oil and gas operator may have to apply for a variance to the state spacing order. Both the BLM and COGCC are committed to working with industry on these problems to take full advantage of the new technology.

Abandonment

The life span of fields varies because of the unique characteristics of any given field. Reserves, reservoir characteristics, the nature of the petroleum, subsurface geology, and political, economic, and environmental constraints all affect the life span of the field from discovery to abandonment. The life of a typical field is 15 to 25 years. Abandonment of individual wells may start early in the life of a field and reach a maximum when the field is depleted.

Well plugging and abandonment requirements vary with the rock formations, subsurface water, well site, and the well. In all cases, all formations bearing useable-quality water, oil, gas, or geothermal resources, and/or prospectively valuable deposits of minerals will be protected. Generally, in a dry (never produced) well, the hole below the casing is filled with heavy drilling mud, a cement plug is installed at bottom of the casing, the casing is filled with heavy mud, and a cement cap is installed on top. A pipe monument giving the location, lease number, operator, and name of the well is required unless waived by the Authorized Officer. If waived, the casing may be cut off and capped below ground level. Protection of aquifers and known oil and gas producing formations may require placement of additional cement plugs.

In some cases, formerly producing wells are plugged as soon as they are depleted. In other cases, depleted wells are not plugged immediately but are allowed to stand idle for possible later use in a secondary recovery program. Truck-mounted equipment is used to plug former producing wells. In addition to the measures required for a dry hole, plugging of a depleted producing well requires a cement plug in the perforated section in the producing zone. If the casing is salvaged, a cement plug is put across the casing stub. The cement pumpjack foundations are removed or buried below ground level. Surface flow and injection lines are removed, but buried pipelines are usually left in place and plugged at intervals as a safety measure.

After plugging, the drilling rig is removed and the surface, including the reserve mud pit, is restored to the requirements of the surface management agency. This may involve the use of dozers and graders to recontour those disturbed areas associated with the drill pad plus the access road to the particular pad. The reserve pit (the part of the mud pit in which a reserve supply of drilling fluid and/or water is stored) must be evaporated or pumped dry, and filled with soil material stockpiled where the site was prepared. There will be little leakage if the pit was lined with plastic or bentonite. The area will be reshaped to a useful layout that will allow revegetation to take place, restore the landform as near as possible to its original contour, and minimize erosion. After grading the subsoil and spreading the stockpiled topsoil, the site is seeded with a grass mixture that will establish a good growth. A fence may be erected to protect the site until revegetation is complete, particularly in livestock concentration areas.

Appendix C

CONDITIONS OF APPROVAL

Introduction

Post-lease operations proposals are reviewed to ensure conformance with the plan. The mitigative measures listed represent the post-lease environmental protection to which BLM is committed as a result of the analysis in the plan/EIS. Note that there is no commitment to the specific wording of a Condition of Approval (COA).

The listed mitigative measures may apply to all oil and gas exploration and development activities and associated rights-of-way. The Authorized Officer will choose among these measures at the field development stage to mitigate or avoid environmental impacts identified on a site-specific basis. When attached to an approval document, the measures are known as COAs. The Authorized Officer is not limited to the list of COAs shown here, but may development others as unforeseen impacts occur as long as the new COAs conform with the limitations of the granted lease rights and the guidance set forth in this plan and subsequent amendments.

COAs are not added to applications if they are unnecessary (do not apply to the case in question) or, are duplicative, as when the mitigative measure is already incorporated in the operator's submittal.

Geophysical Operations

The following guidance is for the development of standards to be attached, as appropriate, to the Notice of Intent (NOI) for geophysical operations at the discretion of the Authorized Officer and in accordance with the resource management plan/environmental impact statement (RMP/EIS) record of decision. The statements below will be used as guidance by BLM field personnel in determining what protective measures will be used on geophysical operations. Only those items pertaining to a given operation will be appended to the NOI, and only if they are not already contained in the proposed plan of operation. A.

A. Notification

If noncompliance with terms and conditions occurs, the operator will be notified by BLM and instructed as to the appropriate action. If the operator fails to take appropriate action, the operator will be subject to enforcement action in accordance with 43 CFR 3163.

Wildfires begun or sighted during seismic operations will be reported immediately to the Canon City Fire Dispatch Office and/or the resource area office of jurisdiction. The operator is liable for the full cost of fire suppression of all fires on or in the vicinity of the project set or caused by his employees, whether set directly or indirectly as a result of operations.

The operator shall notify the Authorized Officer, or his representative at least 48 hours prior to beginning operations.

The operator shall also report progress on a weekly basis until completion. A prework conference may be required.

Immediately upon completion of operations, a Notice of Completion of Oil & Gas Exploration Operations and an updated BLM planimetric map or USGS topographic map showing revisions to the original NOI shall be submitted to the Authorized Officer. The map will be used to perform a final compliance inspection of the exploration area.

A copy of all COAs, along with a copy of the submitted NOI, shall be kept in the field by each seismic crew, for inspection by BLM personnel.

Any exploration greater than one-quarter mile from the proposed seismograph line route filed with the NOI will require prior approval from the Authorized Officer.

B. Cultural Resources

The Programmatic Agreement between the BLM, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, signed February 6, 1987, contains guidance for oil and gas, seismic, and other land use operations. Appendix B of the agreement specifically outlines BLM procedures for both oil and gas APDs and for seismic operations. In addition, guidance is provided in : "Handbook for Cultural Resources Inventory/Mitigation" (Colorado State Office Release 8-13), dated 1990.

In addition to the above guidance, the operator shall immediately bring to the attention of the Authorized Officer any and all antiquities or other objects of historic, paleontological, or scientific interest, including, but not limited to, prehistoric or historic ruins or artifacts discovered as a result of operations. The operator and the Authorized Officer shall consult and determine the best option for avoiding or mitigating site damage.

Operators are also reminded that the removal, injury, defacement, or alternation of any object of scenic, archaeological, historical, or scientific interest is a federal crime and may be punishable by fine and/or jail terms.

C. Threatened, Endangered, and Sensitive Species

An inventory for threatened and endangered plant species is required on any portions of the line or staging areas proposed in known or realistic potential habitat for threatened, endangered, or candidate plant species. A map

will be maintained by the BLM outlining these areas and made available to the public.

D. Construction

All infestations of noxious or poisonous weeds, resulting from surface disturbance caused by the operator, will be controlled before spreading occurs into the surrounding area. Method of weed control will be reviewed by the Authorized Officer prior to commencement.

No dirt work nor clearing of vegetation will occur without specific approval. All merchantable timber and/or firewood shall be purchased by the operator at the total appraised price that is determined by the BLM.

During periods of adverse conditions such as thawing, heavy rains, snow, or flooding, all activities off existing maintained roads that create excessive surface rutting will be suspended. When adverse conditions exist, the operator will contact the Authorized Officer for an evaluation and decision based on soil type, slope, vegetation, and cover.

Drill hole cuttings will be returned to the hole if possible, or at a minimum, raked and spread out so as not to impede regrowth of vegetation or to create erosion problems.

Operations shall be done in a manner which prevents damage, interference, or disruption of water flows and improvements associated with all springs, wells, or impoundments. It is the operator's responsibility to enact the precautions necessary to prevent damage, interference, or disruptions. Vibrator sources will not be operated closer than 300 feet, and large explosive charges, greater than 40 pounds, will not be used closer than 1,320 feet of springs, wells, or impoundments. The Authorized Officer may approve closer source distances if the contractor demonstrates that the resource will be protected.

During periods of adverse conditions caused by climatic factors such as thawing, heavy rains, snow, or flooding, all activities off existing maintained roads that create excessive surface rutting will be suspended. When adverse conditions exist, the operator will contact the Authorized Officer for an evaluation and decision based on soil types, slope, vegetation, and cover.

No fence will be cut unless no other alternative exists. Before cutting through any fences, the operator shall firmly brace the fence on both sides of the cut; a temporary gate will be installed for use during the course of operations unless the fence is immediately repaired. Upon completion of operations, fences shall be restored to at least their original condition.

Activities of the seismic operators shall not prevent, obstruct, nor unduly interfere with any activities of other authorized users of the public lands. Removal or alteration of existing improvements (fences, cattle guards, etc.) is not allowed without prior approval. Fences are to be braced to BLMs standards prior to cutting them.

All debris, such as paper, cans, wire, flagging, or other trash, shall be removed and properly disposed of upon completion. No oil or lubricants shall be drained onto the ground. All vehicles (including drills) will be limited to existing roads, except in approved areas. Improvement of existing roads and trails is not permitted, unless prior approval is obtained.

Water for drilling purposes will not be obtained from federally owned or controlled water sources such as reservoirs and springs unless specific permission is obtained from the Authorized Officer.

Any available information concerning water sands or artesian flows must be reported to the resource area office.

Whenever possible, a portable mud pit shall be used when drilling with fluids.

There will be no straight line of sight dozing. Any path dozed through a timbered area will take an irregular path. Any pushed trees are to be stockpiled adjacent to the line so they are readily retrievable without additional disturbance. All trees are to be pulled and spread back onto the line or access route.

Tall brush, sagebrush parks and open areas: There will be no removal of brush or grass by blading. Brush may be crushed or removed by keeping the blade 6 inches off the ground surface. In open or brush areas, vehicle paths will take an irregular path to discourage line of sight paths.

Improvement of existing roads or trails: Blading will be allowed only if the trail is impassable by vehicles or geophysical equipment. No widening nor realignment will be allowed. Existing trails may have to be reclaimed or closed.

New trails can be constructed only when vehicle and equipment passage is impossible and only with the concurrence of the Authorized Officer. No straight line of sight trails will be allowed. All trails will be reshaped to original contour (including bench cuts). Waterbars will be placed on slopes as directed by the Authorized Officer.

Construction of drainage crossings which cannot otherwise be crossed: Existing fords are to be used if possible. A cut and stockpile process will be used to create a low water crossing or upgrade an existing crossing unless otherwise specified by the Authorized Officer.

E. Explosives

Powder magazine sites on public lands must be approved in writing by the area manager prior to use. The transportation, storage, and use of explosives on BLM surface will be done in accordance with ATF P 5400. 7 (11/82).

F. Rights-of-Way

Access to Federal lands across non-Federal lands is not guaranteed by the government. Permission to enter or cross private, or state-owned lands must be obtained from the landowner(s).

G. Miscellaneous

All personnel (contractors, subcontractors) working in the field with the seismic operator will be familiar with and follow the conditions appended to the NOI.

Helicopters will operate between staging areas and seismic line within corridors and at altitudes that allow safe, efficient, and environmentally sensitive operations. Operating parameters will be determined on a line-to-line basis as mutually agreed by BLM, helicopter operator, and contractor.

Aircraft landing sites on public lands must be approved in writing by the area manager prior to use.

H. Reclamation

All surface disturbance would be recontoured and revegetated according to an approved reclamation plan.

Reclamation of disturbed areas shall be completed, as directed by the Authorized Officer, within 30 days of terminating seismograph work on any line. Delay of reclamation for any reason, such as weather, must be approved by BLM. Adequate vegetative cover (and seed mixture, based on site-specific analysis, to be used) shall be established by the Authorized Officer.

Application for Permit to Drill Operations

The following guidance will be used to develop COAs, which are attached, as appropriate, to approved APDs, sundry notices, or oil and gas related right-of-way actions at the discretion of the Authorized Officer and in accordance with the RMP/EIS record of decision.

This appendix shows the most common COAs used; however, the reader is reminded that COAs are designed for specific operations. In practice, COAs shown below may or may not be used on any given approval document, and other COAs, not specifically stated here, will be written to accomplish the tasks envisioned in this plan. The categories shown below are a good representation of the list of mitigative measures considered by BLM resource specialists for every approved field operation.

A. Notification

In order for BLM inspectors to check the initial construction operations, it is necessary that BLM be notified when construction begins. To help ensure that all parties understand the requirements for construction, the operator must ensure that all employees and subcontractors are adequately aware of the COAs. Examples of such notification requirements are shown below:

The operator or his contractor will contact the approving resource area office 48 hours before beginning any work on public land.

The operator will give the dirt contractor a copy of the Surface Use Plan and any additional BLM COAs before any work begins. A copy of the approved Surface Use Plan will be available onsite for inspection during construction.

The operator or his contractor will contact the approving resource area office 48 hours before starting reclamation work and within 48 hours of completion of reclamation work.

Proper precautions shall be taken at all times to prevent or suppress fires. Range or forest fires will be reported to the BLM district or resource area office. All other fires or explosions that cause damage to property, equipment, loss of oil or gas, or result in injuries to personnel will be reported to the Authorized Officer.

B. Other Agency Approvals

Some operations on public lands affect adjoining private lands and require approval by state, local, or other Federal agencies. It is solely the responsibility of the operator to be aware of these requirements and gain the necessary approvals. Upon notification by another agency of operators' failure to obtain necessary permitting, a notice of noncompliance will be issued and operations may be suspended. In a few cases, BLM wants to make it clear that the "BLM approved" operations may not proceed until such approval is granted. In those cases, a COA is appended to the approved application such as: Use of water for operations will be approved by obtaining a temporary use permit from the Colorado State Water Resources Engineer and by receiving permission from the landowner or surface managing agency to use the land containing the water source.

C. Cultural Resources

The Programmatic Agreement between the BLM, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, signed February 6, 1987, contains guidance for oil and gas, seismic, and other land use opera-

tions. Appendix B of the agreement specifically outlines BLM procedures for both oil and gas APDs and for seismic operations. In addition, guidance is provided in : "Handbook for Cultural Resources Inventory/Mitigation" (Colorado State Office Release 8-13), dated 1990.

In addition to the above guidance, the operator shall immediately bring to the attention of the Authorized Officer any and all antiquities or other objects of historic, paleontological, or scientific interest, including, but not limited to, prehistoric or historic ruins or artifacts discovered as a result of operations. The operator and the Authorized Officer shall consult and determine the best option for avoiding or mitigating site damage.

Operators are also reminded that the removal, injury, defacement, or alternation of any object of scenic, archaeological, historical, or scientific interest is a federal crime and may be punishable by fine and/or jail terms.

D. Threatened, Endangered, and Sensitive Species

The lessee may be required to provide inventory information for certain species if it is determined that inadequate information is available to make appropriate decisions relating to mitigation. These species could involve threatened, endangered, sensitive and/or rare plant or animal species, or other species protected by law or of high interest, such as bighorn sheep lambing areas, elk calving areas, raptors, etc.

Apply "Suggested Practices for Raptor Protection on Powerlines" on all proposed transmission lines to be constructed to ensure they are properly grounded to prevent unnecessary electrocution of raptors.

The locations of all known populations of Colorado BLM sensitive plants and selected high priority remnant vegetation associations would be protected from human-induced surface disturbing activities to the extent such protection does not unduly hinder or preclude exercising valid existing rights. The area of protection will include the actual location of the populations or occurrences of important vegetation associated to receive protection, and shall be determined in consultation and coordination with the Colorado Natural Areas Program (CNAP).

Those populations/occurrences, upon which analysis determines protection to be necessary, shall be protected by: 1) requiring relocation or rerouting of proposed well sites, pipelines, roads, other surface facilities, etc., or 2) applying other protective mitigation (i. e., fencing). BLM will effectively mitigate potential impacts to important populations/occurrences to the degree that existing development rights are not unduly hindered or precluded.

E. Resources (other than Oil and Gas)

Surface-disturbing activities within or adjacent to intermittent or perennial water sources, associated floodplains, and riparian areas will only be allowed where mitigative measures can be employed to protect floodplains, water quality, and riparian values.

Well pads, roads, and facilities will be constructed and maintained to avoid unnecessary impacts to air quality.

Raptor and sandhill crane nests will be protected from human-induced surface-disturbing activities to the extent such protection does not unduly hinder or preclude exercising valid existing rights.

All trees requiring removal shall be disposed of by the operator.

Where earth blading is required, stumps shall be removed and scattered or buried in an area designated by the Authorized Officer. Where earth blading is not required, stump height shall not exceed 12 inches. A wood permit from BLM for the wood removed (for the appraised value) will be required prior to any clearing.

Water wells drilled to provide water for drilling purposes will be approved by, and offered to, BLM for use prior to plugging the water well. Water rights will be held by BLM. The BLM will be notified of any water aquifers encountered during drilling that could be developed for water prior to final plugging of the well.

All operations will be conducted so as not to cause pollution or change the character of streams, lakes, ponds, water holes, seeps, or marshes. This relates directly to damages caused to fish and wildlife resources. Surface disturbance that causes active soil movement will be corrected.

F. Construction

Linear-type facilities such as roads, powerlines, and pipelines shall cohabit and follow a common route unless otherwise approved by the Authorized Officer. Surface disturbance will be minimized.

Well pads, roads, and facilities will be located to minimize visual impacts.

To protect watersheds from accelerated erosion, increased slumping, and increased sediment and salinity loading, all development activities may be curtailed at the discretion of the Authorized Officer during periods when the soil is saturated.

Trash and garbage must be contained in an closed receptacle or in an earthen pit. If an earthen pit is used, it must be covered to prevent contents from escaping. Burning

and/or burying is not authorized. Contents from a trash receptacle or pit must be hauled to an approved county landfill. This pertains to all phases of lease operations.

Surface disturbance and vehicular travel will be limited to the approved location and approved access route. Any additional area needed must be approved in advance.

Above-ground facilities will be painted to blend with the surrounding environment using a specified color from the Rocky Mountain Regional Committee Standard Environmental Color chart.

1. Roads (On Lease)

Existing roads should be used to the extent possible. Additional roads, if needed, shall be kept to an absolute minimum and the location of routes must be approved by BLM prior to construction. On determination of an impending field development, a transportation plan will be requested to reduce unnecessary access roads. Roads will be constructed and maintained to BLM road standards (BLM Manual Section 9113) unless otherwise authorized by the Authorized Officer.

Companies controlling roads that provide access into crucial wildlife areas may be required to close the road with a lockable gate to prevent general use of the road during critical periods of the year when resource problems are experienced (during hunting seasons, winter, etc.). This restrictive measure will be applied where needed to protect wildlife resources or to minimize environmental degradation.

Use of closed road segments will be restricted to legitimate, authorized agents of: 1) the lessee and/or their subcontractor(s), 2) BLM, 3) other agencies with a legitimate need (CDOW, other law enforcement agencies, etc.). Unauthorized use or failure to lock gates during specified time frames by the lessee or its subcontractors would be considered a violation of the terms of the APD or associated grants. This will apply to BLM roads and other roads on public lands.

Improvement or upgrading of existing roads and trails shall conform to the same requirements as the approval APD.

The operator shall regularly maintain all roads used for access to the lease operation. This shall include installation of additional surfacing and surface drainage control structures needed, which was not foreseen during construction.

At cessation of operations, the Authorized Officer will decide which roads will be closed and rehabilitated and which will remain open for public use.

Any access routes previously available to the public will not be unnecessarily blocked off from public use.

Cattle guards heavy enough to handle proposed road traffic will be installed whenever access roads are through pasture gates or fences. These cattle guards shall be maintained on a regular basis to ensure their effectiveness at turning livestock. This includes cleaning out under cattle guard bases when needed.

Improvement to existing access will be necessary and limited to a 14-foot crowned and ditched road surface with turnouts as needed and minimum disturbance of surrounding soil and vegetation (abrupt back-sloped borrow ditch). New construction will be limited to the same specifications as above. Cleared trees and brush along the road right-of-way will be windrowed to the side in convenient clearings. Surfacing material will not be placed on the access road or location without prior BLM approval.

The operator will be required to construct waterbars on abandoned roads and pipeline routes. General guidelines for installation of waterbars are: less than 2-percent grade--200-foot spacing; 4- to 5-percent grade--75-foot spacing; greater than 5-percent grade--50-foot spacing. Unstable soils may require a closer spacing, whereas the spacing may be greater on stable soils and rock outcroppings. The waterbars shall be constructed to drain freely to the natural ground level and to prevent siltation and clogging.

New roads constructed for oil and gas purposes within crucial big game winter range and isolated and/or roadless areas will be reclaimed upon completion of the oil and gas operation.

2. Pads

Selecting Locations for Well Sites, etc. : In planning well sites, tank batteries, sump, reserve and mud pits, and pumping stations, the operator shall select locations that involve the least disruption to scenic values and other surface resources. The operator shall employ construction techniques and design practices, including selection of material, camouflage techniques, and rehabilitation practices that will preserve scenic aesthetic qualities. The following guidelines can be used by operators to assist in minimizing surface disturbance and to aid in the maintenance of the best possible conditions for rehabilitation.

Steep slopes shall be avoided, the site shall be located on the most level location obtainable that will accommodate the intended use.

View the site location as to how it will affect the road location.

What may be gained on a good location may be lost from an adverse access route.

Adjust the site layout to conform to the best topographic situation. Deep vertical cuts and steep long fill slopes should

be avoided. All cut and fill slopes should be constructed to the least percent slope practical.

The top 12 inches of soil material will be removed from the location and stockpiled separately from the trees on the location. Topsoil along the access will be reserved in place.

3. Pits (All)

Excavations used for the permanent impoundment of usable water should be sloped at a 3:1 grade to establish safe access for humans, livestock, and wildlife.

A minimum of 2 feet of free board will be maintained between the maximum fluid level and the top of the berm. These pits will be designed to exclude all surface runoff. The pits will have the maximum volume in cut.

Prior to closure, a randomly selected sample of drilling pits within established fields will be sampled for hazardous materials. In wildcat wells, all pits will be sampled for hazardous materials prior to abandonment, unless specifically exempted by the Authorized Officer. Sampling will be done by an independent contractor agreeable to the operator and Authorized Officer. Testing will be done at a lab with quality control standards acceptable to USGS.

Final written certification is required that there are no hazardous chemicals on the RCRA list left in the drilling fluids within the mud pit. If the operator cannot provide certification, the drilling fluids and pit liner must be disposed at a federally approved hazardous materials site.

Reserve and other containment pits are used during the exploration and/or operation of the lease may require fences and/or other devices to exclude migratory birds, livestock, and/or wildlife. The need and type of protective requirement will be determined on a case-by-case basis.

All pits, cellars, rat holes, and other bore holes unnecessary for further lease operations, excluding the reserve pit, will be back-filled immediately after the drilling rig is released to conform with surrounding terrain. Pits, cellars and/or bore holes that remain on location must be fenced as specified for the reserve pit.

Reserve pit fluids will be allowed to evaporate through the entire summer season (June through August) after drilling is completed, unless an alternate method of disposal is approved. After the fluids disappear, the reserve pit muds will be allowed to dry sufficiently to allow back-filling. The back-filling of the reserve pit will be done so the muds and associated solids will be confined to the pit and not squeezed out and incorporated in the surface materials. There will be a minimum of 3 feet of cover (overburden) on the pit. When the work is complete, the pit area will support the weight of heavy equipment without sinking.

Semi-closed or closed mud systems may be required where conditions warrant. Produced water will be injected, contained in a lined pit, or hauled to a federally approved disposal facility.

Installed pit liners must be impermeable and must be resistant to weather, sunlight, hydrocarbons, aqueous acids, alkalies, salt, fungi, or other substances likely to be contained in the drilling fluids or produced water.

The reserve pit liner will be of sufficient strength and construction to ensure impermeability. The liner will be underlain by a suitable bedding material and other measures taken as needed to protect the integrity of the liner.

A leak detection system will be installed to monitor lined reserve pits. This system must be installed in order to detect liner leakage. The leak detection plan must be submitted to and approved by the Authorized Officer during APD approval. This plan must include the system design including line installation, monitoring plan, and the individual responsible for the required monitoring.

For lined pits, the liner and contents will be buried in place and effectively capped with clay or other impermeable materials, or disposed of in a non-polluting method acceptable to the Authorized Officer.

If air or gas drilling, the operator shall control the blooie line discharge dust by use of water injection or any other acceptable method. The blooie line discharge shall be a minimum of 100 feet from the blow out preventer and be directed into the blooie pit so that the cuttings and waste are contained in the pit.

4. Pipelines

Alignment, siting, and reclamation of pipelines and flowlines should be designed to conform to adjacent terrain and to prevent or minimize vehicular travel. If maintenance is necessary in problem areas, consider use of an all-terrain vehicle (ATV) or snowcat, etc. , in lieu of regular truck. Surface disturbance for pipeline construction would be restricted to the minimum amount necessary, as determined by the Authorized Officer.

Relocation of portions of the line may be necessary to reduce the impact to surface resources.

For associated pipeline rights-of-way, except rights-of-way expressly authorizing a road after construction of the facility is complete, the right-of-way holder shall not use the right-of-way as a road for purpose other than routine maintenance. Necessary routine maintenance will be determined through consultation with the Authorized Officer.

Existing telephone, telegraph, powerlines, pipelines, roads, trails, fences, ditches, and like improvements shall be

protected during construction, operation, maintenance, and termination of an oil and gas facility. Damage caused by such activities shall be properly repaired to a condition satisfactory to the Authorized Officer or the facility owner/operator.

Pipeline routes will be graded to conform to the adjacent terrain, waterbarred, and reseeded.

When clearing is necessary, the width disturbed will be kept to a minimum. Bladed materials shall be placed back into the cleared route upon completion of construction.

Pipeline construction shall not block, dam, nor change the natural course of any drainage. Suspended pipelines will provide adequate clearance for runoff.

Pipeline trenches shall be compacted during back-filling. These trenches will be maintained in order to correct settlement and prevent erosion. Waterbars and other erosion control devices will be repaired as necessary.

Pumping stations shall be kept in a neat and well-maintained condition.

Abandonment and Rehabilitation: Reclamation and abandonment of pipelines and flow-lines may involve replacing fill in the original cuts, reducing and grading cut and fill slopes to conform to the adjacent terrain, replacement of surface soil material, waterbarring, and revegetating in accordance with rehabilitation practices.

Crossing over pipelines owned by other companies shall be accomplished in accordance with an agreement secured with that company.

G. Drilling

Water for drilling purposes will not be obtained from federally owned or controlled water sources such as reservoirs and springs unless specified permission is obtained from the Area Manager.

The BLM will be notified of any water aquifers encountered during drilling that could be developed for water prior to final plugging of the dry hole. Water rights will be held by the BLM.

H. Production

Compaction and construction of the berms surrounding tank batteries will be constructed prior to storage of fluids and designed to prevent lateral movement of fluids through the utilized materials. The berms must be constructed to contain at minimum 120 percent of the storage capacity of the largest tank within the berm. All loading lines will be placed inside the berm.

Surface buildings, supporting facilities, and other structures, not required for present or future operations, shall be removed upon termination of use.

All improvements, including fences, gates, cattle guards, roads, trails, pipelines, bridges, water developments, and control structures will be maintained in a serviceable and safe condition.

Any release of production water on or across the land will need prior approval by the BLM.

Mud, separation pits, and other containments used during the exploration or operation of the lease for the storage of oil and other hazardous materials shall be adequately fenced, posted, or covered. Additional protective measures may be needed to minimize hazards and prevent access to humans, livestock, waterfowl, and other wildlife. The pits should be allowed to dry before back-filling and rehabilitation.

All production and storage facilities must have adequate protection from spills.

The Spill Prevention Control and Countermeasure Plan required by the Environmental Protection Agency must be available for inspection at all appropriate field offices. All spills must be reported to the Authorized Officer.

The reserve pit and that portion of the location and access road not needed for production or production facilities will be reclaimed as described in the reclamation section. Enough topsoil will be kept to reclaim the remainder of the location at a future date. This remaining stockpile of topsoil will be seeded in place using the prescribed seed mixture.

A gate may be required to limit public access during the wildlife winter use periods (December 15 through March 31) when the operator maintains a road open for winter use.

If the well is located within 2,500 feet (one-half mile) of residences, appropriate noise mitigation (i. e. , hospital muffler, vegetation screening, electric motors, etc.) will be employed to ensure adherence to Federal, state, and local noise standards during operation of the well.

Within 60 days of completion of construction, the holder shall provide the Authorized Officer an as-built survey of facilities as constructed.

I. Reclamation

All disturbed areas not needed for lease operations will be revegetated as soon as possible. The operator will re-establish perennial vegetation compatible to surrounding undisturbed vegetation. The plant species to be seeded and the seeding rate will be approved by the Authorized Officer prior to seeding. Successful revegetation will be considered

completed when the percent canopy cover is equal to surrounding undisturbed vegetation. The species considered in measuring percent cover will be those seeded as well as desirable pre-existing species. Undesirable weedy species such as kuchia, cheatgrass, and other noxious weeds will not be included unless otherwise directed by the Authorized Officer. The operator will continue revegetation efforts using any and all cultural methods available until this standard is met.

Noxious weeds introduced because of soil disturbance and reclamation will be treated by methods approved by the Authorized Officer. These methods may include biological, mechanical, or chemical. Should chemical methods be approved, the lessee must submit a Pesticide Use Proposal to the Authorized Officer 60 days prior to the planned application date.

In the event a producing well is developed, the unused disturbed areas surrounding the well location will be recontoured to appropriate confirmation (one which allows lease operations and avoids steep cut and fill slopes) as soon as possible. Some or all of the stockpiled topsoil will be evenly distributed over these recontoured areas. Brush cleared prior to construction of the well site shall be scattered back over the recontoured area.

Mulching of the seedbed following seeding may be required under certain conditions (i. e. , expected severe erosion), as determined by the surface owner/manager.

Surface topsoil-like material, if available, will be stripped from all areas where surface disturbance is necessary and stockpiled in a manner and location that will allow easy replacement. These stockpiles shall be protected from loss. After reshaping the site, soil material should be distributed to a uniform depth that will allow the establishment of desirable vegetation. The disturbed areas shall be scarified prior to replacement of surface soil material.

All disturbed areas will be recontoured to blend as nearly as possible with the natural topography. This includes removing all berms and refilling all cuts. All compacted portions of the pad will be ripped to a depth of 12 inches unless in solid rock.

After revegetation is complete, the stockpiled trees will be scattered evenly over the disturbed areas. The access will be blocked to prevent vehicular access.

Seed certification tags will be submitted to the Authorized Officer for seed used in reclamation.

Prior to abandonment of the facilities authorized by this grant, the holder shall contact the Authorized Officer to arrange a joint inspection of the right-of-way. The inspection will be held to agree on an acceptable abandonment and rehabilitation plan. The Authorized Officer must approve the plan in writing prior to the holder commencing any abandonment and/or rehabilitation activities. The plan may include removal of surfacing material from the road, recontouring, replacement of topsoil, seeding, mulching, etc.

Cut and fill slopes shall be reduced and graded to conform the site to the adjacent terrain. The disturbed sites will be prepared to provide a seedbed for re-establishment of desirable vegetation and reshaped to blend with the natural contour. Such practices may include contouring, terracing, gouging, scarifying, mulching, fertilizing, seeding, and planting.

J. Miscellaneous

On determination by the Authorized Officer of an impending field development, a transportation plan will be required to reduce unnecessary access roads.

Additional site surveys, grading plans, and engineering designs may be required in VRM Class II areas.

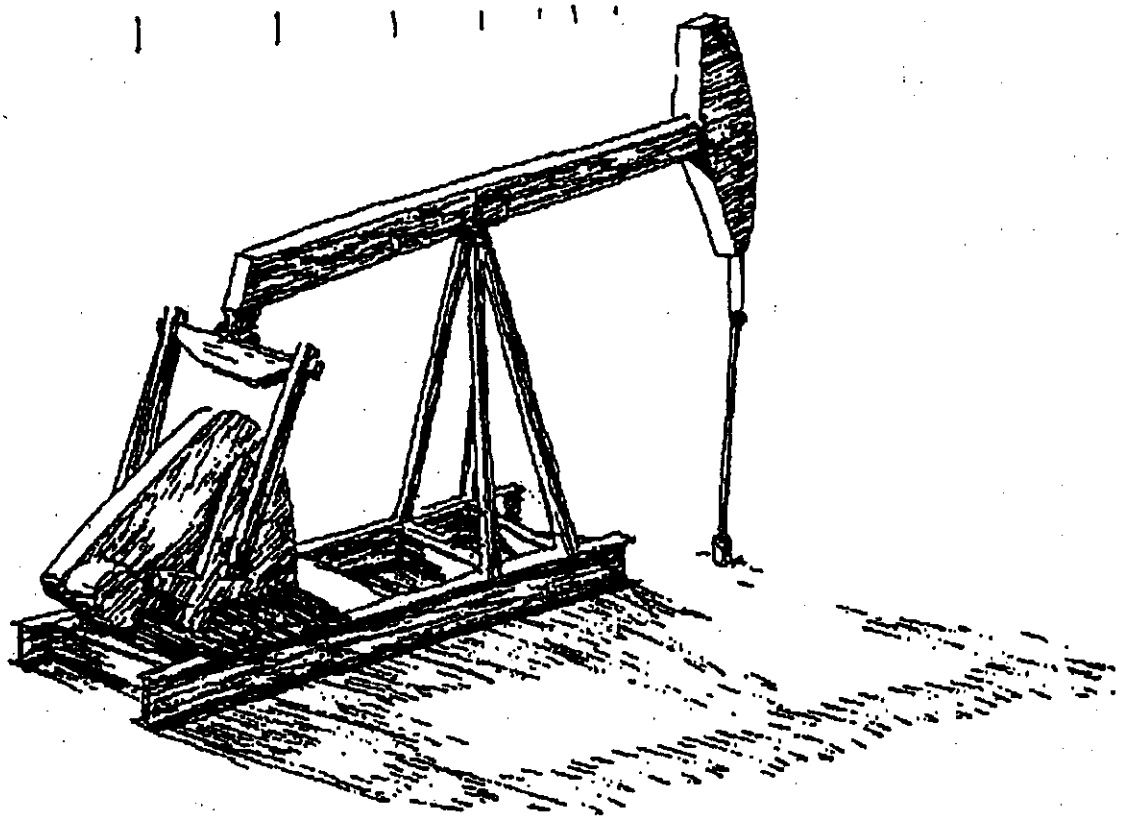
Should additional site-specific environmental analyses at the time of exploration or development reveal the need for additional restrictions or the continuance of existing lease stipulations, these restrictions will become part of the development or operational plan.

All survey monuments, witness corners, reference monuments, and bearing trees shall be protected against destruction, obliteration, or damage. Any markers so affected must be re-established at the lessee's expense in accordance with accepted BLM survey practices defined in the "Manual of Surveying Instructions for the Survey of the Public Lands of the United States."

Burning of solid or liquid wastes usually requires a burning permit. The permit must be obtained from the state air quality agency.

SPECIAL STIPULATIONS

The following stipulations will be added, as prescribed in this plan, to future oil and gas leases on both Federal surface and split-estate lands. The actual wording of these stipulations may be adjusted at the time of leasing to reflect future legislation, court decisions, or policy changes; however, the protection standards in these stipulations would be maintained. Any change to the protection content of the stipulation would require an amendment to the RMP/EIS.



TIMING LIMITATION STIPULATION

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of production facilities.

December 15 to March 31

On the lands described below:

For the purpose of (reasons): Protecting crucial deer, elk, antelope, or bighorn sheep winter range from activities that would cause these species to abandon areas of crucial winter cover and forage for less suitable ranges; San Luis Resource Management Plan (decisions RCO 1-1, 2-1, and 7-1).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that the crucial winter range is (1) not being utilized and is expected to remain in such a condition because of a temporary change in climate and/or habitat, or that (2) impacts can be mitigated to avoid the abandonment of crucial winter cover and forage.

This stipulation may be waived by the Authorized Officer only upon a determination that crucial winter range does not exist within the lease.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

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TIMING LIMITATION STIPULATION

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of production facilities.

February 15 to July 15

On the lands described below:

For the purpose of (reasons): Protecting waterfowl from activities that would alter breeding behavior, increase the incidence of nest abandonment, and decrease breeding success; San Luis Resource Management Plan (decisions RCO 1-2, LUA 4-4)

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that the waterfowl nesting area is (1) not being utilized and is expected to remain in such a condition because of a temporary change in climate and/or habitat, or that (2) impacts can be mitigated to result in the avoidance of nest abandonment and decreased breeding success.

This stipulation may be waived by the Authorized Officer only upon a determination that waterfowl nesting areas do not exist with the lease.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

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Fluid Minerals Management

Serial No.

TIMING LIMITATION STIPULATION

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of production facilities.

May 15 to July 15

On the lands described below:

For the purpose of (reasons): Protecting **pronghorn antelope range** from activities which would force antelope into less suitable range during the fawning season; San Luis Resource Management Plan (decision RCO 1-1).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that the antelope fawning area is (1) not being utilized and is expected to remain in such a condition because of a temporary change in climate and/or habitat, or that (2) impacts can be mitigated to result in avoiding antelope disturbance during fawning season.

This stipulation may be waived by the Authorized Officer only upon a determination that antelope fawning range does not exist within the lease.

for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Appendix C

Serial No.

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting lambing areas selected by bighorn sheep for topography, slope, aspect, and escape cover; San Luis Resource Management Plan (decision LUA 2-2).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that the lambing area is (1) not being utilized and is expected to remain in such condition because of a temporary change in climate and/or habitat, and (2) operations can be conducted, which avoid a change in the topography, slope, aspect, and escape cover.

This stipulation may be waived by the Authorized Officer only upon a determination that bighorn sheep lambing areas do not exist within the lease.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Fluid Minerals Management

Serial No.

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting the scenic and recreational value as well as the physical improvements of the Monte Vista Park; San Luis Resource Management Plan (decision LUA 1-2).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts to the scenic, recreational, and physical improvement values.

This stipulation may be waived by the Authorized Officer only upon a determination that the Monte Vista Park is no longer utilized for recreational purposes.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Serial No.

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting the historic, scenic and recreational values as well as the physical improvements of the **Pike Stockade Historic Site**; San Luis Resource Management Plan (decision LUA 1-2).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts to the historic, scenic, recreational and physical improvement values.

This stipulation may be waived by the Authorized Officer only upon a determination that Pike Stockade Historic Site no longer exists.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Fluid Minerals Management

Serial No.

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting the recreational and scenic values of the **Flat Top SPNM** in its natural setting; San Luis Resource Management Plan (decision LUA 8-2).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts to the recreational, scenic and natural values.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Serial No._____

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting the natural and scenic values of the **Rio Grande River Corridor** ACEC; San Luis Resource Management Plan (decision LUA 9-3).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts to the natural and scenic values.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting residential development within the **Town of South Fork,** Colorado; San Luis Resource Management Plan (decision LUA 1-2).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts to the residential values.

This stipulation may be waived by the Authorized Officer only upon determination that residential development no longer exists within the lease.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Serial No._____

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting recreational and visual resource values within the Cumbres and Toltec ACEC; San Luis Resource Management Plan (decision LUA 10-3).

An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be screened from scenic viewsheds and drill rig and other equipment noises can be eliminated.

No waiver criteria.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date

Fluid Minerals Management

Serial No.

NO SURFACE OCCUPANCY STIPULATION

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description):

For the purpose of: Protecting cultural resource values within the 200-acre Folsom Site, within the Sand Castle ACEC; San Luis Resource Management Plan (decision LUA 3-4).

No exception nor waiver criteria.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

Form #/Date