Reasonably Foreseeable Development Scenario for Oil and Gas

Fishlake National Forest

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SUMMARY

A reasonably foreseeable development scenario for oil and natural gas is developed for the Fishlake National Forest based on the assumption that all potentially productive areas can be open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation or executive order. It covers a time period of 15 years and includes all lands within the Forest boundaries regardless of ownership and adjacent non forest lands where oil and gas activity may impact Forest lands.

Several defined oil and gas plays cover parts of the area of interest but exploration of Forest lands has been minimal. The Covenant Oil Field on BLM lands is approximately 4 miles west of the Richfield Ranger District and its discovery in 2004 greatly increased interest in the oil and gas potential of the surrounding area including parts of the Fishlake National Forest. Few wells have been drilled on Forest lands and only one oil and gas lease currently exists.

Oil and gas occurrence potential in the eastern part of the Fillmore Ranger District and the northern part of the Richfield Ranger District is rated as high with a high degree of certainty based on identified plays and established production in the Covenant Field and in Cretaceous reservoirs in Carbon and Emery Counties. Other parts are rated as having only moderate or low potential for oil and natural gas occurrence. The south central part of the Forest has a low potential for oil and natural gas occurrence but may have a high potential for carbon dioxide gas occurrence.

The Forest area with the highest oil and gas development potential is the eastern part of the Fillmore Ranger District and the extreme northern part of the Beaver Ranger District. This rating is based on the discovery of the Covenant Field and the currently high lever of interest in the Sevier Frontal Zone Play. The eastern part of the Fremont River Ranger District is also rated as having a high development potential based largely on the Permo-Triassic Unconformity Play (including the nearby Upper Valley Oil Field) but questions concerning source rocks, migration paths and timing, carbon dioxide gas flushing and the results of previous exploration efforts detract from this area. The northeastern part of the Richfield Ranger District has moderate potential for gas development resulting from Cretaceous sandstone and coalbed methane plays and current production in Emery and Carbon Counties. Remaining parts of the Forest are rated as having low potential for development based on hypothetical plays, carbon dioxide flushing and results of previous exploration efforts.

A baseline reasonable foreseeable development scenario projects 45 exploration wells (3 wells each year) for the Forest during the next 15 years. These exploration wells may result in the discovery of two new oil or gas fields. One of these will likely be in the Sevier Frontal Zone Play and like the Covenant Field will contain 10 development wells.

The other field may be similar to the Upper Valley Field in the Dixie National Forest but consisting of 20 development wells. This scenario projects a total of 73 wells during the next 15 years.

Total gross disturbance from oil and gas exploration and production operations is projected to be 1,420.9 acres. At the end of the 15 year analysis period net disturbance is estimated to be 573.0 acres.

INTRODUCTION

The recently signed Memorandum of Understanding (MOU) between the Bureau of Land Management (BLM) and the Forest Service (FS) states that BLM has sole responsibility to provide Reasonably Foreseeable Development Scenarios (RFD) for oil and gas leasing on National Forest System (NFS) lands, if requested, and outlines what should be included in the RFD. The MOU further states that the RFD will follow the Interagency Reference Guide "Reasonably Foreseeable Development Scenarios and Cumulative Effects Analysis". Following this, the BLM Utah State Office and the Fishlake National Forest are preparing a RFD for oil and gas for the Fishlake National Forest (FNF).

The RFD will draw heavily from the report "*The Oil, Gas, Coalbed Gas, Carbon Dioxide, and Geothermal Resources of the Fishlake National Forest, Southwestern Utah"* prepared by the Utah Geological Survey (UGS, 2004) and an addendum (UGS, 2005), but will include some additional resource information. It will be consistent with BLM Handbook 1624-1 and BLM Instructional Memorandum (IM) 2004-089 as well as The Interagency Reference Guide. IM 2004-089 requires that the RFD project a baseline scenario of activity assuming all potentially productive areas are open to leasing under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation or executive order. The RFD Scenario presented here is a reasonable, technical, and scientific estimate of anticipated oil and gas activity using the best information currently available. The baseline scenario will be adjusted according to each alternative developed in the planning process in order to determine cumulative impacts from oil and gas activity.

The FNF includes four separate but closely spaced areas consisting of the Fillmore, Beaver, Richfield and Fremont River Ranger Districts (RDs). It should be noted that the recently designated Fremont River RD includes the old Loa RD of the FNF as well as the former Teasdale RD of the Dixie NF. The baseline scenario will be for all lands, regardless of ownership, within all RDs and a reasonable distance outside their boundaries where the cumulative effects of oil and gas activity may impact FNF lands and for a time period of 15 years.

DESCRIPTION OF GEOLOGY

The Utah Geological Survey report referenced above gives a detailed description of the general geology of the FNF and surrounding area. A brief summary is given here and the interested reader is referred to the referenced UGS reports (2004, 2005), Stokes (1987) and Hintze (1988) for more detailed discussions of geological relationships.

The FNF covers parts of three physiographic provinces, from west to east, the Basin and Range, Basin and Range/Colorado Plateau Transition Zone and the Colorado Plateau (UGS, 2004). With elevations generally exceeding 6,000 feet the FNS includes mostly mountain ranges and high plateaus (Tushar, Pavant and Canyon ranges and the Sevier, Fishlake and Wasatch plateaus). The intervening valleys contain BLM, Private and State of Utah lands.

Stratigraphy, Source Rocks and Reservoirs

Figure 1 shows the general stratigraphy in the area of interest. Although not listed in Figure 1, most of south central Utah is underlain by Early Proterozoic metamorphic rocks which are overlain by a typical Cambrian sequence of basal sandstone, shale and carbonate rocks. Farther south, rocks of Late Proterozoic age are present and contain potential petroleum source rocks. Carbonate rocks of Ordovician and Silurian age are present in the northwestern part of the area but are absent in other parts where a major unconformity separates Cambrian and Devonian age rocks. Early Devonian rocks are present in the northwestern part of the area but thin rapidly to the east and south. Middle and Late Devonian rocks present throughout most of the area were deposited in a shallow marine environment near a fluctuating shoreline.

Marine conditions existed in the FNF area during the Mississippian Period when the Redwall Limestone was deposited. This limestone and dolomitized limestone unit, approximately 800 feet thick under the Wasatch Plateau, has good reservoir characteristics in some areas and has been a major producer of oil and gas at the Lisbon Field in northern San Juan County, Utah. Organic-rich and phosphatic units of Mississippian age in western Utah and eastern Nevada have been recognized as promising petroleum source rocks (Sandberg and Gutschick, 1984). During late Mississippian time, the sea retreated and a regolith of reddish soils formed on the exposed limestone. Early Pennsylvanian seas transgressed the area resulting in a significant unconformity separating the upper Mississippian regolith and lower Pennsylvanian shallow marine sediments. Later, the marine Callville Limestone was deposited in the western part of the FNF area while the eastern part remained a positive area. The entire FNF area was exposed to erosion during latest Pennsylvanian time. As a result of the repeated transgressions and regressions, rocks of Pennsylvanian age show considerable variations in thickness ranging from zero to 500 feet. Crustal instability continued throughout the Permian Period producing a series of eastward marine transgressions and subsequent withdrawals across the area of interest. Major Permian units include, in ascending order, Pakoon Limestone, Cedar Mesa Sandstone, Toroweap Formation and Kaibab Limestone (Black Box Dolomite in Figure 1). The Kaibab Limestone has been a prolific oil producer at the Upper Valley Field in Garfield County.

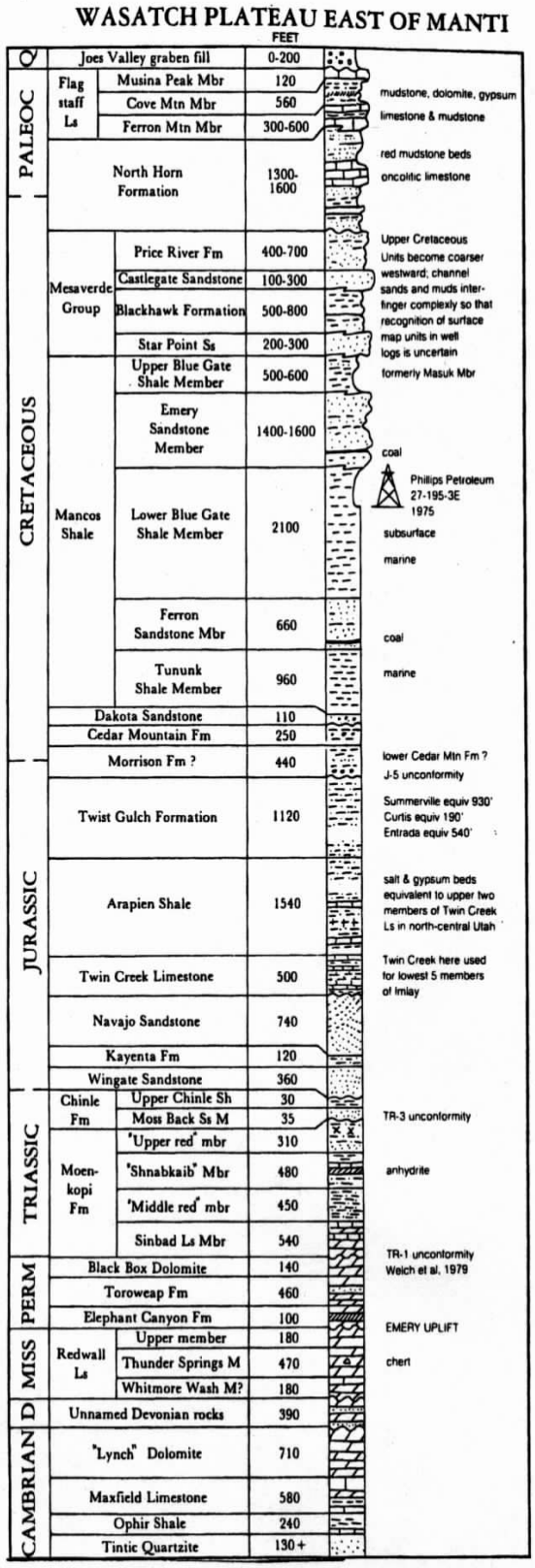


Figure 1. Representative Stratigraphic Column. From Hintze, 1988.

The Kaibab Limestone is unconformably overlain by the Moenkopi Formation of Triassic age which consists of as many as four members in south central Utah including limestone and generally red siltstone and fine-grained ripple-marked sandstone. The clastic units represent fluvial material deposited in a flood plain to tidal flat environment. Hydrocarbons have been produced from Moenkopi reservoirs in the Virgin, Upper Valley and Grassy Trail fields. A major unconformity separates the Moenkopi from the Late Triassic Chinle Formation which consists of continental red-bed deposits. The lower part of the Chinle is named the Shinarump Member and represents discontinuous channel deposits cut into the upper part of the Moenkopi. It possesses good reservoir characteristics in some areas. The upper, Petrified Forest Member contains colorful mudstones and muddy sandstones of continental origin. The thick Jurassic section includes, in ascending order, the Wingate, Kayenta, Navajo, Twin Creek, Arapien, Entrada, Curtis, Summerville and Morrison formations but all units may not be present at a given location and they vary considerably in thickness. Figure 1 includes the Entrada, Curtis and Summerville formations as the Twist Gulch Formation. Several of the units are eolian sandstones (Wingate, Navajo and Entrada) exhibiting spectacular cross-bedding at certain locations and formed in arid coastal environments. The Twin Creek Limestone, Arapien Shale, Curtis and Summerville formations represent shallow marine environments. Wolverine Gas and Oil's discovery of oil in the Navajo Sandstone at the Covenant Field in 2004 sparked a revival of leasing and exploration activity in the area surrounding and including parts of the FNF and discoveries of gas in the Wingate and Entrada formations at Flat Rock and Peter's Point fields have increased interest in the Jurassic eolian sandstones as exploration targets. The Twin Creek Limestone is hydrocarbon-bearing in the Utah-Wyoming Overthrust Belt in northeastern Utah and southwestern Wyoming.

Rocks of Cretaceous age in south central Utah occur in two basins separated by an east-west trending salient where Cretaceous rocks are absent (UGS, 2004, p.15). This salient underlies the southern part of the FNF and the following summary applies to stratigraphic relationships within the northern basin where fluctuations of the Cretaceous shoreline resulted in east-west facies changes. The oldest Cretaceous unit is the Cedar Mountain Formation which is overlain by the Dakota Sandstone. The two units represent changing fluvial and marine environments that existed as the Cretaceous seas transgressed the region. The thick Mancos Shale overlies the Dakota Sandstone and includes, from oldest to youngest, Tununk Shale, Ferron Sandstone, Lower Blue Gate Shale, Emery Sandstone and Upper Blue Gate Shale. The shale members were deposited during periods of maximum transgression whereas the two sandstone members represent regressive cycles. The Mesaverde Group represents the youngest Cretaceous sediments in the northern basin. The lowermost units of the group consist of nearshore marine sandstones which grade upward through paludal and alluvial plain deposits into coarse-grained alluvial fan deposits. The shifting marine shoreline during Cretaceous time resulted in coal formation in several different units (Dakota Sandstone, Ferron Sandstone, Emery Sandstone and lower Mesaverde) which, along with associated carbonaceous shales, served as source rocks for the widespread gas occurrences in the area north and east of FNF.

Sedimentary rocks of Tertiary age are thickest in the northern part of FNF where the units (North Horn, Colton, Green River and Flagstaff formations) represent fluvial and lacustrine sedimentation. Some of these rocks are hydrocarbon bearing in the Uinta Basin north and east of FNF but have not been attractive targets in the forest area proper. A period of uplift and erosion followed deposition of Eocene Strata and preceded Oligocene and lower Miocene volcanic activity. The Marysvale Volcanic Field covers a large area in the southern part of the FNF and consists largely of local accumulations of lava and volcanic debris flows that formed several stratovolcanos (Hintze, 1988). The original volcanic structures have been modified by later faulting and erosion but according to Hintze (1988, p. 67) thicknesses are in the 6,000 feet range. The presence of the large volcanic pile has discouraged exploration for oil and gas resources in the area and heat resulting from the activity acting on carbonate rocks in the subsurface may be the source of carbon dioxide gas encountered in some wells (Anonymous, 1984).

Structure

The eastern portion of the FNF is characterized by typical Colorado Plateau structures with gently warped strata cut in places by high angle normal faults. Deformation generally increases to the west in the Colorado Plateau/Basin and Range Transition Zone and Basin and Range Province. The Sevier fold-and-thrust belt near the central part of the FNF area is of special interest because the frontal zone of the belt contains numerous structures capable of trapping hydrocarbons. This belt is a linear group of closely spaced thrust faults and related folds that extends from the Las Vegas, Nevada area to the Idaho state line (Armstrong, 1968) and is a segment of the larger Cordilleran retroarc fold-and thrust belt which formed during late Mesozoic through Eocene time and extends northward into Canada (DeCelles and Coogan, 2006). In central Utah the Sevier belt consists of the Canyon Range, Pavant, Paxton and Gunnison thrust systems, which together, accommodated at least 220 km of total crustal shortening (DeCelles and Coogan, 2006). The Canyon Range thrust is exposed in the Canyon Range mountains, the Pavant sheet in both the Canyon Range and Pavant Range mountains whereas the two deeper thrust systems are not exposed in the FNF area.

Summary of Oil and Gas Plays

A play is defined as an area of known or suspected oil and or gas accumulations sharing similar geologic, geographic, and temporal properties, such as oil/gas source rocks, migration pathways, timing, trapping mechanisms, and oil/gas (hydrocarbon) type. The geographic limit of each play represents the limits of the geologic elements that define the play.

Several oil and gas plays described by the U. S. Geological Survey (USGS) or the Utah Geological Survey (UGS) extend into the FNF area and are listed below.

USGS 1995 National Assessment Plays:

1902- Late Paleozoic Play (hypothetical).
1907- Sevier Frontal Zone Play (hypothetical when defined).
2052- Emery Play (Ferron Sandstone coalbed gas).
2106- Permo-Triassic Unconformity Play.
2107- Cretaceous Sandstone Play.
2403- Late Proterozic and Cambrian Play (hypothetical).

USGS 2003 Uinta-Piceance Basin Assessment*:

502001- Ferron/Wasatch Plateau Total Petroleum System.
502002- Mesaverde Total Petroleum System.
502003- Mancos/Mowry Total Petroleum System (?).
502004- Phosphoria Total Petroleum System (?).

*Only those Petroleum Systems that include the southern Wasatch Plateau are listed.

UGS 2004 Fishlake National Forest Report:

2100- Cretaceous Coalbed Gas Plays.
2108- Paleozoic Devonian through Pennsylvanian Play.

USGS PLAYS (1995)

The Late Proterozic and Cambrian Play (2403) is a hypothetical play based on the discovery of shales rich in organic carbon in the Late Proterozic Chuar Group in the Grand Canyon. These potential source rocks extend into the subsurface of southern Utah and the play, as defined, covers the southern part of the FNF. Potential reservoirs are siltstones within the Chuar group, basal Cambrian sandstones and possibly other Paleozoic units. Tests of these units in The Circle Cliffs and Kaiparowits Basin encountered carbon dioxide gas but no hydrocarbons.

The Permo-Triassic Unconformity Play (2106) is so named because all known accumulations, shows and oil staining are associated with this unconformity, either above or below. The play covers a large area including the southern and eastern parts of the FNF. Several potential source rocks of Precambrian and Paleozoic age have been recognized but no single one has been positively identified with this play and reservoirs include the Kaibab Limestone (Permian) and the Timpoweap member of the Triassic Moenkopi Formation. The discovery of the Upper Valley field in Garfield County in 1964 stimulated a period of exploration in the area which yielded numerous oil shows but no other commercial production. Several wells drilled in the 1980s south of the FNF encountered carbon dioxide gas in reservoirs above and below the unconformity.

The hypothetical Late Paleozoic Play (1902) covers the extreme southwestern portion of FNF and is based on the possibility of reservoirs, traps and seals in upper Paleozoic units in western Utah. Sparse exploration drilling to date has not produced promising results. The Sevier Frontal Zone Play (1907) was defined as a hypothetical play in the 1995 assessment but has since been confirmed by several productive wells drilled by Wolverine Gas and Oil near the southern end of the play. The play area includes the deformed area near the leading edge of the Sevier Fold and Fault Belt. Production to date has been only from the Navajo Sandstone of Jurassic Age but other units may also be productive in some of the other structural traps in the zone. Little FNF land is included in this play.

The Cretaceous Sandstone Play (2107) includes the southeastern part of FNF on the Wasatch Plateau. Potential Reservoirs in this play include the Ferron Sandstone, marine and deltaic sandstones in the Mesaverde Group and Mancos Shale as well as the deeper Dakota Sandstone. All of these reservoirs have been productive north of the FNF on the Wasatch Plateau and in the Uinta Basin. Closely associated with the Cretaceous Sandstone Play is the Wasatch Plateau-Emery Play (2052), a coalbed gas play based on coals in the Ferron Sandstone Member of the Mancos Shale. These coals have produced large volumes of gas in the Drunkards Wash, Helper and other fields in Carbon and Emery Counties.

All of the above plays were defined in the USGS 1995 National Assessment of United States Oil and Gas Resources (USGS, 1995). An updated assessment of resources in the Uinta–Piceance Basin of Utah and Colorado was published in 2003 and included the Wasatch Plateau which extends into the southeastern part of the FNF (USGS, 2003).

USGS PLAYS (2003)

The Phosphoria TPS (502004) includes all those occurrences inferred to have been derived from the Phosphoria Formation, and in some cases, older Paleozoic source rocks. The TPS was divided into two assessment units one of which (50200402) underlies the

northwestern corner of the Richfield RD. Several fields north and east of FNF are tentatively assigned to the assessment unit including Grassy Trail Creek, Flat Canyon, Ferron, Greater Cisco, Bar X and San Arroyo. Reservoirs are mostly clastic units of Mesozoic age.

The Mancos/Mowry TPS is based on hydrocarbons generated in organic-rich zones in the Mowry Shale and the lower part of the Mancos Shale. Two assessment units are defined in Utah: Uinta Basin Continuous AU (50200362) and Uinta-Piceance Transitional and Migrated AU (502003363) neither of which includes FNF lands although some FNF lands are inside the TPS boundary. A pod of more mature source rock does occur near the base of the Mancos Shale, however, a short distance north of the Richfield RD (USGS, 2003). Gas generated in the Mancos/Mowry TPS have been produce mostly from reservoirs of lower Cretaceous and upper Jurassic ages.

Two Mesaverde TPS assessment units cover the southern Wasatch Plateau area and include the northeastern part of the Richfield RD. The two AUs are the Uinta-Piceance Basin Conventional Gas AU (50200201) and the Uinta Basin Blackhawk Formation Coalbed Gas AU (50200281). The former includes those areas were migrated gas is produced or has the potential to be produced from reservoirs in conventional structural and stratigraphic traps with discrete gas-water contacts. Reservoirs are primarily fluvial channel sandstones in the upper parts of the Mesaverde Group and the overlying Wasatch Formation. The latter AU relates to coalbed gas in coals within the Emery Sandstone Member of the Mancos Shale. The two AUs cover the same lands in the FNF.

The Ferron/Wasatch Plateau TPS (502001) includes most of the Wasatch Plateau with the eastern boundary being located a short distance west of outcrops of the Ferron Sandstone. The western boundary was drawn to include that area where Ferron coals are known or expected to exist and the southern boundary follows the known southern extent of the Ferron. This area includes the northeastern part of the Richfield RD. The TPS is divided into several AUs based on gas sourced by and contained within the coalbeds themselves, four of which are inside the Richfield RD, and one broader AU (50200101) where the coal derived gas has migrated into sandstone reservoirs and exists in conventional structural and stratigraphic traps.

UGS PLAYS (2004)

Utah Geological Survey Play 2108 (Paleozoic Devonian-Pennsylvanian Play) is based on oil shows and small amounts of production from mid paleozoic reservoirs (primarily the Redwall and Callville limestones). The play is subdivided into oil and gas and carbon dioxide plays. The only FNF lands in the oil and gas part of the play are in the extreme eastern part of the Richfield RD.

The UGS Cretaceous Coalbed Gas Plays (2100) is based on coalbed source rocks and reservoirs in the Emery and Ferron sandstones in the Wasatch Plateau area of the Richfield and Fremont River RDs. It is equivalent to the Uinta Basin Blackhawk Coalbed Gas AU (Mesaverde TPS) and the Conventional Ferron Sandstone Gas AU (Ferron/Wasatch TPS) described above.

As noted above UGS (2004) subdivided their play 2108 into a hydrocarbon portion and a carbon dioxide portion. They similarly show the same carbon dioxide area, which includes most of FNF, within USGS (1995) plays 2106 and 2403. This is based on the existence of several wells in the central and southern part of the state that encountered carbon dioxide gas in Paleozoic and lower Mesozoic Reservoirs and is usually attributed to flushing of oil and gas by carbon dioxide gas generated by volcanic heating of carbonate rocks during the Tertiary (Anonymous, 1984). At this point, too few wells have been drilled in this large area to definitively show which areas have been flushed and how efficient the flushing process has been.

PAST AND PRESENT OIL AND GAS EXPLORATION ACTIVITY

An undocumented map in BLM files indicates that several seismic surveys have been conducted in the FNF and surrounding areas. The majority of these surveys on FNF lands were in the eastern Richfield, Fremont River and Fillmore RDs. Very few are shown in the Beaver and southwestern Richfield RDs. The discovery of the Covenant Oil Field in 2004 led to renewed seismic activity in the general area but mostly on BLM, Private and State of Utah lands (UGS, 2005, p.14).

The FNF has not been a hot bed of exploratory drilling. UGS (2004) stated that 21 wells were drilled in the FNF between 1952 and 1984 and that none were drilled after 1984. Most, or all, of the wells were located in the eastern Richfield and the Fremont River RDs. There have been no discoveries on the FNF resulting in a success ratio of zero percent. If BLM, Private and State of Utah lands separating the RDs and a narrow surrounding area are included (approximately 10,000 square miles total), the total becomes 168 wells (IHS Energy Data, 2006) which equates to 0.6 well/township. One hundred and fifty six wells were drilled before discovery of the Covenant Field in 2004 which represents a success ratio of 0.6 percent. Figure 2 is a graph showing the number of wells permitted/year since 1947 in the forest and surrounding area. The number ranges from zero to a high of 14 wells in 1981. The graph indicates three periods of relatively increased activity: mid 1950s, late 1970s/early 1980s, and the present time. The average number of wells permitted each year between 1947 and 2004 was 2.74.

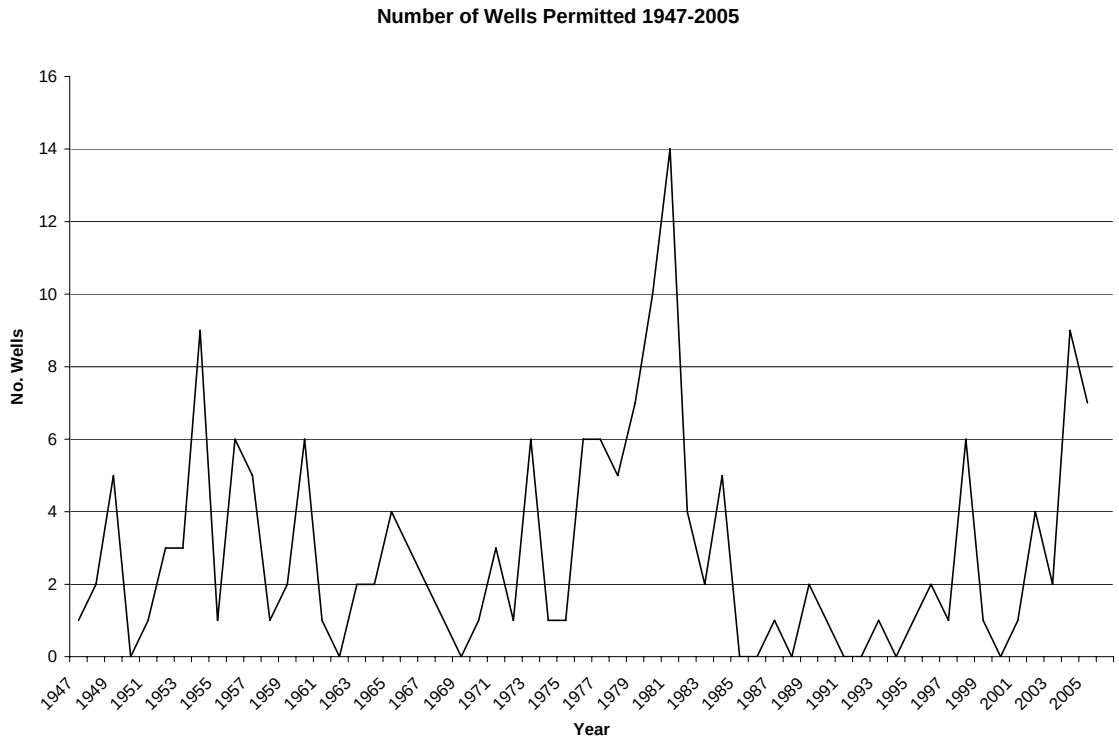


Figure 2. Number of wells permitted each year; 1947-2005. Data are from IHS Energy.

There have been no discoveries inside the FNF and the only discovery in the immediate area is the Covenant Field (2004). This field is in the Wolverine Federal Exploration Unit which extends for 40 miles along the northwestern boundary of the Richfield RD.

PAST AND PRESENT OIL AND GAS DEVELOPMENT ACTIVITY

There is currently one active oil and gas lease within the FNF. Four state oil and gas leases totaling 701.7 acres were transferred to the FNF as a result of the "Utah Schools and Land Exchange Act of 1998" but all but one have since terminated. The remaining lease, now identified as U-78183, includes all of section 32, T. 24 S., R 2 W., 301.7 acres and is held by production in the Wolverine Unit. However, based on the steep slopes and lack of access to this area it is not reasonably foreseeable that it would be occupied for drilling or other facilities. Wolverine has no current plans to drill in this area (personal communications Paul Spiering, Wolverine, 02/06/2007). Most of the BLM lands in the valleys separating the FNF RDs are under lease and it is presumed that the same applies to Private and State of Utah lands. Map 4 shows authorized Federal leases near FNF. Many of the leases on BLM lands are within or near the Sevier Frontal Zone Play (USGS 1907). Map 5 shows townships within the FNF where lands were nominated for oil and gas competitive leas sales during 2005 and 2006. The Wolverine Unit was established in 2003 and the Covenant Oil Field was discovered by the first unit obligation well, the Kings Meadow Ranches 17-1 located in the SENW of section 17, T. 23 S., R. 1 W. Ten

additional wells were drilled on the identified structure with nine of them

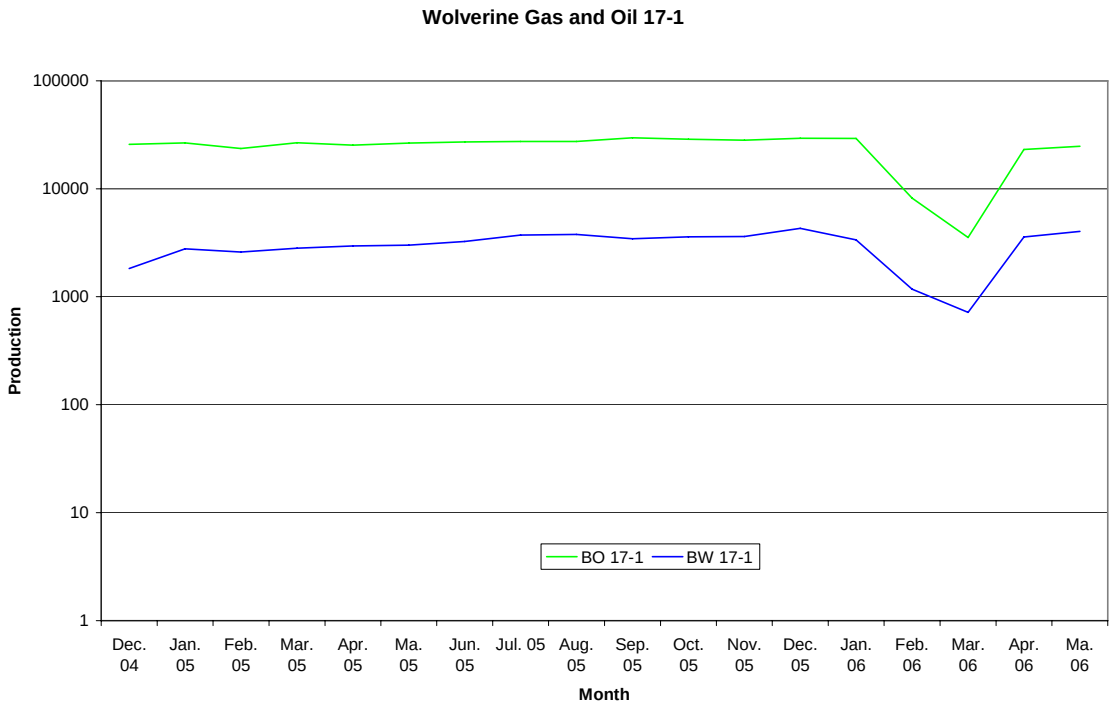


Figure 3. Wolverine Gas and Oil 17-1 well production history from December, 2004 through May, 2006. Production data are from Utah Division of Oil, Gas and Mining.

becoming producers. Participating Areas consisting of 160 acres have been established for each well. The discovery well and the first development well (Covenant 17-2) were vertically drilled whereas the other development wells were all directionally drilled from the two existing pads. All production is from the Navajo Sandstone of Jurassic age and totaled 1,850,232 BO, 0 MCFG and 263,285 BW through May 2006 (Utah Division of Oil, Gas and Mining). Figure 3 shows production history for the Wolverine 17-1 well which indicates no decline in the first 17 months of production except when shut in. Production depths are in the 6,000-6,500 feet range (TVD). None of these wells are on FNF lands but this field is likely representative of any future fields discovered in the Sevier Frontal Zone Play.

OIL AND GAS OCCURRENCE POTENTIAL

A large portion of the FNF is within the boundaries of the BLM Richfield Field Office (RFO) and was included in the RFD developed for that area in 2005 following guidance in BLM IM 2004-089. This RFD included a discussion of the USGS plays discussed above and all other available resource information. Only one of the USGS and UGS plays has produced in the immediate vicinity of the FNF (Covenant Field in USGS Play

1907). Gas production from Cretaceous sandstones and included coal beds (USGS plays 2107 and 2052) has occurred north and east of the forest in Emery and Carbon Counties.

Some of the assessment units in the Mancos/Mowry, Mesaverde and Ferron/Wasatch Plateau TPSs have been prolific producers in the Uinta Basin northeast of the FNF. The Upper Valley Oil Field (USGS Play 2106) on the Dixie National Forest approximately 35 miles south of the FNF has produced over 25 million barrels of oil and small amounts of gas from Kaibab and Moenkopi reservoirs. The South Last Chance Field located 12miles east of the Fremont River RD also tested gas from the Moenkopi but has no production history because it has no pipeline connection (Jackson, 1993). USGS plays 1902 and 2403 are both hypothetical and remain unproductive. Flushing of oil and gas in Paleozoic and Mesozoic reservoirs by carbon dioxide gas has impacted occurrence potential in some areas but the extent of flushing in the various units is not well defined. The Hamilton Brothers 1-1 well (NESW section 1, T.27 S., R.3 E.) encountered significant amounts of carbon dioxide gas in the Kaibab Limestone and lesser amounts in deeper Paleozoic formations and the Shell Oil Company 1-10R Harvey-Federal well (NWNW section 10, T. 32 S., R. 1 E.) tested carbon dioxide gas from the Shinarump. Farther to the east in T.32 S., R. 3 E. three wells drilled by Mid Continent Oil and Gas in the 1980s tested significant amounts of carbon dioxide gas from Permian and Mesozoic reservoirs.

Map 3 shows estimated oil and gas occurrence potential in the FNF and surrounding area using occurrence potential and certainty ratings as defined in Appendix A of this report. The northeastern part of the area is given a high rating for the occurrence of hydrocarbons with a high degree of certainty (H/D) based on known occurrences in the Sevier Frontal Zone Play (Covenant Field) and various Cretaceous plays covering the Wasatch Plateau. The high potential area associated with the Sevier Frontal Zone Play is expanded to the west relative to USGS Play 1907 on the assumption that any structures west of the front could be filled by hydrocarbons migrating from the west. The H/D area includes the northeastern part of the Richfield RD and the eastern part of the Fillmore RD. The southeastern part of the study area is given a high potential for occurrence with a low degree of certainty (H/B) based largely on known occurrences in the Permo-Triassic Unconformity Play (2106) at Upper Valley and Last Chance Fields. The low certainty rating results from the unknown extent of the carbon dioxide gas flushing that has occurred in parts of this and deeper plays. This H/B area includes the eastern part of Fremont River RD. The western part of the study area is given a medium potential for occurrence with a low certainty rating (M/B). The only play covering this area is the hypothetical Basin and Range Late Paleozoic Play (USGS 1902). This play covers a large area of very complex geology and is lightly explored resulting in a low certainty of potential in most areas. The Fillmore and western part of the Beaver RD are included in the area given M/B potential rating. The western Fremont River, western Richfield and eastern Beaver RDs have a low potential for oil and gas occurrence (L/B) but a high potential for the occurrence of carbon dioxide gas with a high certainty because of the Hamilton Brothers, Shell and Midcontinent wells described above.

OIL AND GAS DEVELOPMENT POTENTIAL

The RFD for the Richfield Field Office developed in 2005 included the eastern part of the FNF area and is generally consistent with this RFD in the area of overlap. The entire area of the Sevier Frontal Zone Play (1907) is given a high potential rating for development based on the 2004 discovery of the Covenant Oil Field, developmental drilling results, seismic surveys and leasing activity on BLM, Private and State of Utah lands. A relatively small portion of the FNF is included in this play (Map 2), essentially those portions of the FNF in Sevier County. The northeastern Richfield RD is rated as medium based on the existence of several plays involving source rocks and reservoirs in Cretaceous units and known gas production from these rocks in Emery and Carbon counties. This area is mostly the Wasatch Plateau where topography and lack of infrastructure could discourage development. The remaining portions of FNF are rated as having low potential for development. The only play covering the western part of the area (northern and western Fillmore and Beaver RDs is 1902, the hypothetical Late Paleozoic Basin and Range Play, an area with a complex geologic history which has received little exploration. The southern and western Richfield RD and the Fremont River RD are included in the Permo-Triassic Unconformity Play (2106) and deeper Paleozoic plays but questions regarding source rocks, migration and carbon dioxide flushing have had a dampening effect on exploration and development here. The extreme eastern part of Fremont River RD may be east of the main area of carbon dioxide flushing and is rated as having a high potential for development (Map 6).

RFD BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION

The baseline scenario developed below follows BLM IM 2004-089 and assumes that all potentially productive areas are available for leasing under standard terms and conditions (i.e., lease form without stipulations) except those areas designated as closed to leasing by law, regulation or executive order. It is important to keep this in mind as it represents a major departure from existing conditions. Only an insignificant part of the FNF is currently under lease and past drilling statistics are not reliable indictors of how much activity could be projected under the conditions assumed following IM 2004-089. UGS (2004) indicates a historic drilling rate of 0.65 well/year on the Fishlake National Forest and states that no wells have been drilled in the forest since 1984. When FNF and adjacent BLM, Private and State of Utah lands are considered together the historic rate increases to 3 wells/year (Figure 2). Discovery of the Covenant Field in 2004 increased industry interest in the general area and led to a spate of seismic and leasing activity.

Record oil and natural gas prices in recent years also contributed to the increase in interest.

UGS (2004) projected that 18 exploration wells and 20 development wells (38 total wells) could be drilled in the FNF during the next 15 years or 2.5 wells/year. In a 2005 addendum UGS added 6 wells in the Sevier Frontal Zone Play for a total of 24 total exploration wells and increased the number of development wells from 20 to 31 (55 total wells). This raises the average drilling rate to 3.7 wells/year which is slightly greater than the past rate when all lands are considered.

The RFD for the Richfield Field Office (2005) projected a total of 360 new wells (exploration and development) over the next 15 years on all lands in the Sevier Frontal Zone Play. Most of this play lies outside of the FNF with only a small amount of the western Richfield RD and a somewhat larger part of the northern Beaver and southern Fillmore RD being included. The Richfield Field Office RFD projected 49 new wells on the Wasatch Plateau (Cretaceous plays) but included parts of the Manti-La Sal NF in addition to FNF lands. The southern part of the Wasatch Plateau (the Fishlake NF part) is less prospective than the Manti-La Sal portion as coal gas content and source rock maturity both decrease from north to south (UGS, 2004; USGS, 2003). The Richfield RFD projected 45 wells for the southeastern part of the planning area based largely on plays that do not extend into the FNF.

Drilling history provides little useful information for projecting future activity on FNF lands because of the small number of leases issued in the past. The baseline scenario is based on the assumption that all potentially productive areas can be open for leasing under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation or executive order. This represents very different conditions than those existing in the FNF where fewer than one well/year have been drilled (UGS, 2004). When adjacent BLM, Private and State lands are considered with the FNF lands, the historical rate increases to almost 3 wells/year. The projected baseline scenario developed here is that an average of three exploration wells/year will be drilled over the next 15 years resulting in a total of 45 wells. Two new fields are projected to be discovered. One field is expected to be similar to the Covenant Field (10 wells) and could include lands outside the FNF boundary where the outside activity would result in cumulative impacts on forest lands. The second field will also likely be an oil field similar to the Upper Valley Field including 20 production wells.

Table 1. Baseline RFD scenario.

Exploration wells	45
Development wells (two fields)	30
Total wells	73

*

* Two of the exploration wells are projected to be discovery wells and therefore are also counted as development wells.

It should be emphasized again that this hypothetical scenario assumes that all potentially productive lands are available for leasing with standard stipulations and conditions.

SURFACE DISTURBANCE DUE TO OIL AND GAS ACTIVITY ON ALL LANDS

Seismic Exploration

Seismic exploration is a survey method used by geologists and geophysicists to identify possible traps which could contain reservoirs of oil and gas in permeable rock. It is an indirect method because it is used to map the underground rock structure using shock waves, as opposed to drilling which directly tests the composition and permeability of rock and occurrence of oil and gas in these structures.

Several methods of seismic survey can be used. The primary differences between methods involve how the shock wave is induced into the ground and how the survey areas are accessed. The most common and likely to take place on the Forest are the Vibroseis and Drilling/Explosives methods.

Vibroseis

The thumper and vibrator methods pound or vibrate the earth to create the shock wave. Usually four large trucks, each equipped with vibrator pads (about four feet square), are used. The pads are lowered to the ground and vibrators on all trucks are turned on simultaneously. Information is recorded, the trucks are moved forward a short distance, and the process is repeated. Except where an access trail may be constructed or cross-country travel is necessary, surface disturbance is usually minimal since little surface area or disturbance is required to operate the equipment at each test site. On National Forest System lands this method is used on existing roads and trails that can accommodate this activity without damage. Road building is usually not allowed.

Drilling/Explosives

The drilling method uses small portable drills that drill small-diameter holes to depths of 100 to 200 feet. Four to twelve holes are drilled per mile of line. Usually, a 50-pound charge of explosives is placed in the hole, covered, and detonated. The explosion sends energy waves that are reflected back to the surface from subsurface rock layers. The holes are drilled along a line that can be miles in length. In areas accessible by roads or trails truck-mounted drill rigs are used. In rugged topography, inaccessible to wheeled vehicles, a portable drill may be transported by helicopter. In recent years the use of off-road articulated buggies with large balloon tires has increased because they are very light on the land and less expensive to use than helicopters. The typical drilling seismic operation may use 10 to 15 men operating five to seven vehicles. Under normal conditions, three to five miles of line can be surveyed each day using the explosive method. The vehicles used for a drilling program include several heavy truck-mounted drill rigs or buggy-mounted rigs, water trucks, a computer recording truck, and several light pickups for the surveyors, shot-hole crew, geophone crew, permit man, and party chief. Public roads and existing private roads and trails are used for access and staging areas as much as possible. Several trips a day are made along a seismic line. Drilling water, when needed, is usually obtained locally.

On National Forest System lands some of the seismic exploration is done using off-road buggies. The buggies can only be used in fairly flat terrain thus most of the seismic exploration is done using heliportable methods. Small portable drills are transported by helicopter from site to site to drill the "shot holes". The recording equipment and crews are transported by helicopter or on foot from a staging area or landing zone. Generally, the shot holes are shallower than when drilled with truck mounted drills and the size of the explosive charge used is smaller.

In addition to the traditional two dimensional (2-D) surveys, three dimensional (3-D) surveys are often completed in areas where more detailed information is needed to define a suspected or known structure. The 3-D method is similar to the 2-D method but would employ several parallel lines with similar shot-hole spacing in a semi-grid pattern.

Surface disturbance is generally negligible however the human activity along the lines can be intensive for short periods of time while crews are setting geophones, inducing shock waves, and collecting seismic information. Minor vegetation clearing is needed along the lines to set geophones and drill shot-holes. Drill rigs are portable with self-leveling supports. No excavation of drill pads is necessary. However, hand crews often need to remove rocks, logs, and other debris around the drill site. Once completed, drill cuttings, buggy tracks, and other disturbances are raked by hand crews to minimize evidence of activities. Survey markers are removed and any tree limbs and vegetation removed for operations are broken up and spread over the disturbed areas.

For the Sevier Frontal Play extensive seismic exploration was conducted on National Forest System and adjacent BLM and non-Federal lands from about 2003 through 2006. The UGS (2005, p.15) estimates that only about another 25 line miles of survey would be needed to cover the remainder of prospective lands on the Fishlake National Forest. For the other plays, the UGS estimated that approximately 625 line miles of seismic survey

would be reasonable to cover the prospective lands. Therefore, the total estimated length of survey lines is 650 miles. Of this the UGS estimated that about half would be accessed using buggy mounted equipment and the other half with helicopter transported equipment. Since the topography on lands administered by the Fishlake National Forest is very rugged and cut by deep drainages, probably less than half would be completed with buggy-mounted equipment. Therefore, the disturbance estimates are probably high but feasible. Surface disturbance was estimated at 1.207 acres per line mile for buggy mounted operations and 0.007 acres per line mile for helicopter operations. The main difference is that buggy operations require buggy travel over the entire line where helicopter operations disturb only the small areas around each drilling or shot-hole location. Surface disturbance is calculated as follows:

Surface Disturbance (buggy operations):	325 miles x 1.207 acres per mile = 392.3 acres
Surface Disturbance (helicopter operations):	325 miles x 0.007 acres per mile = 2.3 acres
Total Surface Disturbance:	392.3 acres (buggy operations) + 2.3 acres (helicopter operations) = 394.6 acres

Inspections of operations by Forest personnel during and after completion of operations, has shown that there is little evidence of surface disturbance shortly after operations are completed (Steve Winslow, Project Inspection Reports for 2004 and 2005, Fishlake National Forest). Net surface disturbance that would remain in following years is considered negligible.

Exploration Drilling

It is estimated that 45 exploration wells would be drilled. Two of these wells would be discovery wells leading to field development. The discovery wells are considered in the next section for field development. An analysis by Forest Service Engineers (Fishlake NF O&G Engineering Report, 2007) was completed to determine the average surface disturbance for exploration pads, new access roads, and reconstruction of existing NFS roads.

Drill Pads

Drill pads vary in size depending on topography, depth of well (rig size), duration of drilling and possibly other factors and are usually between 2.5 and 5 acres in area. Drilling pads in the Uinta Basin are usually between 3.7 and 5 acres, including roads which would be a small part of the disturbance there (McKee, 2006). Pads constructed on NFS lands would probably tend to be larger than those in the Uinta Basin because the factors listed above would all tend toward larger pads. Another factor is the recent trend of using larger drill rigs and employing directional drilling to minimize new road

construction in rugged topography or sensitive areas. A drill pad disturbance area of 5.9 acres is assumed here. This estimate assumes the high-end pad dimensions of 425 feet by 350 feet with additional disturbance for topsoil storage, drainage diversions, and vegetation clearing.

Construction of New Roads

New roads would be necessary to access the pads from existing NFS roads and other highways. It is likely that access roads would be longer on NFS lands than on BLM lands because National Forests are often more remote, have more rugged topography and drill sites may be occupied for greater lengths of time requiring more supply storage space. The following parameters were used to calculate the amount of surface disturbance resulting from road construction for each well. A GIS-based analysis was used to determine the average straight line distance of all potential pad locations on the Forest from an existing NFS road or other highway. This average distance was adjusted to account for topography and road grade.

Average adjusted road length	0.75 miles
Width of area disturbed for road	39 feet
Curve widening/turnouts, etc., factor	1.25
Topsoil storage	0.25 acres/mile

Calculations using these figures yield an average disturbance of 6.2 acres per mile of road construction. Related surface disturbance for each well with 0.75 miles of new road would be 4.6 acres.

Reconstruction of Existing National Forest System Roads

Additional disturbance would result from reconstruction of NFS roads to a standard needed to safely accommodate existing traffic, rig mobilization, and other project traffic. The GIS-based analysis was used to determine the average distance of reconstruction. This average distance was increased to meet Forest Service road maintenance objectives for the higher road level.

Average adjusted length	2.59 miles
Width of new disturbance	13 feet
Subtotal road template disturbance	4.09 acres
Additional disturbance for turnouts	0.18 acre
Additional disturbance for curve widening	0.10 acre

Calculations yield an average disturbance of 4.4 acres per well for road reconstruction.

Estimated Surface Disturbance

The projected surface disturbance for each exploration well is summarized below:

Well Pad	5.9 acres
Road Construction	4.6 acres
Road Reconstruction	4.4 acres
Total Disturbance	14.9 acres/well

The total surface disturbance resulting from exploration drilling of 43 exploration wells during the 15 year period is 640.7 acres (45wells – 2 discovery wells) x 14.9 acres/well). If 43 of the 45 wells are dry holes (assuming that the other two are discovery wells), they will be plugged and abandoned and the disturbance would be reclaimed soon after completion. It is assumed that revegetation would meet required standards in approximately 5 years.

Field Development

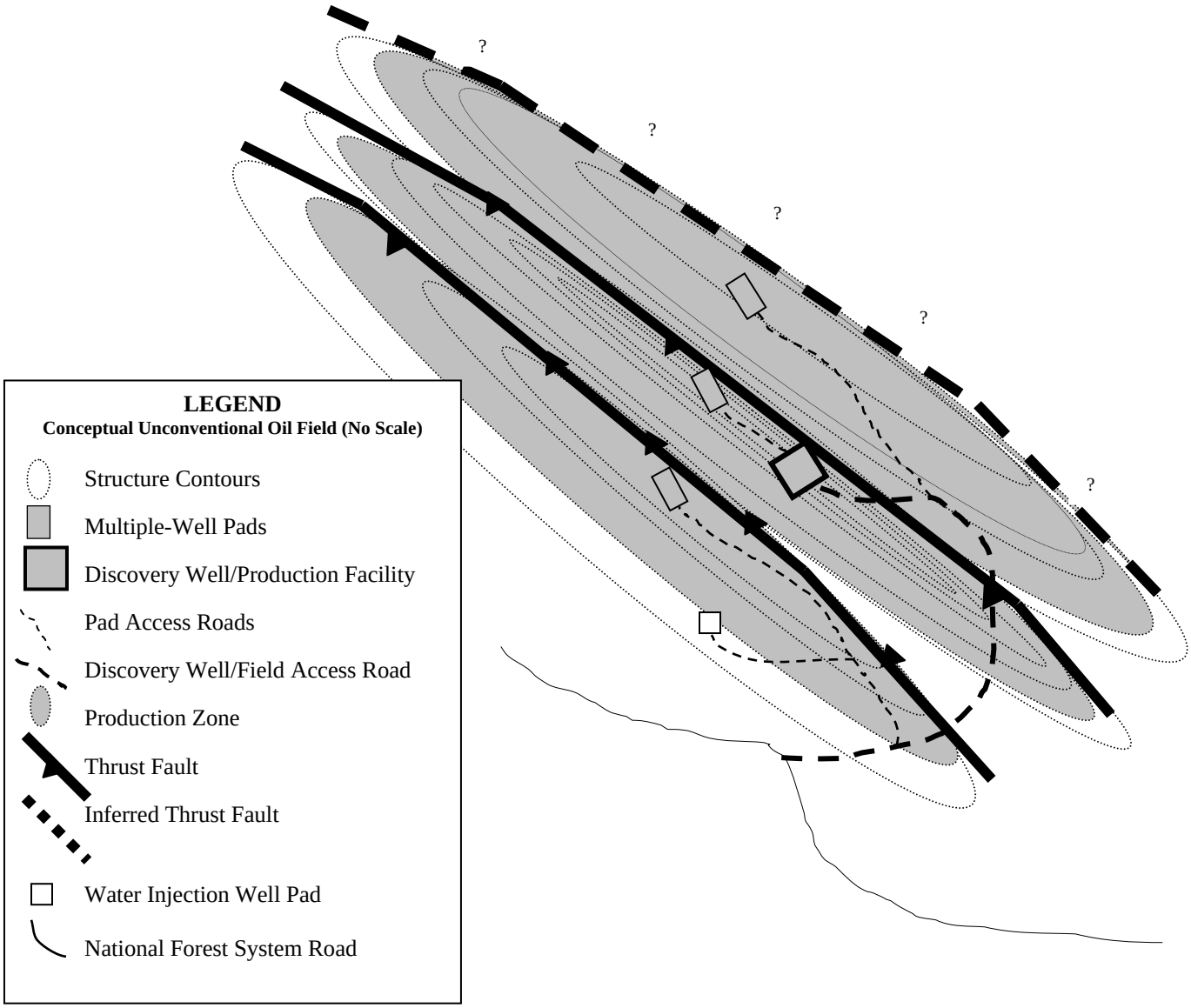
It is projected that two of the 45 exploration wells would make discoveries and lead to two new oil fields that would be developed during the 15 years covered by this RFD. Perhaps the most likely new field would be in the Sevier Frontal Zone Play and consist of 10 production wells. Several of the wells would be drilled from the same pad thus reducing the amount of surface disturbance. The second field could be a conventional oil field similar to the Upper Valley Field but consisting of 20 wells.

Sevier Frontal Zone Play Field

This oil field should be similar to the Covenant Field. Development would most likely involve directional drilling and fewer pads than more conventional fields. It is assumed that the geology and topography would allow for this type of development. Directional drilling would be used to reduce the number of pads and length of new roads. Figure 4 is a conceptual plan view of such a field.

The life of production once full field development has been completed is estimated at 30 years. Overall oil production is estimated at 6,000 to 10,000 barrels per day. Water production and potential enhanced production and water injection are probable at some point during field draw-down. The water disposal well would likely be drilled relatively early in the development process but injection of water for enhanced production would not be necessary for approximately 20 years as the field becomes nearly depleted.

Figure 4. Plan View – Conceptual Sevier Frontal Zone Oil Field (Not to Scale)



Based on the Covenant Field, it is not anticipated that there would be production of hydrogen sulfide to present a potential danger to drillers, field operators, or the public or which would require facilities for containment, monitoring, separation, or disposal.

DISCOVERY/CENTRAL PRODUCTION FACILITES PAD

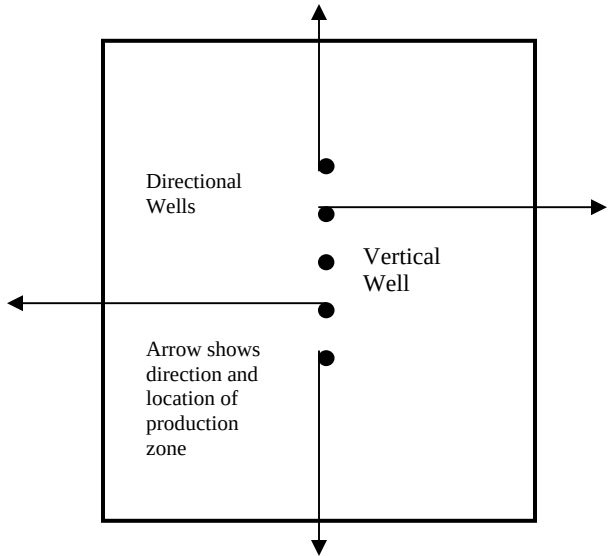
The discovery well pad would be converted to a production well and used as a central production facilities pad. It would be enlarged from the original 5.9-acre disturbed area to a disturbed area of approximately 12 acres to accommodate additional facilities. The cut and fill slopes would be revegetated. The pad access road running surface would stay about the same but the cut and fill slopes would be revegetated. Additional gravel column thickness would probably be required to accommodate all-weather operations for the life of the field. The surface disturbance for this discovery well/central production facilities pad is calculated at:

Discovery/Central Production Facilities Pad: 12.0 - acre pad + 4.6 acres new road + 4.4 acres of road reconstruction = 21.0 acres.

PRODUCTION WELL PADS

Based on development of the Covenant Field, the UGS predicted that two production well pads would be constructed. A third production well pad has since been added to the scenario to account for potential additional development (Figure 4). The pads would be constructed to accommodate the predicted 10 wells, and possibly as many as 15 wells. They would be designed and constructed to accommodate 5 wells each (one vertical and four directional wells). The pads would be the same dimensions as an exploration pad, approximately 350 ft. x 425 ft. approximately based on the size of Production Pad B on BLM lands in the Covenant Field. The pads could contain the wellheads, meters, down-hole submersible pumps, pipeline collectors, water drain/evaporation pit, truck turnaround, and a control building. The pad is large enough to contain other facilities if needed. The Central Production Facility would contain separators and most of the other facilities needed for production. The pads would involve a disturbed area of approximately 5.9 acres, including cut and fill sections and the topsoil stockpile. Initially a vertical well would be drilled. Assuming that this well is successful, four additional wells could be drilled directionally away from the pad in different directions to increase the area of production. One possible configuration of wells on a single pad is shown in Figure 5. The solid dots represent wells on the rectangular working area of a production pad. The arrows show possible directions and production zones for directional wells.

Figure 5. Plan View - Conceptual Multi-Well Production Pad Layout (Not to Scale)



The three additional production pads would share a portion of the original discovery well access road. Based on the well spacing and distance between pads, approximately 1 mile of new access road could be constructed as spur roads for each of the pads.

Total disturbance for the three multi-well production pads is calculated as follows: Production Pads: (3 pads x 5.9 acres/pad) + (3 miles new road x 6.2 acres/mile) = 36.3 acres

ANCILLARY FACILITIES

Ancillary facilities would most likely include an oil pipeline, water pipeline, power transmission line, substation, secondary recovery gas pipeline, water injection well, and pipeline/truck loading facility. Initially crude oil would be trucked to market from the pad locations, most likely a refinery in Utah Valley. At some point, it is likely that a pipeline would be constructed to pipe oil to a truck loading facility possibly located at the intersection of the primary project road and a major Forest or County road. A central production facility at the Covenant Field occupies approximately 29 acres and includes office and shop buildings, facilities for separating the produced oil and water, storage tanks and a "pit" to temporarily store separated water before it is piped to the nearby water disposal well. This facility was constructed on private land owned by the operator and a similar facility on FNF would likely be considerably smaller in area. It is assumed here that the central production facility would likely be about 12 acres as indicated above in the DISCOVERY/CENTRAL PRODUCTION FACILITIES PAD section.

The distance of new pipeline outside of road corridors is estimated at 5 miles with a disturbance of 50 feet. A truck loading pad of approximately 0.5 areas could be needed. Pipeline disturbance is calculated as follows:

Pipelines: (5,280 ft./mile x 5 miles x 50 ft. width) x 1 acre/43,560 sq. ft. = 30.3 acres + 0.5 acre truck loading pad = 30.8 acres.

Using the Upper Valley oil field on the Dixie National Forest as a model, it is assumed that a new overhead powerline of approximately 5 miles and occupying 25 acres, and a substation of approximately 0.4 acres, could be needed to provide electric power for the operation.

Powerlines/Substation: 25 acre corridor + 0.4 acre substation = 25.4 acres.

A water injection well is reasonably foreseeable, even though not all fields produce water in high enough quantities to require disposal. Since produced waters usually contain high concentrations of dissolved solids, they are usually re-injected into the zones from which they were produced or into deeper zones with water of equal or higher concentrations of salts. Usually the water is re-injected into the oil producing zone or slightly deeper at some horizontal distance from the producing wells. The water injection well pad would be constructed near the central production facility and have the same dimensions as an exploration pad. It is assumed that the pad would partially share an access road with one of the production pads but would require approximately ½ mile of new road construction. Water pipelines would most likely be partially buried in the project roads or along side the oil pipeline in the same disturbed corridor. Separation of the water from hydrocarbons would take place on individual production pads or the production facilities pad.

The anticipated surface disturbance is calculated as follows:

Water Injection/Disposal Pad: (1 pad x 5.9 acres) + (0.5 mile road x 6.2 acres/mile) = 9.0 acres

ESTIMATED TOTAL SURFACE DISTURBANCE

The total gross and net disturbance area for Sevier Frontal Play Field is calculated at:

21.0 acres - Discovery/Central Production Facilities Pad and Roads
+36.3 acres – Production Pads and Access Roads
+30.8 acres - Pipelines and Truck Loading Area
+25.4 acres – Powerlines and Substation
+ 9.0 acres – Water Disposal Well Pad and Access Road
122.5 acres - Total Gross Surface Disturbance

The total net disturbance area for a Sevier Frontal Zone Play Field is assumed to be the same as the gross surface disturbance. Since the pads could accommodate multiple wells, they would remain approximately the same size or reduced only slightly in size for long-term production even though cut and fill slopes may be flattened and revegetated for long-term stability.

Conventional Oil Field in Other Plays

This conceptual 20-well field is based on a number of small conventional oil fields in Utah which have a single well on each pad (UGS report). Figure 6 displays a plan view of this conceptual conventional oil field.

Directional drilling has advantages in that it can be used to decrease the length of new roads and number of pads and can be used to drill production zones where construction of

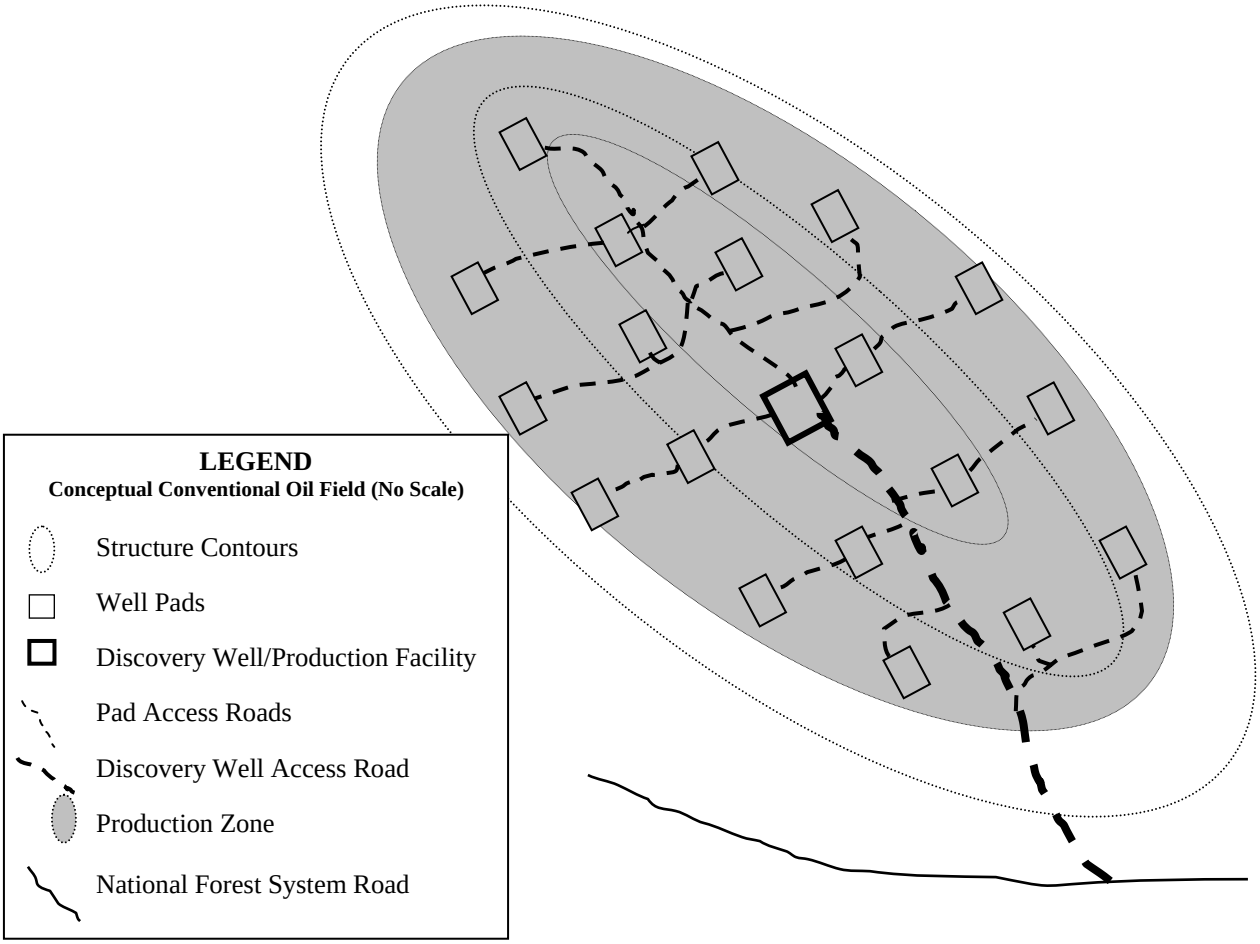
a pad and/or road for vertical wells is not possible. Topography, geologic conditions, and environment issues can prohibit construction of suitable pads. Disadvantages are that directional drilling is more expensive and not always feasible considering underground geologic conditions. Even though directional drilling and production technology is rapidly advancing and industry use of this technology is allowing more multiple-well pads, co-location of wells is not always feasible. Therefore, this scenario is based on conventional oil field developments. Even though this field is based on the assumption that each pad would host only a single well, it is likely that the number of pads and the surface disturbance could be reduced by directional drilling technology and the possibility of drilling more than one well per pad.

The life of production once full field development has been completed is estimated at 30 years. Overall oil production is estimated at 6,000 to 10,000 barrels per day. Water production and injection are probable at some point during late field draw-down after approximately 20 years of production.

Several small oil fields in Utah produce hydrogen sulfide in quantities that require contingencies and production facilities needed to contain and control release into the air. Therefore, it is assumed that this field could also require such facilities. The pads and facilities depicted for this conceptual field could accommodate any facilities needed to contain and control hydrogen-sulfide, therefore no additional surface disturbance has been calculated.

Production of saline water with high total dissolved solids concentrations is also reasonably foreseeable. The most likely scenario is that this water would be disposed of by re-injection back into the rock unit or structure from which it was produced. The purposes would include disposal of the water, protection of other aquifers or surface waters, and increasing underground pressures beneath the oil producing zone, enhancing oil recovery. Since 20 wells are anticipated for this field, it is most likely that one of the marginally producing wells near the fringe of the production zone would be re-entered and converted to a water injection well. No additional pads or surface disturbance is anticipated. Water pipelines would most likely be buried in the project roads or along side the oil pipeline. Separation of the water from hydrocarbons would take place on individual production pads or the central production facilities pad. The estimated pad sizes are sufficient to accommodate these facilities.

Figure 6. Plan View - Conceptual Conventional Oil Field (Not to Scale)



DISCOVERY/CENTRAL PRODUCTION FACILITIES PAD

The discovery well pad would be converted to a production well and used as a central production facility. It would be enlarged from the original 5.9-acre disturbed area to a total disturbed area of 12 acres. The cut and fill slopes would be revegetated.

The new access road for the discovery well would be the same as for an exploration well, since it would have been originally located and drilled as an exploration well. New road access would be 0.75 miles. The well would require 2.59 miles of reconstruction of an existing National Forest System road. After the discovery well is converted to production, the access road would stay about the same but the cut and fill slopes would be revegetated. Additional gravel surface depth would probably be required to accommodate all-weather operations for the life of the field.

Surface disturbance for this facility is calculated as:

Discovery/Central Production Facilities Pad: 12.0 - acre pad + 4.6 acres new road + 4.4 acres of road reconstruction = 21.0 acres

PRODUCTION WELL PADS

Approximately 19 additional production well pads would be constructed. One vertical or directionally-drilled well would be located on each pad. Actual pad locations would be affected by topographic or environmental features. Some pad locations could be offset, using direction drilling to reach the intended production zone. The original pads would be constructed to accommodate the drilling operation similar to exploration wells. The pads would disturb an area of approximately 5.9 acres each. For production operations, the working area would be reduced to approximately 4.0 acres or less. Production facilities on each pad would include the wellhead, pump jack, tanks, separators, water drain/evaporation pit, pipeline collectors, meters, truck turnaround, etc.

The Utah State spacing requirement for oil wells is 160 acres. This means that wells would be spaced approximately ½ mile apart, depending on topography. Assuming approximately ½ mile of new road per well, the total length of new roads would be 9.5 miles. Applying a curve factor of 1.25, the total length of new road for developing the new pads would be 11.9 miles.

Surface disturbance for the additional wells and facilities is calculated at:

Production Wells Gross Disturbance: (19 pads x 5.9 acres/pad) + (11.9 miles new road x 6.2 acres per mile) = 185.9 acres

Production Wells Net Disturbance: (19 pads x 4.0 acres/pad) + (11.9 miles new road x 6.2 acres per mile) = 149.8 acres

ANCILLARY FACILITIES

Ancillary facilities would most likely include an oil pipeline, water pipeline, power transmission line, substation, secondary recovery gas pipeline, water injection well, and pipeline/truck loading facility.

It is most likely that one of the marginally producing wells near the fringe of the production zone would be re-entered and converted to a water injection well. No additional pads or surface disturbance is anticipated.

Pipelines and powerlines would be buried in the access roads but, at some locations, would require additional surface disturbance for placement or burial adjacent to the road or to avoid sensitive areas.

The distance of new pipeline outside of road surfaces is estimated at 5 miles with a disturbance of 50 feet. Oil would most likely be piped to an intersection with an improved road where it could be loaded into trucks for transport to market. A truck loading pad of approximately 0.5 areas could be needed.

This new disturbance is therefore calculated at:

Pipelines: (5,280 ft./mile x 5 miles x 50 ft. width) x 1 acre/43,560 sq. ft. = 30.3 acres + 0.5 acre truck loading pad = 30.8 acres

Using the Upper Valley oil field on the Dixie National Forest as a model, it is assumed that a new overhead powerline of approximately 5 miles and occupying 25 acres, and a substation of approximately 0.4 acres, could be needed to provide electric power for the operation.

Powerlines/Substation: 25 acre corridor + 0.4 acre substation = 25.4 acres.

ESTIMATED TOTAL SURFACE DISTURBANCE

Total gross disturbance for the field is calculated at:

21.0 acres - Discovery/Central Production Facilities Pad and Roads
+185.9 acres - Production Wells and Access Roads
+ 30.8 acres – Pipelines/Truck Loading Area
+ 25.4 acres – Powerlines/Substation
263.1 acres - Total Disturbance

Total net disturbance for the field is calculated at:

21.0 acres - Discovery/Central Production Facilities Pad and Roads
+149.8 acres - Production Wells and Access Roads
+ 30.8 acres - Pipelines/Powerlines
+ 25.4 acres – Powerlines/Substation
227.0 acres - Total Disturbance

Total Estimated Surface Disturbance

Gross disturbance is the total of all disturbance regardless of the duration. The total estimated gross surface disturbance is displayed below by facility:

Seismic Exploration	394.6 acres
Exploration Wells	640.7 acres
Sevier Frontal Play Oil Field	122.5 acres

Conventional Oil Field	263.1 acres
Total Disturbance	1,420.9 acres

Total net or long-term surface disturbance after reclamation would be less than the total gross surface disturbance.

Surface disturbance for seismic lines is temporary, usually lasting only during the field season that operations occur. Operations are conducted by overland travel by rubber-tired vehicles or by helicopter and no road construction occurs.

The 43 exploration well pads and roads (inherently non-productive) would be plugged, abandoned, and reclaimed soon after drilling and revegetated, usually within 5 years.

Production pads and the water disposal well pads for the Conventional Oil Field would be partially reclaimed to a smaller area needed for production and workover (periodic cleaning of the bore with drill rigs) operations. The production pad disturbance area would be reduced from the original 5.9 acres to approximately 4.0 acres.

The total estimated net surface disturbance is displayed below:

Sevier Frontal Zone Play Oil Field	122.5 acres
Conventional Oil Field	227.0 acres
Total Net Disturbance-Production facilities	349.5 acres

At the end of the 15-year analysis period it is assumed that the total area of unreclaimed and residual (not yet determined to meet reclamation standards) surface disturbance would be 349.5 acres associated with production facilities plus the residual disturbance of 223.5 acres (15 wells x 14.9 acres/well) remaining from exploration wells drilled during the final five years, for a total of 573.0 acres.

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APPENDIX A

Mineral Occurrence Potential Classification System

This report uses the mineral occurrence potential classification system found in BLM Manual 3031, *Energy and Mineral Resource Assessment.* The dual system uses a potential rating and a level of certainty rating as defined below.

Level of Potential:

0. The geologic environment, the inferred geologic processes and the lack of mineral occurrences do not indicate potential for accumulation of mineral resources.

L. The geologic environment and inferred geologic processes indicate low potential for accumulation of mineral resources.

M. The geologic environment, the inferred geologic processes and the reported mineral occurrences or valid geochemical/geophysical anomaly indicate moderate potential for accumulation of mineral resources.

H. The geologic environment, the inferred geologic processes, the reported mineral occurrences and/or valid geochemical/geophysical anomaly and the known mines or deposits indicate high potential for accumulation of mineral resources. The "known mines and deposits" do not have to be within the area being classified, but have to be within the same type of geologic environment.

ND. Mineral(s) potential not determined due to lack of useful data. This notation does not require a level of certainty qualifier.

Level of Certainty:

A. The available data are insufficient insufficient and/or cannot be considered as direct or indirect evidence to support or refute the possible existence of mineral resources in the respective area.

B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.

C. The available data provide direct evidence but are quantitatively minimal to support or refute the possible existence of mineral resources.

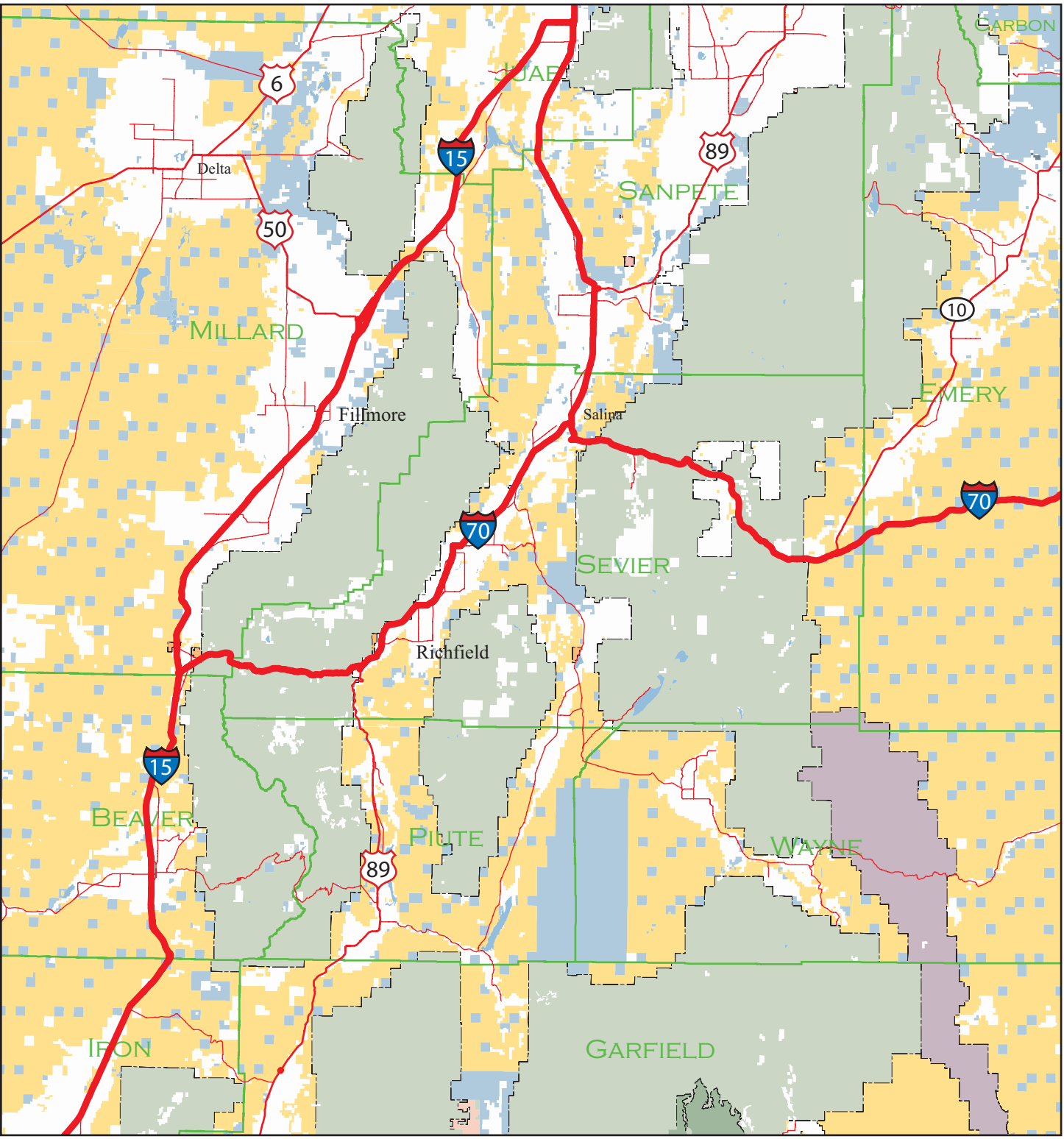
D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources

MAPS

Map 1. Land Ownership.
Map 2. U. S. Geological Survey Oil and Gas Plays (1995).
Map 3. Oil and Gas Occurrence Potential.
Map 4. Authorized Oil and Gas Leases.
Map 5. FNF Lands nominated for Oil and Gas Lease Sales 2005-2006.
Map 6. Oil and Gas Development Potential.

Land Ownership

October 19, 2006



Map - 1

0 2 4 8 Miles

0 2 4 8 Kilometers

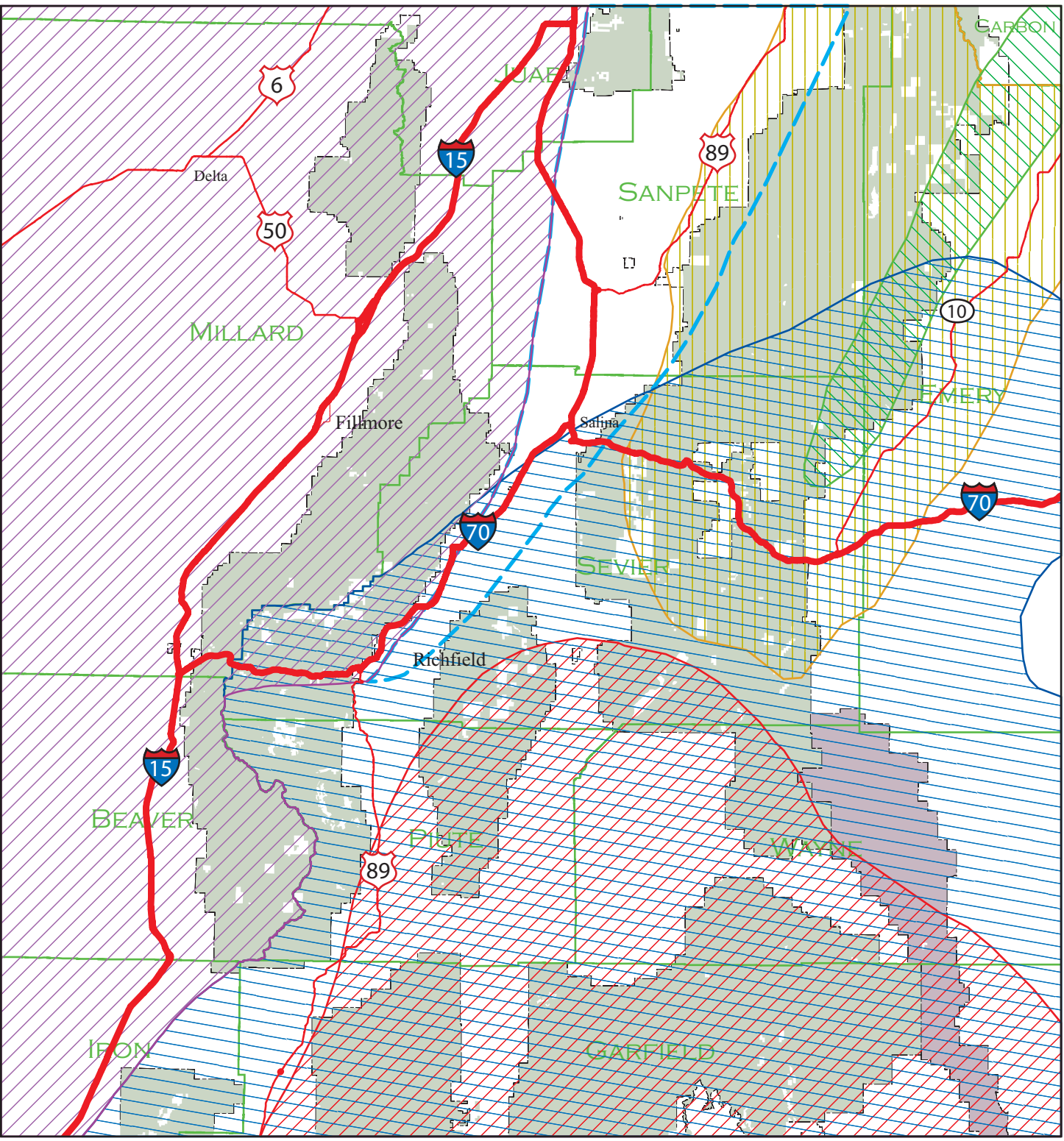
Public Land
State Land
Private Land
National Park
National Forest
National Forest Wilderness

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

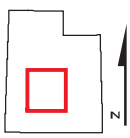
This product may not meet BLM standards for accuracy and content. Different data sources and input scales may cause some misalignment of data layers.

U.S. Geological Survey Oil and Gas Plays (1995)

October 19, 2006



Map - 2



0 2 4 8 Miles

0 2 4 8 Kilometers

1902
1907
2052
2106
2107
2403
National Park
National Forest

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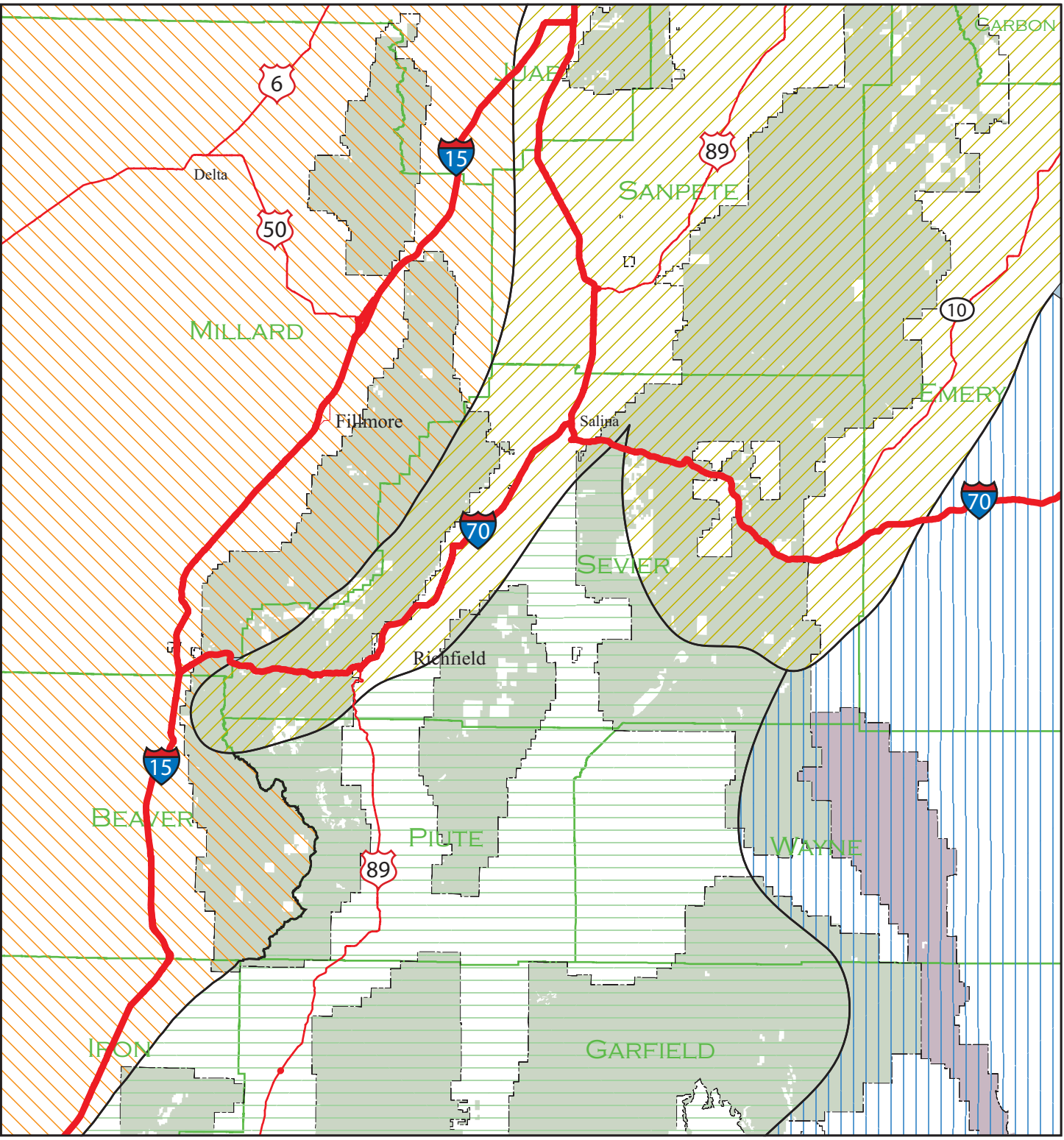
Oil and Gas Occurrence Potential

October 19, 2006



Map - 3

Low Potential / Low Certainty

High Potential / High Certainty

High Potential / Low Certainty

Moderate Potential / Low Certainty

National Park

National Forest

0 2 4 8 Miles

0 2 4 8 Kilometers

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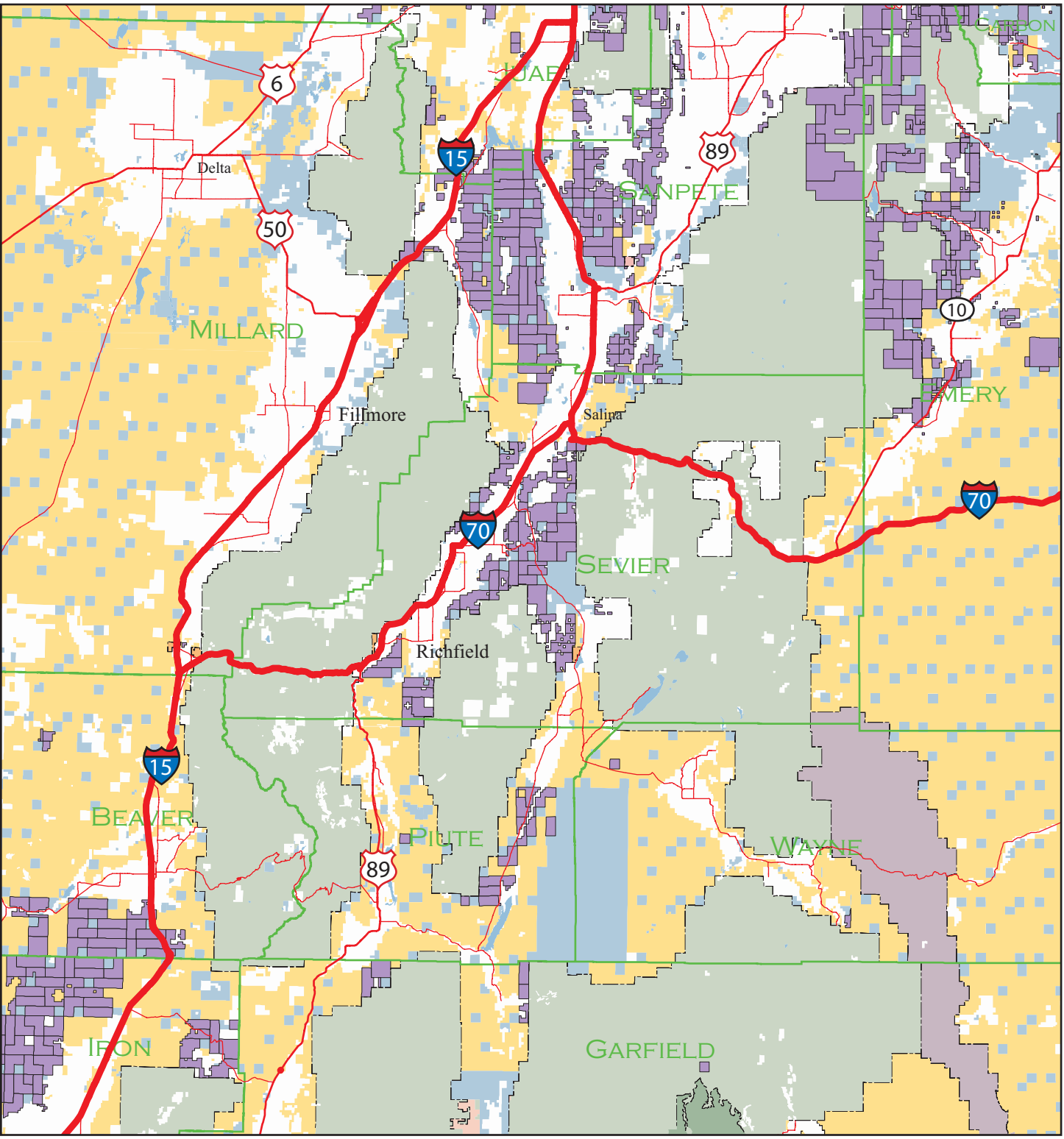
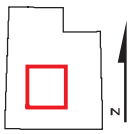
Authorized Oil and Gas Leases

October 26, 2006



Map - 4



0 2 4 8 Miles

0 2 4 8 Kilometers

Public Land
State Land
Private Land
Authorized Oil and Gas Leases
National Park
National Forest
National Forest Wilderness

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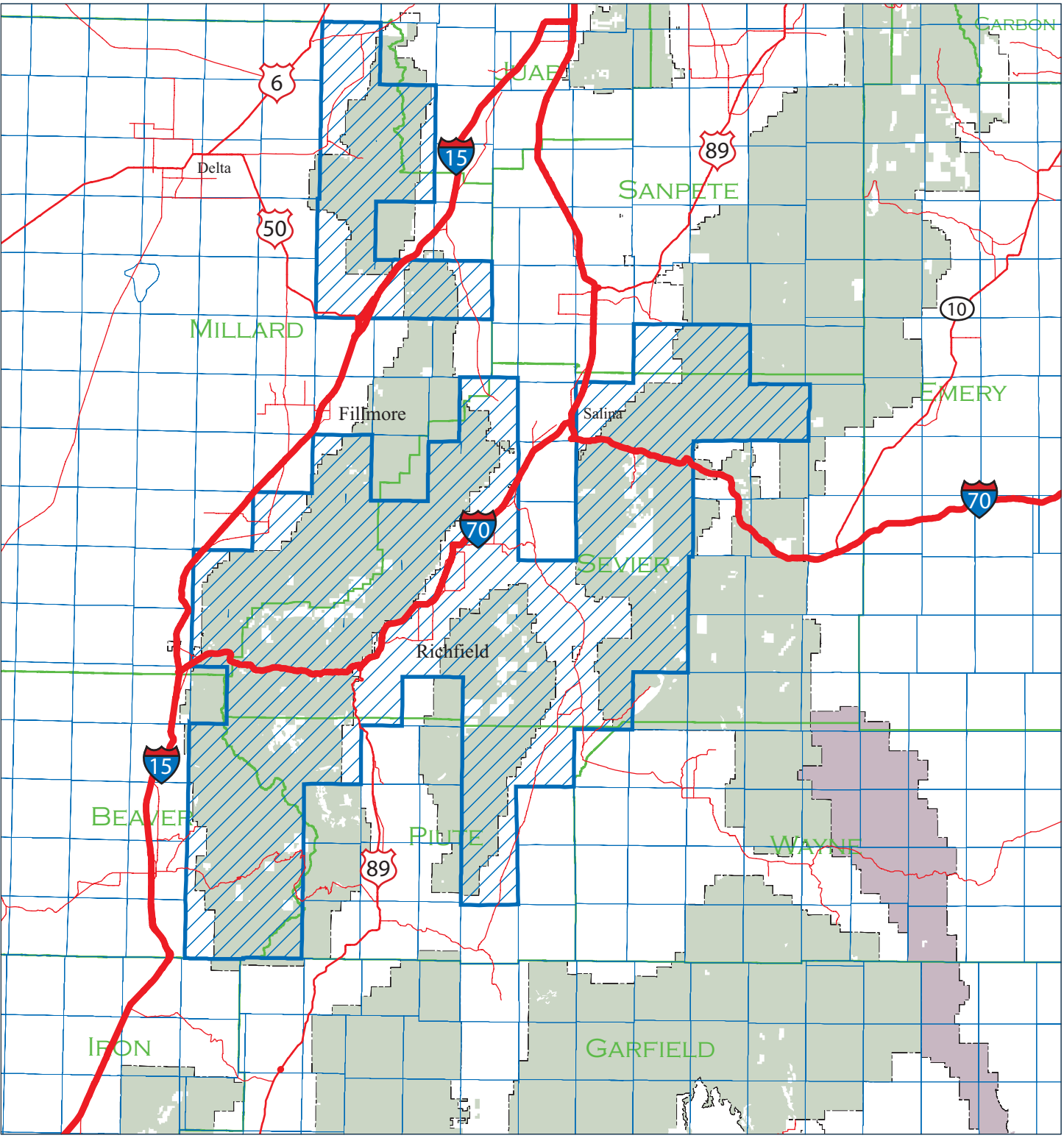
FNF Lands Nominated for Oil & Gas Lease Sales 2005 - 2006

October 19, 2006



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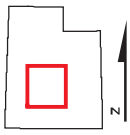

0 2 4 8 Miles

0 2 4 8 Kilometers

Public Land

State Land

Private Land

Townships Where Lands Were Nominated

National Park

National Forest

National Forest Wilderness

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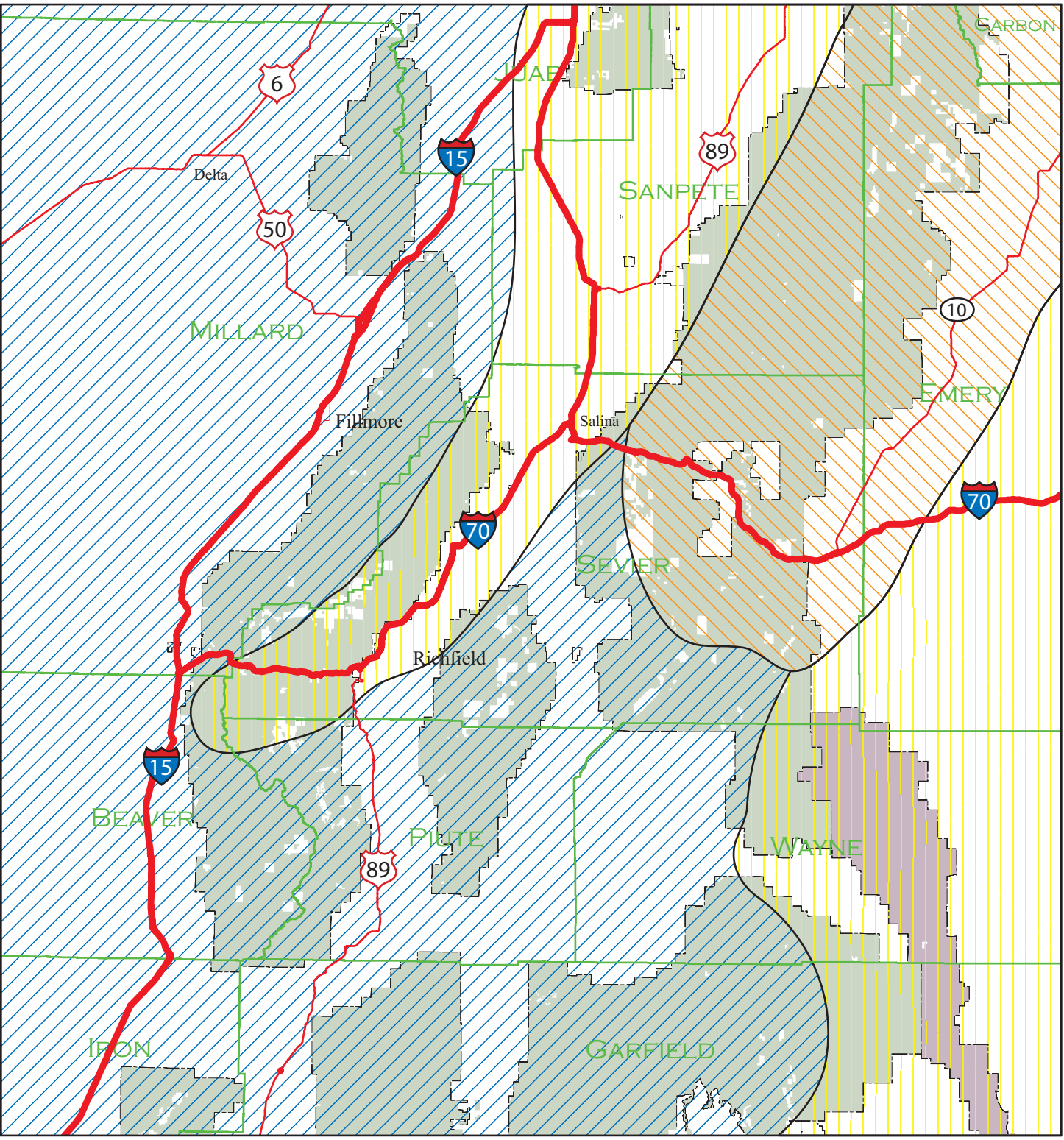
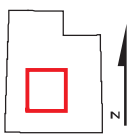
Oil and Gas Development Potential

October 19, 2006



Map - 6



0 2 4 8 Miles

0 2 4 8 Kilometers

High Potential

Moderate Potential

Low Potential

National Park

National Forest

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