

APPENDIX 13

OIL AND GAS AND COALBED METHANE RESOURCES IN THE JACK MORROW HILLS PLANNING AREA

(Part of The Reasonably Foreseeable Development Scenario - 1998 Through 2017)

The Reasonably Foreseeable Development (RFD) comprises this appendix, the Minerals Assumptions (Appendix 10), and Minerals impacts (Chapter 4).

The RFD considers current management of the planning area and the proposed management for each proposed alternative. Past hydrocarbon development and relevant research on hydrocarbon potential is used to make assumptions about the kind and amount of development likely to occur for these alternatives during the period of analysis for the JMHCAP (1998 through 2017).

The planning area is considered to have a high potential for the occurrence of oil and gas. This rating considers a variety of geologic characteristics, including:

- Presence of hydrocarbon source rocks
- Presence of reservoir rocks with adequate porosity/permeability
- Potential for structural/stratigraphic traps to exist
- Opportunity for migration from source to trap and
- Other conditions, such as temperature, depth of burial, and subsurface pressures

For the “Green River Resource Area Resource Management Plan and Final Environmental Impact Statement” (1996) a determination was made of the potential for development. It used high, moderate, and low potential values for each part of the planning area (Map 45) and is considered to still be reasonable for that part covering the planning area. Drilling activity is likely to occur in all areas. The highest rate of activity is expected to occur in the high potential area and the lowest rate is expected in the low potential area.

EXPLORATION AND DRILLING HISTORY

Exploration History

Analysis of past exploration activity indicates how the hydrocarbon resource has been developed in the planning area. Exploration history can be tracked by reviewing information on past Federal Exploratory Units that have been proposed and drilled in the area. Most exploratory wells have been drilled as part of Federal Exploratory Units. Table A13-1 lists Federal Exploratory Units known to have been located entirely or partially within the limits of the planning area. To date, 52 units are known to have been approved or proposed. The large number of approved exploratory units shows that unitization has been a popular method for orderly exploration for hydrocarbons.

Early Units. Easily mapped surface structures in Wyoming were located and tested through the 1940s. In the planning area, the only surface structures were those thought to lie against a long fault system on its north edge. These potential structural traps have occasionally been tested over the years but have not been productive. The first exploratory unit was the Pacific Creek unit (1943) which tested a potential structural trap in this area. No production was found in this Mesaverde Group test and the unit terminated in 1947.

After the Pacific Creek unit test and through the 1960s, 11 more units were tested and one was proposed and latter withdrawn with no test. Only the Nitchie Gulch unit test found commercial hydrocarbons. The Nitchie Gulch unit/field is a combination stratigraphic-structural trap, producing mostly gas from the Frontier and Dakota formations. Little exploration activity occurred in the planning area during this early period because it was thought to be gas prone and gas resources were of minor interest. Industry was concentrating its exploration in areas of Wyoming that were oil prone.

1970-1993. Between 1970 and 1984 an additional 30 exploratory units were created. This period of increased exploratory activity coincided with a nation-wide boom in drilling activity, mainly due to price increases for oil and gas. Of the 30 new units, hydrocarbons were found in eight units (Table A13-2). The traps associated with production from the units named in Table A13-2 are stratigraphic and produce mostly gas.

No exploratory units were proposed for a ten-year period after the Essex Mountain unit terminated in 1984. This was partially due to deteriorating prices, generally low volumes of gas produced from many of the producing units other than Nitchie Gulch unit/field, and a reduced area available for exploration and production due to WSA withdrawals and limitations placed on development. The core area was withheld from leasing in 1992 and the rest of the planning area was removed in 1998. All unleased areas will continue to be suspended until this plan is completed.

Recent Units. Since 1994, increased emphasis on gas exploration in the region has resulted in nine new unit proposals (despite large areas being unavailable for exploration activity) in the planning area. Also, drilling successes to the southwest at Stagecoach Draw and Clay Buttes fields and to the east and southeast in the Great Divide Basin have contributed to increased interest in the area. The recent exploratory unit targets have been stratigraphic trapped Cretaceous-aged sediments.

Within the planning area, the first test of the Big Bear unit was oil productive in the Rock Springs formation. The unit

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terminated, in 1996, due to low production rates from this well. The Northern Lights unit was proposed, but withdrawn November 3, 1998.

Three recently terminated exploratory units covered part of the planning area and the first well for each was drilled outside the planning area.

Riva Exploratory Unit overlapped the planning area on its eastern boundary and terminated June 22, 1995. The operator tested and abandoned a Lewis Shale well drilled in sec. 36 T. 25 N., R. 98 W.

The Encore Exploratory Unit overlapped the planning area on its southeast edge and terminated February 17, 1998. The formation targets were the Almond, Lewis, and Ericson. The well drilled in sec. 32 T. 24 N., R. 99 W. was abandoned.

The Jade Exploratory Unit overlapped the planning area on its eastern boundary and terminated July 1, 1998. The formation targets were the Almond and Lewis. The first well was completed as a Lewis producer in sec. 11 T. 24 N., R. 98 W. It was a low volume gas producer causing unit termination.

Active and pending exploratory units (Map 44) are:

Johnson Gap (Deep), approved effective February 28, 1994. The first well is proposed for sec. 1 T. 23 N., R. 103 W. A "Suspension of Operations and Production" has been granted for this well until this environmental analysis can be completed.

Gold Coast, approved effective January 30, 1998. The first well is proposed for sec. 6 T. 25 N., R. 102 W. A "Suspension of Operations and Production" has been granted for this well until an environmental analysis can be completed.

West 187, approved effective February 25, 1998. The first well is presently pending drilling in sec. 25 T. 23 N., R. 105 W.

Jack Morrow Creek, drilling is pending final approval. The proposal lies in T. 25 N., Rs. 104 and 105 W. and T. 26 N., R. 104 W.

Of the 52 exploratory units, five units are productive and still active; five units have productive wells, but they did not produce in great quantities and have been terminated; 35 did not find productive hydrocarbons and were terminated; three proposed units were withdrawn or canceled; and four exploratory units are pending approval or are waiting to be drilled.

Drilling History

Drilling and completion data were obtained from PI/Dwights LLC., BLM well files, and Wyoming Oil and Gas Conservation Commission well files for Map 65, showing the location of drilled wells in the planning area. Most drilling activity has been concentrated in the south central part of the

planning area (Nitchie Gulch unit/field) with additional exploratory wells scattered across the rest of the area. The concentration area lies along the crest of the Rock Springs Uplift structural high, a good geologic target.

Table 3-06 (Wells Drilled in the JM) shows the history of drilling activity in the planning area. The first test well in the planning area was drilled in 1927, in sec. 16 T. 23 N., R. 104 W. It was a shallow (1,529 feet) Mesaverde Group dry hole drilled by Boars Tusk Oil Company (now defunct). Two additional nonproductive shallow Tertiary-age tests were made in the north part of the planning area in the 1940s.

The first known hydrocarbon show was in the El Paso Natural Gas Company (now defunct) well drilled in 1954 in sec. 29 T. 25 N., R. 103 W. This well tested gas in a number of zones in the Upper Cretaceous section, with a maximum recovery of 240 thousand cubic feet of gas per day recovered from one zone, before the well was abandoned. An additional 12 wells were drilled and abandoned before the first economically productive well was completed in November of 1961. Trigood Oil Company (now defunct) completed the first productive well in sec. 17 T. 23 N., R. 103 W. Gas and some condensate (light oil) production was obtained from both the Frontier and Dakota formations. This was the discovery well for the Nitchie Gulch unit/field.

Wells Drilled. In the planning area 153 wells have been drilled. Of these wells, 66 were completed as producers. Three of these wells were completed as coalbed methane wells. The coalbed methane wells have been tested but have not been put on production. The remaining 87 drilled wells were abandoned after drilling (Map 66).

Units/Fields. A number of units/fields have been found to be productive (Table A13-3). Information about these fields and individual wells is available in the publications "Wyoming Geological Association Symposium, Oil and Gas Fields, Greater Green River Basin" (1979 and 1992) and in BLM and Wyoming Oil and Gas Conservation Commission files.

Drilling Targets. Past drilling targets have been formations of Cretaceous age (145 of the 153 wells drilled). Only two wells have tested formations deeper than the Cretaceous. The Eden Unit #5-11 in sec. 11 T. 22 N., R. 105 W. was proposed as a test of Mississippian-age rocks at 19,500 feet. The well reached 18,150 feet in the Mississippian Madison Formation and was abandoned. No hydrocarbons were discovered in these older sediments. A test of the Madison recovered a small amount of nonflammable gas. Other deep tests further south on the Rock Springs Uplift have tested some nonflammable carbon dioxide gas in the Madison. Carbon dioxide is likely the nonflammable gas recovered on this test.

The other deep test was the Indian Gap unit #1 which reached 10,066 feet in the Nugget formation and was abandoned. No hydrocarbons are known to have been discovered in this well's older sediments.

One other well was expected to test formations older than Cretaceous age. The South Pass Unit #1 in sec. 17 T. 27 N., R. 100 W. was expected to test the Mississippian Madison at 22,000. Instead the well drilled Precambrian granite in the

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near surface, crossed the Wind River thrust fault and drilled Cretaceous-aged sediments to a depth of 22,947 feet.

Six wells were shallow Tertiary targets and none were productive.

Well Elevations and Depths. Well elevations in the planning area have ranged from about 6,400 feet to 8,100 feet. Well depths have ranged from only 218 feet to 22,947 feet. The number of wells drilled by 5,000-foot depth ranges are:

- | | |
|------------------------|----------|
| • < 5,000 feet | 18 wells |
| • 5,000 - 9,999 feet | 80 wells |
| • 10,000 - 14,999 feet | 42 wells |
| • 15,000 - 19,999 feet | 12 wells |
| • > 20,000 feet | 1 well |

Most wells in the 5,000 to 10,000 range lie in the Nitchie Gulch unit/field area because it is the highest structural location on the Rock Springs Uplift. Wells must be drilled deeper outside the Nitchie Gulch unit/field area to reach the same target formations (Frontier and Dakota). The deepest wells to Cretaceous formations have been drilled on the north part of the planning area.

Drilling Rates and Success. Drilling rates and success percentages are shown in Table A13-4.

The drilling rate history shows that there have been two periods of increased activity. The first was centered on the period when the Nitchie Gulch unit/field was first discovered (1961) and developed. Development was on 640-acre spacing. Drilling decreased in the late 1960s and early 1970s because most 640-acre spacing units had been developed.

Drilling increases culminating in 48 wells being drilled in the 1978-1982 period were due to:

- improvements in drilling and completion technology that allow areas with lower gas reserves to be developed;
- the recognition of the importance of stratigraphic traps that contain much of the planning area gas;
- exploration for deeper drilling targets which favor gas over oil; and
- the general increase in gas prices.

During this period well spacing was decreased to 160 acres in much of the Nitchie Gulch unit/field and increased exploration for deeper reserves occurred in the area north and east of the field. Additional exploration is expected to have occurred west of Nitchie Gulch unit/field, but, this area had been withdrawn from leasing because of wilderness characteristics.

Improved success rates in each five year period after the 1968-1972 period have been due to industry's concentration on development drilling in the Nitchie Gulch unit/field, improvements in geologic analysis, and improvements in drilling and completion technology.

Coalbed Methane Drilling History

Tyler, et al. (1997) have reviewed drilling history of the coalbed methane resource in the planning area. In this area

coals of the Fort Union, Almond, and Rock Springs Formations were tested. Development of the two coalbed wells on the south boundary of the planning area was stopped in 1992, primarily by low gas prices and disappointing test results and secondarily by environmental concern over disposal of produced water.

EVALUATION OF POTENTIAL PLAYS AND DRILLING AND EXPLORATION TRENDS

Information on potential plays is available and four exploratory unit proposals have been made. The information from these unit proposals is confidential and only general information can be released. Some additional information has been made available through public comment and personal communication. Drilling projections for each alternative have been made based on this available information and from restrictions (no leasing, no surface occupancy, stage leasing, and controlled surface use) that will be placed on activity.

Information Resources Used

A number of documents are available that have evaluated gas reservoirs and exploration trends for the Greater Green River Basin area. These documents were used to help evaluate the gas reservoirs present in the planning area and determine levels of future activity.

The CD-ROM "Emerging Resources in the Greater Green River Basin" (Gas Research Institute, 1996) is an atlas of the Upper Cretaceous that provided access to geological, production, engineering, and land use data for some of the productive and potentially productive reservoirs in the planning area.

A three CD-ROM set "1995 National Assessment of United States Oil and Gas Resources" (U.S. Geological Survey, 1996) provides a discussion of some of the potential hydrocarbon plays in the planning area. The potential plays discussed are:

- Rock Springs Uplift Play
- Basin Margin Anticline Play
- Subthrust Play

The "Atlas of Major Rocky Mountain Gas Reservoirs" (New Mexico Bureau of Mines & Mineral Resources, 1993) summarizes information on those gas reservoirs with cumulative production of at least 5 billion cubic feet of gas. The reservoirs and their associated plays are discussed. Some of the relevant parameters discussed are reservoir and lithologic data, production data, compositional analyses of produced gas, reservoir engineering parameters, and estimates of proved developed reserves.

The Barlow & Haun, Inc. (1994) publication "Accessibility to the Greater Green River Basin Gas Supply, Southwestern Wyoming" provides additional discussion of plays and maps of play boundaries. It also evaluates the limitations on production and increased costs associated with access to public lands.

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The paper “The Potential for Coalbed Gas Exploration and Production in the Greater Green River Basin, Southwest Wyoming and Northwest Colorado” (Tyler, et al. 1997) presents a discussion of the coalbed gas resource for the planning area and was used to prepare the map of coalbed methane development potential (Map 46).

The comment letter from Barlow & Haun, Inc. (1998) was used as the most up-to-date reference for the plays present and their potential future resource. The plays and their potential future resource are shown in Table A13-5. In addition, Diedrich (1999) has projected that 88 to 111 wells could be drilled in the planning area if areas outside of WSAs is available for development. Landreth (1999) has indicated the producing Frontier and Dakota wells in the Nitchie Gulch unit are being produced to their economic limit and no additional in-fill drilling is anticipated.

Determining Undiscovered Hydrocarbon Accumulations

Two methods were used to help determine the number of wells required to develop undiscovered hydrocarbon accumulations (other than coalbed methane deposits) in the planning area. Both methods derived about the same number of wells from these undiscovered wells.

“Resource Method” - This method was developed from information received in the Barlow & Haun, Inc. (1998) comment letter and information obtained developing this RFD. Barlow & Haun determined a potential future gas resource (not including the coalbed methane resource) of 2,150 billion cubic feet. Present producing wells indicate an average well will produce 2.2 billion cubic feet of gas. To recover the estimated 2,150 billion cubic feet from wells that recover an average of 2.2 billion cubic feet would require 977 producing wells.

“Checkerboard Method” - Stanley’s (1995) “Checkerboard Method” is intended as a simple and quick way of estimating the number of undiscovered accumulations were some past activity has occurred. When this procedure was followed for the planning area we determined that 359 sections could contain producible hydrocarbons. Assuming development of each section would require 2.5 to 3 producing wells, 897 to 1,077 wells would be needed to develop these sections.

Exploratory Unit Activity

The large number of past approved exploratory units shows that unitization has been a popular method for orderly exploration. Recent exploratory unit proposals indicate new exploration interest in the planning area if activity continues to be allowed. Over the busiest past period, 1978-1983, 25 exploratory units were proposed. This rate is assumed to be the maximum rate that could be expected between 1998 and 2017. This rate applied to the 20-year study period means a

maximum of 83 exploratory unit proposals could be made for lands in or partially in the planning area. About 20 percent of past exploratory units have been successful (at least one productive well was drilled) and this success ratio is expected to continue.

Total Projected Wells

Most drilling activity has been concentrated in the south central part of the planning area (Nitchie Gulch unit/field) with additional exploratory wells scattered across the rest of the area. If allowed, most future activity would spread out and down the flanks of the Rock Springs Uplift from present areas of production. Exploration activity is also expected to be concentrated in the areas where exploratory unit proposals have been made, but, have not yet been tested. Scattered tests will continue to be drilled throughout the area with concentrations of wells being drilled around new successful wells. Lowest rates of activity are expected to be on the north edge of the planning area where targets are deep and lie below granites of the Wind River Thrust.

Since no drilling programs have been proposed by industry, a statistical analysis was developed to determine the number of wells that could be drilled. It is difficult to do a statistical analysis of past drilling rates to help predict future rates. Since the 1980s, large parts of the planning area have not been available for development or have had development restrictions and this distorts the data from this period.

A review of past activity and success rates for the planning area shows that the highest 5-year rate was during the 1978-1982 period when 48 wells were drilled. Assuming this highest rate can be projected over a 20 year period, a maximum rate of drilling activity can be projected. At this rate an additional 192 wells could be drilled in the planning area.

A drilling success rate for these wells is expected to be 53 percent. This rate was determined by comparing wells drilled in the period 1978-1997 against the number completed as producers. During this period 46 non-coalbed methane producers have been completed out of the 86 non coalbed methane wells drilled. Recent success rates have been high and are expected to remain relatively high due to continued improvements in geologic analysis and in drilling and completion technology and due to the expected general step-out drilling from already producing areas.

Costs of Time Delays Related to Restrictions

Barlow & Haun (1994) project an increased demand for clean-burning, affordable, natural gas in the area of the planning area. This increased demand coupled with slower drilling response time, due to high level of restriction on activity, does not allow for timely development of drilling programs. This adversely impacts economics for companies trying to develop the resource. Seasonal access restrictions increase the time needed to acquire seismic data, drill individual wells, and develop discovered fields. These delays do not generally prevent an individual operator from developing

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the resource, but they do increase costs of field development and slow the industry's response time to attractive increases in product prices. These time delays coupled with the many other restrictions on activity in the planning area are expected to discourage interest in the area and cause some wells to not be drilled. Barlow & Haun (1994) found that "cumulative costs associated with access in the NEPA process can add \$9,500 to \$21,000 on a per well basis."

Other Mineral Conflicts

Conflicts with other mineral resources can cause restriction to development of the hydrocarbon resource. No conflicts with other mineral resources are expected over the life of this plan.

**TABLE A-13-01
FEDERAL EXPLORATORY UNITS**

Unit Name	Effective Date	Status	Term. Date	Acres	Exploration Targets	Trap Type	Producing Formation
Big Bear	19950531	Productive Terminated	19960725	25,625	Lance, Lewis, Mesaverde, Frontier, and Dakota	Stratigraphic	Rock Springs
Big Dune	19590121	Terminated	19620501	17,675	Fort Union, Lewis, and Almond	Stratigraphic	
Boars Tusk	19790625	Productive Terminated	19861009	11,520	Frontier and Dakota	Stratigraphic	Frontier and Dakota
Buccaneer	19801216	Productive Active		12,160	Fort Union, Lance, and Mesaverde	Stratigraphic	Dakota
Centurion	19810428	Terminated	19810716	24,988	Lewis	Stratigraphic	
Circle Bar	19710115	Terminated	19720613	56,877	Lewis and Mesaverde	Structural closure against Continental fault	
Citation	19811130	Terminated	19820517	24,949	Mesaverde	Stratigraphic	
Continental Peak	19820617	Terminated	19820827	12,813	Granite Wash	Structural, near Continental Fault	
Dickie Springs	19700428	Terminated	19701215	13,074	Mesaverde	Structural closure against Continental fault	
Eden	19720818	Terminated	19750901	39,127	Tertiary and Mesaverde	Stratigraphic with fault control	
Encore	19970325	Terminated	19980217	4,407	Lewis, Almond, Ericson	Stratigraphic	
Essex Mountain	19840506	Productive Terminated	19841018	10,116	Frontier	Stratigraphic	Frontier
Freighter Gap	19810209	Productive Terminated	19870711	24,656	Rock Springs	Stratigraphic	Mowry
Gold Coast	19980130	Exploratory Suspended		25,585	Confidential	Confidential	
Greater Pacific Creek	19780310	Terminated	19801001	31,338	Frontier, Dakota, Nugget, Phosphoria, Tensleep, and Madison	Structural closure	
Harris Slough	19800812	Terminated	19810715	24,983	Lewis	Stratigraphic	
Honeycomb Buttes	19790329	Terminated	19800403	24,969	Mesaverde ?	Unknown	
Hourglass	19800530	Terminated	19810528	24,453	Mesaverde	Stratigraphic	
Indian Gap	19550916	Terminated	19580301	19,826	Nugget	Unknown	
Jack Morrow Creek		Exploratory Proposed		24,921	Confidential	Confidential	
Jade	19970219	Productive Terminated	19980701	19,034	Lewis and Almond	Overpressured Stratigraphic	Lewis
Johnson Gap (Deep)	19940228	Exploratory Suspended		25,970	Confidential	Confidential	
Lost Valley	19780807	Productive Terminated	19851130	40,371	Lewis	Stratigraphic	Mesaverde
Monument Draw	19810917	Terminated	19811229	13,389	Granite Wash	Structural closure	
Monument Ridge	19630529	Terminated	19640201	31,644	Lewis and Rock Springs	Stratigraphic	
Morrow Creek	19541112	Terminated	19560701	25,126	Mesaverde	Structural (seismic) closure against fault	
Morrow Creek	19590917	Terminated	19600501	8,160	Lewis and Mesaverde	Stratigraphic/Structural	
Morrow Creek	19660624	Terminated	19680201	79,301	Almond	Stratigraphic	
Musketeer	19810630	Terminated	19820517	23,626	Mesaverde	Stratigraphic	
Nitchie Gulch	19621001	Productive Active		7,154	Frontier and Dakota	Stratigraphic/Structural	Frontier and Dakota
Northern Lights		Withdrawn		26,908	Confidential	Confidential	
Oasis	19831227	Terminated	19840515	24,677	Morrison	Stratigraphic	
Oregon Trail	19460000	Terminated	?	15,000?	Unknown	Structural closure against Continental fault	
Pacific Creek	19430527	Terminated	19471231	23,036	Mesaverde	Structural closure against Continental fault	
Pacific Creek	19590113	Withdrawn	19610414	27,514	Mesaverde	Structural closure	
Pacific Creek II	19730927	Terminated	19750723	15,939	Ericson	Structural closure	
Packsaddle	19790227	Terminated	19790730	24,779	Frontier	Stratigraphic	

**TABLE A-13-01
FEDERAL EXPLORATORY UNITS**

Packsaddle Canyon		Cancelled	19821015	24,927	Frontier	Stratigraphic	
Parnell Creek	19611103	Terminated	19620501	26,183	Almond	Stratigraphic	
Pinnacles	19670321	Terminated	19680601	150,024	Lewis and Almond	Stratigraphic	
Pirate	19801031	Terminated	19810227	10,165	Mesaverde	Stratigraphic	
Plunge	19600311	Terminated	19620801	21,087	Almond	Unknown	
Rim Rock	19800229	Productive Active		24,816	Frontier	Stratigraphic	Dakota
Riva	19941202	Terminated	19950622	13,179	Lewis	Stratigraphic	
Rock Cabin	19800627	Terminated	19820328	15,336	Lewis, Mesaverde, and Frontier	Stratigraphic	
Saddle Bag	19810528	Terminated	19821024	26,083	Rock Springs	Stratigraphic	
Sands of Time	19830311	Terminated	19830519	24,879	Lewis	Stratigraphic	
Scotty Lake	19781102	Terminated	19800721	23,240	Lewis	Stratigraphic	
South Pass	19810323	Terminated	19830624	24,920	Lewis	Structural closure	
Steamboat	19780418	Productive Active		14,132	Frontier	Stratigraphic	Frontier
Treasure	19790620	Productive Active		24,797	Lewis	Stratigraphic	Dakota
West 187	19980225	Exploratory Active		4,493	Confidential	Confidential	

**TABLE A13-2
UNITS WITH HYDROCARBONS**

Exploratory Unit	Producing Zone(s)
Steamboat	Frontier Formation
Lost Valley	Mesaverde Group (production from outside planning area)
Treasure	Dakota Formation
Boars Tusk	Frontier and Dakota formations
Rim Rock	Dakota Formation
Buccaneer	Dakota Formation
Freighter Gap	Mowry Shale
Essex Mountain	Frontier Formation

**TABLE A13-3
PRODUCTIVE UNITS OR FIELDS**

Unit and/or Field Name	Number of Producing Wells
Nitchie Gulch	48
Boars Tusk	1
Pine Canyon	4
Treasure	2
Essex Mountain	2
Rim Rock	2
Buccaneer	1
Steamboat Mountain	1
Freighter Gap	1
Big Bear	1
Unnamed coalbed methane wells	3

**TABLE A13-4
DRILLING RATES AND SUCCESS PERCENTAGES**

Time Period	Wells Drilled	Producers	Success
Pre-1952	3	0	0%
1953-1957	3	0	0%
1958-1962	16	3	19%
1963-1967	19	9	47%
1968-1972	9	1	11%
1973-1977	14	4	29%
1978-1982	48	17	35%
1983-1987	20	13	65%
1988-1992	19	17	89%
1993-1997	2	2	100%

**TABLE A13-5
PLAYS AND THEIR POTENTIAL FUTURE RESOURCE**

Play	Play Type	Gas Resource BCF (billion cubic feet)
Fort Union and Lance	basin-centered gas	200 BCF
Lewis Shale	deep water marine sandstone	150 BCF
Upper Almond Sandstone	shore-face sandstone	100 BCF
" " "	marine bar sandstone	100 BCF
Lower Almond-Ericson	basin-centered gas	500 BCF
Rock Springs Formation	coalbed methane	50 BCF
Frontier Formation	fluvial sandstone	100 BCF
" "	marine sandstone	100 BCF
Muddy Sandstone	Marine sandstone	200 BCF
" "	fluvial sandstone	100 BCF
Dakota Sandstone	fluvial sandstone	100 BCF
Structural Accumulations	multiple objectives	400 BCF