APPENDIX I

REASONABLE FORESEEABLE DEVELOPMENT SCENARIOS

Appendix I
Reasonable Foreseeable Development Scenarios (Minerals) (From the Winnemucca RMP Mineral Potential Report - BLM 2006a)

As part of the Winnemucca RMP process a Mineral Potential Report was developed to analyze existing and potential development of mineral resources. This appendix includes reasonable development scenarios from that report for oil and gas resources, geothermal resources and solid leasable minerals.

I.1 OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

I.1.1 Development Potential Rankings

Development potential is not a prediction of precise future drilling locations and should not be used as a gauge of future interest or lack of interest in leasing. Oil and gas companies have numerous sources of proprietary data not available to the BLM (such as seismic data or internal geologic reports), which they use prior to making financial commitments to lease or drill. Therefore, even though an area is rated as very low development potential at this time with a low probability for any wells being drilled, a company may still be interested in leasing that area, should it be made available.

The analysis of potential for development of oil and gas resources within the Planning Area is based on bedrock geologic mapping, geophysical data and 47 oil and gas tests drilled in the Planning Area (**Table I-1**). The areas with potential for the occurrence of oil and gas resources within the Planning Area are shown on **Figure I-1**.

Figure I-1 is a map depicting development potential for oil and gas resources within the Planning Area. On this map development potential ranges from moderate to very low. As with the occurrence potential, there are no areas of "high" development potential within the Planning Area. High development potential areas occur only within proven producing petroleum provinces or in areas with a significant number of hydrocarbon "shows". Areas of moderate development potential have a significant thickness of sedimentary section present that includes possible source and reservoir rocks. These areas correspond to the USGS (1995) play areas.

Within the Planning Area, areas having a low potential for development typically have a thin sedimentary section present. They may also have limited source rock potential because of shallow burial and/or limited reservoir potential. Areas of low potential are also used to designate areas where there is insufficient data available to analyze the potential. Areas of low potential occur adjacent to areas of moderate potential in the Tertiary basin of the Western Great Basin Province.

An area of very low development potential lacks source or reservoir rocks or is an area predominantly underlain by metamorphosed or intrusive terrane. Areas of very low potential have no sedimentary source rock section thought to be capable of generating oil or gas and/or very limited reservoir potential.

TABLE I-1
SUMMARY OF OIL AND GAS DRILLING ACTIVITY TO 2004
WINNEMUCCA FIELD AREA, NEVADA

Operator Current Name	Lease Name	Name	Field Name	County Name	Permit #	Permit Date	Total Drilled	Dated Spud	Date Completion	Date Last Activity
BLACK ROCK O&G CO	GOVT	1	WILDCAT	HUMBOLDT		11/23/1921	800	12/3/1921	12/30/1921	12/1/1998
EARTH POWER PROD	N17278	45-14	WILDCAT	HUMBOLDT		9/20/1982	3703	9/30/1982	1/19/1983	12/1/1998
HUMBOLT ASSOC	ELLISON	2	WILDCAT	HUMBOLDT	383	6/16/1984	1020	6/26/1984	7/4/1984	12/1/1998
HUMBOLT ASSOC	ELLISON	1	WILDCAT	HUMBOLDT	268	11/4/1979	986	11/14/1979	7/3/1984	12/1/1998
SUN EXPL & PROD CO	KING LEAR-FEDERAL	1-17	WILDCAT	HUMBOLDT	347	4/7/1983	7931	4/17/1983	6/4/1983	12/1/1998
W PACIFIC RR CO	SULPHUR MP	474.67		HUMBOLDT		1909	970			
ARCO OIL & GAS CORP	ARCO TOBIN UNIT	1	WILDCAT	PERSHING	408	10/28/1984	2065	11/7/1984	12/6/1984	12/1/1998
CHEVRON U S A INC	KYLE-FEDERAL	84-2	WILDCAT	PERSHING		9/7/1980	2104	9/17/1980	10/11/1980	12/1/1998
EVANS BARTON LTD	KYLE SPRING	11-42A	WILDCAT	PERSHING	838	7/10/2001	607	7/24/2001		8/10/2004
EVANS BARTON LTD	KYLE SPRING	12-13D	WILDCAT	PERSHING	759	9/21/1995	1000	10/1/1995	6/1/1997	1/14/2004
EVANS BARTON LTD	KYLE SPRING	12-13	WILDCAT	PERSHING	730	8/2/1994	1162	8/12/1994	8/25/1994	1/23/2003
EVANS BARTON LTD	KYLE SPRING FED	11-14	WILDCAT	PERSHING	791	10/27/1996	2633	11/6/1996	6/1/1997	1/14/2004
EVANS DAVID M	KYLE SPRING	12-13	UNNAMED	PERSHING		10/27/1996	230	11/6/1996	11/6/1996	8/20/2003
EVANS DAVID M	KYLE SPRING FED	11-43	WILDCAT	PERSHING	821	7/13/1998	868	9/23/1998	12/20/2002	9/24/2004
EVANS DAVID M	KYLE SPRING FED	11-23	WILDCAT	PERSHING		5/12/1998	2020	8/1/2000	8/9/2000	5/30/2003
GETTY OIL COMPANY	FEDERAL	44-10	WILDCAT	PERSHING		3/3/1981	7964	3/13/1981	6/27/1982	12/1/1998
GETTY OIL COMPANY	FEE	14-22		PERSHING		3/3/1979	500	3/13/1979	3/14/1979	11/2/2001
GETTY OIL COMPANY	FEE	18-24		PERSHING		3/1/1979	500	3/10/1979	3/12/1979	11/2/2001
GETTY OIL COMPANY	FEE	17-24		PERSHING		2/28/1979	500	3/9/1979	3/10/1979	11/2/2001
GETTY OIL COMPANY	FEE	13-26		PERSHING		2/14/1979	500	2/24/1979	3/8/1979	11/2/2001
GETTY OIL COMPANY	FEE	6-6	WILDCAT	PERSHING		3/5/1979	500	3/15/1979	3/15/1979	12/1/1998
GETTY OIL COMPANY	FEE	15-21	WILDCAT	PERSHING		3/4/1979	500	3/14/1979	3/15/1979	12/1/1998
GETTY OIL COMPANY	FEE	16-22	WILDCAT	PERSHING		3/2/1979	500	3/12/1979	3/13/1979	12/1/1998
GETTY OIL COMPANY	FEE	10-34	WILDCAT	PERSHING		2/16/1979	500	2/26/1979	2/26/1979	12/1/1998
GETTY OIL COMPANY	FEE	11-23	WILDCAT	PERSHING		2/4/1979	500	2/14/1979	2/16/1979	12/1/1998
GETTY OIL COMPANY	FEE	5-8	WILDCAT	PERSHING		2/3/1979	500	2/13/1979	2/13/1979	12/1/1998
GETTY OIL COMPANY	FEE	4-16	WILDCAT	PERSHING		2/2/1979	500	2/12/1979	2/12/1979	12/1/1998
GETTY OIL COMPANY	FEE	7-4	WILDCAT	PERSHING		2/2/1979	500	2/12/1979	2/13/1979	12/1/1998
GETTY OIL COMPANY	FEE	3-10	WILDCAT	PERSHING		2/1/1979	500	2/11/1979	2/11/1979	12/1/1998
GETTY OIL COMPANY	FEE	1-12	WILDCAT	PERSHING		1/28/1979	500	2/7/1979	2/10/1979	12/1/1998
GETTY OIL COMPANY	FEE	2-2	WILDCAT	PERSHING		1/18/1979	500	1/28/1979	2/2/1979	12/1/1998
GETTY OIL COMPANY	FEE	8-34	WILDCAT	PERSHING		1/16/1979	500	1/26/1979	1/29/1979	12/1/1998
GETTY OIL COMPANY	FEE	9-34	WILDCAT	PERSHING		1/15/1979	500	1/25/1979	1/26/1979	12/1/1998
GETTY OIL COMPANY	FEE	12-26	WILDCAT	PERSHING		1/6/1979	400	1/16/1979	2/23/1979	12/1/1998
GETTY OIL COMPANY	IGH	2	COLADO	PERSHING		10/20/1979	1165	10/30/1979	11/18/1979	12/1/1998
OESI POWER		46-28M	HUMBOLDT	PERSHING	284	9/23/1991	260	10/3/1991	10/15/1991	12/1/1998
OUIDA OIL CO	DIXIE	1	WILDCAT	PERSHING	743	2/17/1995	4536	2/27/1995	5/24/1995	12/1/1998
PHILLIPS PETRLM CO	CAMPBELL	E-2	HUMBOLDT	PERSHING		12/27/1978	8061	1/6/1979	10/1/1979	12/1/1998
PHILLIPS PETRLM CO	CAMPBELL	E-1	WILDCAT	PERSHING		10/23/1977	1848	11/2/1977	12/10/1977	12/1/1998
TREGO WELL BLACK R DES	TREGO WELL			PERSHING			1500			
AMOR IV CORPORATION		32A-21	SAN EMIDIO DESERT	WASHOE		10/9/1988	1000	10/19/1988	10/26/1988	12/1/1998
CAITHNESS POWER		32-5	STEAMBOAT SPR	WASHOE	79	10/8/1987	3000	10/18/1987	11/8/1987	12/1/1998
CHEVRON GEOTHERMAL		28-32		WASHOE	67	3/11/1986	3031	3/21/1986	5/12/1986	12/1/1998
PHILLIPS PET-GULF	STEAMBOAT	1	WILDCAT	WASHOE		5/26/1979	3075	6/5/1979	7/16/1979	12/1/1998
PHILLIPS PETRLM CO	COX	I-1	WILDCAT	WASHOE		3/22/1981	3471	4/1/1981	7/1/1981	8/20/2003
SUNOCO ENRGY DEV CO	HOLLAND LIVESTOCK	1-2-FR		WASHOE		2/6/1979	5210	2/16/1979	4/26/1979	2/26/2002
SUNOCO ENRGY DEV CO	HOLLAND LIVESTOCK	1-15G	WILDCAT	WASHOE		12/7/1978	5871	12/17/1978	2/20/1979	12/1/1998

Notes:

Well Data compiled from: P I Dwights Winn FO RMP Washoe, Humboldt, Pershing 2/2005

NBMG, 2001, Oil and Gas Wells Drilled in Nevada (website: http://www.nbmg.unr.edu/lists/oil/oil.htm)

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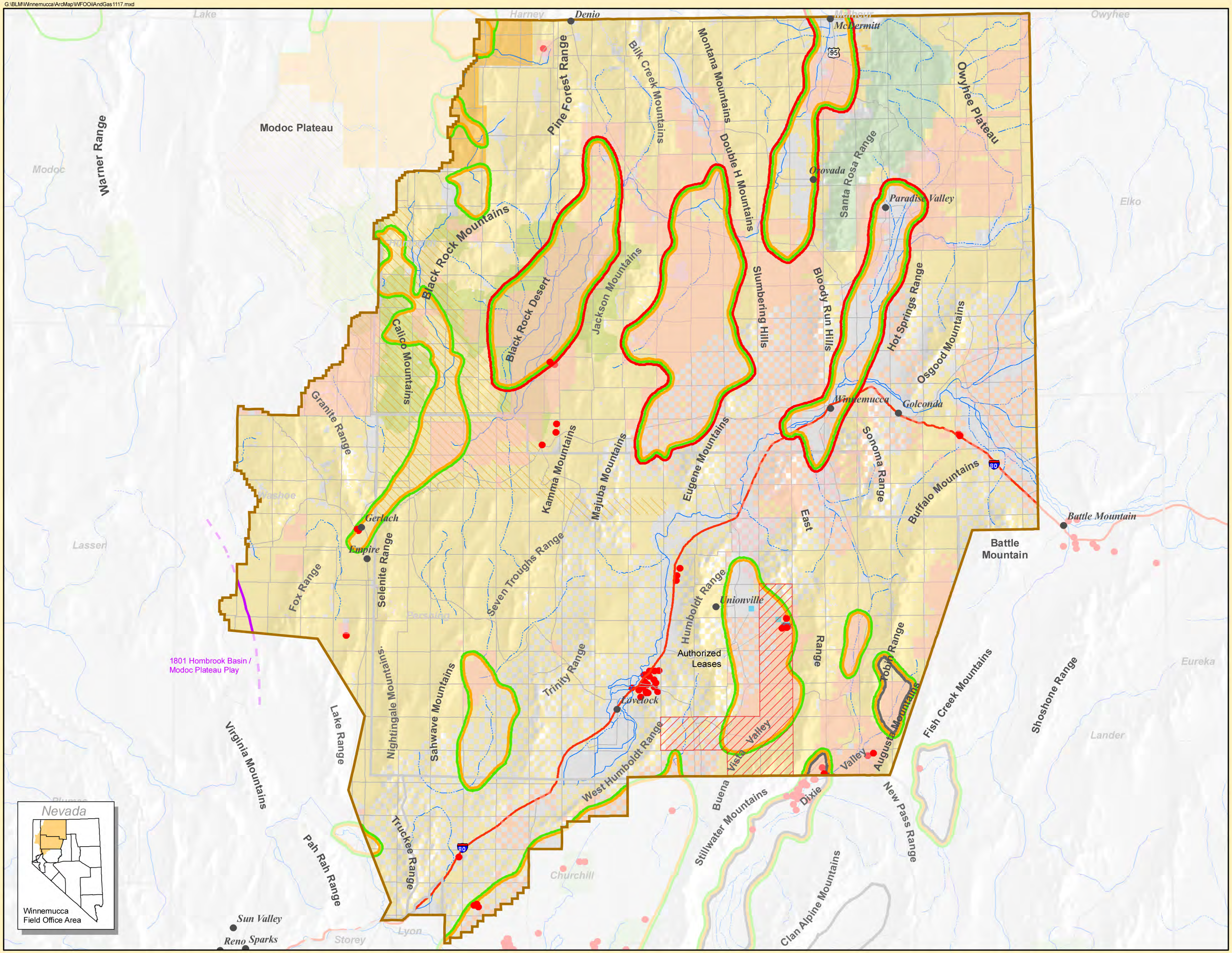


WFO Boundary
Interstate
State Highways
Local Roads
Perennial Stream
Internittent Stream
County Boundaries

Western Great Basin Province Plays

- 1801 Hombrook Basin-Modoc Plateau Play
- 1802 Eastern Oregon Neogene Basins Play
- 1803 Permian-Triassic Source Rocks, Northwestern Nevada and East Central and Eastern Oregon Play
- 1804 Cretaceous Source Rocks, Northwestern Nevada Play
- 1805 Neogene Source Rocks, Northwestern Nevada and Eastern California Play
- Oil and Gas Well Locations

Surface Ownership

- BLM Land
- National Forest
- Wilderness Area
- Wildlife Refuge
- National Conservation Area

Oil and Gas Leases

- Authorized Leases
- Oil and Gas Competitive Lease Area
- Historic Oil and Gas Leases (as of 7/05)

No warranty is made by the Bureau of Land Management (BLM) for use of data for purposes not intended by BLM.

0 Miles 25

Oil and Gas Wells, Leases and USGS Plays
Mineral Assessment Report
Winnemucca Field Office
RMP Planning Area, Nevada
Figure I-1

I.1.2 Drilling Activity Forecast

In order for the BLM to be able to analyze the effects of oil and gas leasing, and possible impacts related to exploration, development, and cumulative effects, it is necessary to estimate how many wells industry might drill in the next 15 to 20 years within the WD Planning Area. The following RFD scenario has been developed using historical oil and gas development, and oil "play" information from the US Geological Survey, potential development map (Figure 4.6) and other data from BLM files, and a number of other technical sources.

The Neogene Source Rock Play areas (**Figure I-1**, green outlined areas) have a moderate to high resource potential; that is, they have a high probability (0.8 to 1.0) of a suitable oil and gas charge occurring in the source rock (USGS, 1995). Even though the probability of occurrence of suitable reservoir rock and traps in the Neogene Basins Play areas (yellow outlined areas) is relatively low (0.2-0.5) (USGS 1995), it is estimated that as many as twelve wildcat wells (wells drilled in areas with no previous production) may be drilled in these Neogene Basins in the next 15 to 20 years. Many of the initial twelve wells would likely be located in the Buena Vista Valley and Kyle Springs areas (**Figure I-1**). Of these twelve wells it is estimated that 10 will be dry holes (no economically producible oil or gas is discovered). Dry holes would be plugged and abandoned with surface reclamation occurring shortly afterward.

It is further estimated that two of the wells drilled in the southeast portion of the Planning Area, probably in the vicinity of the relatively recent leasing activity and within the area nominated for Oil and Gas Competitive Leasing, will produce a discovery **(Figure I-1**). Each of the discovery wells would probably prompt additional step-out wells. A "step-out well" is a well drilled adjacent to or near a proven well to establish the limits and continuity of the oil or gas reservoir and/or to assist with production. It was estimated that a total of four (4) step-out wells would be drilled, two for each discovery. Finally, it is estimated one of the discoveries (including the two step-out wells) would have limited oil production and occur on BLM administered lands.

The general geographic areas within the Planning Area, where oil and gas exploration is predicted to occur are on **Figure I-1**. Each of the areas is associated with an area identified as a Neogene Basin or Neogene Source Rock Play area described above in the section entitled USGS Hydrocarbon Provinces and Plays. It is anticipated that the 12 projected wildcat wells would be drilled somewhere within the basin boundaries of these four play areas with discoveries likely in the Buena Vista Valley area (in the area currently nominated for Oil and Gas Completive Leasing (**Figure I-1, Table I-2**).

Table I-2
Drilling Activity Forecast (RFD)
Mineral Assessment Report Winnemucca District – RMP/EIS Planning Area

Area	Wildcat Wells	Discoveries	Step-out Wells	Commodity
Neogene Basins	12			
Buena Vista Valley Area		2	4	oil or gas
TOTAL	**12**	**2**	**4**	oil or gas

I.1.3 Surface Disturbance Impacts

Construction of temporary road access and a drilling location for each wildcat well may disturb about 6 acres for each wildcat well, or 72 acres for all the wildcat wells. No discoveries of commercial quantities of oil or gas are anticipated during the next 10 to 15 years.

This section of the Reasonable Foreseeable Development Scenario describes the anticipated disturbances associated with the Drilling Activity Forecast (**Table I-2**) predicted in the preceding section. **Table I-3** describes the tasks involved and the surface disturbances that are likely to result from the successful and unsuccessful drilling of wildcat wells, development or step-out drilling, and field production activities of the Winnemucca RFD drilling forecast. The number of acres of disturbance estimated relies on data derived from wildcat well drilling elsewhere within the Planning Area and on existing small scale production from fields developed elsewhere in Nevada. Reclaimed acres (regraded and seeded) are assumed to be stabilized after 2 years.

Table I-3
Estimated Cumulative Impacts of Oil and Gas Exploration and Development (RFD)
Mineral Assessment Report Winnemucca District – RMP/EIS
Planning Area

Type of Disturbance	Required Tasks		Acres Disturbed Pre-Site Reclamation	Acres Disturbed Post-Site Reclamation
Ten (10) Unsuccessful Wildcat Wells	Well Site - Maximum area of 3.6 acres (about 380 ft. x 400 ft.) cleared per well pad.		35	0 (2 years)
	Access Roads – 40 ft. width x lineal footage (3.6 miles or 18,480 lineal feet) or about 17 acres per well site.		170	0 (2 years)
One (1) Well Drilled with a Gas Field Discovery Two (2) Step-out Wells Drilled with No Production because of distance to Gas Transmission Lines	- Gas field would be discovered in the Buena Vista Valley west of the East Range (Field would be approximately 3 square miles in surface area). - Compressor stations would normally be necessary along the feeder pipeline route but the distance to the main transmission line is too long, and the field is shut in. - Condensate, gas, and water separation would occur at the well sites, during production testing. Water disposal would be into a lined pit at the surface or water would be injected into the subsurface through a dry hole converted into a water disposal well. Gas would be flared. Condensate would be shipped by truck (1 truck every 4 days).		Not Applicable	Not Applicable
	1 discovery well - 2 additional step out wells per discovery well	Well Site - Maximum area of 3.6 acres (about 380 ft. x 400 ft.) cleared per well pad.(3 wells total)	10.5	3.6 (2 years)
		Access Roads – 40 ft. width x lineal footage. • 1 at 17 acres (3.6 miles long) • 2at 7.3 acres (1.5 miles long)	31.6	16.7 (2 years)
		Pipelines – no production, none required - Trunk lines to existing transmission lines – 25 ft. width x lineal footage (35 miles long). - Field gathering pipelines will follow access roads and no additional disturbance will result.	0	0 (2years)

Table I-3 (continued)
Estimated Cumulative Impacts of Oil and Gas Exploration and Development (RFD)

Type of Disturbance	Required Tasks		Acres Disturbed Pre-Site Reclamation	Acres Disturbed Post-Site Reclamation
One (1) Oil Field Discovered and Brought into Small Scale Production	- An oil field is possible in the Kyle Springs area - Field would be approximately 1 ½ square miles in surface area. - Oil would be transported by truck to refining facility. - Oil, gas, and water separation would occur at the well sites. Water disposal would be into a lined pit at the surface or water would be injected into the subsurface through a dry hole converted into a water disposal well. Gas would be used on lease to separate oil and water and to heat oil. Gas not used on lease would be reinjected into the formation for pressure maintenance or would be vented / flared to the atmosphere. If sufficient gas quantities are produced this gas may also be captured and sold. For this analysis all unused gas is assumed to be reinjected for pressure maintenance.		Not Applicable	Not Applicable
	- 3 commercially productive wells (one discovery and two step-out wells)	Well Site - Maximum area of 3.6 acres (about 380 ft. x 400 ft.) cleared per well pad.	10.5	3.6 (2 years)
		Access Roads – 40 ft. width x lineal footage. • 1 at 17 acres (3.6 miles long) • 2 at 7.3 acres (1.5 miles long)	31.6	16.7 (2 years)
		Pipelines - Field gathering pipelines will follow access roads and no additional disturbance will result.	0	0

I.2 GEOTHERMAL REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

I.2.1 Reasonably Foreseeable Development Scenario

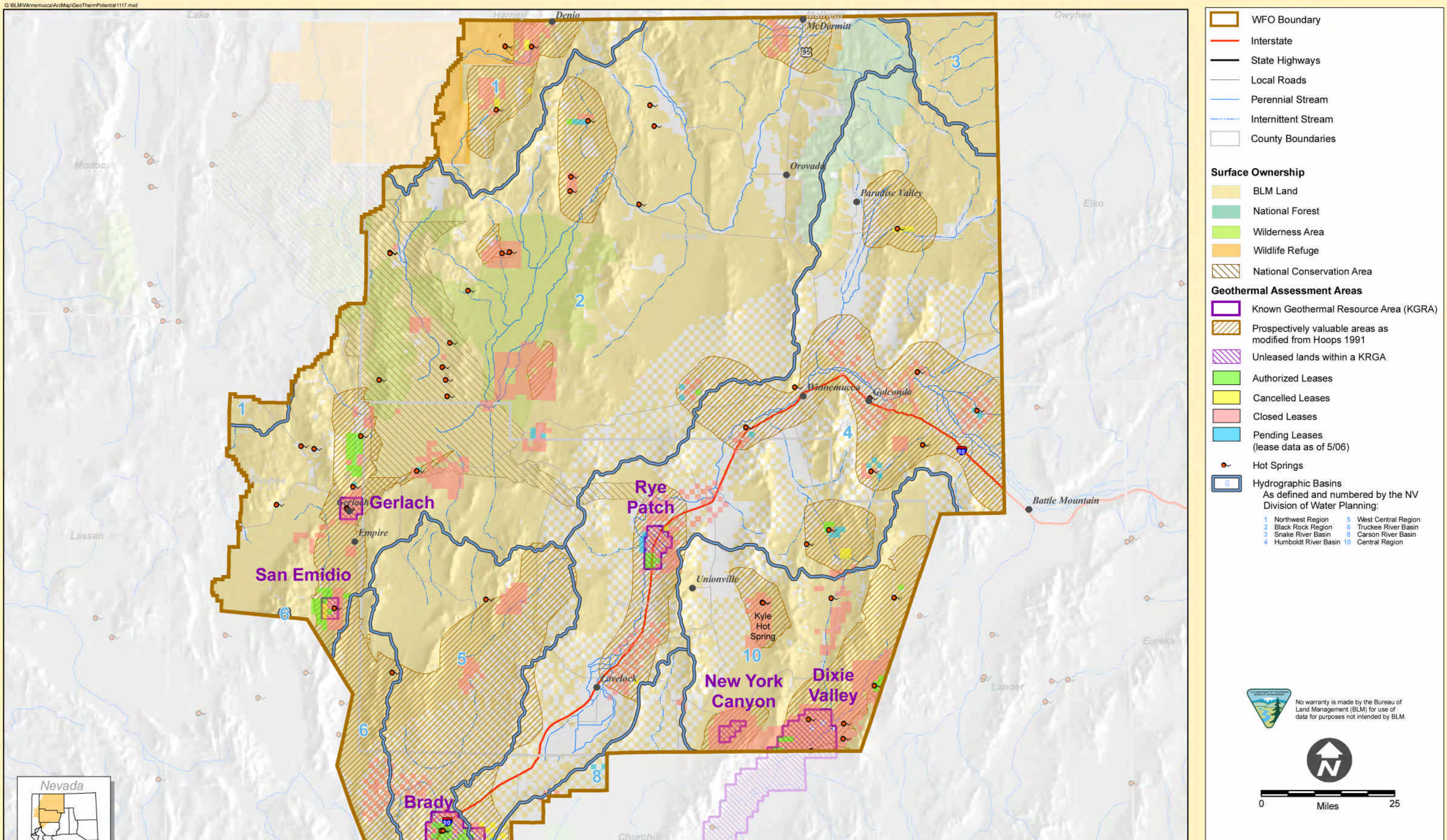
Although the process of leasing geothermal resources does not directly impact the human environment, lease issuance confers the future right to develop geothermal resources, subject to applicable regulations and lease stipulations. Thus reasonably foreseeable future development scenarios would project surface disturbance to some of the leased lands (see **Figure I-2**). A reasonably foreseeable development scenario discloses future potential direct and indirect impacts that could occur once the lands are leased. This evaluation does not replace the requirement that BLM conduct a site-specific environmental analysis at the exploration, development drilling, and utilization stages, in order to comply with the National Environmental Policy Act (NEPA).

Development of geothermal resources, as with many mineral resources, is a dynamic process difficult to separate cleanly into component parts for descriptive purposes. However, there are three definable and generally sequential phases of geothermal development. The probable sequence and degree of environmental impact would be contingent upon the success or failure of each preceding phase. The three phases are: 1) exploration; 2) production and injection well drilling, utilization, and; 3) final plugging and reclamation.

Exploration. This stage includes all activities to explore for geothermal resources. There are many discrete or identifiable actions which characterize this stage, including generally geologic, geochemical, and geophysical surveys. Cross-country vehicle travel could occur in order to complete the surveys. In some instances these surveys are not considered necessary. Road building and drill pad construction could occur in order to drill temperature gradient and exploration wells. Most activities at this stage are proposed to the BLM via a Notice of Intent to Conduct Geothermal Resource Exploration Operations, otherwise known as a Notice of Intent, or just NOI.

Geologic, Geochemical, and Geophysical Surveys. These surveys typically consist of analyzing the surface geology, collecting water data and samples from hot springs, and collection of geophysical data by various methods. Based on the analysis of the data gathered, inference can be made as to where higher temperature gradients could occur. This work usually covers a broad surface area. Typically, geologic, geochemical, and geophysical surveys cause minimal surface disturbance and are often considered casual use. If the proposed activities exceed the casual use threshold they may be categorically excluded from extensive NEPA analysis, or require consideration at the Environmental Assessment (EA) level.

Drilling Temperature Gradient Wells. Temperature gradient wells are often drilled to confirm the locations of higher temperature zones. These wells are small diameter (generally less than six inches) and are drilled to depths of several hundred to several thousand feet and often (but not always) include road building and drill pad construction. When completed, the operator lowers a thermistor down the well to measure how the temperature varies (typically increases) with depth. An operator could not produce any fluids out of, or inject any fluids into, a temperature gradient well. An operator could drill several gradient wells, on un-leased land or leases that they own, to determine the extent of the temperature anomaly and where the highest temperature gradient occurs. Well pads are about .1 acres (55 feet by 80 feet) in size, and may be bladed or established without removing existing vegetation. Typically these wells are located adjacent to existing roads; however, new road construction could be necessary. Temperature gradient studies may be categorically



Geothermal Potential Map
Mineral Assessment Report
Winnemucca Field Office
RMP Planning Area, Nevada
Figure I-2

excluded from extensive NEPA analysis. When greater levels of disturbance are necessary (for example, road building) preparation of an EA is appropriate.

Drilling Exploration Wells. After the data gathered in the previous exploration activities have been evaluated, one or more exploration wells could be drilled in order to test the prospect. These holes may be several hundred to several thousand feet deep. In the geologic environments within the Winnemucca District they are typically two to four thousand feet deep. These wells could be tested for flow and injection parameters. A Geothermal Drilling Permit (GDP) must be approved for each well drilled. Each well pad with associated facilities would disturb an area of about 350 feet by 350 feet, or approximately 2.8 acres. In many cases a new road could be constructed into the site, creating additional disturbance. One or more GDPs will typically be analyzed in an EA.

Production, Utilization, and Injection Well Drilling. If the exploration activities have produced results that strongly indicate the presence of a heat reservoir capable of commercial production, development of the field(s) will ensue. Development and utilization proposals require NEPA analysis, often at the EA level, but in certain circumstances an EIS might be required. To date Winnemucca District has not had a geothermal proposal rise to analysis by an EIS. Because of the need to develop a production field and an injection field (in most cases), more surface disturbance for constructing roads and drill pads would occur. The producing limits of a field are determined by drilling of production and injection wells. In the early stages the status of any given well may be uncertain, because of limited knowledge of the details of the reservoir. Once there is confidence about the setting and geometry of the reservoir, development of the production facilities will begin. Generally, prior to initiating development scenarios, geothermal developers secure contracts with power companies that allow connection to the regional electrical grid. Development of production capabilities could include the construction of a geothermal electric generating plant, direct use facilities (such as green houses or dehydration plants), or a combination of the two. Other facilities that would be constructed include pipelines, at least one electric transmission line and administrative facilities such as offices, a warehouse, and maintenance facilities. If the development is for direct use the generating facilities would be replaced by greenhouses, dehydration plants, and possibly cooling ponds.

Road Construction. Often new access roads to well pad sites must be built. These roads are usually a half-mile to two miles in length, and are single lane with regularly-spaced turnouts. When the decision is made to develop a production facility, often a main access road will need to be constructed, or an existing road must be brought up to sufficient standards to safely handle traffic related to the construction of the production infrastructure. The distance from the production facility to a public road will vary, but may be as far as ten miles.

Drill Site Construction. The well pad for a production or injection well is essentially the same as that for the exploration wells, or 2.8 acres in size. The number of wells drilled depends on the geothermal resource available. On average, twenty production wells and ten injection wells would be drilled.

Geothermal Pipelines. Geothermal pipelines are usually 24-36 inches in diameter and covered with insulation. They carry geothermal fluid from the production wells to the power plant for use, and away from the power plant to the injection wells. It is standard practice for them to parallel the access roads when possible. Typically they could be one to two miles in length, and at least two (one each for production and injection) are required. However, the number and routes are dependent on the field configuration and plant location within the production complex.

Power Plant and/or Direct-Use Facility Construction. Electrical generation plants would typically range in generating capacity from 15 to 60 megawatts, in past experience of the District. The plant and other required facilities would occupy up to 30 acres, and would typically include cooling towers. Direct use facilities could include construction of greenhouses or vegetable dehydration plants and other facilities such as cooling ponds. These facilities could occupy 5–30 acres depending on their purpose.

Electric Transmission Line Construction. Most projects in the district are not located in close proximity to regional transmission lines, so electric transmission lines could range in length from 5-50 miles. They would most likely be supported by wooden poles. Typically a switching station also is required to be constructed where the outgoing electrical transmission line meets the grid.

Miscellaneous Support Facilities. These facilities could include administrative offices, warehouses and wareyards, maintenance buildings, communication systems, septic systems, and potable water wells and distribution. Most of these would be closely associated with the power plant, and are included in the acreage assigned for that facility.

Ongoing support activities for production. This involves the continued operation and maintenance of the field(s) and includes: new drill sites to replace poorly performing wells (requiring new GDPs), maintenance of existing facilities such as roads and pipelines, and waste disposal.

Interim reclamation. Several of the facilities at a producing site would be subject to interim reclamation. Drill pads are to be reclaimed to only the area necessary for continued operations. Road shoulders and ditches should be revegetated promptly after construction.

Plugging and final reclamation. This closing stage involves abandonment when exploration is unsuccessful or after production ceases. This includes the following discrete operations: surface equipment removal, plugging and abandoning drill holes and wells, and surface rehabilitation. All surface disturbances must be reclaimed to BLM standards. Reclamation includes removing all facilities, and re-grading and re-contouring all surface disturbances to blend with the surrounding topography, and re-establishment of a desirable variety of vegetation.

I.2.2 Quantitative Reasonably Foreseeable Development Scenario

Until actual geothermal exploration and development begins, it is difficult to quantify the resource potential and possible production measures necessary to develop the resources. In order to assess environmental impacts resulting from an action as general as geothermal exploration, development, and production, it is necessary to assume given levels of intensities of such development.

Models were created (summarized in **Tables I-4 and I-5**) which describe the major processes and actions involved in the various stages of lease implementation. They serve as the baseline against which to analyze impacts on the existing environment.

General Assumptions

This scenario is for the time-frame 2005 through 2025. For the purpose of this analysis, it is assumed that in addition to the approximately 131 leases existing at the end of 2005, 500 lease parcels will be sold during that time. Approximately 10 leases per year will be closed, terminated, cancelled, or relinquished, but that is not considered significant in this analysis. All leases will have three temperature gradient holes drilled, a total of 50 leases will have two exploration holes drilled but 25 of those leases would go no further toward production. On the remaining 25 leases, five 45-megawatt power plants would be developed within the district, each associated with five leases.

Surface Disturbance

Exploration. During the exploration stage, surface disturbance is minimal with few adverse impacts until the operator makes the decision to drill one or more exploration wells. An exploration-drilling model is shown below which lists the maximum degree of surface disturbance expected during this phase. This and other models, which follow, tend to maximize the degree of surface disturbance that could occur.

Up to three temperature gradient wells at size of 0.1 acre/site, could be drilled on each lease. This would disturb up to approximately three-tenths (0.3) of an acre per lease, with each well pad being approximately 2.8 acres. A total of 50 leases would have two exploration wells drilled, each with an access road one-half mile in length that would disturb approximately 1.5 acres. Total disturbance per lease having this activity is approximately 8.9 acres (see **Table I-4**).

Table I-4
Assumption Regarding Surface Disturbance for Geothermal Exploration

Activity	Area Of Disturbance (Acres)	Disturbance per lease parcel	Disturbance over planning area, for life of Plan
Temperature gradient wells, 3 per lease	0.1 acre/site	0.3 acres	150 acres
Exploration wells (average of 3000 feet deep), 50 w/ two sites each	2.8 acres/ site	5.6 acres	280 acres
Exploration Roads, 0.5 mile per drill site	3 acres/mile	3 acres	150 acres
Total exploration disturbance, life of Plan		8.9 acres	580 acres

Production, Utilization, and Injection Well drilling. The following model illustrates construction activities required to develop a 45-megawatt electrical power generating plant, associated wells, pipelines, roads, and electrical transmission lines. The number of wells includes those used for production, standby, and injection. Since development may occur in 5- to 15-megawatt increments over a period of several years, the degree of surface disturbance at any given time is likely to be less than assumed in the model. Mitigation and enhancement would have occurred on some portions of the lease before additional portions of the lease are developed.

Up to 6 wells (nominally 4 production and 2 injection) could be drilled on each lease, a total of 30 wells for the power plant. Not all wells drilled would necessarily be used (some could be shut in). Several of the wells required are likely to have been the exploration wells drilled previously, but will be considered in the total disturbance in this scenario, for the sake of simplicity. Each well pad would disturb approximately 2.8 acres. Thirty-eight acres of internal access roads would be created, primarily to service the wells. One pipeline of one mile length would transmit geothermal fluid to the power plant from production wells, and one pipeline of similar length would transmit used fluids to the injection wells. These pipelines would occupy/disturb approximately 5 acres each. The power plant and related support and administrative facilities would occupy approximately 30 acres, and a main access road would disturb approximately 30 acres. A 20-mile transmission line would occupy approximately 180 acres, but would actually disturb only about 25 acres for setting poles and a limited-use (two-track or trail) maintenance road. Total surface disturbance for each plant would total approximately 217 acres (see **Table I-5**).

Table I-5
Surface Disturbance Expected to Result from Development of Five 45-Megawatt Power Plants

Feature	Features/Plant	Disturbed Acres/Feature	Total Disturbed Acres/plant	Disturbance over planning area, for life of Plan
Wells	30	2.8	84	420
Access Road (spurs)	12.5 miles	3/mile	38	190
Pipelines	2 (1 mile ea.)	5	10	50
Power Plant	1	30	30	150
Main Access Road	1 (5 miles)	30	30	150
Transmission Line	1 (20 miles)	25	25	125
TOTAL			217	1085

Interim reclamation. Several of the facilities at a producing site would be subject to interim reclamation. Drill pads are to be reclaimed to only the area necessary for continued operations. About 50 percent of the well pad area would be subject to that interim reclamation. The shoulders and ditches of the main access road should be revegetated promptly after construction, reducing the vegetative disturbance by about 40 percent. Approximately 54 acres of the average plant development disturbance would be reclaimed on an interim basis, typically within two to three years after construction. This would amount to 270 acres of the disturbance expected over the planning area during the life of the plan.

Development Time-frames

The time-frames for a typical geothermal project are estimated as follows.

- Exploration: 1 to 5 years.
- Development: 2 to 10 years.
- Production: 30 to 50 years or more, but highly dependent on maintaining the geothermal field properly.

Geothermal Fluid Production and Associated Waste Production

Geothermal fluid production and associated waste production (salt and mineral-laden brine) is likely to occur for short periods as wells are tested to determine reservoir characteristics. Using data from other areas of geothermal development, it appears that production of geothermal fluids could be expected to vary from 1-6 million gallons per day, per well. Flow tests in Nevada rarely go for more than 48 hours, but occasionally may last for up to 7 days. Ordinarily all fluids are captured in a reserve pit or sump.

Once production is begun, most geothermal fluids produced are re-injected back into the geothermal reservoir, via injection wells. Binary power plants[1] utilize a closed loop system and are non-consumptive. They are the only type that has been developed on federal land in the Winnemucca District, and given the types and temperatures of geothermal systems present, that trend is likely to continue. In flash steam facilities about 15-20 percent of the fluid would be lost due to flashing to steam and evaporation through cooling towers or ponds. Fluids could also be lost due to pipeline failures or surface discharge for monitoring/testing the geothermal reservoir.

Plugging and final reclamation. As mentioned before, the close-out stage involves abandonment when exploration is unsuccessful or after production ceases. Certain facilities (for example a drill hole and pad) may be abandoned before the entire operation is ready for closure. In its final manifestation this includes the following activities: surface equipment removal, plugging and abandoning drill holes and wells, and surface rehabilitation of all project related disturbances. Reclamation consists of re-grading and re-contouring all surface disturbances to blend with the surrounding topography, and re-establishment of a desirable variety of vegetation. All surface disturbances must be reclaimed to BLM standards before permits are closed.

I.3 SOLID LEASABLE MINERAL POTENTIAL

The potential for development of leasable industrial rocks and mineral resources of the WD Planning Area are summarized below. These include the following: sodium minerals (including salt), and sulfur.

I.3.1 Sodium Minerals (salt)

There is good potential for the development of salt deposits in the Planning Area. The salt deposits occur in the playas of which the Planning Area has several. Although there is no current production of salt in the Planning Area, former salt mines include White Plains, Carson Sink, and Eagle Marsh in Churchill County and Buffalo Springs in Washoe County (Nash, 1996) (**Figure I-3, Table I-6**).

There are several mines that produced sulfur as a by product of gold and/or silver ores in the Planning Area. These include Sulfur in Humboldt County, Humboldt House (also known as Imlay) in Pershing County, and San Emidio in Washoe County (Papke and Castor, 2003; Tingley, 1998). Due to the high operating cost necessary for their development, and a technology generally incompatible with heap leach gold recovery operations at large gold mining operations, it is not likely that further large scale development of secondary sulfur mineral deposits will occur in Planning Area.

[1] In binary power plants, the hot geothermal fluid is used to heat a separate, binary fluid (typically a light hydrocarbon like butane, pentane, or heptane) in a heat transfer process. The binary fluid flashes at a lower temperature and is used to turn the power generating turbines.

I.3.2 Sulfur

There is low potential for the development of fumarole-related, sulfur deposits in the WD Planning Area. This is because fumarole environments have been thoroughly prospected for gold-silver-mercury deposits. Undiscovered deposits within 200 meters of the surface are predicted to either be small or buried by younger alluvium. Fumarole sulfur deposits tend to be small in size and can be rich in metals that are costly to remove. An economic deposit must be near an efficient transportation route (Nash, 1996).

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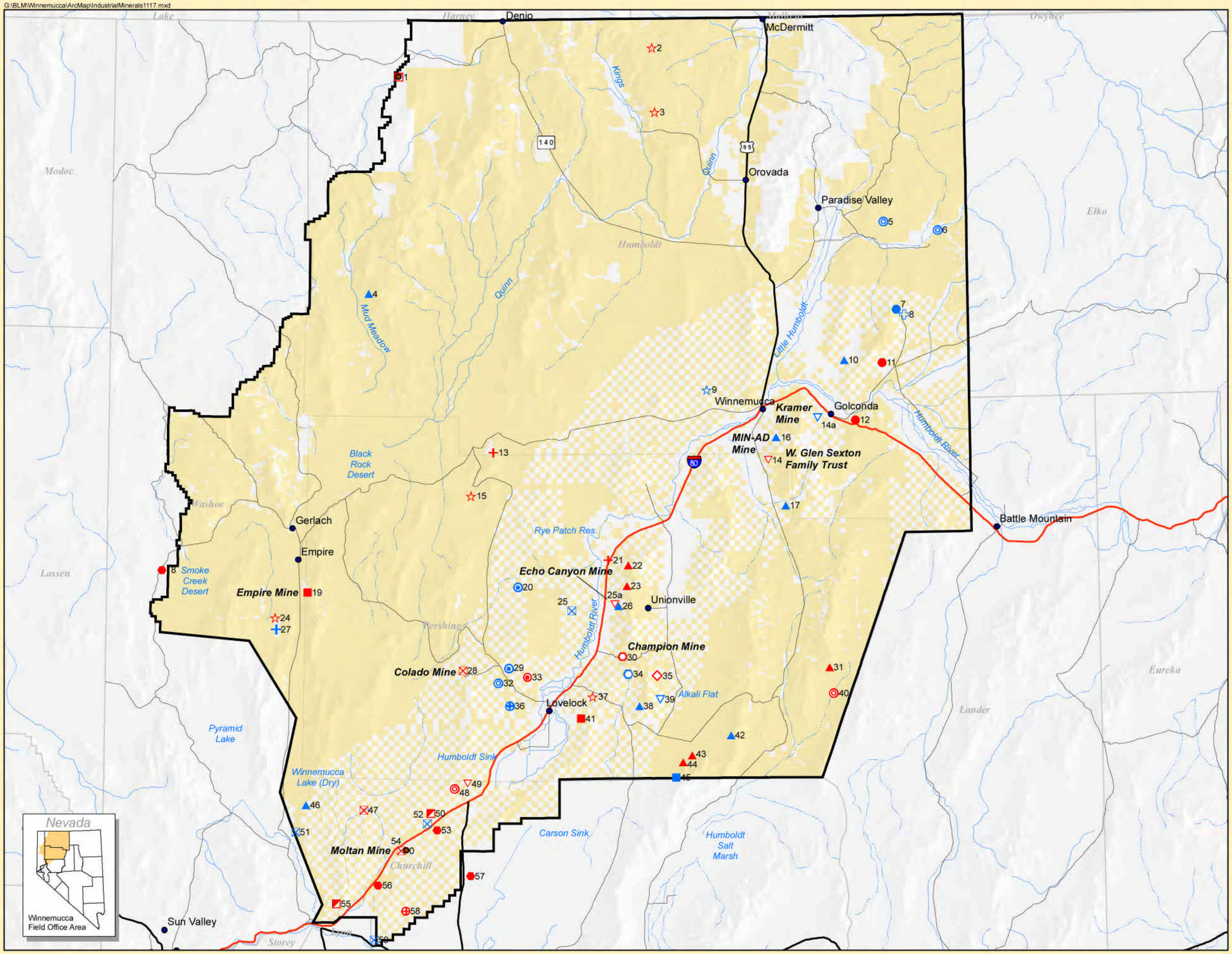

WFO Boundary
Interstate
State Highways
Local Roads
Perennial Stream
Intermittent Stream
County Boundaries

Bureau of Land Management

Active or Significant Past Production	No Significant Past Production	
⬡	⬡	Aluminum minerals
●	●	Barite
◩		Building stone
▽	▽	Carbonate rocks
☆	☆	Clay
⊠	⊠	Diatomite
▲	▲	Fluorspar
■	■	Gypsum
⊙	⊙	Perlite
⊕	⊕	Pumice, pumicite or cinder
▼	▼	Silica
⬢		Sodium minerals
+	+	Sulfur
◇		Talcose minerals
	✲	Wollastonite
◎	◎	Zeolite

After Nash 1996; Papke and Castor 2003; and Nevada Bureau of Miners and Geology 2004

No warranty is made by the Bureau of Land Management (BLM) for use of data for purposes not intended by BLM.

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Industrial Minerals
Mineral Assessment Report
Winnemucca Field Office
RMP Planning Area, Nevada
Figure I-3

Table I-6
Industrial Mineral Deposits of the Winnemucca FO Planning Area
Mineral Assessment Report Winnemucca District–RMP/EIS Planning Area

Commodity	Deposit # This Report	County	Mine Name	Deposit # Map #142*
Stone, Building	1	Humboldt	Virgin Valley (Wegman Quarry)	9
Clay	2	Humboldt	Bull Basin (Montana Mountains)	8
Clay	3	Humboldt	Disaster Peak	9
Fluorspar	4	Humboldt	Sunset	7
Zeolite	5	Humboldt	Spring Creek	11
Zeolite	6	Humboldt	Chimney Reservoir	12
Barite	7	Humboldt	Anderson	37
Wollastonite	8	Humboldt	Getchell	3
Clay	9	Humboldt	Barret Springs	10
Silica	10	Humboldt	Stone Corral	13
Barite	11	Humboldt	Redhouse	38
Barite	12	Humboldt	Horton – Little Britches	39
Sulfur	13	Humboldt	Sulphur	3
Carbonate	14	Pershing	W. Glen Sexton Mine	13
Silica	14a	Humboldt	Kramer Hill Mine	none
Clay	15	Pershing	Rosebud Canyon	27
Carbonate	16	Pershing	Min-Ad Mine East Range	14
Fluorspar	17	Pershing	Mammoth	34
Sodium Minerals	18	Washoe	Buffalo Springs	19
Gypsum	19	Pershing	Empire	20
Perlite	20	Pershing	North Trinity Range	16
Sulfur	21	Pershing	Humboldt House	4
Fluorspar	22	Pershing	Piedmont	35
Fluorspar	23	Pershing	Valery	36
Clay	24	Washoe	San Emidio	31
Diatomite	25	Pershing	Rye Patch	20
Limestone	25a	Pershing	Echo Canyon	In Permitting
Carbonate	26	Pershing	Humboldt Range	15
Sulfur	27	Washoe	San Emidio	5
Diatomite	28	Pershing	Colado (Velvet District)	21
Perlite	29	Pershing	Trinity Range	17
Aluminum Minerals	30	Pershing	Champion	3
Fluorspar	31	Pershing	Needle Peak	37
Zeolite	32	Pershing	Lovelock	24
Perlite	33	Pershing	Pearl Hill (Velvet District)	18
Aluminum Minerals	34	Pershing	Lincoln Hill	4
Talc Minerals	35	Pershing	Humboldt Range Pinite	13
Pumice	36	Pershing	Lovelock	13
Clay	37	Pershing	Coal Canyon Deposits	28
Fluorspar	38	Pershing	Emerald Spar	38
Carbonate	39	Pershing	Buffalo Mountain	16
Zeolite	40	Pershing	Jersey Valley	25
Gypsum	41	Pershing	Lovelock area	21

Table I-6 (continued)
Industrial Mineral Deposits of the Winnemucca FO Planning Area

Commodity	Deposit # This Report	County	Mine Name	Deposit # Map #142*
Fluorspar	42	Pershing	Susie	39
Fluorspar	43	Pershing	Nevada Fluorspar	40
Clay	44	Pershing	New York Canyon (Stoker)	29
Gypsum	45	Pershing	Corn Beef	22
Silica	46	Washoe	Winnemucca Lake	18
Diatomite	47	Churchill	Nightingale (Truckee Range)	1
Zeolite	48	Churchill	Trinity Range	1
Carbonate	49	Churchill	Ocala	1
Stone, Building	50	Churchill	Trinity Range	1
Diatomite	51	Washoe	Nixon	26
Diatomite	52	Churchill	Trinity	2
Sodium Minerals	53	Churchill	White Plains	1
Diatomite	54	Churchill	Moltan Mine Desert Peak (Hot Spring Mountain area)	3
Stone, Building	55	Churchill	Black Mountain	2
Sodium Minerals	56	Churchill	Eagle Marsh	4
Sodium Minerals	57	Churchill	Carson Sink	3
Pumice	58	Churchill	Posalite	2
Diatomite	59	Churchill	Black Butte	4

* Deposit number from Nevada Bureau of Mines and Geology Map 142 Industrial Minerals of Nevada.

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