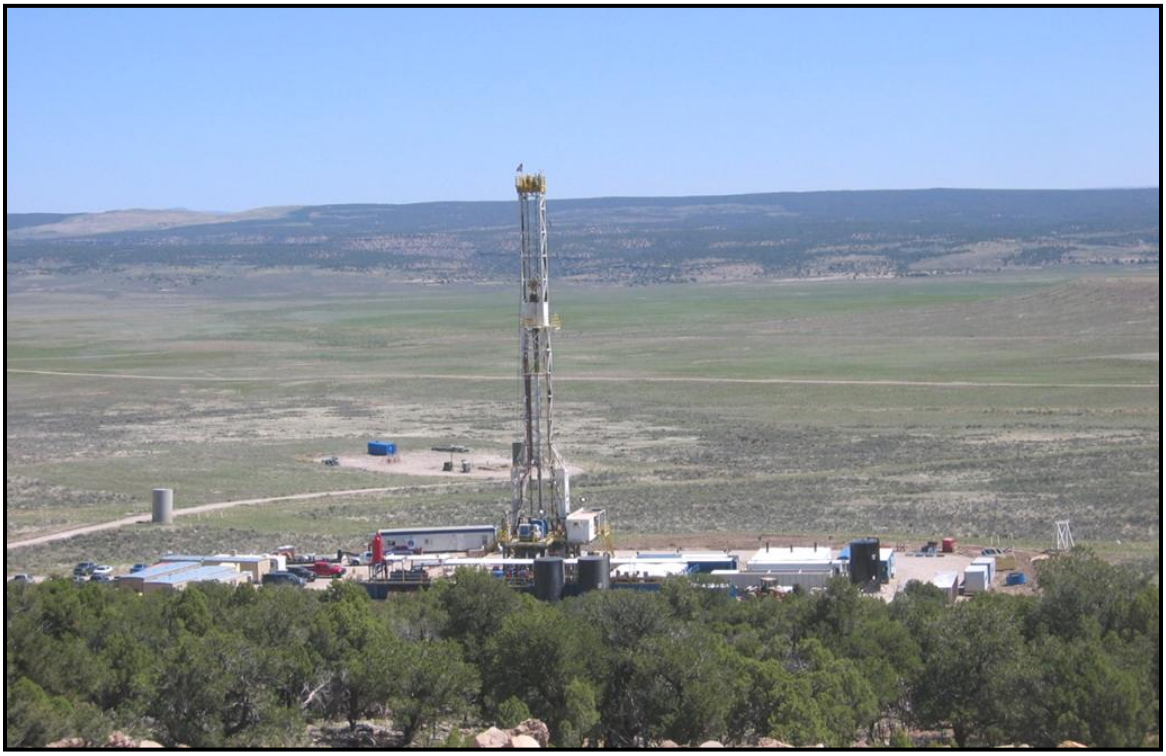
2009 ADDENDUM TO THE OIL AND GAS POTENTIAL AND REASONABLE FORESEEABLE DEVELOPMENT (RFD) SCENARIOS IN THE SAN JUAN NATIONAL FOREST AND BLM PUBLIC LANDS, COLORADO



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UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FINAL REPORT
Addendum to the Oil and Gas Potential and Reasonable Foreseeable Development (RFD) Scenarios in The San Juan National Forest and BLM Public Lands Durango, Colorado July 2010

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Cover photograph of the Nabors M13 Pace drilling rig with a derrick height of 202' and a closed loop drilling system at the EnCana Andy's Mesa Federal #71 wellsite, Section 28-T44-R16W in Andy's Mesa Field, San Miguel County, Colorado. Photo taken by Rod Brashear on May 30, 2008.

2009 ADDENDUM TO THE OIL AND GAS POTENTIAL AND REASONABLE FORESEEABLE DEVELOPMENT (RFD) SCENARIOS IN THE SAN JUAN NATIONAL FOREST AND BLM PUBLIC LANDS, COLORADO

I. EXECUTIVE SUMMARY

In December 2006, the U.S. Forest Service (USFS) – Bureau of Land Management (BLM) released an Oil and Gas Potential and Reasonable Foreseeable Development (RFD) Scenarios document for the San Juan National Forest and BLM Public Lands planning area. This 15-year (2006-2020) projection was associated with a Draft Land Management Plan/Draft Environmental Impact Statement (DLMP/DEIS) for federal lands managed by the San Juan Public Lands Center (SJPLC). The DLMP/DEIS was published a year later in December 2007. A technical review by the BLM in 2008 indicated that prospective shale gas plays would become a future contributor of hydrocarbon production in the region. As such, the USFS and BLM found it necessary to publish an Addendum to the RFD and a Supplement to the DLMP/DEIS in order to update the documents and account for additional shale gas resources.

The USFS - BLM San Juan Public Lands (SJPL) planning area encompasses a total of 3,582,479 acres of federal, state, local, private, and tribal lands in southwestern Colorado. The Paradox Basin Gothic Shale Gas Play area is located in the western part of this region and constitutes 646,403 acres (18%) of all lands in the SJPL planning area. Surface land ownership in the shale gas trend consists of roughly equal proportions of federal (NFS and BLM lands with 39% and 16% surface jurisdiction within the Gothic Shale Gas Play, respectively) and nonfederal (mostly privately-owned lands comprising 42% of the Gothic Shale Gas Play area) lands. Oil and gas mineral estate also consists of large proportions of both federal (NFS and BLM lands with 33% and 24% mineral estate jurisdiction within the Gothic Shale Gas Play, respectively) and nonfederal (mostly private surface/nonfederal mineral estate with 34% of the Gothic Shale Gas Play area) acreage across the shale gas trend. Just over a third (35%) of the federal mineral estate lands are currently held by existing oil and gas leases within the Gothic Shale Gas Play. Since 2006, most of the leasing, permitting, and drilling activity in the Gothic Shale Gas Play has been focused on private fee lands along the western boundary of the trend.

The original 2006 RFD document estimated 1,185 oil and gas wells on 795 new and 390 existing pads with 3,185 acres of well-related gross surface disturbance (i.e. well pads, access roads, and flowlines) and 937 acres of infrastructure-related gross surface disturbance (e.g. processing plants, compressor stations, pipelines) in the Paradox Basin, Northern San Juan Basin, and San Juan Sag tectonic-physiographic provinces of southwestern Colorado by 2021. These activity and surface disturbance projections represent the combined estimates for five major oil and gas play types in the SJPL planning area. The 2006 RFD also predicted that an ultimate production volume of

9 million barrels of oil (MMBO) and 3.25 trillion cubic feet of gas (TCFG) could be recovered from these 1,185 projected wells during the 15-year (2006-2020) scenario period. The validity of the 2006 RFD well projections for each of these five play types in the SJPL planning area are confirmed in this 2009 RFD Addendum.

The 2006 RFD pre-dated industry activity within a sixth major play type, specifically unconventional natural gas resources in the Gothic Shale interval of the Paradox Formation in San Miguel, Dolores, and Montezuma Counties. Although the gas-charged nature of the Gothic Shale has long been recognized, conventional drilling and extraction techniques were historically unsuccessful in generating economically-producible completions in these unique reservoirs. Since about 2005, however, the combined technology of long-reach horizontal drilling and advanced hydraulic fracturing techniques, coupled with higher natural gas prices due to increased demand, has spurred the recent exploration and development of shale gas reservoirs across numerous basins in the continental United States.

Drilling, production, and surface disturbance estimates were projected for the Gothic Shale Gas Play frontier area of the Paradox Basin in the 2009 RFD Addendum. This addendum is not a stand-alone document and must only be considered with the 2006 RFD. The 2006 RFD and 2009 RFD Addendum together provide the scientific and technical foundation for the Supplemental DLMP/DEIS to address the potential environmental and socioeconomic impacts of such development, determine how best to protect other important resource values through lease stipulations and best management practices, and how to best manage the location, timing, duration, and magnitude of the anticipated industry activities.

This 2009 RFD Addendum projects that an additional 1,769 Gothic shale gas wells on 1,132 new well pads with 5,887 acres of well-related surface disturbance will occur on all lands (i.e. federal, state, local, and private) in the Gothic Shale Gas Play of the SJPL planning area during the 15-year (2009-2023) analysis period. These wells could have the potential to produce 2.7 trillion cubic feet of gas (TCFG) in the SJPL planning area by the end of Year 2023. Revised cumulative totals combining the assessments in the 2006 RFD and the 2009 RFD Addendum for federal and non-federal lands in the San Juan Public Lands planning area are projected at 2,954 wells on 2,317 new or existing well pads with 9,072 acres of well-related surface disturbance by 2024. Combined infrastructure-related surface disturbance amounts to an additional 1,847 acres (937 acres in the 2006 RFD and 910 acres for the GSGP in the 2009 RFD Addendum). Total gross surface disturbance (i.e. well-related and infrastructure-related impacts) is estimated at 10,919 acres or about 0.3% of the total land base in the SJPL planning area.

II. INTRODUCTION

In 2006, the San Juan Public Lands Center (SJPLC) released an Oil and Gas Potential and Reasonable Foreseeable Development (RFD) Scenarios document (SJPL, 2006) associated with a 2007 Draft Land Management Plan/Draft Environmental Impact Statement (DLMP/DEIS) (SJPL, 2007) for the San Juan National Forest (SJNF) and Bureau of Land Management (BLM) Public Lands planning area. This 2006 Reasonable Foreseeable Development (RFD) report summarized the geologic setting, major plays, historical and current oil and gas activity, hydrocarbon potential, and development occurrence for all lands (i.e. federal, tribal, state, local, and private) within the boundaries of what is collectively referred to as the San Juan Public Lands (SJPL) planning area (Figure 1). The 2006 RFD oil and gas development scenario represented a technical and scientific approximation of the reasonably foreseeable, baseline industry activity case (i.e. estimated numbers of wells and pads, well-related and infrastructure-related surface disturbance calculations, and production volumes) in the SJPL planning area on both federal and nonfederal lands over the 15-year period from 2006 to 2020. The projections were based largely on the best available information at the time, primarily on factors related to subsurface geologic concepts and past and present oil and gas drilling and production histories in the area. The 2006 RFD also considered a number of other important variables in the analysis, including but not necessarily limited to economics, technology, physical access, existing or anticipated infrastructure, and transportation. This RFD scenario was then used to aid in developing the alternatives and management actions analyzed in the 2007 DLMP/DEIS.

The 2006 RFD scenario projected 1,185 oil and gas wells on 795 new and 390 existing pads with about 3,185 acres of well-related surface disturbance and 937 acres of infrastructure-related disturbance for five major oil and gas play categories on federal and non-federal lands in the SJPL planning area by 2021 (Table 1). It was further predicted that these wells could ultimately produce 9 million barrels of oil (MMBO) and 3.25 trillion cubic feet of gas (TCFG) during the 15-year (2006-2020) analysis period. Coalbed methane development wells in the Northern San Juan Basin accounted for 63% of the projected drilling activity in the SJPL planning area (Table 1). Conventional oil and gas wells of the Paradox Basin in the western part of the SJPL planning area represented another 32% of the total wells estimated in the 2006 RFD scenario analysis (Table 1).

Public comments regarding the 2006 RFD were received mostly from oil and gas industry counterparts in early 2008. This external feedback suggested that the 2006 RFD had underestimated well, pad, and surface disturbance estimates in the Paradox Basin based on promising drilling and testing results from two wildcat wells in an emerging exploratory trend, the Gothic Shale Gas Play, occurring at about the same time that the 2006 RFD document was released. After reviewing this information, the SJPLC elected to draft a Supplemental DLMP/DEIS and a supporting RFD Addendum in order to adjust the original 2006 RFD projections upward and address the potential impacts of Gothic Shale Gas exploration and development activities in the SJPL planning area. The 2009

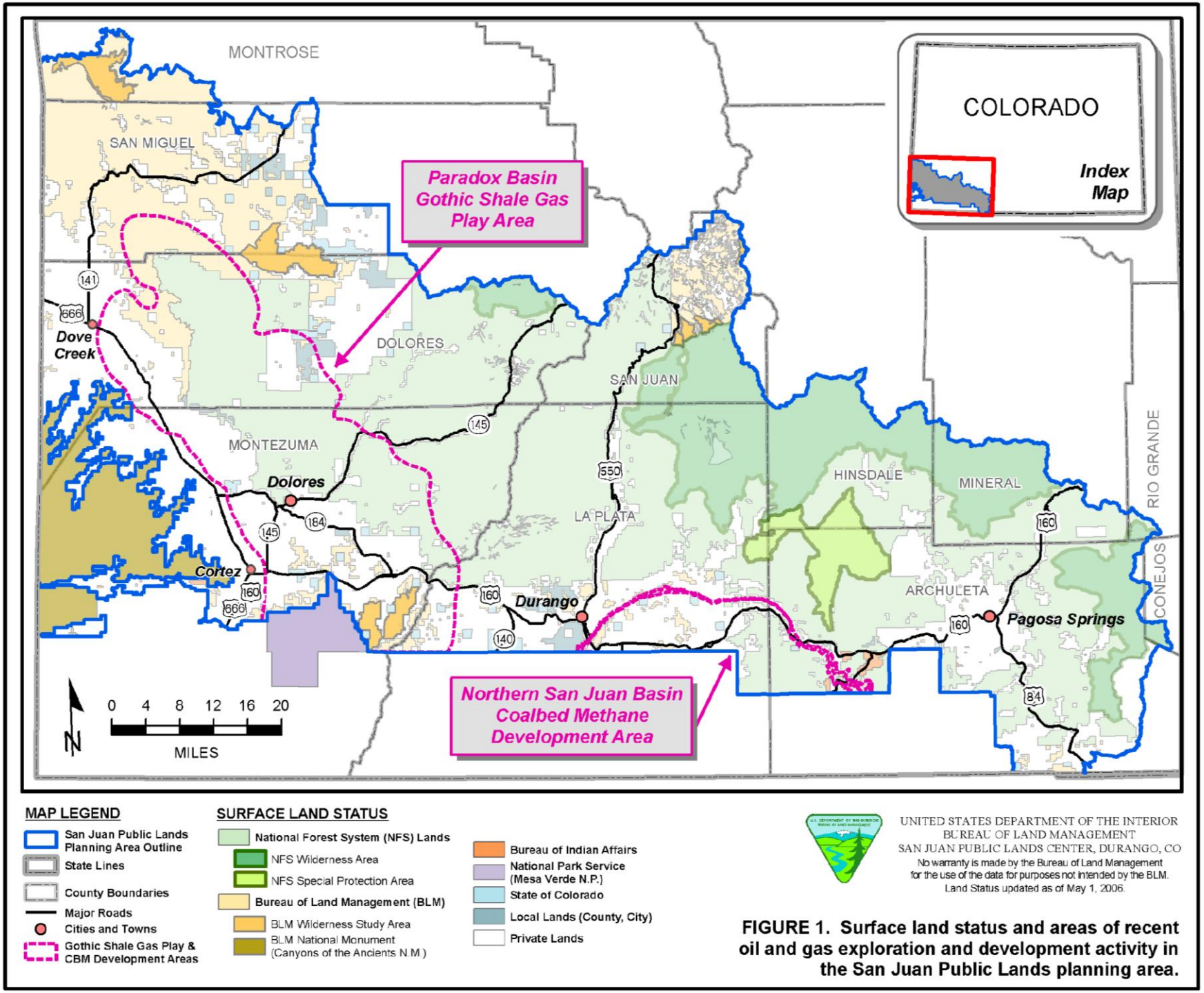

FIGURE 1. Surface land status and areas of recent oil and gas exploration and development activity in the San Juan Public Lands planning area.

RFD Addendum also provided an opportunity to re-examine the original RFD well approximations for each of the other five major play categories reviewed in 2006, particularly for the industry activity scenarios associated with the drilling of CBM infill wells in the Northern San Juan Basin province. Since 2006, not only had large areas been approved for downspacing units in the Northern San Juan Basin CBM region of the planning area, but numerous infill wells were also being permitted and drilled just south of the SJPL planning area on Southern Ute Indian Reservation lands along the Colorado-New Mexico state line.

	Paradox Basin Conventional Oil & Gas	San Juan Sag Conventional Oil & Gas	N. San Juan Basin Conventional Oil & Gas	N. San Juan Basin 320/160-Acre CBM Infill	N. San Juan Basin 80-Acre CBM Infill	*2006 RFD TOTALS*
OIL & GAS WELLS	375	30	30	300	450	***1185***
WELL PADS	375	30	30	300	60 new, 390 existing	***795 new, 390 existing***
SURFACE DISTURBANCE	1,470 acres	120 acres	120 acres	1,175 acres	300 acres	***3,185 acres Well-Related & 937 acres Infrastructure-Related Disturbance***

Table 1: Summary table of projected numbers of wells, pads, and surface disturbance for the five major oil and gas play type categories in the 2006 RFD for all lands in the San Juan Public Lands (SJPL) planning area.

Geographic Location and Description: The U.S Forest Service (USFS) - Bureau of Land Management (BLM) San Juan Public Lands (SJPL) planning area encompasses about 3,582,479 acres of federal and non-federal surface lands across portions of eleven counties in southwestern Colorado (Figure 1). The Gothic Shale Gas Play region is located in the western part of the SJPL planning area in Montezuma, Dolores, and San Miguel Counties, Colorado (Figure 1). It constitutes about 646,403 acres or 18% of all federal, private, tribal, state, and local (county and city) lands in the SJPL planning area (Table 2). The Gothic Shale Gas Play consists of a northwest-southeast geological trend of thick, gas-saturated shale occurring at depths between about 6,500 and 8,500 feet below the ground surface. Since about 2006, this shale gas trend has become the focus of recent leasing, permitting, and drilling activity by the oil and gas industry.

Surface land ownership in the Gothic Shale Gas Play consists of nearly equal proportions of federal and nonfederal properties (Figure 1, Table 2). Most of the acreage in the trend is privately-owned, nonfederal land (42% of the Gothic Shale Gas Play) that roughly parallels the western boundary of the Gothic Shale Gas Play area. Federal lands are comprised primarily of NFS lands (39% of the Gothic Shale Gas Play) of the SJNF along the eastern edge of the trend, and secondarily of BLM lands (16% of the Gothic Shale

Gas Play) in the northern and southern areas of the shale gas region. Surface lands held by the State of Colorado and local governments (county and city) account for the remaining ownership in the Gothic Shale Gas Play area.

Surface Ownership	Gothic Shale Gas Play Area (acres)	CBM 80-Acre Infill Project Area (acres)
Federal Surface Lands	**354,800**	**56,851**
NFS	252,320	49,407
BLM	102,480	6,726
BIA	0	718
Nonfederal Surface Lands	**291,603**	**68,640**
State	10,714	2,788
Local	7,204	100
Private	273,685	65,752
TOTAL AREA (acres)	***646,403***	***125,491***

Table 2: Acreage estimates for surface ownership categories in the Paradox Basin Gothic Shale Gas Play and Northern San Juan Basin Coalbed Methane (CBM) 80-Acre Infill Project areas of the San Juan Public Lands (SJPL) planning area.

Subsurface oil and gas mineral estate in the Gothic Shale Gas Play area also includes large portions of both federal and nonfederal ownership (Figure 2, Table 3). In terms of the various surface land/mineral estate ownership categories, private surface/nonfederal oil and gas mineral estate (presumably fee acreage) constitutes the largest ownership category with just over a third of the area in the Gothic shale gas trend. NFS and BLM surface lands with underlying federal oil and gas mineral estate represent the next two largest jurisdiction categories with roughly 33% and 16% of the Gothic Shale Gas Play area, respectively. Split estate lands comprise the remaining federal oil and gas mineral estate in the Gothic Shale Gas Play area, much of which underlies privately-owned surface land (Table 3). In total, approximately 35% of the federal oil mineral estate in the trend is currently held under existing oil and gas leases. While only about one-fifth (19%) of mineral estate on NFS surface lands is currently leased, just over half (56%) of the oil and gas mineral estate under the jurisdiction of BLM (including BLM surface lands and split estate acreage) is currently leased (Table 3). To date, the recent leasing, permitting, and drilling activity observed in the Gothic Shale Gas Play has primarily occurred on private fee lands across the region.

The Northern San Juan Basin Coalbed Methane (CBM) 80-Acre Infill Project area of Colorado has also experienced a considerable amount of recent industry activity. The region is located along the south-central border of the SJPL planning area in La Plata and Archuleta Counties and encompasses about 125,491 acres or 3.5% of all lands the SJPL planning area (Figure 1, Table 2). Federal and nonfederal surface lands comprise roughly

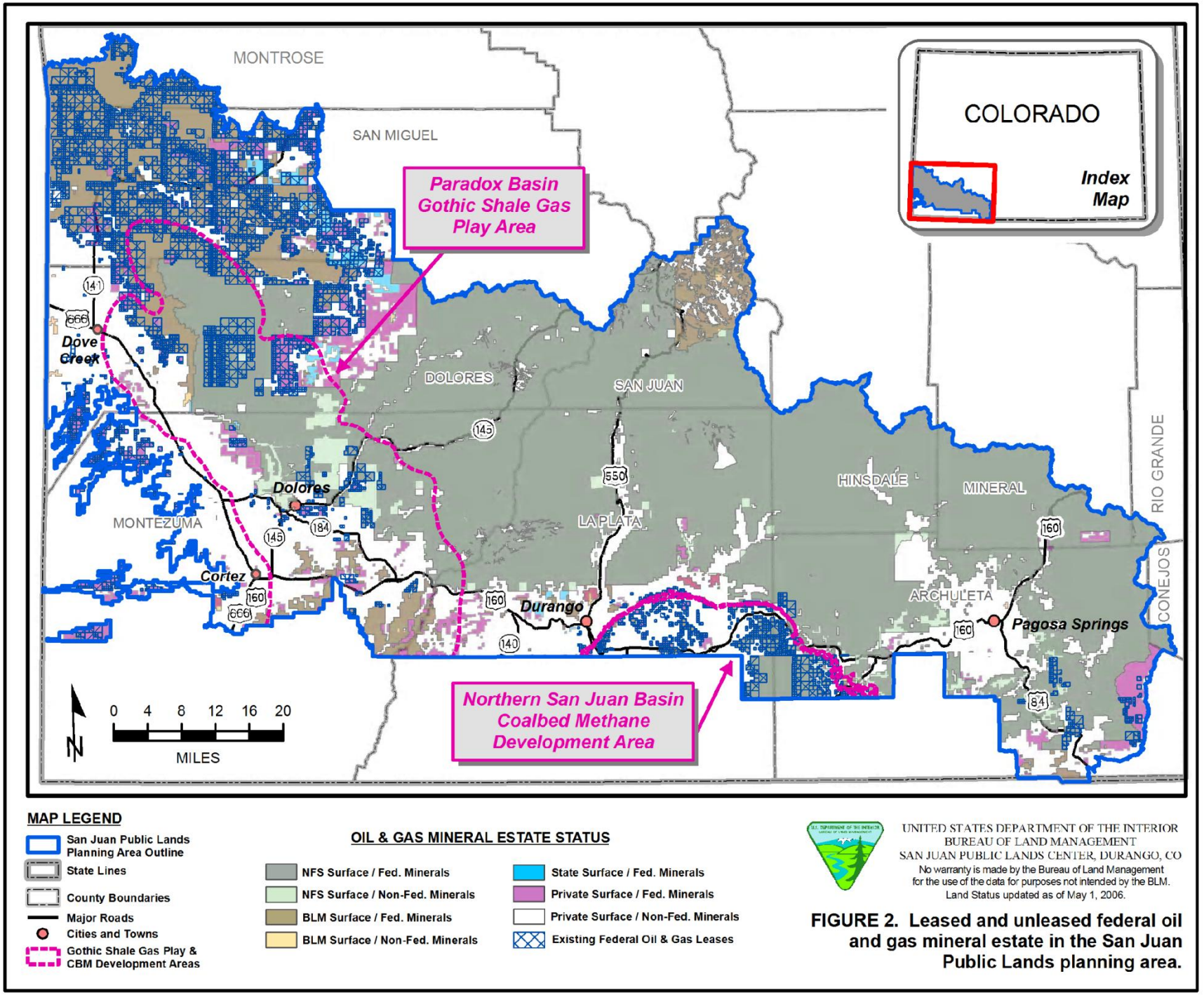

FIGURE 2. Leased and unleased federal oil and gas mineral estate in the San Juan Public Lands planning area.

45% and 55% of the lands in the Northern San Juan Basin CBM project area, respectively (Table 2). Most of the public lands are located within the SJNF in the eastern half of the CBM project area; nonfederal (mostly privately-owned) lands are concentrated in the western half of this region (Figure 1).

Surface Ownership / Oil & Gas Mineral Estate Ownership	Leased Lands (acres)	% of Gothic Shale Gas Play	Unleased Lands (acres)	% of Gothic Shale Gas Play	Total Area (acres)	% of Gothic Shale Gas Play
NFS Surface/Federal (USFS) O&G	40,076	6.2%	173,375	26.8%	213,451	33.0%
NFS Surface/Nonfederal O&G	NA	NA	NA	NA	38,869	6.0%
BLM Surface/Federal (BLM) O&G	54,296	8.4%	47,311	7.3%	101,607	15.7%
BLM Surface/Nonfederal O&G	NA	NA	NA	NA	851	0.1%
PRIVATE Surface/Federal (BLM) O&G	32,987	5.1%	18,620	2.9%	51,607	8.0%
PRIVATE Surface/Nonfederal O&G	NA	NA	NA	NA	222,430	34.4%
STATE Surface/Federal (BLM) O&G	0	0.0%	0	0.0%	0	0.0%
STATE Surface/Nonfederal O&G	NA	NA	NA	NA	10,384	1.6%
LOCAL Surface/Federal (BLM) O&G	327	0.1%	2,636	0.4%	2,963	0.5%
LOCAL Surface/Nonfederal O&G	NA	NA	NA	NA	4,241	0.7%
TOTALS	***127,686***	***19.8%***	***241,942***	***37.4%***	***646,403***	***100.0%***

Table 3: Acreage estimates and proportions for leased and unleased federal and nonfederal oil and gas mineral estate by jurisdiction for ownership categories of the Gothic Shale Gas Play in the San Juan Public Lands planning area.

Subsurface oil and gas mineral estate acreage is split equally between federal and nonfederal ownership in the Northern San Juan Basin CBM 80-Acre Infill Project area (Table 4). Most of the federal mineral estate in this area overlies NFS (76%) and BLM (18%) surface lands, with only a small proportion (6%) of the subsurface oil and gas ownership occurring on split estate acreage (Table 4). Approximately 87% of the federal mineral estate is currently leased in the Northern San Juan Basin CBM Project area (Table 4, Figure 2).

Total CBM 80-Acre Infill Project Area	125,491
Federal Oil & Gas Mineral Estate	**62,657**
On NFS Surface Lands	47,626
On BLM Surface Lands	11,471
On Private Surface Lands	2,702
On State Surface Lands	858
Non-Federal Oil & Gas Mineral Estate	**62,834**
Leased Federal Oil & Gas Mineral Estate	**54,774**
NFS Lands	40,753
BLM Lands	14,021
Unleased Federal Oil & Gas Mineral Estate	**7,883**

Table 4: Acreage estimates for leased and unleased federal and nonfederal oil and gas mineral estate by jurisdiction for the Northern San Juan Basin Coalbed Methane (CBM) 80-Acre Infill Project area.

Purpose and Scope of the RFD: The Reasonable Foreseeable Development (RFD) scenario is a long-term, reasonable projection of anticipated oil and gas exploration, development, production, and reclamation activity expected to occur on all lands within a defined geographic area over a specific period of time. The RFD includes all interrelated and interdependent oil and gas activities that could potentially occur in the analysis area regardless of land ownership or jurisdiction. The projections are technical and scientific approximations based on the best available information on geology and past and present oil and gas activity. The RFD scenario is also developed with consideration of other significant factors such as economics, technology, and physical limitations on access, existing or anticipated infrastructure, and transportation. The estimation is, however, exclusive of other concerns that might compete for use of land in a multiple-use scenario (e.g. recreation, wildlife, mining, etc.) and also omits lands that are legally unavailable for oil and gas leasing (i.e. BLM wilderness study areas).

The 2009 RFD Addendum is not an independent, stand-alone document and must be considered in association with the 2006 RFD. The 2006 RFD and 2009 RFD Addendum are reference reports that together support the San Juan Public Lands 2007 DLMP/DEIS and Supplemental DLMP/DEIS. They provide the basic technical information needed to perform a thorough environmental analysis of the direct, indirect, and cumulative effects of the oil and gas activity that could reasonably be expected as the result of a USFS or BLM leasing decision on federal mineral estate in the SJPL planning area. The baseline information presented in an RFD facilitates consideration of the potential effect of various levels of leasing restrictions and best management practices, including those effects on the volume of oil and gas resources that may be produced or foregone under the different land and leasing alternatives. The two RFD's provide vital information for the review and evaluation of the existing management direction and the identification and assessment of various alternatives for the San Juan Public Lands Final Land Management Plan/Final Environmental Impact Statement (FLMP/FEIS). It is the SJPL FLMP/FEIS that will analyze and disclose the effects of oil and gas leasing and development on other important resource values, such as wildlife habitat, public health and safety, cultural assets, and local community concerns. Through the land use planning and NEPA process, the BLM and USFS will ultimately determine how much, when, and where federal mineral estate lands are made available for oil and gas development and which specific lease stipulations and conditions of approval (COA) are required in order to protect other resources.

While the combined 2006 RFD and 2009 RFD Addendum scenarios estimate a relatively large number of additional wells over the next 15 years (2009-2023), it is the SJPL FLMP/FDEIS and related leasing decisions that will provide direction on the magnitude, location, timing, and duration of exploration and development activities on public lands in the SJPL planning area. For the BLM, this leasing decision is made in the Record of Decision (ROD); for the USFS, it is made in the Leasing Decision document. The ROD and Leasing Decision will balance the management of oil gas resources with the management of other competing resources in the SJPL planning area.

III. EVALUATION OF THE 2006 RFD WELL PROJECTIONS

As part of this 2009 RFD Addendum, a review of the oil and gas activity estimates from the earlier 2006 RFD was performed in order to validate and, if necessary, update the 15-year (2006-2020) projections for the SJPL planning area. The 2006 RFD well projections were based primarily on hydrocarbon resource potential, oil and gas price and demand trends, and historical drilling activity and recent development trends on all lands within the SJPL planning area. The 2006 RFD predicted a total of 1,185 oil and gas wells on 795 new and 390 existing (expanded) well pads in the SJPL planning area by 2021 (Table 1). The resulting gross surface disturbance associated with this projected activity totaled 3,185 acres of well-related disturbance (i.e. well pads, access roads, and flowlines) and 937 acres of infrastructure-related disturbance (e.g. processing plants, compressor stations, pipelines) in the Paradox Basin, Northern San Juan Basin, and San Juan Sag provinces of southwestern Colorado (Table 1).

2006 RFD Conventional Oil and Gas Well Projections: The 2006 RFD 15-year (2006-2020) presented projections for oil and gas wells drilled in conventional hydrocarbon plays of the eastern Paradox Basin, Northern San Juan Basin, and San Juan Sag provinces in the San Juan Public Lands planning area (Table 5). These projections have been reviewed in the 2009 RFD Addendum based on information from past and current industry activity and an understanding of regional geologic trends and hydrocarbon play types in the area.

	2006 RFD Well Projections	2006 RFD Well Pad Projections
Paradox Basin Conventional O&G Plays	375 wells (25 wells/year)	375 well pads
Northern San Juan Basin Conventional O&G Plays	30 wells (2 wells/year)	30 well pads
San Juan Sag Conventional O&G Plays	30 wells (2 wells/year)	30 well pads
CONVENTIONAL PLAY TOTALS	435 wells	435 well pads

Table 5: 2006 RFD well and well pad projections for conventional oil and gas plays on federal and non-federal lands in the San Juan Public Lands planning area.

Nearly a third of all the wells projected in the 2006 RFD are associated with conventional oil and gas plays in the eastern Paradox Basin of southwestern Colorado. Specifically, the 2006 RFD projected the drilling of 375 conventional oil and gas wells from single well pads during the 15-year (2006-2020) scenario period from 2006 to 2020 (Table 5).

During the three years since the 2006 RFD was released, drilling rates across the province have been variable, ranging between 16 and 29 wells drilled annually (IHS Energy Group, 2009). Such short-term fluctuations superimposed on the longer-term 15-year activity projection are expected, and this range of variability is considered reasonable given the 15-year constant average of 25 wells per year projected in the 2006 RFD. Although industry activity during the 2008-2009 economic recession is below the 25 wells per year average, current permitting trends demonstrate sustained interest in conventional oil and gas plays of the eastern Paradox Basin. For example, five permits were approved in 2009 for wells targeting a variety of conventional plays in wildcat and field outpost locations across the eastern Paradox Basin of San Juan Public Lands planning area (IHS, 2009; COGCC, 2009). During the same time, twice as many permits were issued for development drilling activities in existing fields of the Paradox Fold and Fault Belt in western Colorado alone, where operators are targeting complex structural-stratigraphic traps in Paleozoic reservoirs (IHS, 2009; COGCC, 2009). Given this level of industry interest in conventional plays of the eastern Paradox Basin, it is reasonable to anticipate that that drilling rates will gradually increase in the near future as U.S. natural gas prices and the overall global economy progressively rebound.

The 2006 RFD also anticipated limited exploration and development of conventional oil and gas reservoirs the Northern San Juan Basin and San Juan Sag portion of the SJPL planning area, with approximately 30 wells (2 wells per year) drilled from single well pads in each of these plays over the 15-year (2006-2020) RFD projection period (Table 5). The combined total of wells drilled in these two conventional play provinces represents only about 5% of the total number of wells projected in the 2006 RFD. Since 2006, both provinces have exhibited limited but continued drilling and permitting activity and these levels are considered to be consistent with the projections of the 2006 RFD.

In the San Juan Sag and associated Archuleta Anticlinorium provinces, only three wells targeting conventional hydrocarbon plays have been drilled from 2007 to 2009. These three wells were development locations in an existing field (Navajo Field) in the southern part of the Archuleta Anticlinorium pursuing shallow (<2,500') oil objectives in the Upper Cretaceous Gallup interval. Another four conventional locations were permitted but not yet drilled during the same timeframe. Three of these proposed wells were exploratory wildcat locations targeting shallow (<2,500') gas reserves in the Upper Cretaceous Dakota Formation. The fourth is a development well location just offset to the three recently drilled development wells noted above. The drilling and permitting of 7 wells in the San Juan Sag and Archuleta Anticlinorium provinces in the three years since the 2006 RFD was released directly coincides with the annual average drilling projection of approximately 2 wells per year in this area and indicates continued, but limited, industry interest in this area in the future.

The Northern San Juan Basin province has also demonstrated minimal drilling and permitting of wells targeting conventional oil and gas plays in the SJPL planning area. Within this region, only two conventional wells (targeting Cretaceous and Jurassic sands below 6,000') have been drilled in the three year period following release of the 2006 RFD. This diminished activity is likely related to two factors. First, most operators have

been capital-constrained and are consequently focused on the drilling of lower risk/lower cost unconventional CBM infill wells with predictable recoveries rather than higher risk/higher cost conventional exploratory wells with significant reserve growth potential. Second, the SJPL Office authorized the drilling of up to 138 80-acre infill CBM wells on federal lands in April 2007 (SJPL, 2007a). This decision opened up additional acreage for unconventional gas development and spurred CBM drilling activity in the SJPL planning area of the Northern San Juan Basin. Both these impacts have resulted in diminished interest in conventional oil and gas plays in the province between 2007 and 2009.

Although recent drilling rates targeting conventional plays in the Northern San Juan Basin are below the anticipated 2006 RFD projection of 2 wells per year, it is expected that these rates will gradually approach this average given the anticipated long-term increase in natural gas prices. This expectation is also supported by industry activity in the Northern San Juan Basin on Southern Ute Indian tribal lands south of the SJPL planning area. These tribal lands are located in the less deformed, deeper portion of the San Juan Basin where Cretaceous and Jurassic conventional gas sand reservoirs are being actively explored and exploited. As these reservoirs are defined and developed, exploration will eventually extend toward the basin margins and into the SJPL planning area to the north. Thus, this review supports the earlier 2006 RFD projection for the drilling of 30 wells in conventional hydrocarbon plays in the Northern San Juan Basin province.

In summary, the 2006 RFD projections for drilling associated with conventional oil and gas wells in the eastern Paradox, Northern San Juan Basin, and San Juan Sag provinces of the SJPL planning area are considered sound. This assessment is based on information regarding local industry activity, regional geologic trends, and U.S. natural gas price predictions. Nearly all of the conventional oil and gas wells drilled and permitted in these three provinces are associated with single well pad surface locations. Thus, the well pad projections presented in the 2006 RFD are also acceptable.

2006 RFD Unconventional Northern San Juan Basin CBM Well Projections: The original 2006 RFD also projected the drilling of unconventional coalbed methane (CBM) infill wells on federal and non-federal lands in the Northern San Juan Basin portion of the SJPL planning area. The 2006 RFD scenario anticipated 300 CBM infill wells at 320-acre and 160-acre well spacings, and 450 infill wells at 80-acre well spacings would be drilled in the area by 2015 (Table 6). More specifically, the 300 320-/160-acre CBM infill wells were expected to be drilled during the five year period from 2006 to 2010 at an annual rate of 60 wells per year. The 450 80-acre CBM infill wells were expected to be drilled three years later in the development scenario, during the five year period from 2009 to 2014. In total, the RFD projected the drilling of 750 CBM infill wells on federal and non-federal lands in the Northern San Juan Basin province of the Sand Juan Public Lands planning area (Table 6).

	2006 RFD Well Projections	2006 RFD Well Pad Projections
Northern San Juan Basin CBM Infill Project 320/160-Acre Spacing	300 wells (60 wells/year from 2006-2010)	300 well pads
Northern San Juan Basin CBM Infill Project 80-Acre Spacing	450 wells (90 wells/year from 2009-2014)	60 well pads & 390 existing well pads (expanded)
UNCONVENTIONAL CBM PLAY TOTALS	750 wells	360 well pads & 390 existing well pads (expanded)

Table 6: 2006 RFD well and well pad projections for conventional oil and gas plays on federal and non-federal lands in the San Juan Public Lands planning area.

The 2006 RFD projection was based on sustained, favorable trends for three primary factors: resource capacity, competitive gas prices, and industry feedback regarding CBM development in the Northern San Juan Basin (SJPL, 2004). Coalbed methane resource capacity in the Northern San Juan Basin has not changed substantially since the release of the original 2006 RFD. Specifically, the area continues to demonstrate a high sustained resource capacity based on the presence of favorable source/reservoir rock (i.e. the Late Cretaceous Fruitland Coal) that is stratigraphically positioned within and/or immediately updip of the mature oil and gas generating window. Secondly, natural gas prices that rapidly fell from historical highs in mid-2008 (>$8.00/MCFG) to less than half of this value (<$4.00/MCFG) in September 2009 have gradually improved and are expected to stabilize and increase over the long-term (EIA, 2010a). Lastly, although CBM drilling activity in the Northern San Juan basin has declined since 2006 in response to natural gas price fluctuations, sustained industry interest is evidenced by continued leasing and permitting activity in the Northern San Juan Basin on federal, non-federal and tribal lands both in the SJPL planning area and on the Southern Ute Indian reservation immediately south of the planning area. Thus, there continue to be long-term favorable outlooks for the three primary factors which formed the basis of the 2006 RFD projections and there is no need to revise the 2006 RFD estimate for the drilling of CBM infill wells in the Northern San Juan Basin CBM Project area. It is expected that the recent decline in drilling activity will be corrected in the long-term with the drilling of CBM infill wells throughout the final five years of the 2006 RFD (2006-2020) projection period.

The 2006 RFD also anticipated that the 750 CBM infill wells would be drilled from 360 new, single well pad locations and the remaining 390 wells would be drilled from existing, expanded well pad locations. Currently, most 80-acre CBM infill wells on Southern Ute Indian tribal lands to the south are being directionally drilled from existing, expanded pad locations and it is reasonable to expect that co-location and directional drilling practices will be applied in the SJPL planning area.

Differences between the 2006 RFD and the 2009 RFD Addendum: There are two differences in the analysis model between the original RFD released in 2006 and this RFD Addendum released in 2009. The first issue is related to the RFD scenario period. Although both documents reference 15-year projection periods, the 2006 RFD covers the timeframe from 2006 to 2020 while the 2009 RFD Addendum encompasses the years from 2009 to 2023. Since much of the drilling activity (and corresponding surface disturbance) in the SJPL planning area has been deferred due to low oil and gas prices and depressed economic conditions since late 2008, activities projected early in the life of the 2006 RFD have effectively shifted about two years forward in time. Thus, the difference in the timeframes between the two RFD's is considered negligible and the Gothic Shale Gas Play projections generated in this study have simply been added to the unadjusted well, pad, and surface disturbance estimates reported in the 2006 RFD. This approach enables summation of the projections in both RFD documents together in order to estimate the total impacts of all oil and gas activities throughout the SJPL planning area during the 15-year period from 2009 to 2023.

Second, the RFD analysis area differs geographically in the southwestern most part of Colorado between the two documents. In this region, the 2009 RFD Addendum SJPL planning area extends all the way to the boundary of Canyon of the Ancients National Monument (CANM) (Figure 1). The southwestern boundary of the 2006 RFD study area, however, follows U.S. HWY 666 (a.k.a. U.S. HWY 491) from south of Cortez, Colorado, northward toward Dove Creek, Colorado. At the point where U.S. HWY 666 intersects the T39N-T40N common township line just south of Dove Creek, the 2006 RFD study area trends westward along the T39N-T40N township line to the Colorado-Utah state line. Other than this one difference, the areas of interest in both documents mimic one another. Most of the additional land (182,935 acres) included in the southwestern part of the 2009 RFD Addendum, the SJPL planning area is almost entirely outside of the Gothic Shale Gas Play area. As such, this geographic discrepancy has little to no effect in developing and analyzing the possible leasing restrictions and various plan alternatives for the Supplemental DLMP/DEIS associated with this RFD Addendum in the SJPL planning area.

IV. DESCRIPTION OF GEOLOGY

The Gothic Shale Gas Play is located in the Paradox Basin tectonic-physiographic province of southwestern Colorado (Figure 3). Although the Paradox Basin is a mature oil and gas province, the Gothic Shale Gas trend has emerged as a new frontier play area since about 2006. A "play" is best described as a set of oil or gas accumulations that are geologically, geographically, and temporally related. A given play contains multiple hydrocarbon accumulations because of identical or similar geological conditions such as reservoir lithology, hydrocarbon migration pathways and timing, trapping mechanisms, source rocks, vertical and lateral seals, and hydrocarbon type (Gautier and others, 1996).

The Paradox Basin is an elliptical, asymmetric basin of Pennsylvanian to Early Permian age that formed in southeastern Utah and southwestern Colorado. The Hermosa Group is comprised of the Pinkerton Trail, Paradox, and Honaker Trail Formations and is the predominant synorogenic sedimentary fill of the basin (Figure 4) (Hite et al., 1984; Huffman, 1995; Schamel, 2008). The Paradox Formation is characterized by a thick depositional sequence of at least 29 alternating, lithologic cycles composed of black shales, carbonates, and evaporites in a section up to 14,000 feet thick (Hite, 1960; Hite et al., 1984; Trudgill and Arbuckle, 2009). These stacked sedimentary cycles record the history of repeated, frequent relative sea level fluctuations in a restricted marine basin during Pennsylvanian age (Hite, 1970; Hite and Buckner, 1981; Trudgill and Arbuckle, 2009). Conventional oil- and gas-bearing carbonate, siliciclastic, and fractured fine-grained reservoirs, as well as unconventional shale gas accumulations, are associated with many of the lithologic cycles within the Paradox Formation (Schneider et al., 1971; Reid and Berghorn, 1981; Peterson, 1989; Huffman, 1995; Nuccio and Condon, 1996a; Nuccio and Condon, 1996b; Stevenson and Wray, 2009; Schamel, 2009).

The Gothic Shale is one of the several black, dense, organic-rich shales that occur within the Paradox Formation of the Hermosa Group (Hite et al., 1984). The Gothic Shale is bounded above by the Lower Ismay Carbonates and bounded below by the Upper Desert Creek Carbonates and Anhydrites (Figure 5). A slightly younger, thinner "sister" shale, designated the Hovenweep Shale, occurs about 100 feet above the Gothic Shale interval within the Ismay Member. A third, older black shale, named the Chimney Rock Shale, is positioned roughly 150 feet below the Gothic Shale between the Desert Creek and Akah Members of the Paradox Formation (Figure 5). In terms of the lithologic cycles mentioned above, these black shales represent periods of peak marine transgression in the middle of the numerous transgressive-regressive evaporite cycles that comprise the Pennsylvanian Paradox Formation (Hite, 1968; Rasmussen and Rasmussen, 2009; Schamel, 2009; Trudgill and Arbuckle, 2009).

Stratigraphically, Gothic Shale Gas Play area is defined by a thick (>100') wedge of relatively undeformed, organic-rich prodelta deposits that accumulated in a marine setting along an ancient Pennsylvanian shoreline just east of the Gothic shale gas trend (Fetzner, 1960; Hite et al., 1984). Much of the terrigenous sediment within the prodelta wedge was presumably derived from contemporaneous, stacked fan-delta complexes

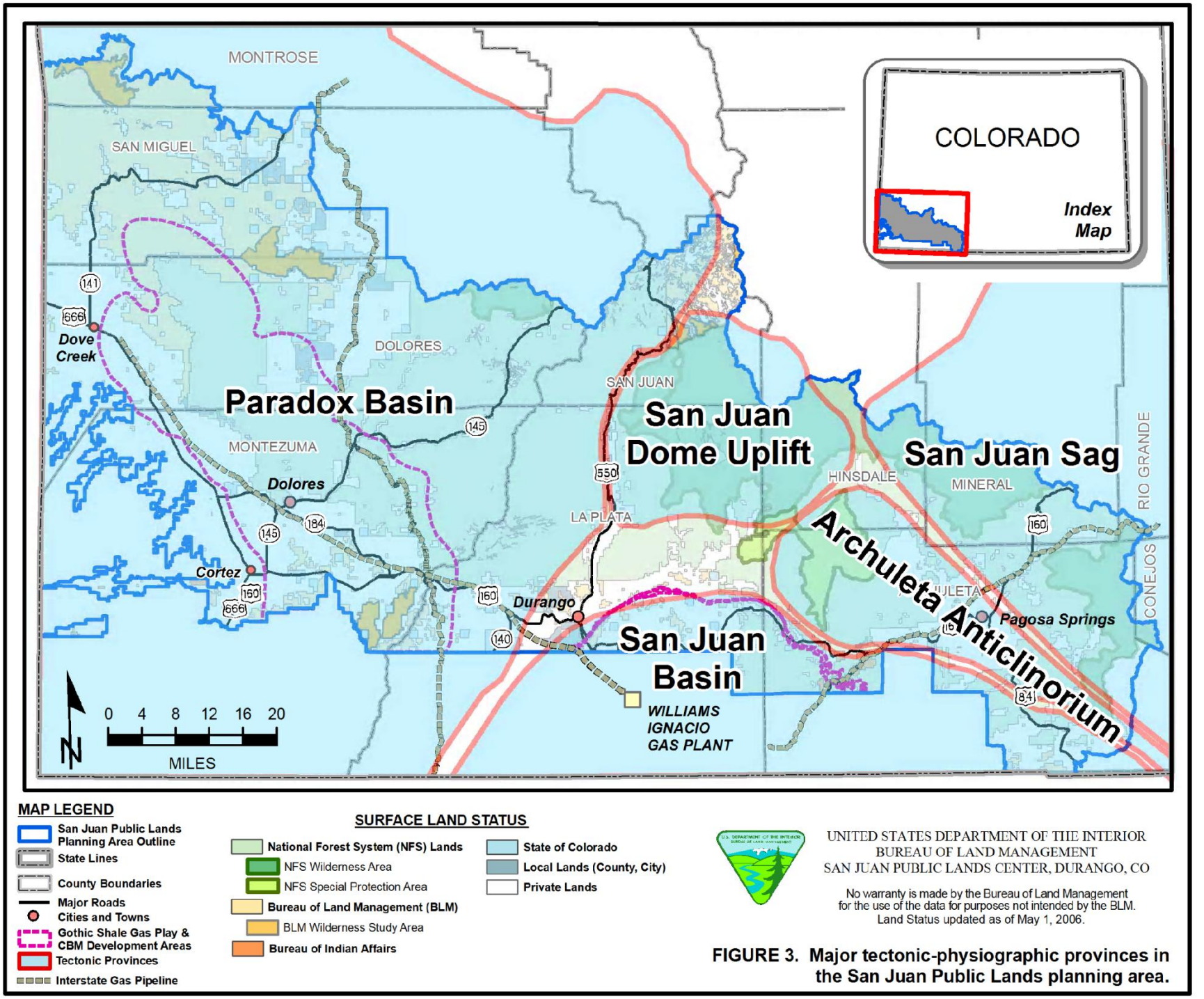

FIGURE 3. Major tectonic-physiographic provinces in the San Juan Public Lands planning area.

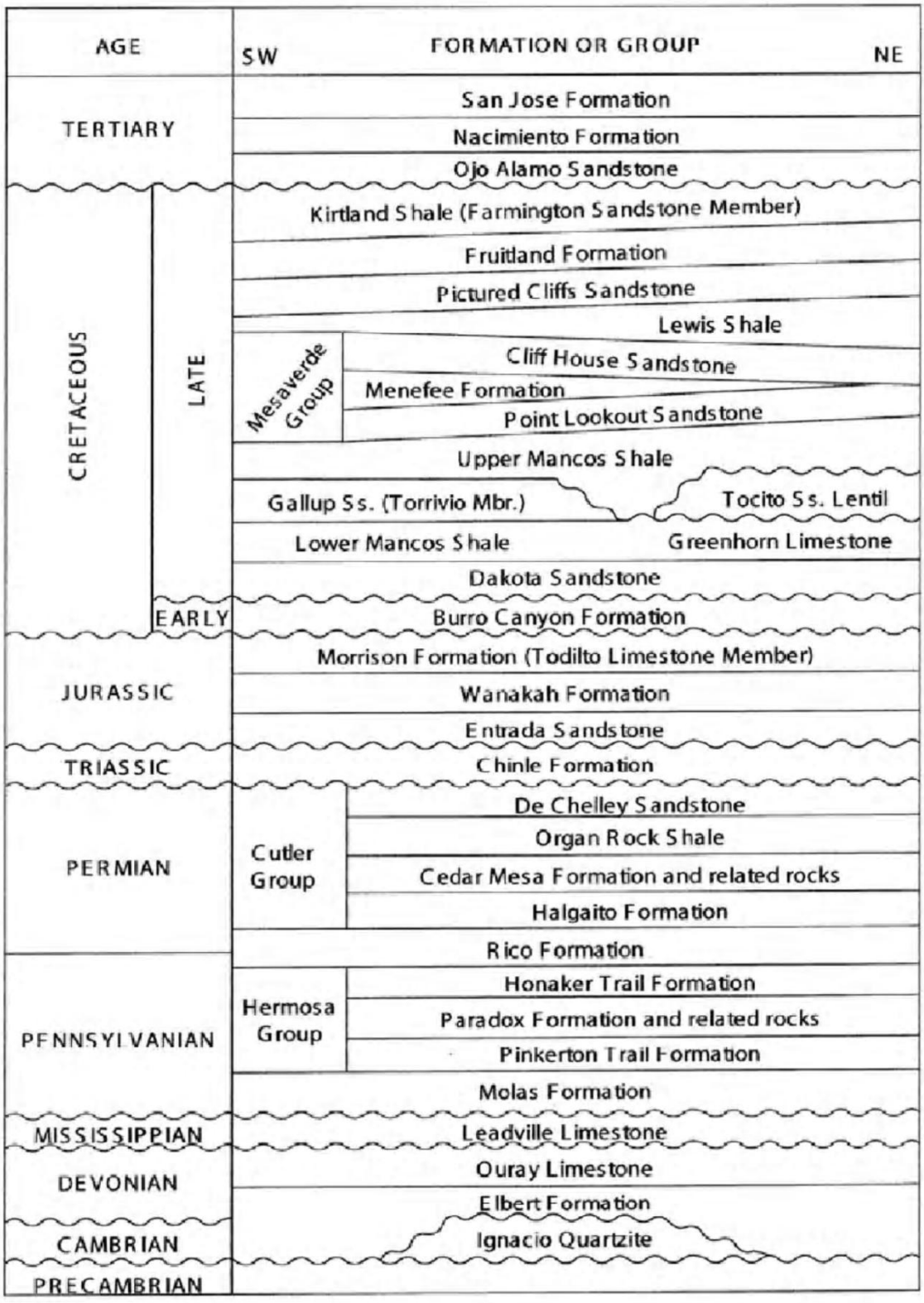

Figure 4: General stratigraphic column chart for rocks in eastern Paradox Basin and vicinity, southwest Colorado (from Huffman, 1995).

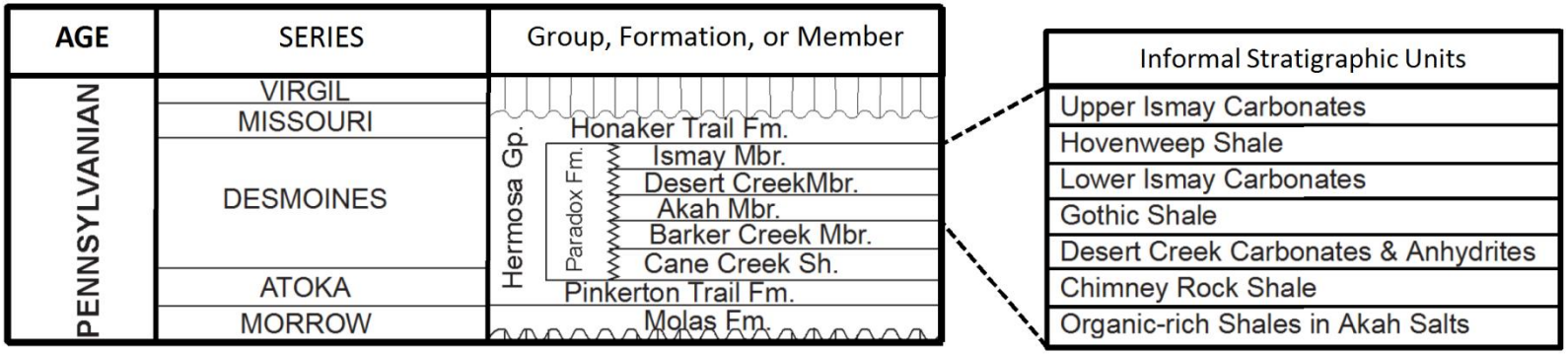

Figure 5: Formal and informal stratigraphic nomenclature for Pennsylvanian sedimentary rocks of the eastern Paradox Basin in the San Juan Public Lands Planning area (modified from Stevenson and Wray, 2009).

(collectively known as the "Silverton Delta") localized just updip of the trend and along the paleoshoreline in southwestern Colorado (Fetzner, 1960; Spoelhof, 1976; Hite et al., 1984; Peterson, 1989). The Gothic Shale Gas Play occurs at depths of about 5,500 to 7,500 feet below the ground surface (Schamel, 2008), laterally forming a northwest-southeast trending belt approximately 20 miles wide and 55 miles long across portions of San Miguel, Dolores, and Montezuma Counties in the SJPL planning area (Figure 3).

Unconventional shale gas accumulations have become the focus of recent exploration and development activity across the continental United States (e.g. the Barnett Shale of the Fort Worth Basin in Texas; the Woodford and Fayetteville Shales of the Arkoma Basin in Oklahoma and Arkansas, respectively; the Antrim Shale of the Michigan Basin in Michigan, among others) (Hill et al, 2008; USDOE, 2009). Unconventional shale gas reservoirs typically extend over widespread geographic areas - the black, organic-rich shales of the Paradox Formation are no exception. Not only are substantial shale gas resources expected across the Gothic Shale Gas Play area (Wood Mackenzie, 2009), but immediately offset (and possibly overlapping) shale gas trends may also be associated with the black, organic rich shales that occur both above (i.e. the Hovenweep Shale) and below (i.e. the Chimney Rock Shale) the Gothic Shale interval. Recognizing that the upper Paradox Formation represents an overall progradational, shoaling-upward sedimentary sequence (Gianinny and Miskell-Gerhardt, 2009), it is possible that a similar prodelta shale gas wedge of Chimney Rock Shale is present east (i.e. landward) of and parallel to the Gothic Shale Gas Play, and that a comparable Hovenweep Shale trend occurs west (i.e. basinward) of and parallel to the Gothic Shale Gas Play.

The Gothic Shale Gas Play area has experienced a relatively stable tectonic/structural history in this portion of the SJPL planning area. The southeastern Paradox Basin is characterized by an overall west-dipping sequence of Paleozoic and Mesozoic sedimentary rocks with relatively simple subsurface structural configurations (Peterson, 1989; Condon, 1997). Large- to medium-scale, gentle anticlinal and synclinal folds which formed above deep-seated salt swells are sometimes superimposed upon the regional dip (Kitcho, 1981). Minor normal faulting is also occasionally observed within the Gothic Shale Gas Play area (Kitcho, 1981; Peterson, 1989). These sub-regional structures have only limited influence on the distribution of the few existing fields in the Gothic Shale Gas Play area because most are conventional accumulations dominated by stratigraphic trap components (Schneider et al., 1971; Berghorn and Reid, 1981; Scott and Klipping, 1981; Peterson, 1989; Huffman, 1995). In considering the burial history of unconventional shale gas resources in the trend, it is this relatively undeformed structural record that is largely responsible for the accumulation of in situ hydrocarbons in the Gothic Shale interval.

The Gothic Shale interval is itself the source, reservoir, and seal of this unconventional, continuous-type gas accumulation. Lithologically, the interval is an organic-rich, dolomitic mudstone with thicknesses ranging from less than 50 feet to more than 150 feet (Hite et al., 1984; Schamel, 2009). Similar to other shale gas reservoirs in the United States, the Gothic Shale is characterized by very low porosities of not more than about

5%, effective permeabilities in the nano-darcy range, and water saturations less than or equal to 25% (Hill et al., 2008; Schamel, 2009; BBC, 2009a; BBC, 2009b). Compositionally, the black shales of the Hermosa Group typically contain nearly equal proportions of mud-sized quartz particles, carbonate minerals, and clay minerals/organic particles (Schamel, 2009). As a result, the Gothic Shale is relatively brittle and responds favorably to fracture stimulation during completion operations. Although the Paradox Formation black shales have been described as organic-rich, Total Organic Content (TOC) values are typically lean, averaging between 2% to 4% of total weight percent (Schamel, 2009). Much of the Gothic Shale's organic content is terrestrial-sourced, Type III kerogen (vitrinite and huminite) that converts to natural gas during thermal maturation (Nuccio and Condon, 1996a; Nuccio and Condon, 1996b). Natural gas that accumulates in such dense shale occurs as both free gas in natural fractures and pore spaces and adsorbed gas on the surfaces of organic matter.

The Middle Pennsylvanian Gothic Shale Gas Play underlies more than 1,000 square miles of surface land in the SJPL planning area. Although unconventional gas resources are sometimes referred to as "continuous" hydrocarbon accumulations (USGS, 1995), it is likely that only a portion of the Gothic Shale Gas Play acreage will be economically productive due to lithologic variations in properties such as mineralogy, total organic carbon, natural fracture density and orientation, water saturation, effective porosity, or formation thickness. As exploration and development activity proceeds, operators will need to determine the critical properties that control the distribution of smaller, more favorable "sweet spots" in the Gothic shale gas trend. Success will be dependent on the ability of operators to effectively identify and economically produce gas from these isolated sweet spots across the prospective area.

V. PAST AND PRESENT EXPLORATION AND DEVELOPMENT ACTIVITY

The SJPL planning area has experienced a long history of oil and gas exploration and production activity with over 1,600 wells drilled since about 1920 (Figure 6) (IHS, 2010). The first field discovered in the SJPL planning area was McElmo Field, located about 10 miles west of Cortez, Colorado. Following the drilling of a wildcat test well by Midwest Oil Company, commercial gas production was established from the Pennsylvanian Paradox Formation in McElmo Field in 1922. Seven years later and about 15 miles south of Pagosa Springs, Colorado, Standard Oil Company of Colorado drilled the #1 Fitzhugh wildcat. This well discovered oil reserves in the Cretaceous Dakota Formation in Chromo Field and established the first commercial oil production in the SJPL planning area. Since 1920, the SJPL planning area has experienced extensive oil and gas exploration and development activities, mostly focused on the exploitation of CBM gas reserves in the Ignacio Blanco Field of the Northern San Juan Basin in La Plata County, Colorado, particularly during the late 1980's through early 1990's.

Since about 2006, exploration and development activities targeting Pennsylvanian shale gas reservoirs have become an important exploration and production target in the eastern Paradox Basin of the SJPL planning area. Most of this activity has been pursued by Bill Barrett Corporation (BBC), the primary operator in the trend, and their working interest partner, Williams Production Company. With at least 397,000 gross (208,000 net) undeveloped acres leased in the eastern Paradox Basin of Colorado (Oil and Gas Journal, 2008), BBC is well-positioned to control the location and pace of exploration and development activities in the emerging Gothic Shale Gas Play area. This operator is currently using 3D seismic data to refine proposed drilling locations and enhance the identification of localized "sweet spots" in the Gothic Shale Gas Play area. At least three 3D seismic surveys have either been permitted or acquired on private fee lands proximal to the two initial vertical discovery wells drilled in the trend (i.e. the #1 Koskie-Brumley and the #1 Johnson-Alkali Canyon wells). Another four 3D seismic surveys have also been proposed on federal surface lands in the eastern Paradox Basin. No other types of geophysical (e.g. magnetic, gravity, resistivity) or geochemical surveys have either been previously completed or are currently permitted on federal lands in the Gothic Shale Gas Play area.

In late 2006 and 2007, BBC initiated the drilling of four vertical Gothic shale gas wells in Dolores and Montezuma Counties, Colorado. Of these four exploratory wildcat wells, both the #1 Koskie-Brumley Draw and #1 Johnson-Alkali Canyon, drilled just east of U.S. HWY 666 about 12 miles north of Cortez and 8 miles southeast of Dove Creek, respectively) demonstrated very encouraging test results in the Gothic Shale interval. Extensive log, core, test, and production data were obtained from the wells. In 2008 and 2009, the operator followed up success in these wildcat wells with the drilling of eight horizontal confirmation boreholes in the Koskie and Johnson discovery areas. Also in 2008, BBC spudded a vertical wildcat (the #13-15-37-17 Gray well) and horizontal appraisal well approximately 10 miles northwest of Cortez in the Hovenweep Shale

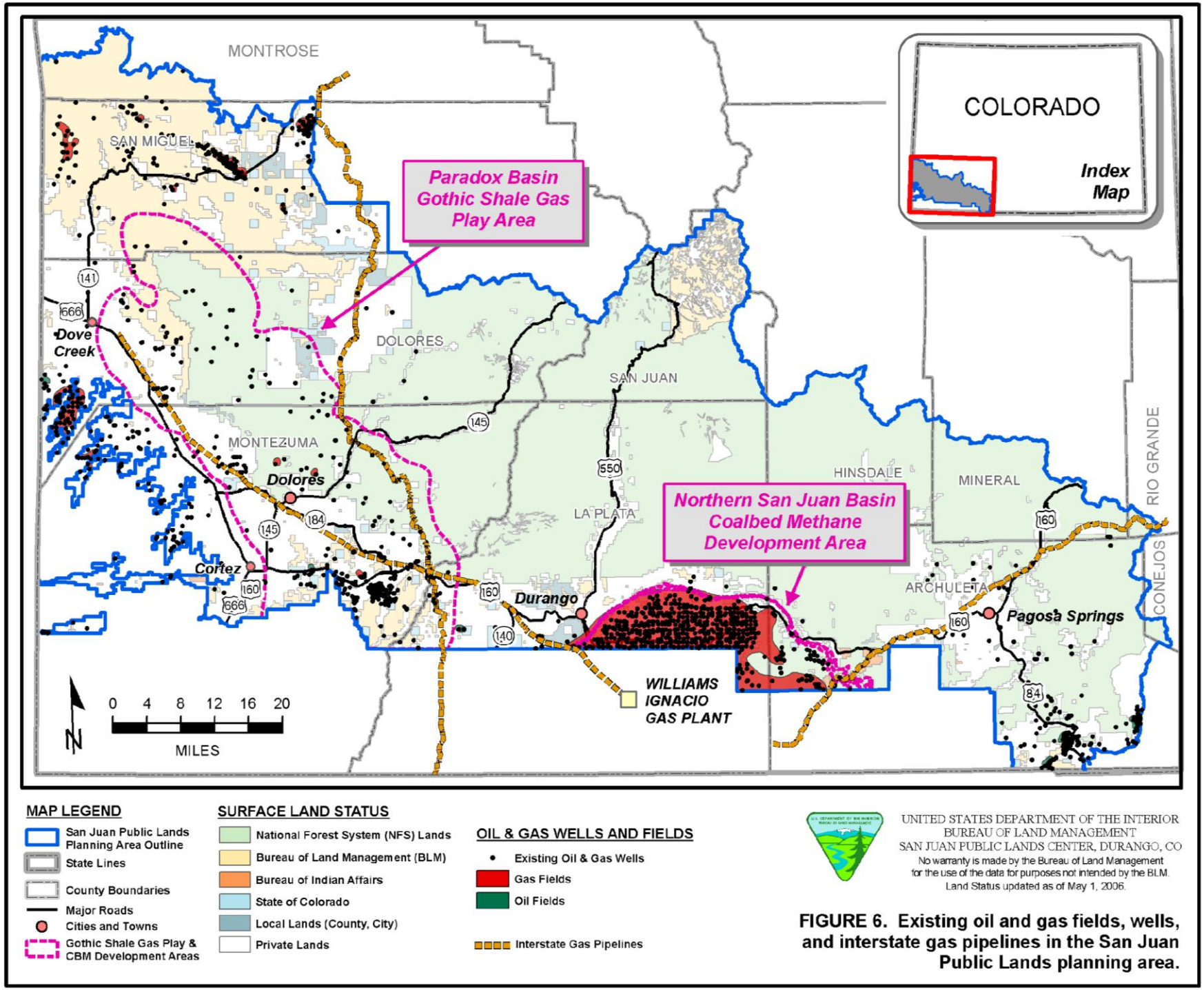

FIGURE 6. Existing oil and gas fields, wells, and interstate gas pipelines in the San Juan Public Lands planning area.

trend. Although the Hovenweep Shale proved to be somewhat thinner than the underlying Gothic Shale, test results obtained in the Hovenweep shale gas interval were also encouraging. In December 2008, BBC tied directly into Williams' Northwest interstate pipeline system and placed the first Gothic shale gas completion online. A total of three wells have been connected to the sales line since that time with gas production reaching approximately 2 million cubic feet of gas per day (MMCFG/D) in February 2009 from the three completions.

In 2009, considerable permitting activity was observed in the Gothic Shale Gas Play with 40 drilling permits approved in Dolores, Montezuma, and San Miguel Counties from three industry operators (Bill Barrett Corporation, Black Resources, Inc., and EnCana Oil & Gas (USA) Inc.). During the first half of 2009 there was continuous drilling activity in the trend where 3 horizontal Gothic shale gas wells with 3,000 to 4,000 foot lateral legs (and completion interval lengths between about 1,800 and 2,900 feet) were spudded and drilled in the northern part of Montezuma County. The latter half of the year, however, was characterized by an absence of drilling activity in the trend due depressed gas prices and the overall effects of the global recession. With about 44 currently permitted and pending well locations (COGCC, 2009), it is likely that this hiatus is only temporary and that drilling in the Gothic Shale Gas Play will resume in 2010.

The success of wildcat wells drilled in the Gothic Shale Gas Play is attributed to the presence of hydrocarbon-saturated formation across the relatively undeformed portions of the southeast Paradox Basin where natural faulting and fracturing of the interval is relatively low, thus resulting in natural gas resources trapped within the shale rather than migrating into overlying reservoir units. Although exploration drilling in the Gothic Shale Gas Play has been successful, there does appear to be a steep learning curve associated with the application of advanced hydraulic fracture stimulation technologies during completion operations. Commercial success in the trend is dependent on operators obtaining high initial flow rates early in the life of these shale gas wells.

Economic gas production for a typical horizontal Gothic shale gas well has been modeled with the hyperbolic production profile illustrated in Figure 7. Commercial completions are expected to initially come online at a rate of 2.75 MMCFG/D with a rapid decrease in flow rate during the first two years of production, followed by a much slower rate of decline throughout the remaining 15-year economic life of the well. Such a hyperbolic decline curve would generate estimated ultimate reserves (EUR) of 4.09 billion cubic feet of gas (BCFG) for a typical commercial completion in the Gothic Shale Gas Play.

Industry has yet to formally report sustained initial production rates of at least 1 MMCFG/D for the early Gothic Shale horizontal development wells that have already been drilled in the trend. With the potential to extract large volumes of natural gas across the Gothic Shale Gas Play area, however, it is expected that operators will continue to experiment with advanced fracing and completion techniques and that commercial flow rates will eventually be attained within the trend. Operator investment in these multi-stage, high-cost Gothic shale gas completions will largely be controlled by trends in

U.S. natural gas prices. In general, experts are predicting a gradual, long-term increase in U.S. prices from current levels at just under $4.50/MCFG in December 2009 to over $6.00/MCFG during the 15-year RFD scenario period from 2009 to 2023 (Figure 8).

To date, the oil and gas companies pursing Gothic shale gas targets in the eastern Paradox Basin of Colorado include Bill Barrett Corporation, Williams Production Company, Samson Resources Company, Questar Exploration and Production Company, Black Resources, Inc., Davis Petroleum Corporation, EnCana Oil & Gas (USA), Inc., and Cabot Oil and Gas Corporation, among others.

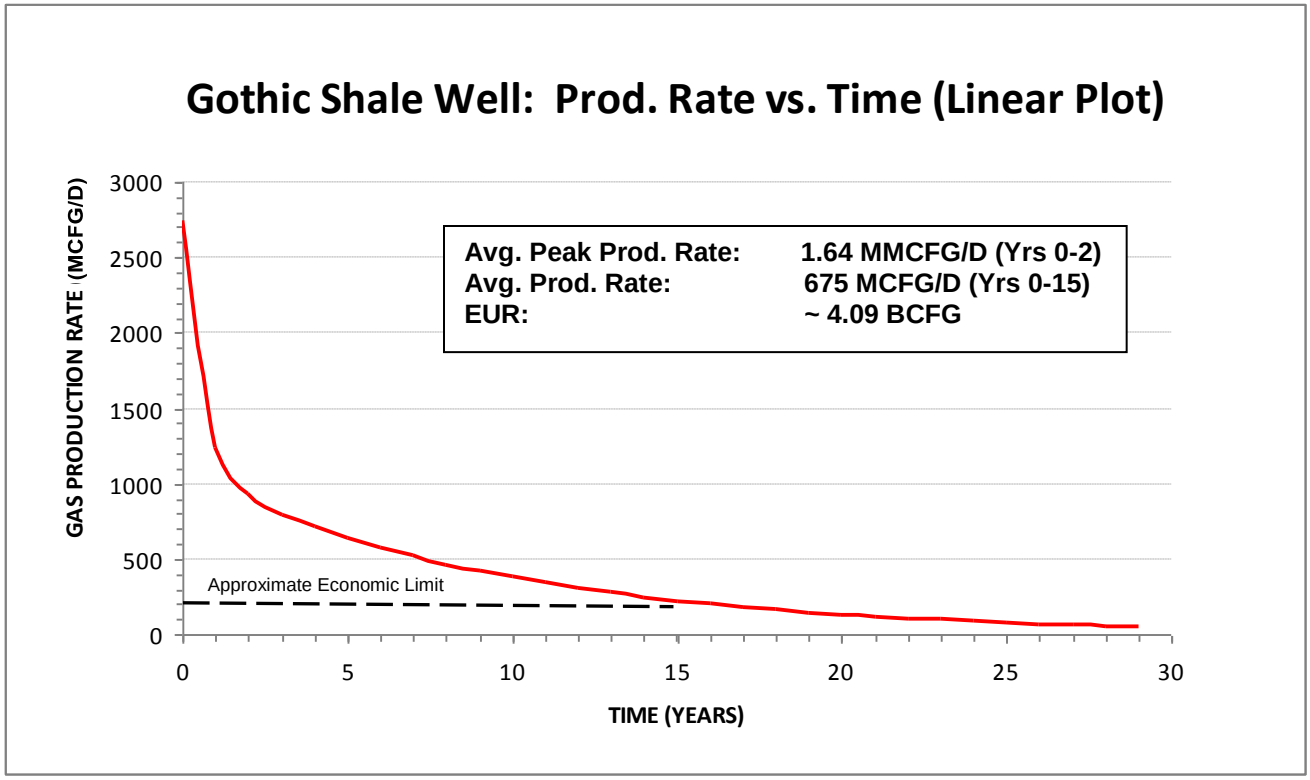

Figure 7: Type production curve for a typical horizontal gas completion in the Gothic Shale Gas Play.

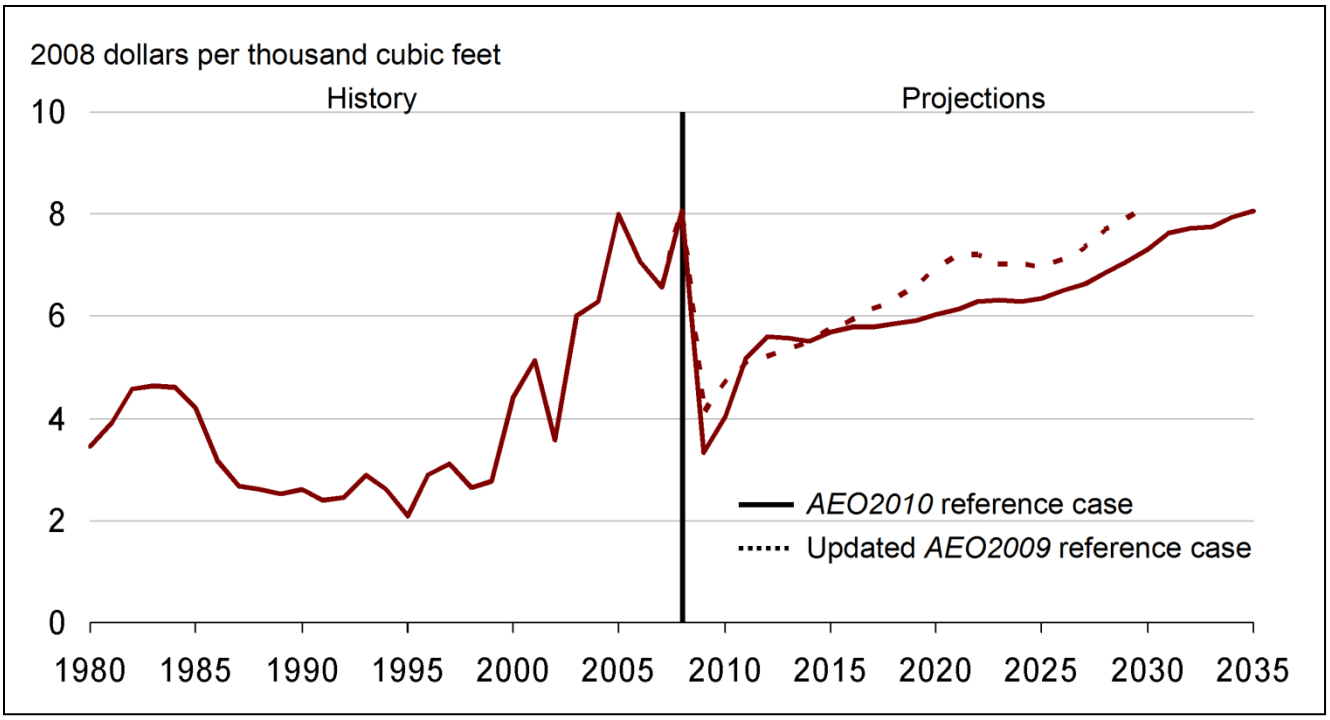

Figure 8: EIA natural gas price forecast curve (EIA, 2020b).

VI. HYDROCARBON OCCURRENCE AND DEVELOPMENT POTENTIAL

Hydrocarbon Occurrence Potential: The gas-saturated nature of the black, organic-rich shales of the Paradox Formation has long been recognized, as evidenced by mudlog shows, drillstem tests, and drilling shows in historical wells drilled across the eastern Paradox Basin region (Schamel, 2006). North of the Gothic Shale Gas Play area, conventionally-trapped hydrocarbon accumulations have sometimes been encountered in highly fractured Pennsylvanian black shale reservoirs, primarily on the flanks of salt anticlines in the structurally complex Paradox Fold and Fault Belt of eastern Utah and western Colorado (Schneider et al., 1971; Peterson, 1989; Schamel, 2006). Within the stable Gothic Shale Gas Play area of southwestern Colorado where natural faulting and fracturing has been less intense, unconventional natural gas reserves occur within relatively impermeable shale intervals. Industry's inability to establish commercial production in such tight, dense rock resulted in the Gothic Shale being overlooked as a potential development target throughout much of the exploration and development history in the basin. With recent, cost-effective advances in long-reach horizontal drilling and multi-stage hydraulic fracturing techniques in economically successful shale gas plays throughout the nation, the hydrocarbon occurrence potential of the Gothic Shale Gas Play has considerably improved.

An oil and gas occurrence potential map was constructed in order to update the four major classes of hydrocarbon occurrence potential in the SJPL planning area and upgrade the overall hydrocarbon occurrence potential for the Gothic Shale Gas Play area in the western portion of the planning area (Figure 9). This geologic interpretation utilized several types of data for the projection of hydrocarbon occurrence. First, the hydrocarbon occurrence map included in the original 2006 RFD was overlain on a basemap to serve as a generalized starting point for the interpretation. Next, a bedrock geologic map (Tweto, 1979) was superimposed upon the original RFD occurrence map in order to more precisely define the four major classes of hydrocarbon occurrence potential (High, Moderate, Low, and None) (BLM, 1990) and identify areas that might need revision. Lastly, the resultant potential map was then compared to the distribution of existing wells in the region in order to refine the boundaries between the four major classes and validate the revised map interpretations.

In general, "high" potential areas are defined by the presence of proven source and reservoir-quality rocks that have experienced a favorable thermal maturation history for the generation and trapping of substantial hydrocarbon accumulations. "Moderate" potential areas are those characterized by geophysical or geological indications of the presence of source and reservoir-quality rocks which may have undergone a favorable thermal maturation history for the generation and trapping of hydrocarbon accumulations. "Low" potential areas possess an absence of one or more of the previously described variables (e.g. source rocks, reservoir rocks, thermal maturation, trap presence). Areas of "no known" or "no" hydrocarbon occurrence potential are those with an absence of source rock, reservoir rock, thermal maturation, and trap presence, essentially excluding the occurrence of hydrocarbons in a particular area.

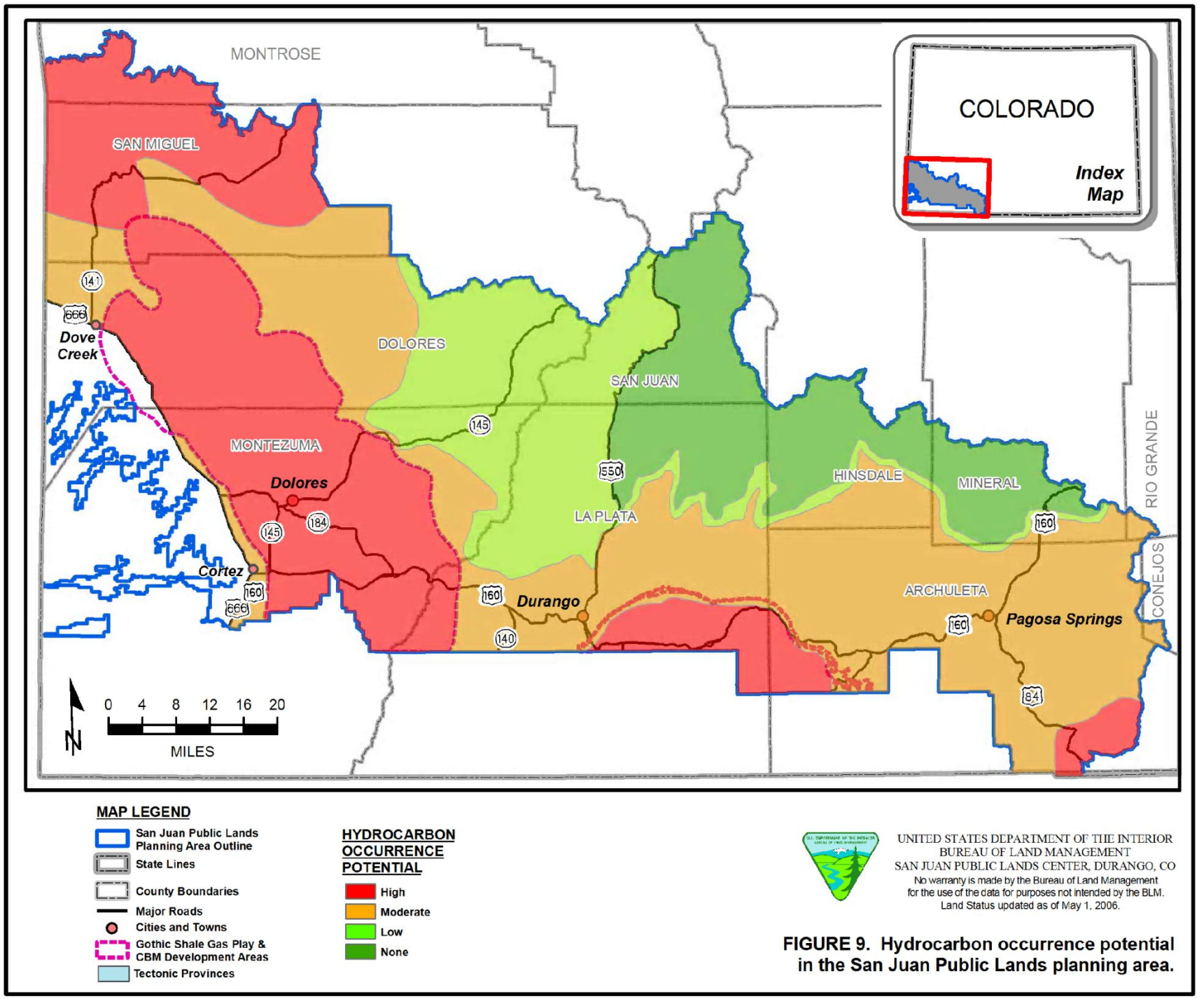

FIGURE 9. Hydrocarbon occurrence potential in the San Juan Public Lands planning area.

The modified oil and gas occurrence potential map presented in this 2009 RFD Addendum indicates that nearly all of the Gothic Shale Gas Play area has a high chance of encountering potentially productive hydrocarbon-bearing rocks in the subsurface (Figure 9). The same Gothic Shale Gas Play area was characterized with only a low to moderate chance of encountering hydrocarbon-bearing rock in the original 2006 RFD hydrocarbon occurrence potential map (SJPL, 2006). The upgrade in hydrocarbon occurrence potential for the Gothic shale gas trend is based on the encouraging drilling and test results reported in wells drilled since late 2006.

Hydrocarbon Development Potential: There are several important indicators of future oil and gas development activity that can be used to assess hydrocarbon development potential for a given area. These include the historical and geospatial distribution of existing oil and gas wells and fields, the density and location of currently permitted (but not yet drilled) wells, geologically controlled variations in hydrocarbon occurrence potential, and the presence of distinct tectonic/physiographic features across the SJPL planning area. The BLM's understanding of future industry operations has also been enhanced by informal discussions with several operators that are currently active in southwestern Colorado.

To date, 294 wells have been drilled in the Gothic Shale Gas Play (IHS, 2009). Of these wells, 83 (28%) are producers and 211 (72%) are dry holes. Except for a high density of wells near Mesaverde National Park, most of these wells are evenly and sparsely spaced across the shale gas trend. Examination of the geospatial distribution of oil and gas fields in the Gothic Shale Gas Play area reveals no more than a dozen small fields within the trend boundaries (Figure 6). The low proportion of oil and gas producers in the trend, combined with the small field size and paucity of proven hydrocarbon accumulations in western half of the play area, suggests that hydrocarbon development potential in the Gothic Shale Gas Play area is either in the low or moderate range. As stated previously, there are currently 44 approved or pending drilling permits across the Gothic Shale Gas Play area. Such industry activity supports a classification of moderate hydrocarbon development potential for the Gothic shale gas trend.

VII. RFD BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION FOR THE GOTHIC SHALE GAS PLAY

The baseline (unrestricted) estimation of wells that could be drilled in the Gothic Shale Gas Play in the 15-year analysis period (2009-2023) with pads, facilities, and associated surface disturbance is based on the following assumptions:

- All potentially productive areas are open for leasing under standard lease terms, except those areas identified as legally unavailable for leasing.
- Although the economic state of the oil and gas industry and its support industries will experience short-term highs and lows as commodity prices fluctuate, the long-term economic state will remain relatively stable with future costs and pricing slowly escalating.
- Drill rig availability is sufficient.
- Produced water handling, fresh water needs, availability of service company services, and experienced drilling and service company personnel are not constrained.
- New cost-effective drilling and completion technologies will serve to drive exploration and development and improve initial flow rates in producing wells to approximately 2.75 MMCFG/D.
- No hydrogen sulfide is present and impurities and inerts are marginal in the Gothic Shale interval.
- Throughout the 15-year planning period, well pad spacing for the Gothic Shale Gas Play is assumed to remain constant at 160 acres (i.e. 4 pads per square mile).
- Drilling and completion operations will occur year-round.
- The number of days to drill and complete a typical shale gas well is estimated to be 30 days through Years 0 -7 and gradually decreasing to 20 days by Year 13.
- Exploration wells will primarily be drilled from single-well pads and development wells will primarily be drilled from two-well pads.
- The number of single-well and two-well pads will vary in the following proportions, consistent with the general drilling activity model, in order to project a systematic decrease in exploratory drilling activity and a corresponding increase in development drilling during the 15 year (2009-2023) RFD analysis period:

  - Years 0-7 (2009-2015): 75% of the wells drilled will be on one-well pads
    25% of the wells drilled will be on two-well pads
  - Years 8-12 (2016-2020): 50% of the wells drilled will be on one-well pads
    50% of the wells drilled will be on two-well pads
  - Years 13-15 (2010-2023): 25% of the wells drilled will be on one-well pads
    75% of the wells drilled will be on two-well pads

- Approximately 28% (180,993 acres or 283 mi^2) of the total Gothic Shale Gas Play area (646,403 acres or 1,010 mi^2) will be developed by the oil and gas industry.
- In order to project annual and cumulative gas production in the Gothic Shale Gas Play, exploratory and development wells will vary in the following proportions

and with the following success rates, consistent with the general drilling a activity model:

- Years 0-7 (2009-2015): 80% exploratory wells (with a 60% success rate)
  20% development wells (with a 92% success rate)
- Years 8-12 (2016-2020): 35% exploratory wells (with a 70% success rate)
  65% development wells (with a 95% success rate)
- Years 13-15 (2021-2023): 17% exploratory wells (with a 80% success rate)
  83% development wells (with a 98% success rate)

In determining well, well pad, and surface disturbance projections for the Gothic Shale Gas Play area, it was first assumed that only 28% of the shale gas trend would be developed by the oil and gas industry during the 15-year (2009-2023) analysis period. Similar to other shale gas plays throughout the U.S., it is expected that only a fraction of the Gothic Shale Gas Play will be available, productive, and economically viable for oil and gas development and that the trend will be characterized by numerous, isolated "sweet spots" of localized productivity within the larger trend area. Although the Gothic Shale is a continuous, thick, and gas-saturated interval across the entire play area, differences in productivity related to variations in critical rock properties (e.g. total organic content, clay mineral volume, clay-sized quartz content, natural fractures, etc.) will occur across the shale gas trend. Exploration and development activity within the overall trend will be also be impacted by other limitations such as topographic slope, physical accessibility, and the location of existing man-made facilities and structures.

For the purposes of this RFD analysis, a development occurrence factor of 28% was used to estimate the economically viable area within the Gothic Shale Gas Play. Selection of this value was based on previous discussions during a technical meeting between the BLM and Bill Barrett Corporation (BBC, 2008), an operator highly active in drilling Gothic shale gas targets in recent years. At that meeting, technical professionals from Bill Barrett cited a productive area of 25-30% for the Gothic Shale Gas Play. In addition, recent RFD projections for an exploratory trend associated with the Cretaceous Niobrara Formation (a tight, calcareous claystone) in the Kremmling Field Office administrative area of northwestern Colorado estimated a similar (25%) factor for that speculative play area (BLM, 2007). With this information, a mid-range factor of 28% was used to estimate a development occurrence area of 180,993 acres or 283 mi^2 in the Gothic shale gas trend for the eastern Paradox Basin of Colorado.

Given 283 mi^2 of potential development in the Gothic Shale Gas Play, a total of 1,132 individual well pads were projected in the trend by assuming a well pad density of 4 well pads per square mile (equivalent to 160-acre well pad spacing). This assumed pad density is consistent with information provided by BBC for their Gothic Shale development projects in Dolores and Montezuma Counties, Colorado (BBC, 2009a; BBC, 2009b). Next, a hypothetical RFD drilling and development activity curve for the 1,132 surface well pads was then was generated for federal and non-federal lands in Gothic Shale Gas Play area (Figure 10). The well pad curve was forced to fit a model

which reflected an initial, slow exploratory and appraisal phase of drilling activity between Years 0-7 (2009-2015), followed by a period dominated by increased drilling of appraisal and field development wells during Years 8-12 (2016-2020), with a final period of infill development drilling through Years 13-15 (2021-2023). The resultant curve was then used to project the annual number of one- and two-well pads per year, escalating from 2 well pads annually in Year 0 (2009) to 147 well pads annually in Year 15 (2023). More specifically, a total of 495 single-well pads and 637 dual-well pads were estimated during the 15-year (2009-2023) analysis period. Larger multi-well pads were not incorporated into the analysis because both current and planned development activity indicate the utilization of only one- and two-well pads in the play (COGCC, 2009; BBC, 2009a; BBC, 2009b). Consequently, up to 4 dual-well pads per square mile (equivalent to an 80-acre downhole well spacing) is assumed for areas with full field development in this RFD analysis.

Based on the annual well pad activity model, two additional curves were generated for the drilling analysis (Figure 10). One curve predicted the number of new wells drilled annually and another projected the number of active drilling rigs in the productive Gothic Shale Gas Play. This approach estimated that 1,769 individual wells could be drilled in the unconventional shale gas trend of the Paradox Basin between 2009 and 2023 for the baseline industry activity scenario (Figure 10). The projected 1,769 wells equated to an average annual drilling rate of 118 wells per year from 2009 to 2023. More specifically, the drilling of 186 wells is predicted during the initial exploratory and appraisal phase of activity (Years 0-7) from 2009 to 2015, with an additional 819 new wells drilled during an intermediate phase of field development (Years 8-12) from 2016 to 2020, and followed by the drilling of 764 more wells during the final stage of infill field development in the trend (Years 13-15) from 2021 to 2023. As many as 14 drilling rigs are projected to be operating in the Gothic Shale Gas Play year-round by 2019. Approximately 1,556 of the 1,769 total wells projected are anticipated to be producers, capable of yielding an estimated cumulative volume of 2.7 TCFG during the 15-year (2009-2023) RFD scenario period.

This 2009 RFD Addendum estimates that 1,179 individual wells (1,556 producers and 213 dry holes) could be drilled on 1,132 well pads (495 one-well pads and 637 two-well pads) (Tables 7 and 8). Based on amount of acreage for each of the individual surface land/mineral estate ownership categories in the Gothic Shale Gas Play, the estimated number of wells that could be drilled in each ownership category have been quantified (Table 7). These projections have also been combined with the well, well pad, and surface disturbance estimates from the 2006 RFD, resulting in a baseline activity case of 2,954 wells, 1,927 wells pads, and 10,919 acres of gross surface disturbance on federal and non-federal lands in the SJPL planning area by 2024 (Table 8). Major operational constraints that may affect the baseline activity projections include regulatory limitations, natural gas prices, drilling rig availability, fresh water costs, produced water handling and/or disposal expenses, and air quality controls, among others.

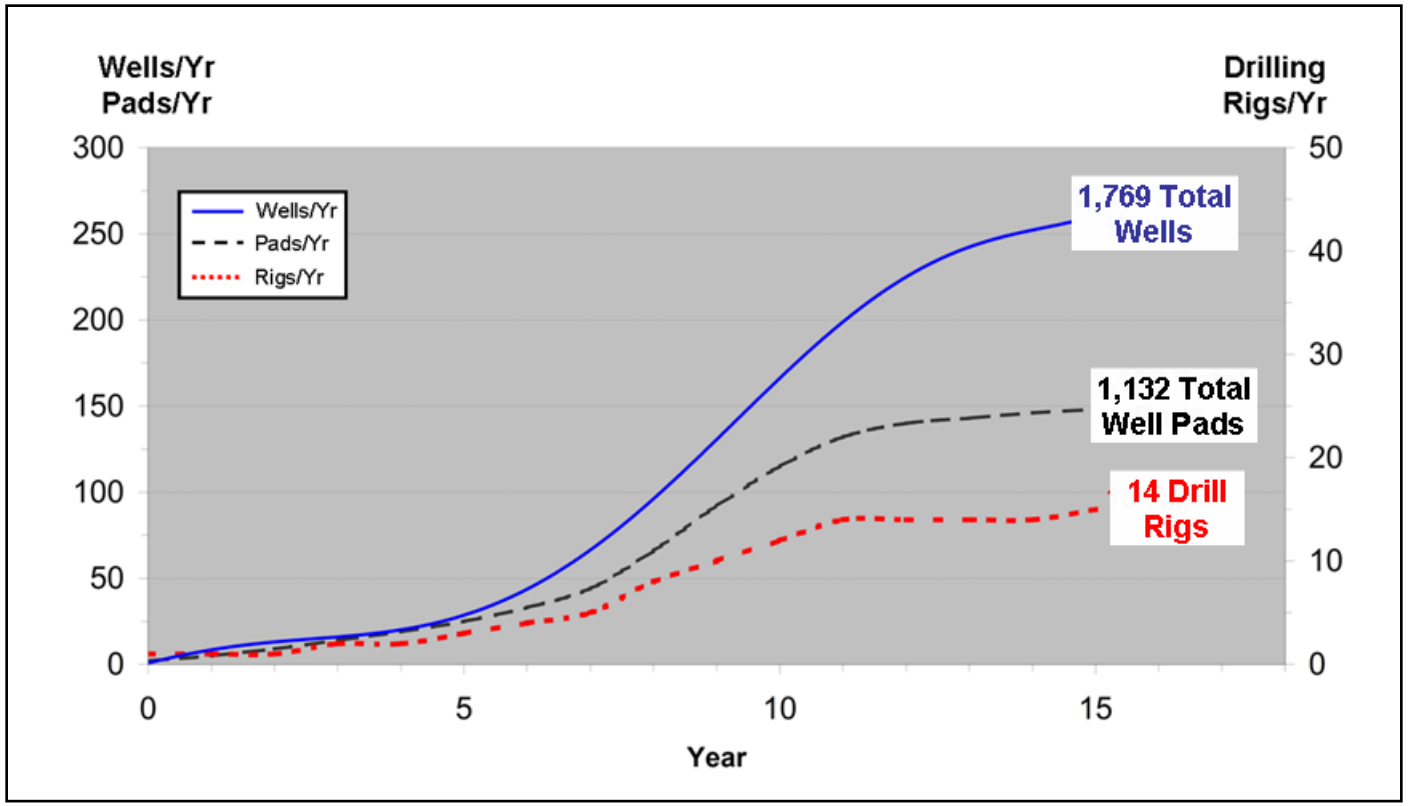

Figure 10: 2009 RFD Addendum Scenario – 2009-2023 Projection of drilling rigs, well pads, and gas wells drilled annually in the Gothic Shale Gas Play of the San Juan Public Lands planning area of Colorado.

Surface/Federal Oil & Gas Mineral Estate Ownership Categories	*Number of Wells*		*Number of Well Pads (Single Pads & Dual Pads)*		*Well-related Surface Disturbance (acres)*		*Infrastructure-Related Surf. Disturbance (acres)*	
	Unleased Lands	**Leased Lands**	**Unleased Lands**	**Leased Lands**	**Unleased Lands**	**Leased Lands**	**Unleased Lands**	**Leased Lands**
NFS Surface/Federal (USFS) Oil & Gas	474	110	133 & 171	31 & 39	1578	365	244	56
BLM Surface/Federal (BLM) Oil & Gas	129	149	36 & 47	41 & 54	430	495	66	77
PRIVATE Surface/Federal (BLM) Oil & Gas	51	90	14 & 18	25 & 32	171	300	26	46
STATE Surface/Federal (BLM) Oil & Gas	0	0	0 & 0	0 & 0	0	0	0	0
LOCAL Surface/Federal (BLM) Oil & Gas	7	2	2 & 3	1 & 1	23	6	4	1
TOTALS	***661***	***351***	***185 & 239***	***98 & 126***	***2202***	***1166***	***340***	***180***

Surface/Nonfederal Oil & Gas Mineral Estate Ownershiip Categories	**Leased & Unleased Lands**	**Leased & Unleased Lands**	**Leased & Unleased Lands**	**Leased & Unleased Lands**
NFS Surface/Nonfederal Oil & Gas	106	30 & 38	353	55
BLM Surface/Nonfederal Oil & Gas	2	1 & 1	6	1
PRIVATE Surface/Nonfederal Oil & Gas	609	170 & 219	2025	313
STATE Surface/Nonfederal Oil & Gas	28	8 & 10	94	15
LOCAL Surface/Nonfederal Oil & Gas	12	3 & 4	41	6
TOTALS	***757***	***212 & 272***	***2519***	***390***

2009 SUPPLEMENTAL RFD TOTALS:	**1,769 Wells**	**495 & 637 Well Pads**	**5,887 Acres**	**910 Acres**

Table 7: Summary table of well, pad, and surface disturbance projections for the various land and mineral ownership and jurisdiction categories in the Gothic Shale Gas Play of the San Juan Public Lands planning area.

	2006 RFD Conventional & CBM Plays	2009 Supplemental RFD Gothic Shale Gas Play	2006 & 2009 Combined Totals SJPL Planning Area
Oil & Gas Wells	1,185 wells	1,769 wells	2,954 wells
Well Pads	795 pads	495 one-well pads 637 two-well pads	1,927 well pads
Surface Disturbance	3,185 acres well-related & 937 acres infrastructure-related	5,887 acres well-related & 910 acres infrastructure-related	9,072 acres well-related & 1,847 acres infrastructure-related

Table 8: Summary table of new well, well pad, and gross surface disturbance projections for the 2006 RFD and 2009 RFD Addendum for federal and non-federal lands in the San Juan Public Lands planning area.

VIII. SURFACE DISTURBANCE ESTIMATES DUE TO OIL AND GAS ACTIVITY

Total gross surface disturbance for wellsite-related and infrastructure-related development activities in the Pennsylvanian Gothic Shale Gas Play area of the Paradox Basin approaches nearly 6,800 total acres for the 15-year (2009-2023) RFD analysis period (Table 7, Table 8). Calculations quantifying such disturbance in the trend are detailed below.

Wellsite-related Surface Disturbance Estimates: Future, unconstrained gross surface disturbance for "wellsite-related" activities includes those surface impacts due to the construction of: (a) new well pads; (b) access roads; and (c) gas flowlines. These projections are based primarily on the total number of projected one-well and two-well pad locations anticipated within the Gothic Shale Gas Play area. Estimation of gross wellsite-related surface disturbance involved the following computations:

- Total Number of Well Pads:
  - 495 one-well pads + 637 two-well pads = 1,132 total pads
- Well Pad Surface Disturbance:
  - One-Well Pads: 2.5 acres / one-well pad * 495 one-well pads = 1,237 acres surface disturbance
  - Two-Well Pads: 3.0 acres / two-well pad * 637 two-well pads = 1,911 acres surface disturbance
- Access Road Disturbance:
  - 0.5 mile (or 2,640') distance * 40' right of way width * 1,132 well pads = 2,739 acres surface disturbance
- Associated Flowlines:
  - co-located in access road right of ways = 0 acres surface disturbance

The well pad disturbance sizes of 2.5 acres for one-well pads and 3.0 acres for two-well pads are consistent with those currently being built in the eastern Paradox, northern San Juan, and northern Piceance Basins of Colorado, and the Williston Basin of Montana. Single and dual well pad sizes in other areas or trends may be larger or smaller by comparison. For wells targeting Gothic Shale gas reservoirs, pad size will be primarily determined by three important factors: the number of wells drilled on the pad, the capacity of the reserve pits to hold the drill cuttings from all wells drilled on the pad, and the capacity of fresh water storage ponds/pits to contain sufficient volumes of water needed for drilling and completion operations for all wells on the pad. This RFD analysis

is based on projections for one- and two-well pads only, and assumes that all drill cuttings will remain on the pad and eventually buried onsite rather than being removed and transported to an approved waste facility. It also assumes that large freshwater storage ponds/pits will be constructed on each well pad rather than at centralized locations between the individual wellsites. Multi-well pads with higher numbers of wells per pad could also be utilized in the Gothic Shale Gas Play area. Such development would require increased pad size but reduced road and flowline construction with less well-related surface disturbance as compared to the single/dual well pad development scenario.

Well pad surface disturbance for the 495 one-well and 637 two-well pads is estimated at 3,148 acres. Access roads account for another 2,739 acres of surface disturbance or approximately 566 miles of new road construction in the SJPL planning area. Associated flowlines which transport production from Gothic shale gas wells are assumed to be co-located within the access road right of ways (and laid on the ground surface when feasible), and therefore do not contribute to additional wellsite-related surface disturbance in the trend. In total, 5,887 acres of gross wellsite-related disturbance is estimated in the Gothic Shale Gas Play during the 15-year (2006-2023) RFD scenario period. As mentioned above, this disturbance estimate could be significantly lower if development drilling from large multi-well pads is adopted in the area, given favorable economic conditions and continued application of advanced drilling and completion technologies in the future.

Infrastructure-related Surface Disturbance Estimates: Gross surface disturbance categories for "infrastructure-related" oil and gas activity include: (a) impacts due to the construction of major gas transmission pipelines; and (b) impacts due to other types of transport or processing systems, including gathering pipelines, processing plants, and compression stations. The projections for infrastructure-related surface disturbance in the Gothic Shale Gas Play area is based on largely on information regarding the existing major pipeline systems in the SJPL planning area, as well as surface disturbance projections for analogous developments elsewhere in the Rocky Mountain region.

Gross surface disturbance due to the construction of major ($\geq$24" diameter) gas transmission pipelines in the area was first addressed. Presently, there are two interstate gas pipelines in the Gothic Shale Gas Play area – Williams' Northwest pipeline in the western part of the trend, and a TransColorado pipeline along the southeastern edge of the trend (Figure 4). Although the two pipelines are currently operational, both are near maximum flow capacity. As such, an additional major gas transmission line will be needed should the Gothic Shale Gas Play prove to be an economically viable development area.

A future interstate pipeline would probably be located mostly on private surface land and parallel to an existing pipeline corridor in the area. In calculating the gross surface disturbance for such a project, a maximum pipeline length of 75 miles was chosen in order to accommodate nearly any north-south path through the SJPL planning area in the vicinity of the Gothic Shale Gas Play area. Assuming a standard (50') pipeline right of

way, an estimated surface disturbance of 455 acres is associated with the construction of a new major gas pipeline in the region.

- Major Gas Transmission Pipelines:
  - 1 pipeline * 75 miles (or 396,000') * 50' pipeline right of way = 455 acres surface disturbance

Lastly, gross surface disturbance due to the construction of additional infrastructure-related activities was also addressed. Such projects include surface impacts due to the building of additional support facilities such as gathering pipelines, centralized compressor stations, and gas processing plants. Providing reasonable surface disturbance projections for individual gas delivery systems and processing facilities across an emerging trend where only two wells have been completed and placed online is both complicated and difficult. Thus, a simpler and more generic approach was needed.

For this purpose, infrastructure-related surface disturbance estimates from several previously-released RFD's for areas in western Colorado were examined (BLM, 2005; BLM, 2007; BLM, 2008; SJPL, 2006). Comparison of wellsite- and infrastructure-related gross surface disturbance estimates showed that infrastructure-related disturbance ranged between 7% and 28% of wellsite-related disturbance in these recent analyses. Since the estimated major pipeline disturbance of 455 acres represented about 7.7% of total wellsite-related surface disturbance in the Gothic Shale Gas Play, this same acreage was also utilized as an estimate of disturbance for additional infrastructure-related activities in the trend.

- Additional Gathering Pipelines, Compressor Stations, and Gas Processing Plants:
  - 455 acres (equivalent to major gas transmission pipeline disturbance)

This approach yields in an estimate of 910 acres for total infrastructure-related surface disturbance in the Gothic Shale Gas Play area, which is roughly 15% of the total wellsite-related disturbance, well within the 7% - 28% range of values noted in previously-released RFD's addressing areas in western Colorado. When the projected total gross infrastructure-related disturbance is combined with that for wellsite-related disturbance, approximately 6,797 acres of projected surface disturbance is anticipated in the Gothic Shale Gas Play during the 15 year (2009-2023) RFD analysis period (Table 8).

IX. SUMMARY

During the 15-year (2009-2023) RFD analysis period, it is projected that exploration and development drilling for unconventional gas resources in the emerging Pennsylvanian Gothic Shale Gas Play will be focused within the high hydrocarbon occurrence potential area in the western part of the SJPL planning area (Figure 9). Most of the initial drilling activity is expected to target localized "sweet spots" of production on private fee acreage along the western boundary of the Gothic shale gas trend (Figure 2), especially near existing gas transmission lines and other surrounding infrastructure. Operators may then begin to step out from these early field development successes and test more remote locations characterized by favorable geologic and seismic expression, with increasing focus on the development of public lands that are concentrated in the eastern portion of the Gothic Shale Gas Play area.

It is projected that approximately 1,769 wells on 1,132 single- and dual-well pads could be drilled in the Gothic Shale Gas Play in the reasonably foreseeable, baseline industry activity case. These wells have the potential to produce approximately 2.7 TCFG from the Gothic Shale interval. Gross surface disturbance is projected at 5,887 acres for wellsite-related activities and 910 acres for infrastructure-related activities in the shale gas trend during the 15-year (2009-2023) projection period. Combined with earlier estimates presented in the 2006 RFD, a total of 2,954 wells on 2,317 pads with 10,919 acres of surface disturbance is projected for all conventional and unconventional plays in the SJPL planning area by 2024.

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