Appendix C

Reserved and Outstanding Oil and Gas Development on the Allegheny National Forest

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APPENDIX C–RESERVED AND OUTSTANDING OIL AND GAS DEVELOPMENT ON THE ALLEGHENY NATIONAL FOREST

Introduction

The purpose of this document is to provide background information on reserved and outstanding oil and gas development on the Allegheny National Forest (ANF). It is intended to replace information pertaining to reserved and outstanding oil and gas development found in Appendix F of the ANF Land and Resource Management Plan (Forest Plan) Final Environmental Impact Statement (FEIS) (USDA-FS 2007b). The Forest Plan was administratively appealed, with the result that the Chief of the Forest Service directed the Regional Forester for the Forest Service Eastern Region to provide for public notice and comment on the application of design criteria to reserved and outstanding oil and gas development (pvt OGD), and changes in Section 2800 of the 2007 Forest Plan. In the appeal decision, the Chief also instructed the Regional Forester to clarify the ANF's authority to manage oil and gas activities and to more fully document the cumulative effects of oil and gas development on air quality (USDA-FS 2008).

The roles and responsibilities of the Forest Service, Commonwealth of Pennsylvania and private mineral owners will be clarified in this appendix. The ANF's legal authority to determine the reasonable and necessary use of surface resources when reserved and outstanding oil and gas rights are exercised will be disclosed, thus serving as the basis for development of S&Gs included in the Forest Plan.

Background

In 1859, Colonel Edwin L. Drake struck oil on Oil Creek in Venango County, which is about 15 air miles southwest of the ANF. This started the worldwide commercial oil industry. Rapid development followed and spread to the northeast across the Allegheny Plateau, much of which was held in corporate ownership by large timber companies. During this period, developers purchased oil and gas rights from private landowners and began development. Some leases, particularly on the southwest corner of the ANF, date from the 1880s.

The Allegheny National Forest (ANF) is about 513,000 acres in size where 93 percent of the mineral estate is privately owned and of that 93 percent, about 52 percent are outstanding and 48 percent reserved. Outstanding mineral estates are created when the rights to the mineral estate have been separated or split from the surface estate prior to acquisition by the United States. Reserved mineral estates are created when a private owner sells or exchanges his surface estate to the United States, but keeps or reserves the right to the mineral estate.

Regulation and administration of outstanding mineral rights are defined by mineral severance deed language, private leases, industry standards, and some Federal and State laws/regulations.

There are four different types of reserved rights found on the ANF. These rights are commonly referred to as the 1911, 1937, 1947 and 1963 reserved rights. These rights are categorized by the set of Secretary of Agriculture Rules and Regulations that were in effect at the time of acquisition (i.e. the 1937 rules and regulations would apply to a 1940 acquisition). The percentage of the different types of reserved rights across forest is about 40 percent, 5 percent, 1 percent and 2 percent respectively.

The 1963 rules and regulations are codified in 36 CFR 251.15. Regulation and administration of reserved mineral rights are defined by the Secretary's Rules and Regulations, mineral severance deed language, private leases, industry standards, and some Federal and State laws/regulations.

The various versions of the Secretary's rules and regulations are similar except for variances with the 1911 rules and regulations. Some of the major similarities between all are that proof of ownership, fire prevention, protection of water resources, and payment for lost or damaged vegetation are required. The major differences between the 1911 rules and regulations and the others are that the 1911 do not require a permit, bond or reclamation. The authorized officer does have the option to negotiate additional conditions to further protect the surface.

Methods of extraction for oil and natural gas have changed over time. As technology has improved, new areas previously thought not to be profitable have been developed. Similarly, technological advances have resulted in a second or third entry into areas that were once thought to be depleted.

Roles and Responsibilities

Authorities: Owners of private oil and gas rights have a property right to develop their interests, which includes reasonable use of the surface to the extent necessary to accomplish such development. However, this does not mean their operations are free from limitation or reasonable regulation that might originate under state and/or federal law, whether pursuant to property law concepts or other legal authorities.

Privately owned oil and gas rights on the ANF are still subject to regulation as may be authorized under the laws of Pennsylvania. The Pennsylvania Department of Environmental Protection's (PADEP's) authority under the Pennsylvania Oil and Gas Act (POGA) is an example of one such authority.

As the surface landowner, subject to private outstanding or reserved oil and gas rights, the United States, acting through the Forest Service, has all the property rights as recognized under Pennsylvania law. Additionally, to the extent the application of Pennsylvania law would frustrate the reasonable protection of the Federally-owned land and resources or the Federal purposes for which the land is held, State law would stand preempted by Federal law. *See*: North Dakota v. United States, 460 U.S. 300, 318, 75 L. Ed. 2d 77, 91 (1982) ("Although state law may be borrowed if appropriate, specific aberrant or hostile state rules do not provide appropriate standards for federal law"); Duncan Energy v. United States Forest Service, 50 F.3d 584, 591 (8th Cir. 1995) ("If North Dakota law is read to allow a developer unrestricted access after twenty days' notice, North Dakota law is pre-empted or falls under choice of law principles").

As a surface owner, the United States, through the Forest Service, may participate in any state regulatory process concerning pvt OGD proposals, as such opportunities are afforded to surface owners under state law. For example, the Forest Service can object to the PADEP issuance of permits sought by pvt OGD. Additionally, the United States' surface rights include the ability to prevent pvt OGD from causing unnecessary damage to, or unreasonably interfering with the use of, the surface resources. While owners of oil and gas rights have the right to reasonable use of the surface to the extent necessary for pvt OGD, they also have an obligation under longstanding Pennsylvania common law to minimize harm to the surface. *See*: Gillespie v. American Zinc and Chemical Company, 247 Pa. 222, 229, 93 A.272, 274 (1915) ("As between two proposed locations for the drilling and operation of a well, when one would injure, harass and annoy the owner of the land, without benefit or advantage to the [lessee], while the other would result in no such injury, the [lessee] is bound in equity to choose the latter location, if in so doing he is not substantially injured, or put to disadvantage thereby"); *and* United States v. Minard Run, 1980 U.S. Dist. LEXIS 9570 (W.D. PA 1980) (Citing to Gillespie, "the Supreme Court of Pennsylvania enunciated the principle that, where two alternative methods of proceeding are available to the mineral operator, neither of which is of detriment to the mineral operation and one of which is detrimental to the surface owner, the mineral operator must select the method which does not act to the detriment of the surface owner").

The Forest Service, as delegated by Congress through federal law, has the authority of a sovereign pursuant to applicable federal management purposes to reasonably regulate private property interests in order to protect the federally-owned land and resources from unnecessary or unreasonable degradation. Federal Courts have acknowledged this authority in the context of pvt OGD on National Forest System lands (Duncan Energy v. United States Forest Service, 50 F.3d 584 [8th Cir. 1995]). The authority of Congress, which is delegated to the Forest Service through Federal law, is ultimately grounded in the Property Clause (Art. IV, Section 3, cl. 2) and other provisions of the U.S. Constitution. See for example, 16 U.S.C. 551.

Specific to the ANF, federal law has directed the Forest Service to promulgate regulations that subject outstanding private OGD rights on the Forest to terms and conditions **prior** to any OGD surface-disturbing activities (30 U.S.C. 226[o]). These statutory provisions specify how National Forest timber should be handled in the context of private OGD on the ANF. Id.

Pvt OGD retains protections afforded by the 5th Amendment to the U.S. Constitution and rights holders would be compensated if Forest Service actions were determined by the judiciary to be a regulatory taking compensable under the 5th Amendment to the U.S. Constitution. However, it is the purpose and intent of the Forest Service that its actions pursuant to this programmatic Forest Plan will merely reasonably regulate pvt OGD activities as needed to effect and protect the National Forest purposes and the Federal land and resources administered by the Forest Service.

Implementation: The Forest Service will implement its authority through review and evaluation of site specific pvt OGD operational proposals and the subsequent issuance of a formal permitting document to the pvt OGD. It does not follow, though, that the Forest Service has "veto authority" over private oil and gas development through such review and approval processes. Application of programmatic direction is to be focused on reasonable regulation of development to protect surface resources and not to act in a manner that prohibits private oil and gas rights development.

As the Forest Service applies the design criteria selected through the Supplemental EIS Process at the project level it will endeavor to work cooperatively with the pvt OGD to resolve any concerns it has related to the proposed plan of operations, recognizing the right of the pvt OGD to develop its oil and gas. If circumstances warrant, on a case-specific basis, an authorization to the pvt OGD to operate may contain terms and conditions different from the standards set forth by the design criteria. In making such a determination, the Forest Service will consider at the site specific level the operational impacts, particularly impacts upon the achievement of the Revised Plan's direction applicable to the forest area involved, as well as necessary resource protection.

Along with the legal authority to protect surface resources comes the responsibility to comply with applicable federal laws such as the Endangered Species Act, Clean Water Act, Clean Air Act, and National Historic Preservation Act. The Forest Service works with the U.S. Fish & Wildlife Service, Environmental Protection Agency, and State DEP and SHPO to ensure compliance with these legal obligations through its multi-stage Forest planning and site specific decision-making process.

A formal authorization to operate will be issued by the appropriate Forest Service line officer and will contain terms and conditions enforceable against the pvt OGD. When issued, such authorization will address any other foreseeable issues that could require additional Forest Service approval, i.e., use of Forest Service roads; construction/location of new roads on National Forest lands; location of pipelines and utilities; extraction of sand, gravel and common variety materials from National Forest lands; cutting of National Forest timber.

Administrative Process

Forest Service administration of outstanding and reserved mineral rights will be in accordance with deed provisions as well as Commonwealth and Federal law. The PADEP's Bureau of Oil and Gas Management, is the Commonwealth's regulatory agency for private mineral development.

Pvt OGD proposals are subject to National Environmental Policy Act (NEPA) analysis. Standards and guidelines that identify reasonable and necessary access will be identified to minimize or mitigate impacts to surface resources.

The environmental analysis will be initiated by a pvt OGD company supplying:

- Map of the Planned Development – A map will be provided showing locations and dimensions of all facilities. These facilities include well sites, roads, tank batteries, utility and collection lines, storage areas for equipment and supplies, generators, compressors, meters, and other facilities necessary for production or operation.
- Plan of Operation – The Plan of Operation will include a schedule of construction and drilling activities. This schedule will include the beginning and ending dates for timber harvest, road, well site, and other construction, and the drilling, hydrofracturing, and completion of wells. The Plan of Operation will also identify intended use of forest roads, trails, and other facilities.

The S&Gs identified through NEPA analysis will determine elements to be included in the Erosion and Sedimentation Control Plan – A site-specific plan to minimize erosion and prevent sedimentation of streams will be developed by the operator and must be in accordance with the Pennsylvania Department of Environmental Protection (PA-DEP) Oil and Gas Operators Manual. The ANF will collaborate with the pvt OGD operator on the development of the erosion and sedimentation plan.

Surface disturbing OGD activities shall not commence until the ANF has issued authorization to the pvt OGD operator.

After NEPA analysis is complete, and prior to commencing activities, the pvt OGD company will:

- Provide the name, address, and phone number of a designated field representative. The representative will be familiar with all phases of the project.
- Upon request, the pvt OGD operator will provide copies of Commonwealth approved drilling permits before surface disturbing activities occur.

All merchantable timber will be marked by the Forest Service. Timber will be paid for prior to harvest.

The pvt OGD operator or developer will be responsible for the repair or replacement of ANF surface improvements such as fencing, snowmobile and other trails, recreation facilities including parking areas, trailheads, or other facilities impacted by development or operations.

A Notice to Proceed will be issued for:

- Reserved Mineral Estates – 1937, 1947, and 1963 Rules: the entire scope of development of mineral estates reserved under the Secretary of Agriculture's 1937, 1947, and 1963 rules governing reserved mineral estate development;
- Reserved Mineral Estates – 1911 and Future Rules: to the extent necessary to fully comply with all applicable federal laws, federal regulations, and deed restrictions;
- Outstanding Mineral Interests: to the extent necessary to fully comply with all applicable federal laws, federal regulations, and deed restrictions; and

A Special Used Permit will be issued for:

- Appurtenant, Off-Mineral Estate Development: the entire scope of appurtenant development on areas where the developer lacks rights to the severed mineral estate.

Description of ANF Geology

The ANF is located in the Northern Unglaciated Allegheny Plateau Section of the Appalachian Plateau Geomorphic Province. It is a maturely dissected plateau, characterized by sharper ridge-tops and narrower valleys than the glaciated portions of the plateau just to the north and west. Drainage is dendritic. Mass wasting, fluvial erosion, and transport deposition are the primary geomorphic processes. Broad, low amplitude, northeast to southwest trending folds tilt the horizontally bedded sedimentary layers approximately 6 degrees and lend a subtle grain to the topography.

A veneer of unconsolidated materials overlay bedrock: residuum of flat and gently sloping uplands, colluvium at the base of steep hillsides, and alluvium in narrow valley bottoms. Thicker deposits of clay, silt, sand, and gravel are present in wider valleys. Beneath these sediments, the upper Devonian, lower Mississippian, and Pennsylvania bedrock is composed of a mixed siliciclastic sequence of sandstone, siltstone, shale, subordinate conglomerate, occasional limestone, and coal.

The entire ANF has been ranked as a High Potential for the occurrence of oil and gas, as defined by the US Bureau of Land Management. This ranking is determined by the demonstrated presence of a mature source bed, suitable reservoir strata (containing adequate porosity and permeability) and numerous oil and gas fields demonstrating traps into which petroleum has migrated and been held. Pvt OGD has historically occurred in the Venango and Bradford groups, reaching depths between 500 and 5,000 feet. Current estimates indicate that

known oil and gas fields range across the forest and encompass approximately 191,000 acres (Figure C-1) (PA DCNR 2005). 'Shallow' well development occurs in the Upper Devonian Series and does not penetrate the boundary between the Middle and Upper Devonian Series, or the top of the Tully Limestone or its equivalent in Pennsylvania (Figure C-2) (PA- DCNR 2009).

More recently, exploration and development within the Middle Devonian Series has occurred in Pennsylvania. Important source rocks include, the Hamilton, Onondaga, Oriskany and Medina Groups (Figure C-2). Of particular interest is the Marcellus Shale gas play found within the Hamilton Group. The Marcellus shale play spans six states in the northeastern U.S., encompassing an area of 95,000 square miles (Figure C-3) (USDE-NETL 2009). Estimated production depths are between 4,000 ft and 8,500 ft across the six state area. The first economically producing well in Pennsylvania was drilled in 2003, using horizontal drilling and hydraulic fracturing techniques. As of September 2008, a total of 528 wells in the Marcellus shale had been permitted in Pennsylvania, with 277 of the approved wells having been drilled. (USDE-NETL 2009) There have been 57 Marcellus wells drilled within Elk, Forest, Warren and McKean Counties, but none have occurred on the ANF surface. It is unknown how many of these wells are active or in production.

Description of Surface Oil & Gas Development Activity

Oil and gas well exploration and development has occurred within the four county area for approximately 150 years. Shallow well development has occurred across much of the forest, with an estimated 191,000 acres of known existing oil and gas fields. While there are no Marcellus shale wells currently producing on the ANF, it is anticipated that proposals could be received in the foreseeable future. There is one natural gas storage field located on the ANF.

Stages of Oil and Gas Development

There are numerous stages of OGD that typically occur (USDE-NETL 2009; PADCNR 2002).

1. **Road and well site development–**Activity begins with the design and layout of road locations, well pads, and other associated facilities that will allow for safe and efficient development. Environmental concerns are taken into consideration to determine the exact location for development and identify measures to mitigate impacts to surface resources.
2. **Drilling and completion–**A drilling rig is used to drill the well. Drilling fluid or forced air is needed to circulate cuttings to the surface to clear the bore-hole, to lubricate and cool the drilling bit, to stabilize the well bore and thus prevent cave-ins, and to control down hole fluid pressure. Multiple layers of steel pipe (casing) are put into the hole and cemented in place to protect freshwater formations. Drill cuttings produced during drilling are either stored on-site in a pit or removed to another location.
3. **Fracturing–** Fracturing is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing gas and oil to flow more readily toward the well bore. This involves lowering explosive charges into the hole to the precise depth of the deepest reservoir in the well from which production is desired. The shots are detonated creating perforations, or holes, in the casing at the level of the deepest reservoir. These perforations provide openings for sand, water, and possibly acid, which is pumped down the well and through the perforations at high pressures. This process creates fractures in rock deep underground that are "propped" open by the sand, allowing the oil and/or natural gas to flow into the well. The acid and water are then permitted to flow back out of the well, and the sand remains in place to keep the fractures open.
4. **Production–** Before the well is put in production, well heads or well jacks, and hook-ups to separators, pipelines or holding tanks are installed. Oil and natural gas are transported from the well site in two different ways. If the well is producing only natural gas, it flows into pipelines that take it to a processing facility and eventually to an end user (e.g. homes or businesses). If both oil and natural gas are produced, the products are run through a separator. The oil that is produced is piped to holding tanks and eventually transferred to trucks and taken to a refinery.
5. **Salt water and Brine disposal–** Brine water is produced as a by-product. Brine water is piped to holding

tanks, transferred to trucks, and normally taken to a waste water treatment facility. Produced brine may be re-injected into the formation if the operator has an Underground Injection Control permit. The U.S. Environmental Protection Agency has primacy for this program. Operators are not allowed to dispose of brine by surface spraying Forest Service or pvt OGD roads for dust abatement.

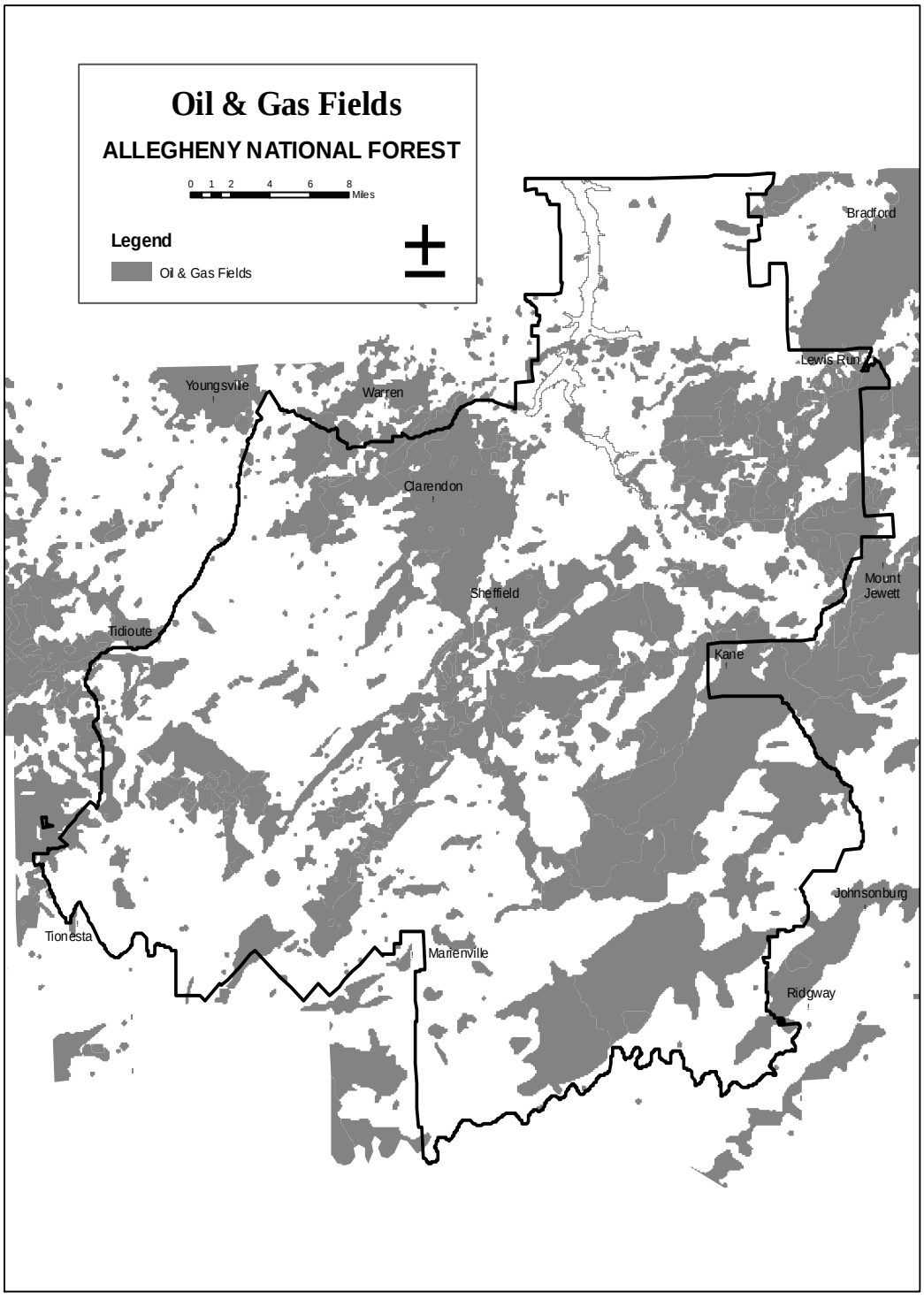
6. **Plugging and Reclamation–**The Pennsylvania Oil and Gas Act of 1984 requires that non-producing wells be plugged. This involves removing all pipes from the well bore, and cleaning it, and filling it with a non-porous material. A cement plug is used to seal off crucial potions of the well, such as coal seams, oil and gas formations and fresh groundwater aquifers. The end result is a "plug" that prevents gas or liquids from entering or flowing in the well bore (PA DEP 2008).

Abanonded Wells and Oil Spills

In 1992, the Oil and Gas Act was amended to allow certain oil or gas wells abandoned before April 1985 to be classified as 'orphan' wells. These wells pose hazards to the environment and to human health and safety. Natural gas or oil can flow from an abandoned well and contaminate water sources. Natural gas can accumulate in nearby buildings, and create hazardous situations. Oil can leak from abandoned wells, causing surface pollution. The PADEP Bureau of Oil and Gas management oversees the Orphan Well Program to locate and plug orphan wells.

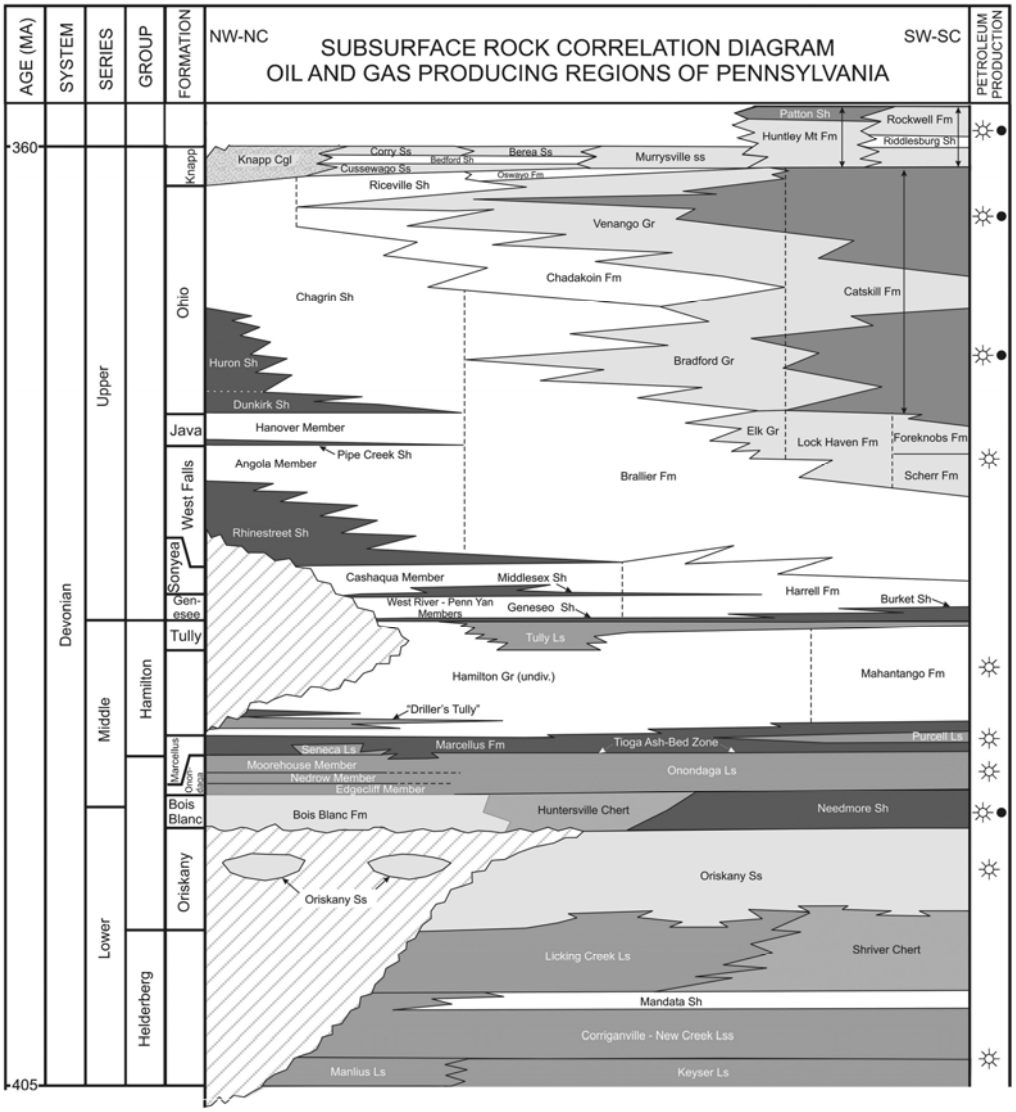
While infrequent, oil spills (where oil leaves the well pad) do occasionally occur. Operators are required to establish a Preparedness, Prevention and Contingency Plan that includes emergency response actions and a list of agencies to be notified (PA Oil and Gas Operator's Manual). In the last 3 years, six reportable spills are known to have occurred on the ANF. One of the more serious spills on the forest occurred in August 2008 as a result of criminal activity. Approximately 17,000 gallons of oil reached streams within the Chappel Fork watershed. Prompt response by the operator, the Pennsylvania Emergency Management Agency (McKean County), Pennsylvania State Police, PADEP, Pennsylvania Fish and Boat Commission, Forest Service, and other agencies resulted in rapid containment.

Figure C-1 Shallow Oil and Gas Fields on the Allegheny National Forest



(Source: PA DCNR Bureau of Topographic and Geologic Survey. Oil and Gas Fields and Pools of Pennsylvania. GIS Shapefile of ANF Region, received November 2005, Pittsburgh, PA)

Figure C-2 Subsurface Rock Correlation Diagram

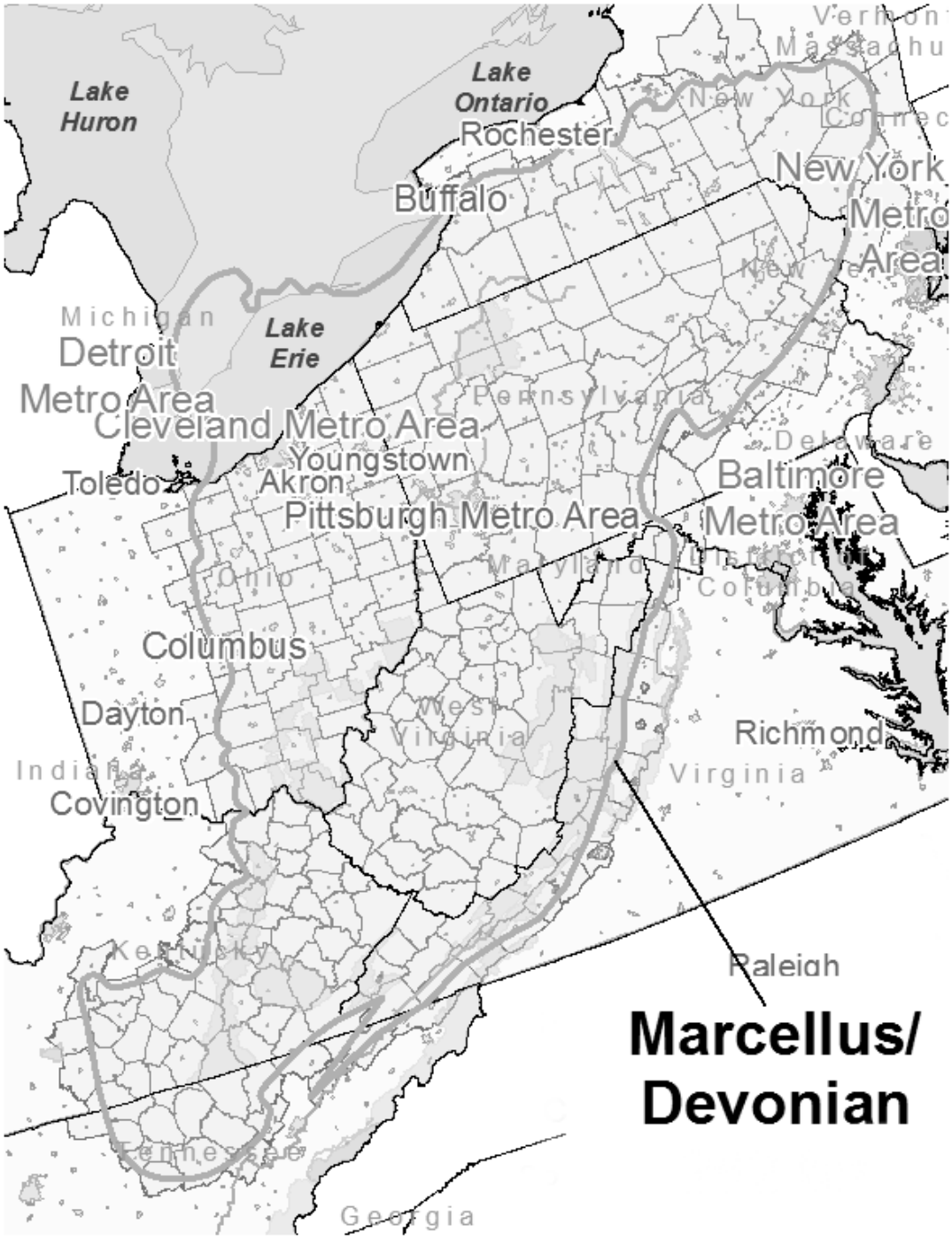


Legend

- Conglomerate
- Sandstone
- Siltstone and shale
- Organic shale
- "Red Beds"
- Coal
- Limestone
- Dolostone
- Coalbed methane
- Natural gas
- Oil
- Show of gas
- Chert
- Evaporite
- Crystalline basement rock
- Unconformity

Source: Pennsylvania Department of Conservation and Natural Resources. Subsurface Rock Correlation Diagram - Devonian System. http://www.dcnr.state.pa.us/topogeo/drc/drcdiagram.aspx

Figure C-3 Marcellus Shale in the Appalachian Basin



Source: USDE-NETL; ALL Consulting,2009

Shallow (Conventional) Oil and Gas Well Development

The formations which contain shallow oil and gas reserves underlying the ANF have low permeability and effective porosity. To maximize production of such formations, close well spacing of approximately 500 feet – 1,000 feet is utilized. This equates to approximately one well drilled per every 5 acres.

An average well pad is 0.3 acres in size, for each new well drilled. Gathering pipelines are generally buried within the width of the road clearing. The lines may feed into a larger distribution line, or may be connected to a tank battery. Tank batteries store oil and brine before it is hauled offsite in tanker trucks.

Deep Gas Well Development

This information is derived from activity in other areas of Pennsylvania, since deep well development has not taken place on the ANF with any success as of yet.

Depending on the type of drilling technique used, well spacing can vary greatly. Use of vertical wells may result in a well pad spacing of one well per 40 acres. The density of horizontal well pad spacing can be more variable and is dependent upon the number of wells located at the same site. Horizontal well drilling may result in well pads spaced every 640 acres. In general, deep wells have a spacing ranging from one well pad every 40 acres to one well pad every 640 acres. This means that in order to completely develop 640 acres (1 square-mile) would require 16 vertical wells each located on a separate well pad. Alternatively, six to eight horizontal wells (potentially more) drilled from only one well pad could access the same reservoir volume (USDE NETL 2009).

Due to the depth of the wells, well pad size varies between 3 to 5 acres in size. This is partially dependent upon whether or not the well(s) being drilled are vertical or horizontal. On average, 3.5 million gallons of water are used for the fracing process (USDE NETL 2009). The water is either trucked or pumped in depending on the proximity to a water source, and stored in either a holding pond (that comprises part of the 3 to 5 acre well pad) or in holding tanks located on the well pad.

Typically, drilling operations take place around the clock. The process of developing deep horizontal wells can take up to a year to complete from the start of road and well pad construction to the production phase. When drilling horizontal deep wells, an operator will typically drill between 6 and 8 wells at one time. Once the drilling phase is complete the fracing phase will begin. Pvt OGD operators will not conduct both drilling and fracing operations at the same time because of the amount and size of the equipment. Therefore, it can take up to a year to put a deep horizontal well into production.

Table C-1 Comparison between Shallow & Deep Wells

	Shallow Wells	Deep Wells (Vertical)	Deep Wells (Horizontal)
Well Pad Size	0.3 acres[1]	3 acres[2]	3–5 acres[3]
Road width	35 feet[1]	50 feet[1]	50 feet[1]
Well Pads Per Acre	1:5[1]	1:40[2]	1:640[2]
Duration of Drilling	2–3 days[3]	4–5 days[3]	3 weeks[3]
Duration of Fracing	1 day[3]	1–2 days[3]	3 days[3]
Staging Time	1 day[3]	2–3 days[3]	6–15 days[3]
Water Used for Fracing	30,000–50,000 gallons[3]	1 million gallons[3]	3–5 million gallons[3]
Water Needing to be Treated	minimal[3]	300,000–400,000 gallons[3 & 4]	900,000–2,000,000 gallons[3 & 4]
Number of Wells per Well Pad	1	1	6-8[3]
Cost per Well	$100,000–$110,000[3]	$750,000–$1,000,000[3]	$3,000,000–$6,000,000[3]

[1] ANF Assumptions
[2] Based on USDE-NETL 2009.
[3] (Kuzma Personal Communication 2009).
[4] Dependent on whether or not an on-site treatment facility is used.

Natural Gas Storage Fields

Another kind of pvt OGD occurring within the boundary of the ANF is the development of a natural gas storage field (NGSF). NGSFs consist of porous and permeable underground formations that are confined by impermeable rock barriers. Most NGSFs found in the United States are depleted oil and/or gas fields (EIA 2009). These fields are naturally occurring, and their potential as secure containers has been proven over millions of years as reservoirs held their original deposits of oil and gas (FERC 2009). Even though natural gas is used year round, its peak use is during the winter months. As a result, stored natural gas plays a vital role in ensuring that any excess supply delivered during the summer months is available to meet the increased demand in winter months (NaturalGas.org, 2009). Using previously developed oil and/or gas fields that are now depleted; existing infrastructure such as pipelines, roads, and wells can be

utilized.

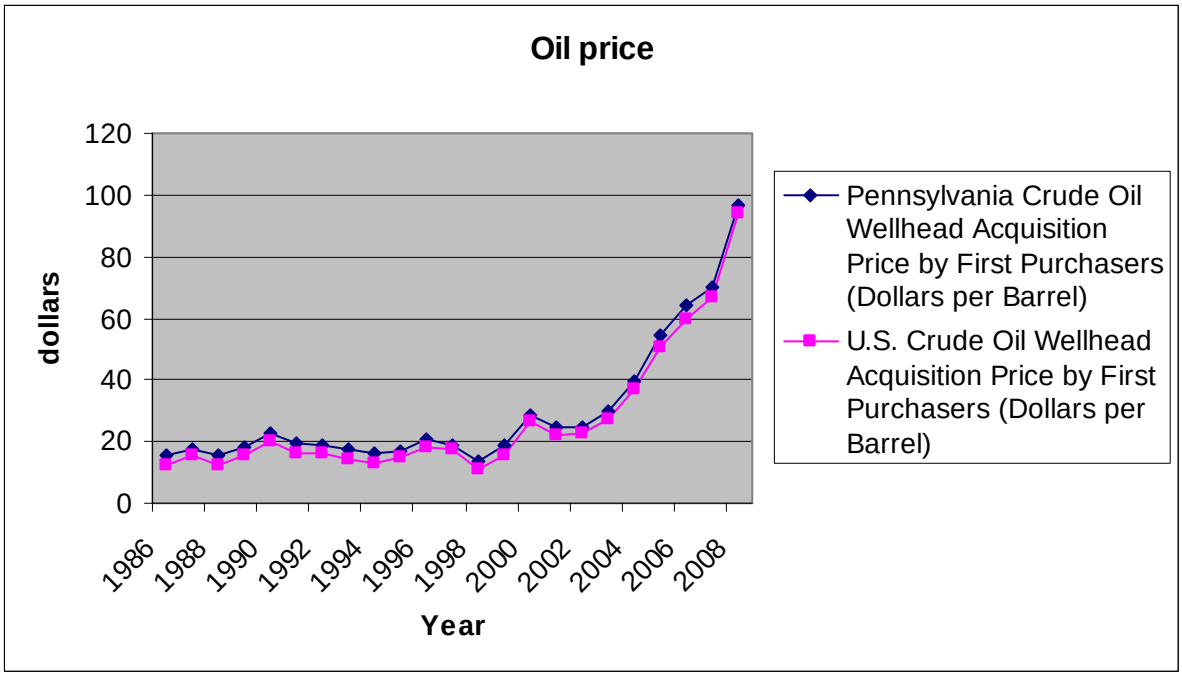
Currently there is one NGSF located on the ANF. The injection wells associated with this field are considered in the number of existing operating wells on the ANF. Because the NGSF on the ANF serves interstate commerce, it is also subject to the jurisdiction of the Federal Energy Regulatory Commission (FERC) (EIA 2009).

Unlike shallow oil and gas wells that on average have a life span of about 30 years, storage fields may have a life span that is substantially longer. This would result in long-term use and maintenance needs in areas that are used as NGSFs.

Levels of Oil and Gas Development Activity

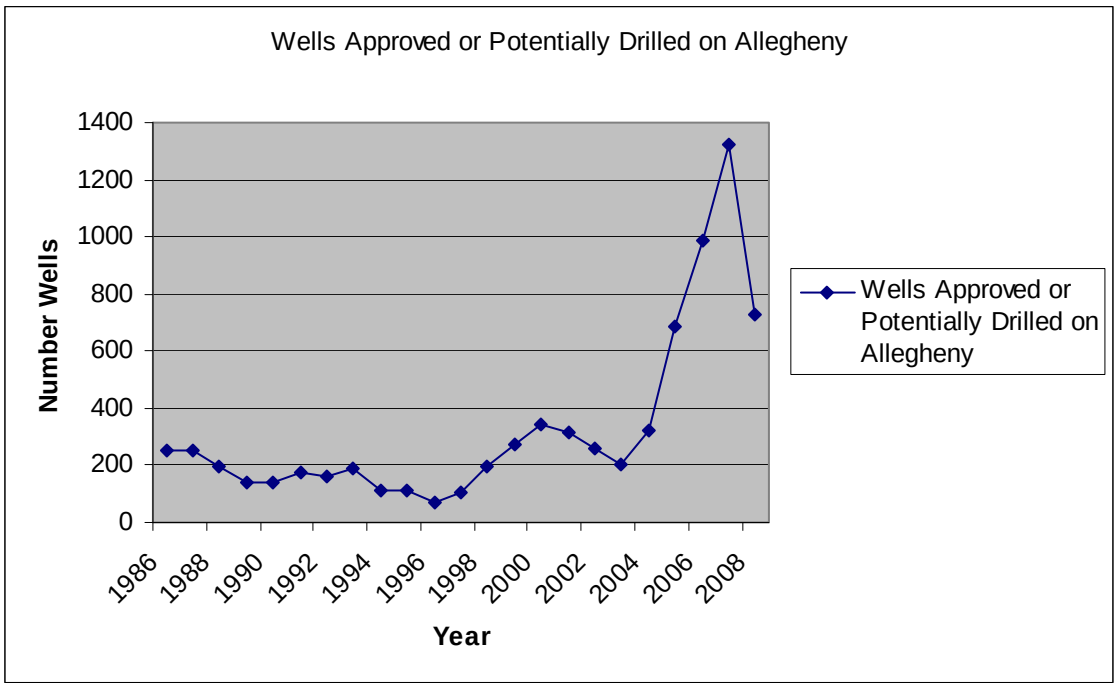
Pvt OGD activity tends to be cyclic over time and can vary greatly from one year to the next. It is driven by the price of oil and natural gas on the local and regional markets. When oil and gas prices are high, the level of development can be constrained by the availability of drilling rigs, service equipment and personnel.

Figure C-4 – U.S. and Pennsylvania Crude Oil Price (1986 – 2008)



(Source - http://tonto.eia.doe.gov/dnav/pet/hist/f000000__3a.htm, http://tonto.eia.doe.gov/dnav/pet/hist/f001242__3a.htm)

Figure C-5 – Number of wells approved/potentially drilled on the ANF, 1986 - 2008



(Source – from Table C-2, and ANF OGD Program Records)

Estimates of the number of existing, active wells are speculative at best. Numbers of wells are based upon the number of locations approved for development. In most cases, when approval is granted, wells are subsequently drilled. However, there are rare incidents when the well is never drilled. In these cases, the land may or may not be cleared, however site construction would not likely occur.

The analysis of pvt OGD activity completed for the FEIS was based upon levels of activity that occurred prior to 2006 and potential impacts that could occur during the planning period from 2006–2020. This update considers the same time frames and is based upon the same assumptions used in the FEIS.

Private OGD Activity (1986 – 2005)

Pvt OGD activity levels for the period from 1986 through 2005 show that 4,493 wells were approved, with increasing numbers of wells approved from 2000 through 2005 (Table C-2). The number of wells approved ranged from a low of 68 wells in 1996 to a high of 688 wells in 2005. An average of 225 wells per year was approved for this 20 year time span. The estimate for the total number of active wells on the ANF at the end of 2005 was estimated to be 8,000. Figure C-6 displays the approximate location of wells approved since 1986 on ANF ownership.

Table C-2 Wells Approved and Potentially Drilled 1986–2005

Fiscal Year	Wells Approved and Potentially Drilled	Fiscal Year	Wells Approved and Potentially Drilled	Fiscal Year	Wells Approved and Potentially Drilled
1986	250	1993	188	2000	345
1987	250	1994	112	2001	315
1988	196	1995	109	2002	259
1989	139	1996	68	2003	202
1990	139	1997	102	2004	321
1991	176	1998	199	2005	688
1992	160	1999	275		
20 Year Total			**4,493**		
20 Year Annual Average			**225**		

Estimates for the amount of land use change that occurred as a result of this development can be made, assuming that 1.3 acres of land are converted from forested to non-forested land (including land area needed for well pads, roads, tank batteries, etc) and .25 miles of road per well are constructed (Table C-3).

Table C-3 Wells Developed and Land Use Change from 1986 through 2005

Wells Developed 1986–2005		Average Annual Activity 1986–2005	
Total # wells	4,493	Average # wells/year	225
Estimated land use change	5,840ac	Average acres of land use change	293 ac
Estimated road miles	1,123 mi	Average miles of road constructed/year	56 mi

Future Activity Potential

Estimates for future OGD will be made here with consideration of the following elements:

- Average annual rate of development
- Potential for future activity

Average Annual Rate of Development

Appendix F of the Forest Plan FEIS considered three development scenarios for future pvt OGD. One was based on the historic level of development (based on the years 1986–2005), one was based on a high quarter scenario of 800 wells per year, and a third was based on the average of the other two (Table C-4).

Table C-4 Estimated Number of Wells, Miles of Roads, and Acres of Clearing Through 2020

Scenario	Measure						
	Existing Wells	Additional Wells (2020)	**Total Wells**	Existing pvt OGD Roads (mi)	Additional pvt OGD Roads (mi) (2020)	**Total Roads (mi)**	Additional Acres of Land Use Change (2020)
Historic Trend 1986–2005 (225 wells/year)	8,000	3,375	**11,375**	1,250	850	**2,100**	4,600
High Quarter (800 wells/year)	8,000	12,000	**20,000**	1,250	3,000	**4,250**	15,600
Average Future Projection (Average of High Quarter and Historic Trend: 512 wells/year)	8,000	7,680	**15,680**	1,250	1,920	**3,120**	9,980

Estimates of additional road construction and land conversion can be calculated, assuming that 1.3 acres of land are converted from forested to non-forest land (including land area needed for well pads, roads, tank batteries, etc.) including .25 miles of road per well are constructed.

The average future projection scenario of 512 wells per year and estimates of land conversion and road construction were used in resource analyses in the FEIS for cumulative affects analyses. This level of potential future development will also be used in the supplemental environmental impact statement (SEIS).

Since 2005, level of development has remained high; 985 wells were approved in 2006, while 1,323 were approved in 2007 and 730 approved in 2008. The annual amount for each of these years exceeds the average annual amount included in the future projection. Given the cyclic nature of patterns of development, annual production levels will be closely monitored and evaluated at 5 year intervals.

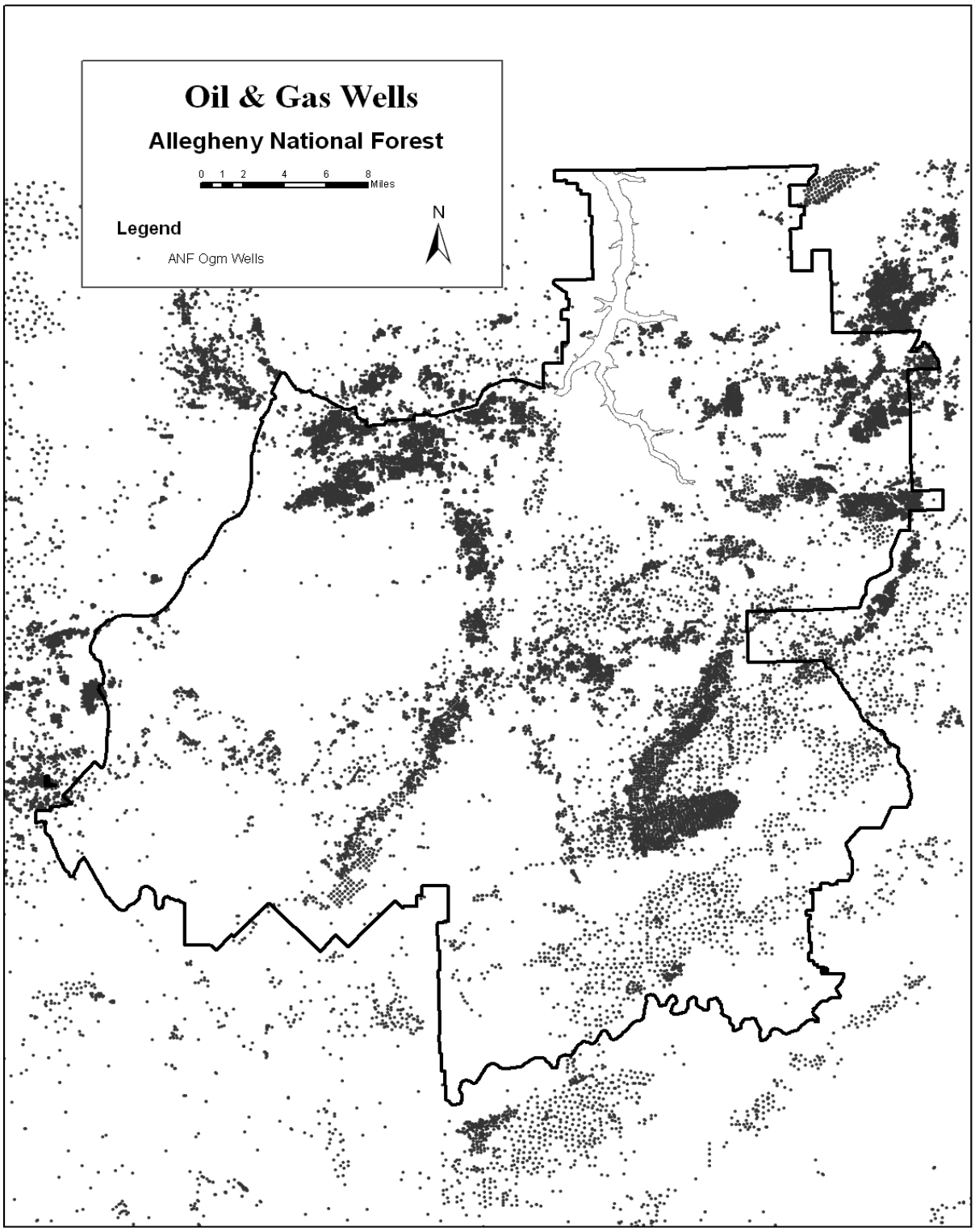
Potential for Future Activity

Future development potential is constrained by two factors – the extent of the shallow oil and gas reserves on the ANF, and the development pattern (spacing) that occurs.

Extent of the Shallow Oil Field

Current size estimates of 191,000 acres for the shallow oil and gas field on the subsurface of the ANF are based on a GIS calculation of areas outlined in Figure C-1 (PA DCNR 2005). Recent activity outside the areas that historically have been developed suggests that additional reserves exist. Some development has already occurred outside the areas outlined in Figure C-1. Additionally, proposals have been received for areas outside those areas. Advances in technology, higher prices for products (that make development of areas that were once considered to be more marginal), and higher demand have made development of areas once considered to be marginal likely. An estimate for additional development potential has been made by assuming expansion of the existing mapped areas could occur, and inclusions within the existing field could be developed, thus increasing the area 50,000 acres for a total of 241,000 acres.

Figure C-2 Oil and Gas Wells Drilled on the Forest Since 1986



Saturation Point Analysis

Well spacing is determined by the pvt OGD operator's petroleum engineer or geologist. Spacing is based upon a number of factors, including depth to producing layers, number of producing layers, estimated production, and costs associated with development of wells, roads and other infrastructure. Well spacing varies from one development area to another.

Three areas were evaluated for well spacing in the FEIS Appendix F. The first area is located in the Salmon Creek drainage. Well spacing is approximately 1000 feet between wells. The second area evaluated is in Sackett. This area, developed in the 1980s has a well spacing of approximately 800 feet between wells. The third area is along FR 456 near Red Bridge. This new development has a spacing of approximately 660 feet between wells. Recent development proposals have included areas where new wells are being drilled in between wells drilled in the past – resulting in approximately 500 foot spacing between wells. Table C-4 displays differences in impacts (miles of road constructed and acres of land use change from forested to non-forested condition) and considers two different scenarios – the 191,000 acres that historically have been drilled versus the 241,000 acres where development may potentially occur.

In Table C-5, the number of wells was calculated by estimating the number of acres per well for the given spacing. As an example, for a 1,000 foot well spacing, an area 1,000 feet by 1,000 feet, or 23 acres, has one well. Therefore, 191,000 acres divided by 23 yields approximately 9,000 wells.

The total miles of roads was calculated by multiplying the amount of road miles per well for a given spacing scenario times the total number of wells. Acres were calculated based on 1.3 acres impacted per well including 0.25 miles of road construction.

Table C-5 Long-term Potential for Saturation Level Development

Well Spacing		191,000 Acre Oil Field			241,000 Acre Oil Field		
		wells	road (mi)	acres	wells	road (mi)	acres
500 Feet	1 well / 5 ac	38,200	7,950	41,340	48,200	10,025	52,100
660 Feet	1 well / 10 ac	19,000	2,400	16,000	24,000	3,000	20,000
800 Feet	1 well / 15 ac	13,000	2,000	12,000	16,000	2,500	15,000
1,000 Feet	1 well / 23 ac	9,000	1,600	9,000	11,000	2,000	12,000

The two scenarios indicate a range of different saturation levels based on the four different well spacing assumptions. The analysis suggests the range of likely saturation is between 9,000 and 41,340 active wells. A comparison between the estimated number of wells in Table C-4 and the potential number of wells identified for Table C-5 suggests that if development occurs at 512 wells per year, a total of 15,680 wells could be present at the end of the plan period. Depending on where the saturation point is relative to the two scenarios described, this projected development for the plan period would represent saturation for two of the four spacing assumptions in the first scenario and saturation for two of the four spacing assumptions in the second scenario.

For purposes of long-term effects analysis, saturation is estimated to be 20,000 wells. Using the second scenario where increase in size of the oil field is assumed, the average distance between wells being somewhere between 660 feet and 800 feet. This considers the likelihood of some additional development occurring within existing fields as well as the likelihood for some expansion in new areas. The likely prospect is that old wells will be plugged and intensive new drilling will occur in historic oil fields with improved technologies, keeping the ultimate number of active wells within one of these saturation points.

Potential for Future Activity – Deep wells

Appendix F of the Forest Plan FEIS did not consider the potential for the development of deep wells on the ANF. As of June 2009, there are no active deep wells on the ANF. In 2007, one deep well was drilled. Development occurred in an active/depleted gravel pit using existing access roads. Minimal expansion of infrastructure (roads, storage areas, etc) was needed for drilling to occur. The well was not put into production.

The first economically producing deep well in Pennsylvania was drilled in 2003, using horizontal drilling and hydraulic fracturing techniques. As of September 2008, a total of 528 wells in the Marcellus shale had been permitted in Pennsylvania, with 277 of the approved wells having been drilled (USDE-NETL 2009).

As of June 2009, there have been 57 Marcellus wells drilled within Elk, Forest, Warren and McKean Counties (Kuzma personal communication). It is unknown how many of these wells are active or are in production. Twenty-two of these occurred within townships that are entirely or partially within the proclamation boundary of the ANF. Over a six-year time span, less than ten wells per year have been drilled within the four county area. ANF acreage comprises less than one-third of the four county area, therefore for purposes of this analysis it will be assumed approximately 3 deep wells/year could be developed on the ANF within the reasonably foreseeable future.

Average disturbance associated with the construction of the development site is between 3 – 5 acres (depending on whether it is a vertical well or a horizontal well, Table C-1). Assuming an average of 4 acres per development site, a total of 12 acres of disturbance potentially could occur per year. Additional disturbance needed for access roads and other infrastructure is difficult to estimate as many variables related to the specific location where development occurs would need to be considered. If development occurred adjacent to an existing Forest System road or pvt OGD road, minimal additional clearing would occur. If development occurred in an area where few roads exist, considerably more clearing would occur. Similarly, the need for pipelines would be determined by proximity to existing facilities.

On sites where multiple horizontal wells are developed, disturbance could occur over a span of years and would be dependant upon a particular developer's business plan for the timing and duration of impacts. Given the cost of development of deep wells, the price of natural gas on local and regional markets is likely to be even more of a factor than in shallow well developments, thus predicting a 'typical' development scenario would be difficult to do.

Cumulative Effects Estimates within ANF, Proclamation Boundary, and 4 County Region

Cumulative effects estimates will be based on the potential for additional development to occur on private land with in the proclamation boundary and on land within the four-county area that comprises the ANF. Deep well development will be considered a reasonably foreseeable future action and is incorporated in this analysis. Given the limited amount of development to date in deep wells within the four-county area, and given the uncertainty for when deep well development might occur, no additional estimates for road miles or clearing will be made. If development does occur, and if road miles or acreage estimates are exceeded, additional analysis could occur.

Table C-6 Cumulative Oil and Gas Development by 2020

Scenario	Measure						
	Existing Wells	Additional Wells	**Total Wells**	Existing pvt OGD Roads (mi)	Additional pvt OGD Roads (mi)	**Total Roads (mi)**	Additional Acres of Clearing
Average Future Projection (512 wells/year) on ANF (506,000 ac)	8,000	7,680	**15,680**	1,250	1,920	**3,120**	9,980
Average Future Projection (512 wells/year) within Proclamation Boundary (740,000 ac)	11,700	11,200	**22,900**	1,825	2,800	**4,625**	14,560
Average Future Projection (512 wells/year) within 4 County Region (1,743,500 ac)	27,565	26,410	**53,975**	4,300	6,600	**7,750**	34,330

*Assumption is made that existing and projected pvt OGD on other lands is evenly proportionate to that on ANF lands. This is based on the roughly proportionate level of known oil fields displayed in Figure C-1.

Factors used to calculate estimates on all lands from existing data on NFS lands:

- Existing wells equals 1 well per 63.25 acres
- Existing pvt OGD roads equals 0.156 miles of road per well
- Additional wells equals 1.01 per 1,000 acres annually for 15 years
- Additional pvt OGD roads equals 0.25 miles of road per well
- Additional acres of clearing equals 1.3 acres per well
- Total wells equals existing plus additional
- Total roads equals existing plus additional
- Plugging of abandoned wells would not reduce projected future active wells

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