

Mineral Resources

Introduction

Forest Plan direction identifies goals and objectives for the management of mineral resources on the Monongahela National Forest (MNF):

- *Goal MG01 - Make minerals available for exploration, development and production consistent with other appropriate uses and protection of the environment. Emphasize energy-producing minerals. Facilitate orderly and environmentally sound exploration, development, and production of mineral resources through standardized inspection, monitoring, and reporting requirements.*
- *Goal MG02 - Emphasize appropriate mitigation and reclamation of environmental disturbance for all mineral exploration and development proposals. Reduce environmental effects from past mineral-related activity. Restore disturbed land to a productive condition.*
- *Goal MG03 - Provide for reasonable access to and use of NFS land surface for mineral activities. Allow for and support reasonable use of NFS land for the exercise of reserved and outstanding mineral rights consistent with deed terms and law.*
- *Goal MG04 - Integrate mineral and geology project planning and implementation in a manner that is consistent with other resource management direction. Include collection and analysis of the appropriate geologic information as a part of Forest project planning and decision-making.*
- *Objective MG05 - Inventory abandoned mines and prepare restoration plans to address biological and physical resource concerns, chemical stability, and human health and safety.*
- *Objective MG06 - Keep 70 to 80 percent of federally owned oil and gas available for exploration, development and production.*

We track progress toward the achievement of Forest Plan goals and objectives by monitoring. For example, the Forest Plan (Chapter IV) contains direction for monitoring minerals to determine whether mineral exploration, development, and production mitigation measures are being followed and are effective in reducing impacts. The Forest may not be the entity that issues all permits for mineral development on NFS land, but we do have the responsibility to help ensure that the development activities do not result in unacceptable adverse effects to the land and other Forest resources. We accomplish this through a combination of identifying appropriate lease conditions, operating plan review and approval, and on-site inspections. With on-going mineral activity on the Forest, annual monitoring and evaluation for these effects allows the Forest to make adjustments more quickly to reduce unacceptable effects if present. Through the three monitoring questions answered herein, this monitoring report tracks progress toward achieving goals MG01, MG02, MG03, MG04 and objective MG06.

2010 Program Accomplishments

The Minerals Program accomplishments for Fiscal Year (FY) 2010 included:

- Budget and work planning, including out-year planning.
- In response to industry requests to lease approximately 11,000 acres of federally owned oil and natural gas, we completed the process of recommending consent to leasing with identification of the stipulations and conditions needed to ensure oil and gas leasing is consistent with the Forest Plan.
- Providing input, analysis, and review for various Forest projects.
- Inspecting 31 active mineral operations.
- Monitoring and evaluation efforts as described below.

Monitoring and Evaluation

The 2006 Forest Plan currently has three monitoring questions for Mineral Resources: questions 20, 21, and 22. Monitoring and evaluation efforts in FY 2010 for these questions are described below.

Monitoring Question 20. Are mineral exploration, development and production mitigation measures being followed and are they effective in reducing impacts?

Forest-wide General Monitoring

Forest Plan minerals monitoring included conducting inspection and field-checks of 31 active mineral operations to determine whether Forest Plan standards and mitigating measures identified in mineral operations decisions have been applied, and to look for resource conditions of concern associated with the mineral operations. There were 71 active mineral operations on MNF National Forest System (NFS) lands in FY 2010. Based on funding and direction, the Forest mineral staff inspected 44 percent of the active mineral operations in FY 2010 to a standard that ensures compliance with the approved operating plans (see Inspection Reports within each mineral operation on file with the Forest Geologist in the Forest Supervisor's Office). In FY 2010, one natural gas well was plugged (October 2009) due to a drop in gas production from it. The mineral operations monitored were associated with natural gas exploration, development and production, as well as, natural gas storage operations and maintenance. The active mineral operations chosen for inspection included all sites in which there were mineral operations involving earth disturbance, as well as, a sample of sites on which routine operation and maintenance of the facility occurred.

Monitoring Question 20. Evaluation, Conclusions, and Recommendations

Forest staff inspections of active mineral operations found most operations in compliance with respective operating plans. Operations that were out of compliance were so in ways that did not create substantial adverse environmental effects. For example, natural gas equipment/facilities

on a couple sites were showing rust and needed to be painted. Some operations inspected in FY 2009 that had similar kinds of maintenance needs showed improvement by the 2010 inspection period, and other sites developed undesirable conditions, such as tall grass around the wellhead. Operators are allowed to cut grass around the well pad after the July 15th ground-nesting bird protection period.

One of three wells in one gas field showed a newly installed gate and new signs. This was an improvement from the previous year but some of the facilities could have benefited from painting as identified in 2009. Another well site in a natural gas storage field inspected in June 2010 showed high grass around the wellhead and valves and, when later checked in August, the pad had been mowed.

Invasive plant presence has been monitored to a limited extent on gas well sites. Of the 31 well sites examined, thistles were found on 1 site, compared to 2 sites from last year. These figures are more of a representative sample of the numbers of wells inspected rather than a reduction in thistle. Several sites re-inspected in 2010 that had identified weeds in 2009 did not show weeds but the seasonal timing of the inspection and recent mowing may have been factors in the absence of weeds.

Inspection reports note that invasive thistle continues to grow, although not abundant on any of the sites. The Forest has told the operators to remove the thistle by cutting it prior to flowering and seeding. Such seeds once dropped, can remain in the ground for five years before sprouting. Manual thistle removal appears to be keeping the thistle from becoming abundant on the affected well sites, but it is not eliminating the thistle. Because thistle needs well-lighted conditions to thrive, it is not likely that the thistle will spread very far into the adjacent woods from the affected well sites.

Recommendations: Continue monitoring active mineral operations for compliance with approved operating plans. In particular, continue to identify site maintenance needs and invasive species presence at gas well sites and associated roads and pipelines, so that appropriate actions may be taken to ensure compliance with operating plans and thwart the proliferation and spread of invasive species at natural gas facility sites.

Follow-up Detailed Monitoring at Berry Energy B-800 Site

The Berry Energy, Inc. Gas Well B-800, was drilled in FY 2008, and we reported the results of some detailed monitoring in the 2008 and 2009 annual monitoring reports. In this 2010 monitoring report, we provide additional information on a monitoring item from FY 2009 that was deferred until FY 2010.

Detailed Monitoring Question

Were there other effects of concern that occurred as a result of the B-800 gas well project?

Our monitoring examined the effects of land application of drill pit fluids. The approved plan allowed for land application of drilling fluids according to the terms of the General Water

Pollution Control Permit GP-WV-1-88 at a location where they could not seep into the area's karst. This General Water Pollution Control permit authorizes land application as long as the fluids that are land applied meet the permit conditions.

Evaluation and Conclusions

The drilling pit liquids were treated to prepare for land application, and land application of approximately 80,000 gallons of drill pit fluids occurred in the designated area about 750 feet northwest of the drill site over the period of June 12 to June 21, 2008.

The area identified for land application was located where fluids could not seep into karst, and in gently sloping terrain to avoid risk of eroding overland flows. The size of the land application area was to be as small as possible to limit the potential for interfering with active Fernow silvicultural and prescribed fire research studies.

Impacts to vegetation occurred within the land application area even though the land application complied with the permit terms. Monitoring focused on the estimated 0.5-acre land application site used June 12-21 (USDA FS 2009 pp 46-49). This report provides a summary of monitoring findings through the end of FY 2010 (September 30, 2010).

The Fernow Experimental Forest staff continued to monitor vegetation and soil at the land application site and in a control area that was unaffected by land application.

Land Application Area Vegetation Monitoring Results

The results of the Fernow Experimental Forest staff's vegetation monitoring in the 0.5-acre land application area indicated that in July 2008, shortly after the land application occurred, 115 trees ranging in size from 1 to 27 inches in diameter (at breast height) showed symptoms of damage, including leaf browning, leaf drop, or twig dieback. In May 2009, 147 trees, or an additional 32 trees over the 2008 number of trees showed symptoms of damage. About half of the 147 trees had no live foliage, and were considered dead. Some sprouting of tree seedlings and ground vegetation was observed, as well as areas of dead ground vegetation, within the land application area in May 2009 (USDA FS 2011). Vegetation monitoring in the summer of 2010 documented an additional six trees of the 147 ranging in size from about 1 to 10 inches in diameter as dead (Adams, In Press). In 2010, understory herbaceous vegetation re-growth was evident. The photographs below taken in August 2008 and June 2010 provide a visual comparison of the forest floor vegetation in the land application area (Figures MR-1 and MR-2).



Figure MR-1. Land Application area in August 2008, within two months of applying drill pit fluids



Figure MR-2. Land Application area in June 2010, about two years after applying drill pit fluids

Land Application Area Soil Analyses Results

Soil samples (collected from the top 10 cm, or slightly shallower than 4 inches) collected in July 2008, October 2008, May 2009, October 2009, and July 2010 were analyzed for a variety of elements¹ (data is located in the Forest geologist's file). Several elements were found at higher or slightly higher concentrations in the control area than in the land application area:

¹ Soil analytes discussed herein collected by Fernow Experimental Forest scientist Mary Beth Adams (unpublished data) include chloride, iron, manganese, calcium, potassium, magnesium, phosphorous, aluminum, sodium, zinc, and lead. Target analyte metals analysis was completed on the May 2009 soil sample, and included silver, arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, mercury, nickel, antimony, selenium, strontium, thallium and vanadium.

exchangeable manganese and aluminum; total lead, arsenic, barium, cadmium, copper, mercury, selenium and vanadium. Chromium was slightly higher, but not substantially so, in the land application area compared to the control area. Several elements showed concentrations below the minimum detectable limits for the analyses methods. These were silver, beryllium, cobalt, antimony, and thallium. The results for all of these elements indicate that no State soil limits set by regulation were exceeded in the land application area.

Exchangeable iron and zinc were higher in the control area than the land application area in four of the five samples, and slightly lower in the control area than the land application area in the October 2008 sample. Exchangeable phosphorus was higher in the control area than the land application area in three of the five samples, and slightly lower in the control area in the October 2008 and Summer 2010 samples. Exchangeable calcium, potassium and magnesium were somewhat elevated in the land application area compared to the control area; however the concentrations of these common soil nutrients were within the expected ranges of soils on forested land in the MNF (soils data on file with the Forest Soil Scientist, Stephanie J. Connolly). Variability in concentrations of these elements in the land application and control areas may be due to soil sampling method and the natural variability in the soil profile.

Chloride, sodium, and strontium were elevated in the land application area compared to the control area.

Soil samples were analyzed one time for the element strontium. Although substantially higher in the land application area (87.7 mg/kg) compared to the control area (9.19 mg/kg), strontium is plentiful in the geosphere in concentrations as high as 400 mg/kg. Whole body content of strontium in humans (most of which is found in bones) has been documented to be 5 mg/kg in an average American adult, and people take in about 2 mg of strontium each day (<http://www.frankmckinnon.com/strontium.htm>). There is no regulatory standard set for strontium in soil. Chloride and sodium concentrations in the land application and control areas are depicted in Figure MR-3.

Both chloride and sodium concentrations in soil at the land application site have declined, and currently appear to be approaching pre-land application concentrations. Of the various elements tested in the soil and the findings described above, chloride and sodium concentrations in the soil appear to provide a reasonable way to continue tracking soil chemistry trends within the land application site. The sodium and chloride concentrations documented in the treated area, in contrast to the concentrations found in the control area, suggest that either or both of these elements are likely the source of the observed impacts to vegetation.

The drop in the number of new trees dying, the return of growth in understory herbaceous vegetation, and the soil sodium and chloride concentrations at levels approaching those of the control area, suggest the land application site may be starting to recover.

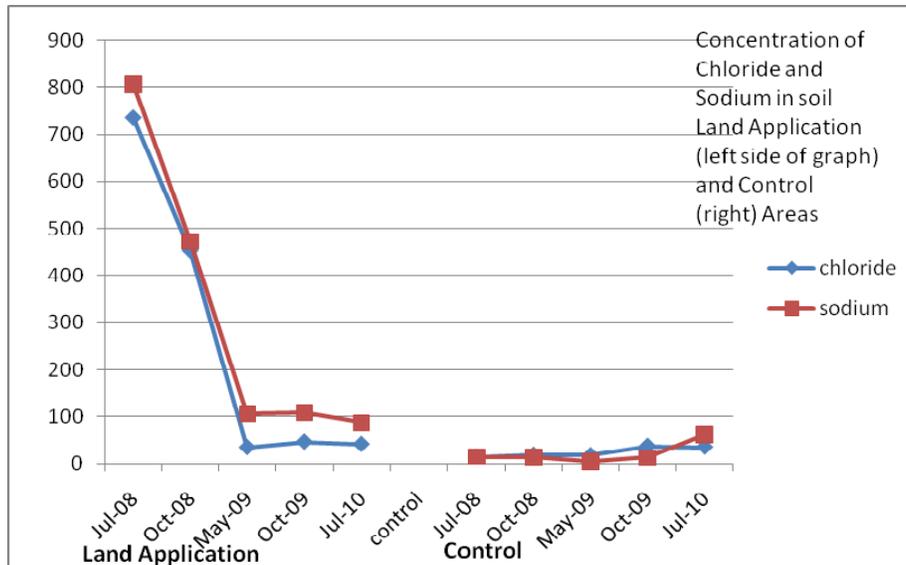


Figure MR-3. Chloride and sodium concentration in soil at the land application site for Berry Energy B-800 gas well drill pit fluids and control (unaffected by land application) site.

Another piece of information collected during land application monitoring may have a bearing on the vegetation impacts observed. Although chloride concentration in the land applied drill pit fluids met the General Water Pollution Control Permit GP-WV-1-88 requirements, a Forest Service-collected sample of the drilling fluids being discharged documented a one-time high chloride concentration of 14,250 mg/l (USDA FS 2009 p. 46). This spike in chloride concentration could indicate that pit fluids were chemically non-homogeneous, and, as a result, fluids with higher concentrations of chlorides may have been applied to certain areas within the land application area. Although the opportunity to test such a theory on this land application instance had passed, Fernow and MNF staff completed a limited test of the hypothesis regarding chemical non-homogeneity of fluids that have flowed back to the surface from hydraulic fracturing. Although in an 18-foot tall upright tank rather than a drill pit, flowback fluids had chlorides concentrations that increased substantially with depth in the tank, supporting the hypothesis of chemical non-homogeneity (Edwards et al., In press). Because the study was done on one tank only, conclusions applicable to drilling fluids contained in pits cannot be made. However, recognizing the possibility of spatial variation in drill pit fluid chemistry provides the Forest Service with information useful to evaluating future proposals for land application of drill pit fluids on NFS land. This knowledge will also guide operators who plan to drill on NFS land to take actions to collect pre-discharge drill pit samples that are representative of thoroughly mixed drill pit fluid composition, and to ensure drill pit fluids are appropriately mixed at the time of discharge onto the land application site.

Through monitoring the land application, we gathered information about what happened and why it happened in order to help to avoid similar impacts to vegetation from land application of drill pit fluids on NFS land in the future. Based on the findings, it appears that the land application area received doses of sodium and chloride from the pit fluids that were too high for the vegetation to absorb them without being damaged. Because the land application site was confined to a small area to avoid impacting nearby on-going research, repeated hose applications

occurred within the confines of the 0.5-acre area. This resulted in some areas receiving drill pit fluid several times over the 10-day land application time period. Each application that delivered fluid containing sodium and chloride added to what had already been applied, resulting in higher concentrations of sodium and chloride accumulating in the soil and soil water, which was then taken up by plants in the height of the growing season. We also note that the concentration of chloride in the drill pit fluid at the discharge hose outlet varied, which may also have resulted in higher concentrations of drill pit fluid chemical constituents delivered to some spots within the land application area.

Recommendations: As long as soil chemistry data is collected, continue to track the land application and control areas' soil chemistry, and report findings in the FY 2011 monitoring report. Incorporate vegetation data collected by the Fernow Experimental Forest staff within the land application and control areas into monitoring reporting, as it becomes available.

Continue to incorporate new knowledge pertinent to land application of drill pit fluids into Forest Service processes for reviewing and evaluating gas well drilling proposals involving land application of drill pit fluids.

Apply the knowledge that repeated fluid application to an area over a short time period and/or during the growing season for plants, depending on the concentrations of chemical constituents in the fluid, may damage vegetation. In practice, operators would need to demonstrate that the pit is thoroughly mixed prior to predischage sampling and immediately prior to land application, and avoid discharging drill pit fluids onto the same ground more than once during land application.

Monitoring Question 21. How close are projected estimates of National Forest System land that could be impacted by natural gas development to actual amounts?

Periodically comparing our predictions on the amount of NFS land impacted by mineral activity to actual amounts provides a way to check whether mineral activity could be producing effects outside of anticipated ranges. Such monitoring also provides additional information on progress toward achieving Goals MG01, MG02 and MG04, which address mineral operations being conducted consistent with other uses and protection of the environment in ways that appropriately mitigate and reclaim mineral-related environmental disturbance, and in a manner that is consistent with other resource management direction.

Leasing the federally owned oil and gas estate is a Forest Plan implementation activity that could result in a proposal by the lessee to develop the natural gas within the leasehold area (USDA FS 2006b, pp. 42-43). Recently, a number of groups and individuals—who objected to the latest federal gas lease offerings on the Forest, or who attended a MNF-sponsored seminar on federal gas leasing and operations in March 2010—voiced concerns that exploration and development of the Marcellus shale, a relatively new Appalachian region natural gas exploration and development effort, will result in unacceptable effects to MNF resources, and these effects have not been analyzed or disclosed. These groups and individuals were concerned that the reasonably foreseeable natural gas development scenario prepared for Forest Plan revision no

longer represents potential gas development, and thus the scenario no longer provides a reasonable basis for effects.

We have heard concerns that Marcellus shale gas exploration and development will result in greater effects to National Forest resources than analyzed and disclosed in previous Forest Plan environmental documents because of what these people have seen and heard about Marcellus shale developments. In particular, some concerns people have expressed include:

- The overall area of National Forest land that could be impacted may be larger than predicted because Marcellus gas well sites are generally 4-5 acres in size compared to the estimated 2-acre well site projected in the Forest's reasonably foreseeable gas development scenario,
- Large volumes of freshwater typically required to complete hydraulic fracturing to release gas from the Marcellus shale could dry up or reduce aquatic habitat in Forest streams, and affect groundwater quantity,
- Disposal of used hydraulic fracturing water that flows back from the well could pollute land, streams, and groundwater if land application of these fluids is allowed to occur or if illegal disposal occurs, and
- Contamination or loss of groundwater quantity may occur due to high-pressure hydraulic fracturing.

As a result of these concerns, the aforementioned groups and individuals want the Forest Service to not consent to oil and gas leasing on the MNF, discard or amend the Forest's foreseeable gas development scenario as a basis for effects, and/or re-analyze effects of Marcellus shale gas exploration and development on MNF resources.

The Monongahela NF FY 2009 Monitoring and Evaluation report for mineral resources discussed the adequacy of the Forest Plan and associated NEPA documentation regarding future potential Marcellus shale development under a federal oil and gas lease. In this FY 2010 report for mineral resources, we provide an update on gas leasing and development activity and review its projected impacts based on the reasonably foreseeable development scenario, and examine how foreseeable Marcellus shale gas exploration and development may bear on projected impacts to MNF land and resources.

Monitoring Question 21: Evaluation, Conclusions, and Recommendations

Evaluation

The Forest Plan revision process provided the opportunity to determine if National Forest resource impacts from natural gas exploration and development have been occurring as predicted. Disturbance—including earth disturbance, vegetation clearing, and conversion from forested to herbaceous vegetation types—and associated effects were considered during Forest Plan revision for the projected reasonably foreseeable amount of natural gas leasing and development in the Monongahela National Forest Final Environmental Impact Statement (FEIS) for Forest Plan Revision (September 2006).

A comparison of predicted versus actual natural gas development on the Forest indicated substantially less development has occurred than predicted for the period 1991 through June

2006 (FEIS, p 3-368). Other than a natural gas pipeline installation involving an estimated 7.25 acres of earth disturbance (Nine and Nichols gas pipelines, approved in 2004 and 2008), no new surface-disturbing gas exploration, development, or production operations occurred in FY 2010. After adding in new surface disturbances for the period June 2006 through FY 2010, a comparison of predicted and actual surface-disturbing gas activities shows about 20 percent of the projected number of wells have been drilled, and 6 percent of the anticipated acres of surface disturbance, 8 percent of the anticipated road miles, and 30 percent of the anticipated gas pipeline miles have been actually proposed and authorized since 1991. Therefore, disturbance from gas development has been and continues to occur at levels considerably less than predicted in 1991 and reassessed in 2006.

At a site-specific scale, gas well site disturbed area and opening size were examined to determine how their size compared to acreage estimates used to generate earth disturbance projections. The Forest Plan revision effects analysis used an earth disturbance estimate of an average 2 acres per well site. Findings from an unpublished 2007 report by Mary Beth Adams indicate that gas well sites on the Forest range in size from an estimated 0.4 acres to 2.5 acres, with an average size of about 1.25 acres. These findings on well site size are another indication that earth disturbance from gas development is occurring at levels less than predicted.

Future Activity within Federally-Issued Leases

Prior to forwarding lands to the Bureau of Land Management (BLM) to be offered in a lease sale, the Forest staff verify that such leasing has been adequately addressed in the Forest Plan's NEPA document, identify conditions of surface occupancy from the Forest Plan, and determine that operations would be allowed somewhere on the proposed lease area, except where stipulations prohibit all surface occupancy (USDA FS 2006b, pp. 42-43). This process has been used on the MNF for more than two decades for the purpose of providing consent to the BLM to lease federally owned oil and gas. Approximately 107,600 acres or 19 percent of the federally owned oil and gas is currently leased on NFS land within the MNF.

Once a lease has been issued, proposals to conduct operations within the lease area undergo a site-specific analysis according to the National Environmental Policy Act (NEPA). Surface use plans for proposed activities within the lease must be reviewed and approved by the Forest Service before the proposed use of NFS land is authorized (FEIS, p. 3-372). This process for authorizing use of NFS land within a leased area has been used on the MNF for more than two decades.

Reasonably Foreseeable Development Scenario (RFDS): Oil and gas leasing regulation provides direction on the conduct of analyses (36 CFR 228.102 Subpart E). This direction requires a projection analysis of "...the type/amount of post leasing activity that is reasonably foreseeable as a consequence of conducting a leasing program" (36 CFR 228.102 (c)(2) and (3)). The oil and gas RFDS is speculative, but is based primarily on geology, namely the potential for oil and gas resource occurrence based on credible geologic and mineral production information, along with past and present oil and gas activity. This RFDS is also developed with consideration of other important factors such as economics, technology, and physical limitations on access, and existing or anticipated infrastructure and transportation. Existing laws, regulation and certain

administrative limits, such as congressionally designated wilderness being unavailable for federal oil and gas lease, are assumptions included in the RFDS. Although the RFDS has its basis in oil and gas resource potential, it focuses on development potential within the MNF proclamation boundary and purchase units over the life of the Forest Plan (10-15 years). Surface uses necessary to implement the anticipated gas exploration and development on the MNF are included in the RFDS. The RFDS is not a “worst case scenario” based on well-spacing law.

The MNF Forest Plan utilized the RFDS as a basis for determining potential effects to Forest resources from gas leasing and development. The RFDS describes typical operator activities associated with natural gas exploration and developments that are expected to continue over the planning period. These activities include:

- Obtaining an oil and gas lease,
- Conducting preliminary investigations, most commonly by geophysical exploration using seismic shot hole or vibroseis methods,
- Exploratory drilling,
- Development and production (well sites, drilling, pipelines, access roads), and
- Plugging wells and decommissioning facilities that are not part of economical production (USDA FS 2006c, p 3-367).

In the RFDS, planned and potential gas developments were projected to result in the following activities per decade:

- Clearing about 130 acres for 66 gas well sites, each about 2 acres,
- Clearing about 138 acres for an estimated 19 miles of new road to access projected well drilling, and
- Clearing about 473 acres for 78 miles of gas pipeline from an estimated 41 producing wells (out of the 66 drilled wells); rights-of-way may be up to 50 feet wide.

It was assumed that some of the 66 wells would not yield gas. Consequently, it was also assumed that an estimated 50 acres would begin reverting back to forested land shortly after drilling. Cleared areas from producing wells would remain open, supporting herbaceous vegetation, throughout gas production of probably up to 30 years. Due to the intermingled private and federal land and mineral ownership, one half to two thirds of this predicted surface disturbance could be a result of privately owned gas (FEIS, pp. 3-367 to 3-368).

Potential for Marcellus Shale Gas and the Surface Resource Uses Projected in the RFDS

If Marcellus shale gas exploration and development occur within the planning period, they are expected to result in surface uses within the amount and type projected in the RFDS for the reasons explained below.

The Character of Marcellus Shale within the MNF. Economically recoverable Marcellus shale gas resources within the MNF are not proven. Reports range from no natural gas resources of note from tests for Marcellus shale gas in existing wells (Oriskany sandstone/ Huntersville chert) within the Forest, to discovery of Marcellus shale gas on privately owned land within and adjacent to the MNF boundary.

Economic Marcellus shale gas discovery depends on the ability to force the Marcellus shale layer to release a sufficient amount of the gas trapped within the tightly bound shale to recover the costs of drilling and releasing the gas profitably. Although discovery of economic Marcellus shale gas is reportedly occurring near the Forest, the complex folding and faulting of rock layers, combined with the thickness of Marcellus shale within the Forest, are expected to have a bearing on the likelihood and rate of Marcellus shale gas exploration within the Forest such that it is foreseeable to proceed slowly, if or when it does.

Obtaining a sufficient quantity of Marcellus shale natural gas from a well depends on the well bore's ability to extend into and have contact with a large amount of the Marcellus shale formation containing natural gas. If the Marcellus shale layer is discontinuous due to faulting, or difficult to follow with a well bore due to folds in the strata, as is the case within the MNF, establishing contact with extensive areas of gas-bearing portions of the Marcellus formation will be difficult and costly, if possible at all. Faulting present within the Forest also provides a conduit for any gas that may have been present in the Marcellus shale to escape, resulting in no gas or a "dry hole." The drilling history in the Forest for the deeper (than Marcellus) Oriskany sandstone/Huntersville chert provides evidence for the effects of folding and faulting on the potential and risk for discovering economic quantities of gas. Thus, the geologic setting of the MNF is expected to slow, delay, or possibly even preclude exploration and development of Marcellus shale gas within the Forest.

A review of the available information on completed Marcellus shale gas wells, their reported gas flows (final open flow data), and production records on Marcellus pay zone gas wells finds data supporting a lack of or delayed exploration and development.

Figure MR-4 uses data obtained from West Virginia Geological and Economic Survey (WVGES) to show the Marcellus shale gas situation in West Virginia. All but a few of the completed Marcellus pay zone gas wells are outside of or west of the MNF. Even though the shale formation that contains the Marcellus is thicker in the MNF area compared to other parts of West Virginia (hence could have the potential to contain and yield more natural gas), the majority of Marcellus exploration and development has occurred in areas where folding and faulting is less frequent and lower in magnitude (<http://www.wvgs.wvnet.edu/www/datastat/devshales.htm>).

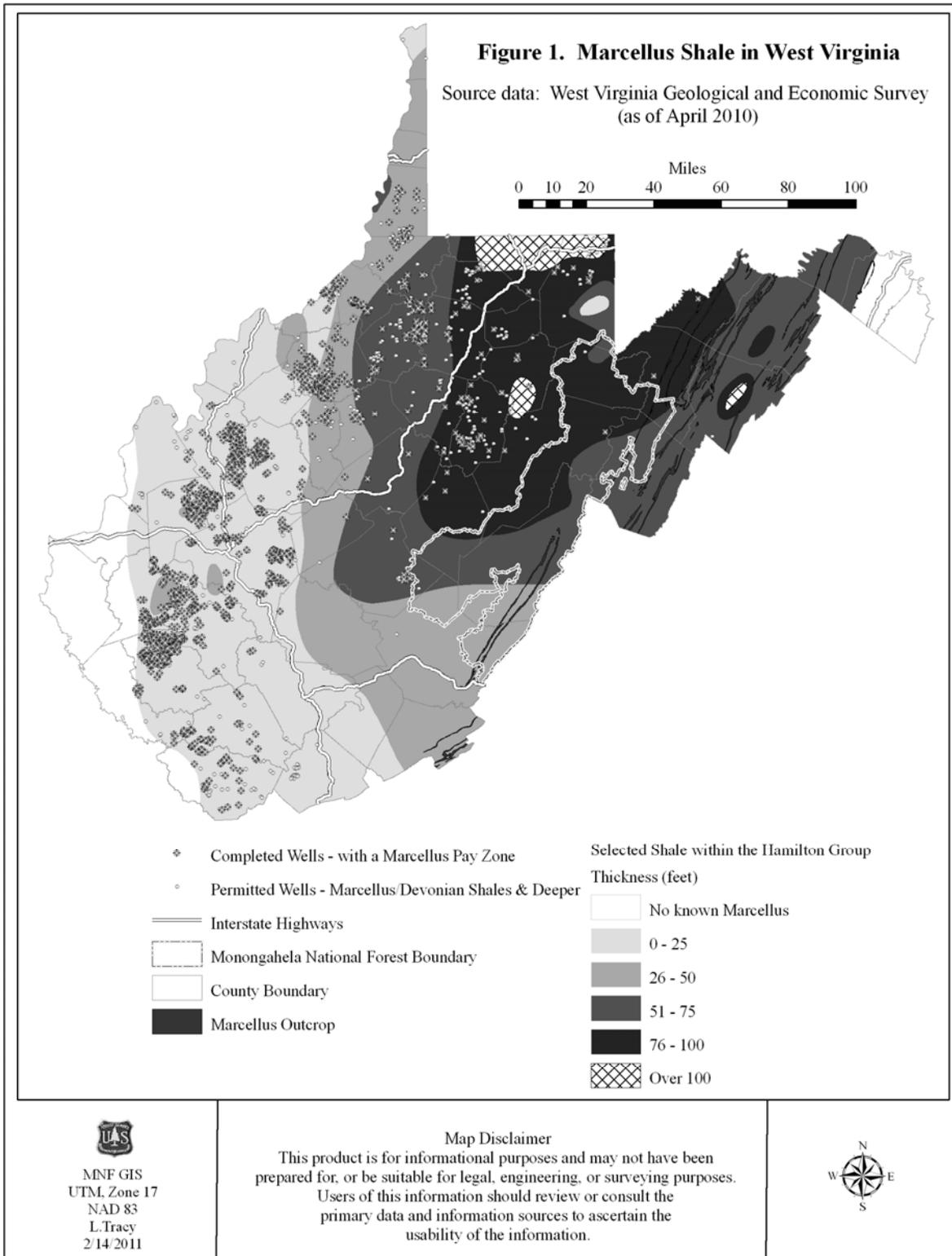


Figure MR-4. Marcellus Shale Development in West Virginia

Comparing gas flows from completed, vertically drilled (approximately vertical in contrast to wells with approximately horizontal bore holes) Marcellus pay zone wells in a similar geologic setting to the MNF with those in less folded and faulted portions of West Virginia, one finds gas flow rates away from the MNF to be on the order of four to eight times that of Marcellus shale wells close in proximity and in geologic setting to the MNF (West Virginia Geological and Economic Survey, 02/2011). No horizontal wells have been drilled in the MNF's geologic setting, therefore, gas flows or production capability from horizontal Marcellus shale wells is unknown (<http://www.dep.wv.gov/oil-and-gas/databaseinfo/Pages/OGD.aspx>).

The combination of low natural gas prices, high drilling and completion costs, paucity or otherwise limited availability of natural gas pipelines to transport gas to markets, and uncertainties associated with potential for successfully finding natural gas in the MNF's geologic setting should act together to slow, delay or possibly preclude development of Marcellus shale gas development in the foreseeable future on the MNF. Marcellus shale gas exploration and development that would occur is expected to produce impacts to surface resources similar to and within anticipated ranges analyzed in MNF 2006 Forest planning documents.

Surface Resource Use Projection. Given the character of Marcellus shale and the complex geology within the MNF, it is reasonable to expect only limited exploration for Marcellus shale gas during the planning period. However, if economically recoverable resources are discovered, additional Marcellus shale gas development could follow.

How would surface resource use associated with exploration and development of Marcellus shale gas compare to surface use projected in the RFDS?

Marcellus shale exploration and development has not occurred to date on Monongahela NFS land. However, we have had an indication on how such exploration and development may occur based on similar activities in other areas. A Marcellus shale well site, on the order of 4-5 acres, would be used to accommodate 6-8 well bores that would be drilled horizontally in different directions into the Marcellus shale formation. The best information available indicates that within the Forest, individual well sites would be spaced so that no more than one well site would occur in approximately 640 acres.

Typical operating activities such as obtaining a lease, conducting preliminary investigations, exploratory drilling, development and production, and plugging wells and decommissioning facilities that are not part of economical production, would still be expected to occur (FEIS, p 3-367). In addition, surface uses associated with projected levels of Marcellus shale exploratory drilling, development, and production are expected to be within predicted amounts in the current RFDS. For example, projected well spacing would be the same as that of the RFDS used in the Forest Plan revision, and this spacing leads to a similar projection of acres of use, or less, for access roads and pipelines (an estimated 13.5 acres, if pipeline rights-of-way were an average of 50 feet wide).

Given that only 6 percent of the anticipated number of acres of surface disturbance has occurred in the last two decades, the Forest Plan revision analysis has considered and analyzed effects on more than 690 acres of disturbance per decade than has actually been occurring. This means that

surface disturbance associated with the limited amount of anticipated Marcellus shale exploration and development, in combination with that of any other gas drilling, would still be expected to fall within Forest Plan revision-analyzed amounts. As such, we conclude that the overall area of NFS land that could be impacted by gas exploration and development, including that of Marcellus shale gas, is not expected to exceed predicted and analyzed amounts during the planning period. Forest staff will continue to monitor any new gas exploration and development on a regular basis to ensure this conclusion is valid.

How are MNF resources protected from potential impacts from drilling and producing Marcellus Formation gas?

People have expressed concerns about a variety of potential surface-impacting activities on an oil and gas lease area associated with Marcellus shale exploration and development. However, Forest Service and BLM regulations (36 CFR 228 E and 43 CFR 3160); authority in the lease (BLM form 3100-11, Section 6 Conduct of Operations); the additional conditions attached to a lease (USDA Forest Service Standard Stipulations, and included Oil and Gas Lease Stipulation/Notifications, Monongahela National Forest, West Virginia); and the NEPA process of reviewing, approving, and applying mitigation to proposals to address site-specific concerns raised and anticipated for Marcellus shale gas, as well as other foreseeable gas exploration and development, provide environmental protections and surface use controls to ensure that any proposed operations could be designed and mitigated to comply with the MNF Forest Plan standards.

Summary of Environmental Protections applicable to proposed gas developments on a federal lease:

1. Federal oil and gas leases contain environmental protection requirements as in Section 6 of the standard lease term:

“Conduct of operations – Lessee shall conduct operations in a manner that minimizes adverse impacts to the land, air and water, to cultural, biological, visual, and other resources, and to accomplish the intent of this section. To the extent consistent with lease rights granted, such measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures.”
2. Environmental protections to which proposed lease operations are subject include a wide range of laws and regulations, including the Endangered Species Act, Archaeological Resources Protection Act, Federal Water Pollution Control Act, Clean Water Act, Clean Air Act, National Environmental Policy Act, as well as all the other environmental protection laws and regulations applicable to NFS land. For example, when an operation is proposed on a federal lease, the Forest Service, under a federal law such as Archaeological Resources Protection Act, can control or prohibit surface occupancy, when justified, without a lease stipulation.
3. In addition to the environmental analysis conducted prior to leasing, a site-specific environmental analysis under NEPA is required for proposed lease operations within the

MNF. The leaseholder cannot construct a road, drill a well, or conduct ground-disturbing operations without approval from the federal government. The leaseholder must submit an Application for Permit to Drill (APD), including Drilling Plan and Surface Use Plan of Operations, which must be reviewed and approved by the BLM and the Forest Service, respectively, before ground-disturbing operations can occur.

4. Proposed lease operations are subject to environmental protection requirements in BLM regulations, including Onshore Oil and Gas Onshore Orders. BLM regulation Onshore Oil and Gas Order No. 1 contains environmental protection requirements for the Drilling Plan and Surface Use Plan of Operations in the APD. For example, Drilling Plan requirements include that “The Drilling Plans must be in sufficient detail to permit a complete appraisal of the technical adequacy of, and environmental effects associated with, the proposed project” (Onshore Oil and Gas Order No. 1, Section III.D.3). BLM regulation Onshore Oil and Gas Order No. 2 contains environmental protection requirements for Drilling Operations, including, “The proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, abnormally pressured zones, and any prospectively valuable deposits of minerals” (Section III.B).
5. Proposed lease operations are subject to environmental protection requirements in Forest Service regulations, including the 36 CFR 228E regulations that implement the Federal Onshore Oil and Gas Leasing Act of 1987. For example, Forest Service oil and gas regulation surface use requirements at 36 CFR 228.108 require environmental protections relating to access facilities, cultural and historical resources, fire prevention and control, fisheries, wildlife and plant habitat, soil erosion and sedimentation, safety, management of wastes, watershed protection, and reclamation.
6. Federal oil and gas leases on the MNF are conditioned such that proposed lease operations are subject to standards in the Forest Plan. Federal leases contain the following special notification:

Operations under this lease will be consistent with the standards found in the Monongahela National Forest Land and Resource Management Plan (Forest Plan), as revised or amended, and are hereby incorporated into this lease in its entirety. Forest Plan standards include restrictions on location, timing and methodology of oil and gas lease operations, and requirements for special surveys that provide for protection of National Forest land and resources. A copy of the Forest Plan is available for inspection from:

USDA Forest Service
200 Sycamore Street
Elkins, West Virginia 26241
7. In addition, proposed federal lease operations are subject to West Virginia laws and regulations governing oil and gas operations, including those requirements for environmental protection and regulation.

Examples of how the environmental protections would work to control effects from Marcellus shale gas drilling and development on federal oil and gas leases on the MNF

With regard to concerns associated with large volumes of freshwater required for horizontal well hydraulic fracturing, the Forest Service has complete authority for approving, not approving, or approving with conditions, the source timing or method of freshwater withdrawal on NFS land within a federal oil and gas lease. The Forest Plan standards that condition leases (see item # 6 above, which is also Oil and Gas Lease Stipulation/Notifications, Monongahela National Forest, West Virginia, Special Notification #1) provide direction for Forest Service use in reaching a decision on the proposed surface use. For example, a proposal to operate on a federal lease would be evaluated with consideration given to the Forest Plan soil and water Goal SW30, “Maintain surface and ground water sources to support healthy riparian and aquatic habitats, wetlands, channel function, and downstream uses”. Additional protection of surface and groundwater quantity is found in West Virginia Division of Environmental Protection (WVDEP) Industry Guidance on Gas Well Drilling/Completion, for Large Water Volume Fracture Treatments (<http://www.dep.wv.gov/oil-and-gas/Resources/Pages/default.aspx>) that addresses issues of water use and withdrawal statewide. This State-issued guidance, coupled with the requirement to submit an addendum to the State well work permit application showing proposed water source(s) location(s) and volume, provides for protection of water and aquatic resources not on NFS land from being substantially adversely impacted by large volume water withdrawals.

Similarly, the Forest Service has authority to approve, not approve, or approve with conditions, proposals for disposal of used hydraulic fracturing water on NFS land with a federal oil and gas lease area as part of completing the site-specific or project level NEPA analysis. This means a proposal to operate on a federal lease, including the proposed method of fluid disposal, would be evaluated for effects with consideration given to the Forest Plan direction and standards. WVDEP’s Industry Guidance (WVDEP Office of Oil and Gas, 03/2011) provides direction that is applicable statewide as well, including a prohibition on applying Marcellus shale formation hydraulic fracturing flowback fluids on the land (WVDEP Office of Oil and Gas 2010), and a discussion of options such as underground injection control, recycling fracture treatment flowback fluids, and disposal at approved, publicly owned treatment facilities. Operators must submit an addendum to the State well work permit application for large volume water use (greater than 210,000 gallons) that identifies the proposed water disposal method to be reviewed and approved as part of the Well work permitting process.

People are also concerned about possible impacts to groundwater from Marcellus shale well drilling and hydraulic fracturing. On NFS land, the BLM has authority to review the drilling plan portion of an application for a permit to drill (APD) on the federal oil and gas lease area, in order to ensure that the drilling plan meets national standards for well control and protection of fresh water zones (43 CFR 3160, Onshore Oil and Gas Order No. 1). A proposal to drill a well on a federal oil and gas lease must address protection and/or isolation of all usable water zones in the well casing design (43 CFR 3160, Onshore Oil and Gas Order No. 2, Section III.B.). As part of the Forest Service’s role in review and approval of a Surface Use Plan of Operation, effects to groundwater will be considered, analyzed and documented as part of the NEPA process completed on a proposal to operate on a federal lease. The review and analysis of the proposed

casing design provides the opportunity to take a hard look at potential for impacts to groundwater, and the authority to approve the casing design or not provides the mechanism for assuring the casing design addresses potential groundwater quality impacts. Thus, this authority provides the means for conditioning the drilling permit to ensure casing design and integrity of the installed casing is adequate to protect fresh groundwater resources from contamination or loss of quantity due to hydraulic fracturing. Hydraulic fracturing for deep gas wells has been occurring on MNF land for several decades with no known instances of groundwater contamination or reports of reduction in flow.

Conclusions

The impacts to NFS land and resources predicted in the Forest Plan revision RFDS continue to represent foreseeable impacts during the planning period, even with the possibility of limited Marcellus shale gas exploration and development.

The Forest Service has the authority to address environmental concerns, including those surrounding Marcellus shale gas drilling and development, when a proposal is made to drill or develop gas resources within a lease. The Forest Plan standards, which are incorporated into, and therefore binding on, federal oil and gas leases, provide the direction for controlling impacts to NFS land and resources to acceptable levels.

Based on the findings in the ***Evaluation*** section (above), at this time there is no justifiable reason to discard as a basis for effects, or amend the Forest's foreseeable gas development scenario, and/or re-analyze effects of Marcellus shale gas exploration and development on MNF resources. The Forest Plan Revision FEIS (2006c) contains the appropriate level of NEPA analysis and documentation to support moving forward with federal oil and gas leasing. At this time there would be no reason to change the Plan Implementation direction for federal oil and gas leasing on the MNF.

Recommendation: Continue to monitor whether or not estimates of MNF resource impacts associated with gas development, which provide the basis for effects analysis related to a variety of MNF resources, are exceeding predicted amounts.

Monitoring Question 22. Are minerals, especially energy-producing minerals, available for exploration, development, and production at predicted levels?

Progress toward achieving Goals MG01 and MG03, and Objective MG06 can be determined by examining whether there have been changes to Forest management direction, standards and guidelines, or the application of standards that would change the amount of federally owned energy-producing minerals available for exploration, development and production. Since these types of changes are not routine, evaluation may not be needed on an annual basis. Rather, examining each year and reporting every five years or when triggered by a change in Forest Plan management direction or standards should indicate progress in the achievement of these Forest Plan goals and objective for minerals.

The 2006 Forest Plan identifies goals and an objective related to ensuring that minerals are available for exploration and development, with emphasis on energy-producing minerals (MG01, MG03, and MG06). The goals are to make minerals available for exploration, development, and production consistent with other appropriate uses and protection of the environment, emphasizing energy minerals (MG01), and provide for reasonable access to and use of NFS land for mineral activities (MG03). The objective (MG06) is to keep 70 to 80 percent of federally owned oil and gas available for exploration, development and production. The 2006 Forest Plan EIS estimated that 74 percent of the federally owned natural gas is currently considered available for exploration, development, and production (USDA FS 2006c, p. 3-375).

Monitoring Question 22: Evaluation, Conclusions, and Recommendation

In the Monongahela National Forest FY 2009 Monitoring and Evaluation Report for Mineral Resources, the amount of federally owned natural gas currently considered available for exploration, development, and production was estimated to be 74%, the same amount as shown in the Monongahela NF Environmental Impact Statement for Forest Plan Revision (September 2006, page 3-375). The monitoring and evaluation frequency for this item is 1-5 years, and the FY 2009 Mineral Resources monitoring recommended that we address Monitoring Question 22 in 5 years or when circumstances come about that result in the possible change in the amount of federal oil and gas available for exploration, development and production. There has been no change in circumstances that would change the amount of federal gas available for exploration, development and production, therefore no new figure to report.