March 2024

Wayne National Forest
Supplemental Environmental Assessment

DOI-BLM-Eastern States-M000-2023-0005-EA

Oil and Gas Leasing, Wayne National Forest,
Marietta Unit of the Athens Ranger District,
Monroe, Noble, and Washington Counties, Ohio

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Acronyms and Abbreviations

ACRONYM/ ABBREVIATION	FULL TERM
2012 SIR	*Supplemental Impact Report: Horizontal Drilling Using High Volume Hydraulic Fracturing – Wayne National Forest*
Action Area	Marietta Unit
Analysis Area	HUC-12 subwatersheds overlapping the Marietta Unit and surrounding the 4-mile buffer
Annual GHG Report	*2021 BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends*
APD	Application for Permit to Drill
ARC	Appalachian Regional Commission
b/d	barrels per day
BA	Biological Assessment
Bcf/d	billion cubic feet/day
BLM	U.S. Department of the Interior, Bureau of Land Management
BLM NEPA Handbook	*BLM National Environmental Policy Act Handbook H-1790-1*
BMP	best management practice
BO	Biological Opinion
CBD	Center for Biological Diversity
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CIAA	Cumulative Impact Analysis Area
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
COA	condition of approval
CSU	controlled surface use
CWA	Clean Water Act
DOGRM	Division of Oil and Gas Resources Management
DOI	U.S. Department of the Interior
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EIS	Environmental Impact Statement
EO	Executive Order
EOI	Expression of Interest
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act of 1976
FMO	federal mineral ownership
FONSI	Finding of No Significant Impact
Forest Plan	*Wayne National Forest 2006 Land and Resource Management Plan*
ft^3/sec	cubic feet per second
GFW	forest-wide guideline

ACRONYM/ ABBREVIATION	FULL TERM
GHG	greenhouse gas
Gold Book	*Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development*
GWP	global warming potentials
HAP	hazardous air pollutant
HUC	Hydrologic Unit Code
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act of 2022
IWG	Interagency Working Group
LNG	liquified natural gas
Mgal	million gallons
MLA	Mineral Leasing Act of 1920
MMst	million short tons
MT	metric tons
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFS	National Forest System
n-hexane	normal-hexane
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NSO	no surface occupancy
O_3	ozone
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
PM_{10}	particulate matter 10 micrometers or less in diameter
$PM_{2.5}$	particulate matter 2.5 micrometers or less in diameter
RFDS	Reasonably Foreseeable Development Scenario
RFSS	Regional Forester Sensitive Species
RUMA	road use maintenance agreement
SC-CH_4	social cost of methane
SC-CO_2	social cost of carbon dioxide
SC-GHG	social cost of greenhouse gases
SC-N_2O	social cost of nitrous oxide
SFW	forest-wide standard
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
STEO	short-term energy outlook
SUPO	Surface Use Plan of Operations
Supplemental EA	Supplemental Environmental Assessment

ACRONYM/ ABBREVIATION	FULL TERM
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WNF	Wayne National Forest
WNS	white-nose syndrome
WOTUS	Waters of the United States

CHAPTER 1. INTRODUCTION AND PURPOSE AND NEED

The U.S. Department of the Interior (DOI), Bureau of Land Management (BLM) has prepared this Supplemental Environmental Assessment (Supplemental EA) to evaluate the anticipated environmental impacts of the Proposed Action, leasing federal mineral estate within the Marietta Unit (Action Area) of the Wayne National Forest (WNF), Athens Ranger District (Figure 1). The U.S. Forest Service (USFS) has participated as a cooperating agency in the preparation of this Supplemental EA. The Marietta Unit lands are within the National Forest System (NFS) and located in Monroe, Noble, and Washington Counties in Ohio (Figure 2).

The parcels that could be leased as part of the Proposed Action consist of all federal mineral estate underlying NFS lands which are estimated to exceed 40,000 acres and which include approximately seven acres of private land inholdings in the Marietta Unit (USFS 2006a). The parcels could be leased for potential future oil and gas development, and drilling into federal minerals would only occur following approval of Applications for Permit to Drill (APDs) that are based on site-specific plans approved by BLM. However, lessees could construct well pads, access roads, and other infrastructure on private land prior to BLM approval of APDs. This analysis supplements an EA prepared by BLM in 2016 for essentially the same purpose, which was challenged in the U.S. District Court for the Southern District of Ohio and found to fall short of the requirements of the National Environmental Policy Act of 1969 (NEPA) with respect to its analysis of certain resource issues (*Center for Biological Diversity et al. v. United States Forest Service et al*. (S.D. Ohio, No. 2:17-cv-372) (*CBD*)). The 2020 and 2021 Court Orders associated with the 2016 EA are included as Appendix C (*CBD Decision Court Orders)* of this Supplemental EA.

Under mineral leasing statutes and regulations, interested parties, such as private individuals or companies, may file Expressions of Interest (EOIs) with the BLM to nominate parcels for competitive bid and leasing. As of 2023, the BLM has received at least 89 EOIs nominating parcels on the Marietta Unit (Figure 3). These include EOIs that have resulted in issuance of leases, through the lease sale process, and EOIs that are currently pending. Consistent with the BLM's statutory obligation to evaluate nominated parcels and hold quarterly competitive lease sales for available oil and gas parcels, this Supplemental EA will be used as a basis for evaluation of future oil and gas leasing requests in the Marietta Unit and will serve as revised NEPA analysis of the agency actions that were remanded to the BLM and USFS by the *CBD* decision. Refer to Appendix C (*CBD Decision Court Orders*) for additional information on the terms of the remand and details concerning the actions remanded to the agencies.

Before each future competitive lease sale, the BLM would review nominated parcels to ensure that potential environmental impacts have been appropriately considered and disclosed to the public. This would begin with confirming the adequacy of the environmental analysis within this Supplemental EA and other prior analyses, such as the previous 2016 EA. After BLM review and approval, the USFS would then review each proposed lease and its supporting analysis to support a determination by the Secretary of Agriculture, as required by statute, to consent, or not consent, to a given lease or group of leases.

A federal oil and gas lease is a legal contract that grants exclusive rights to the lessee to develop federally owned oil and gas resources. However, it does not immediately authorize surface-disturbing activities on federal surface or obligate the lessee to drill a well on the parcel or into

the oil and gas below the parcel in the future. Should the parcel be leased and the lessee submit a detailed plan for oil and gas development, including a plan for any intended surface occupancy on the federal parcel, then the BLM and USFS would conduct appropriate site-specific environmental analysis and any required consultations. If the parcel to be developed is on NFS surface lands, then development must be consistent with the management area direction and applicable forest-wide standards (SFWs) and guidelines as identified in the governing Forest Plan, the *Wayne National Forest 2006 Land and Resource Management Plan* (Forest Plan) (USFS 2006a).

If a lessee proposes to develop federally owned oil and gas resources from private surface, then the BLM would conduct site-specific environmental analysis and provide management direction, but SFWs and guidelines from the Forest Plan (USFS 2006a) would not apply on the private land. However, the BLM would apply appropriate design features, conditions of approval (COAs), and best management practices (BMPs). For additional information, refer to Section 2.2.3, *Best Management Practices, Environmental Protection Measures, and Lease Stipulations* and 2016 EA Appendix C, *Permitting of Oil and Gas Operations on Non-federal Surface* (BLM 2016). The site-specific analysis would be conducted post-lease sale, specifically during the permitting process known as the APD stage. This site-specific analysis is not part of the Proposed Action described in this Supplemental EA. The Proposed Action evaluated in this Supplemental EA is described in further detail in Chapter 2, *Alternatives*.

This Supplemental EA has been prepared in accordance with NEPA, the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500–1508, revised in 2020), the DOI's own regulations in 43 CFR Part 46 and Department Manual section 516, *Environmental Quality* (DOI 2020), and the *BLM National Environmental Policy Act Handbook H-1790*-1 (BLM NEPA Handbook) (BLM 2008). The information presented in this document serves as the basis for the BLM's Authorized Officer to decide whether the Proposed Action may result in significant impacts on the environment. A finding that significant impacts may occur requires the preparation of an Environmental Impact Statement (EIS). If the BLM Authorized Officer determines that no significant impacts are expected, then the officer would issue a Finding of No Significant Impact (FONSI). The USFS will use this Supplemental EA in its review of previous consent authorizations remanded to the agency in *CBD*, and in determining whether to consent to future BLM leasing proposals on the Marietta Unit.

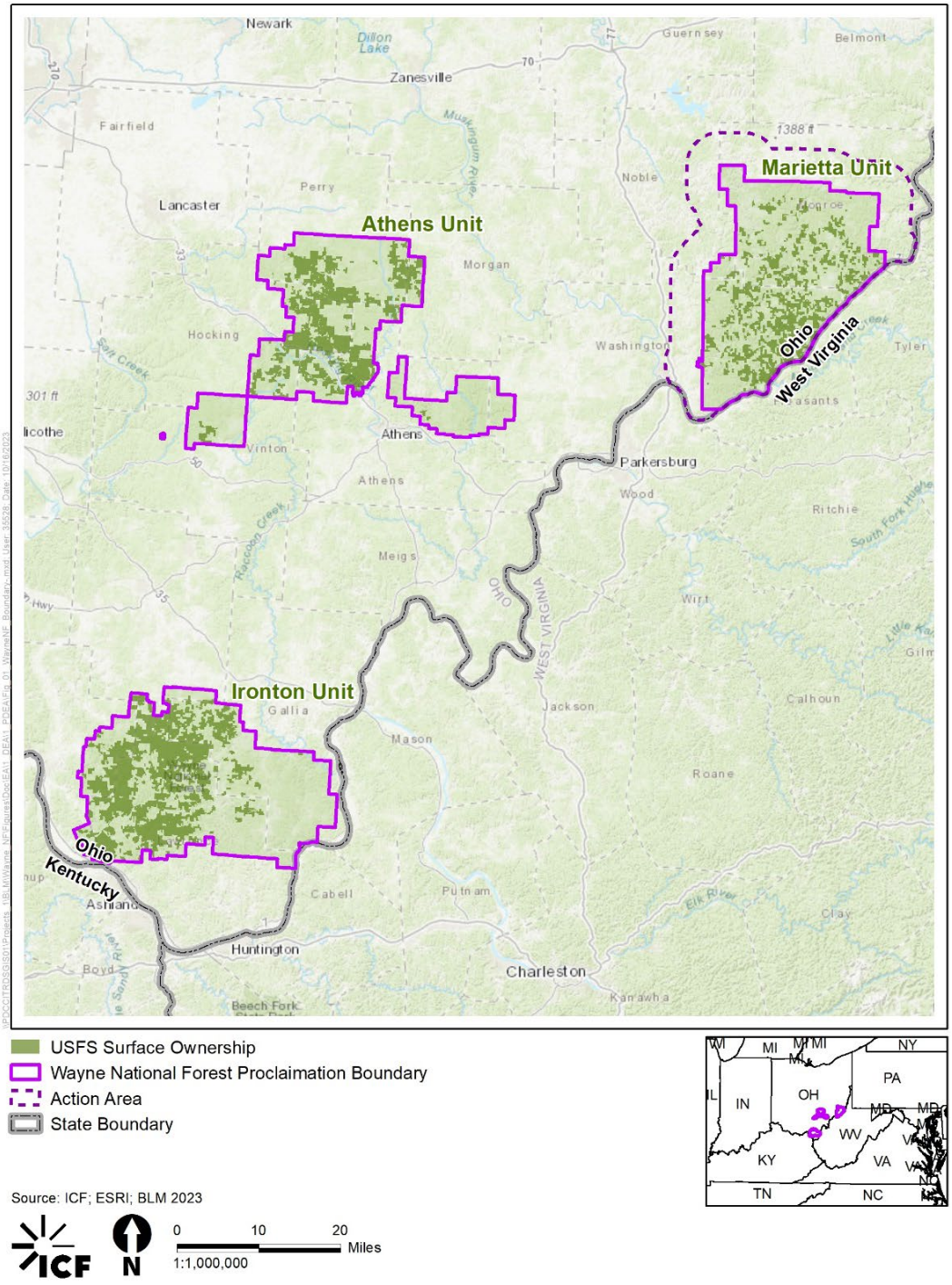


Figure 1. Proclamation Boundary of the Wayne National Forest, Athens Ranger District, Marietta Unit

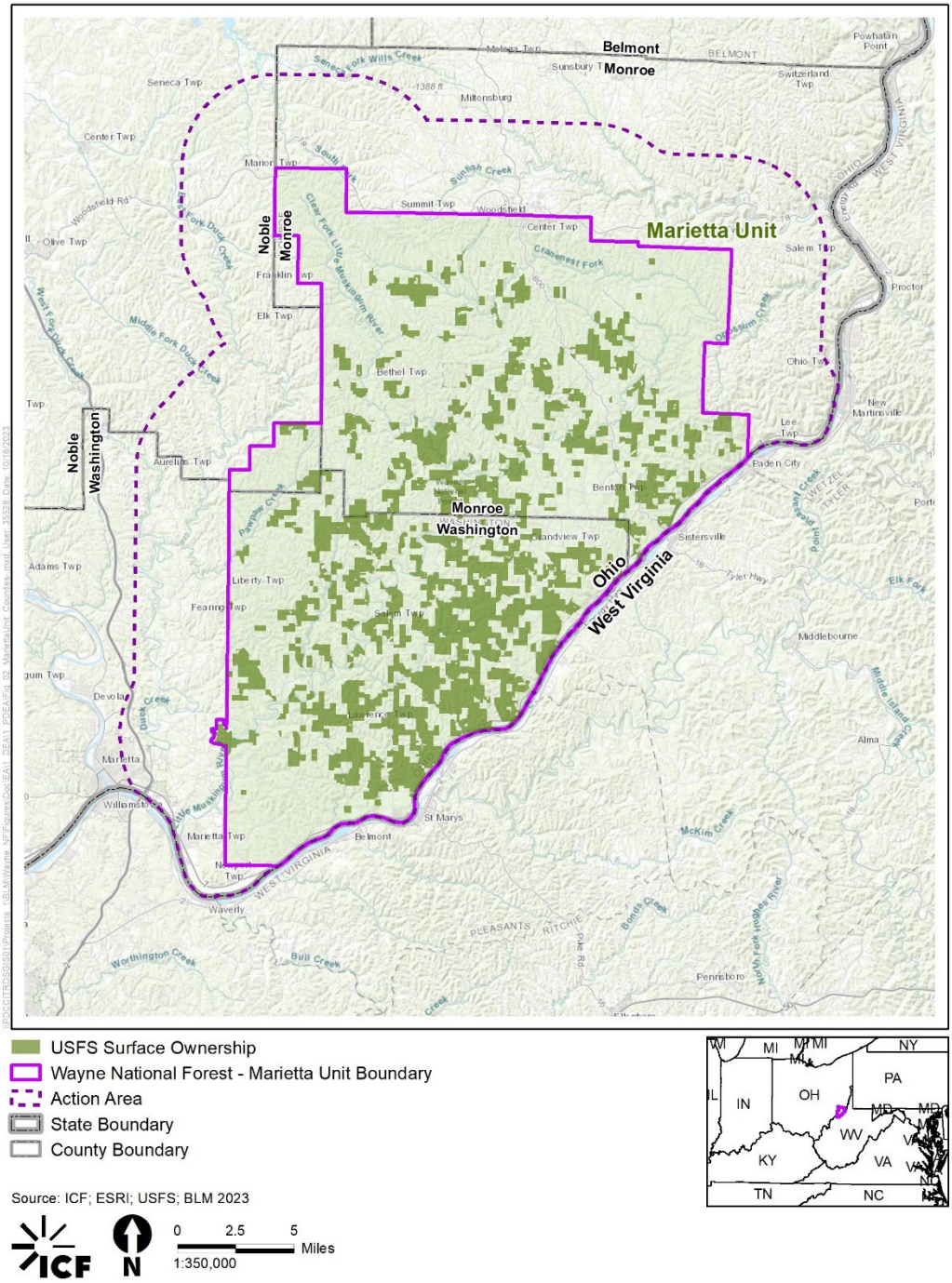


Figure 2. Counties in the Marietta Unit of the Wayne National Forest

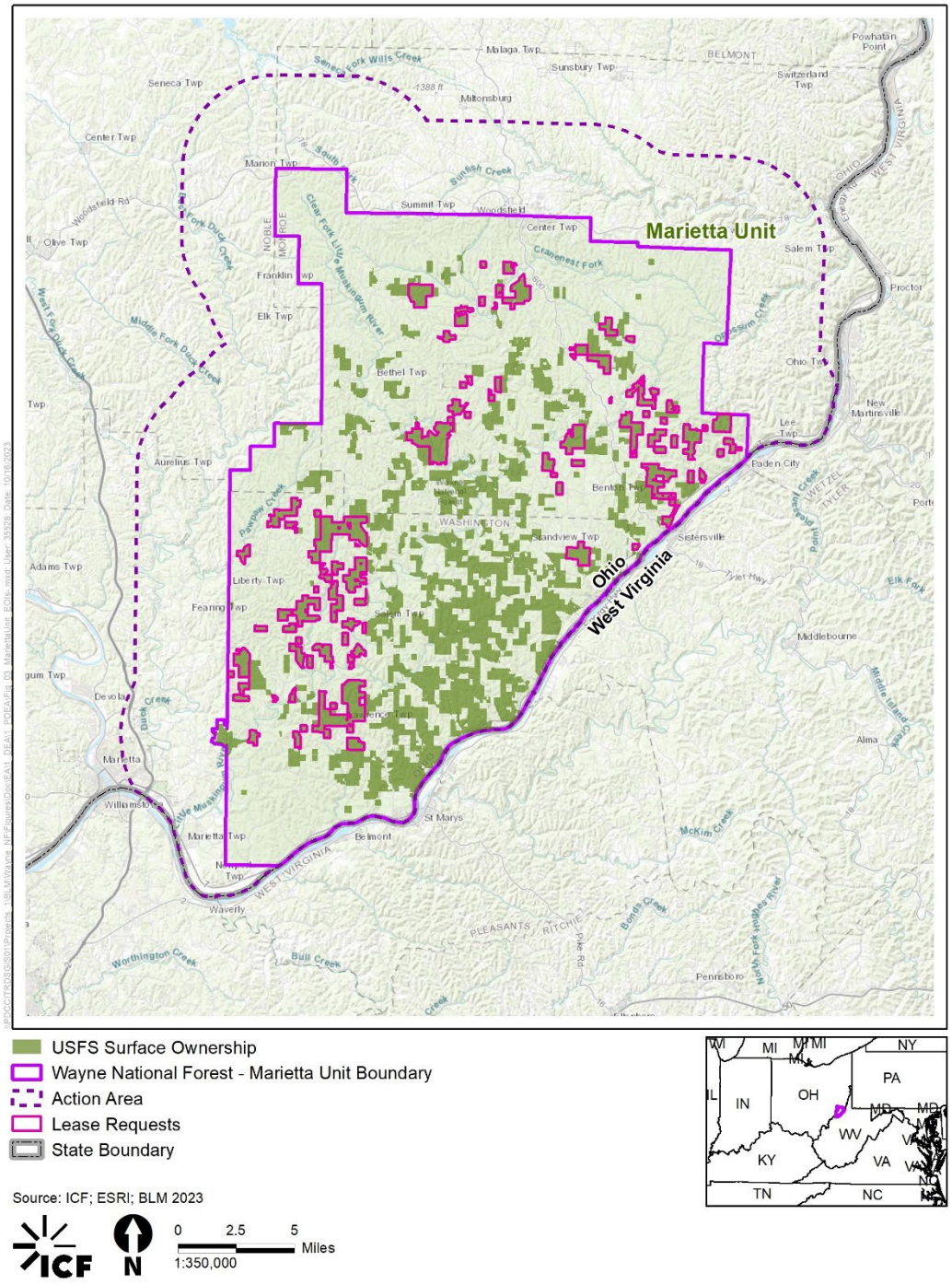


Figure 3. Expressions of Interest on the Marietta Unit

1.1. Background

The WNF's Proclamation Boundary was established by Congress in 1934 and comprises three separate administrative units that encompass parts of 12 counties: (1) the Athens Unit; (2) the Ironton Unit; and (3) the Marietta Unit. These three administrative units compose two Ranger Districts: (1) the Athens Ranger District (Athens and Marietta administrative units); and (2) the Ironton Ranger District. Of the approximately 855,532 acres within the WNF Proclamation Boundary, approximately 244,265 acres, or about 29 percent, are NFS lands that USFS owns and manages. The NFS surface lands overlie oil and gas resources that are both federally and privately-owned, and are intermixed with small communities, roadways, and county or State-held lands. As of 2020, approximately 172,157 acres of federal minerals were located within the WNF Proclamation Boundary (Appendix D, *Reasonably Foreseeable Development Scenario*).

The Record of Decision approving the Forest Plan (USFS 2006a) made all federally owned minerals in the WNF administratively available to be leased. At that time, horizontal drilling was generally not yet economically feasible. Technological developments in the following years resulted in horizontal drilling and hydraulic fracturing becoming more economically viable. In 2012, the USFS prepared the *Supplemental Impact Report: Horizontal Drilling Using High Volume Hydraulic Fracturing – Wayne National Forest* for oil and gas activity (2012 SIR; USFS 2012), which projected that 13 horizontal well sites could possibly be developed using high-volume hydraulic fracturing[1] technology across the WNF through the remainder of the first 10 years of Forest Plan (USFS 2006a) implementation. The BLM then prepared the 2016 EA, later challenged in the *CBD* case, to evaluate the anticipated environmental impacts of leasing federal mineral estate within the Marietta Unit. To estimate anticipated impacts, the analysis relied on the 2006 Reasonably Foreseeable Development Scenario (RFDS) (Appendix G of the 2006 Forest Plan [USFS 2006a]) and on the 2012 SIR (USFS 2012).

The Proposed Action in the 2016 EA (BLM 2016) remains the same for this Supplemental EA (leasing of federal minerals in the WNF Marietta Unit), but the projections of oil and gas activity have been updated. In 2018, USFS announced plans to revise the 2006 Forest Plan (USFS 2006a). In response to a 2019 USFS request, the BLM prepared an updated RFDS in 2020 (Appendix D) to support the revision of the Forest Plan. Although the Forest Plan revision was discontinued, this Supplemental EA nonetheless incorporates the updated projections made in the 2020 RFDS (BLM 2020) to characterize environmental impacts rather than the projections made in the 2006 RFDS (USFS 2006a) and the 2012 SIR (USFS 2012), because the 2020 RFDs incorporates more current information. According to the 2020 RFDS (Appendix D), all wells in the WNF were projected to be primarily gas wells, with many also projected to produce some oil. No oil-only wells were projected in the WNF. Most of these wells were projected in the 2020 RFDS to be horizontally drilled gas wells, accessed from pads on non-federal surface pads using high-volume hydraulic fracturing.

[1] High-volume hydraulic fracturing refers to operations that use a combined total of 300,000 or more gallons of water during all stages of well completion whether the well is vertical or directional, including horizontal, and whether the water is fresh or recycled and regardless of the chemicals or other additives mixed with the water (18 CFR 440.2).

In certain cases, the organization and format of this Supplemental EA may vary from the 2016 EA in order to streamline the content.

1.2. Purpose and Need

The BLM's purpose is to respond to Expressions of Interest (EOIs) to lease federal oil and gas resources through a competitive leasing process and to address certain deficiencies identified in the *CBD* case. The need for the action is established by both the court's ruling, as further discussed below, and by the BLM's responsibility under the Mineral Leasing Act of 1920 (MLA), as amended, to promote the exploration and development of oil and gas on the public domain. With respect to the latter, it is the policy of the BLM—as required by various laws, including the MLA (30 United States Code [USC] 181 et seq.), the Federal Land Policy and Management Act of 1976 (FLPMA), and the Energy Policy Act of 2005—to make mineral resources available for development to meet national, regional, and local needs. Consistent with applicable law, BLM's oil and gas leasing program encourages the sustainable development of domestic oil and gas reserves and complies with FLPMA's multiple-use and sustained yield management goals.

With respect to deficiencies identified in the *CBD* case, the need to develop a Supplemental EA was established by the court's finding that neither the USFS nor the BLM had taken a hard look at the reasonably foreseeable impacts of hydraulic fracturing operations in the WNF, including: (1) impacts of surface-area disturbance; (2) cumulative impacts on the Indiana bat (*Myotis sodalis*) and the Little Muskingum River and other local water sources; and (3) impacts on air quality (see Appendix C, *CBD Decision Court Orders)*

1.2.1. Actions to Be Taken

Based on the analysis in this Supplemental EA, BLM will decide whether, in the future, to lease available NFS parcels in the WNF Marietta Unit for oil and gas drilling and, if leased, what terms and conditions would apply to these leases. In addition, due to the *CBD* decision, the agencies must also determine whether, based on consideration of the impacts identified in this NEPA document, the prior BLM leasing decisions and USFS consent to BLM's proposals to lease—challenged in *CBD* and resulting in issuance of 65 leases—comply with NEPA and will be affirmed, or whether those actions will be revised.

This Supplemental EA addresses the information and alternatives that the BLM's 2016 EA analyzed and supplements them with consideration of the 2020 RFDS and additional analyses in response to *CBD*. In particular, this Supplemental EA analyzes the impacts from the use of high-volume hydraulic fracturing technology on NFS lands and BLM-administered mineral estate in the WNF Marietta Unit. The decisions that will follow this Supplemental EA only apply to NFS lands and BLM-administered mineral estate; no decisions based on this Supplemental EA would change the independent rights or authority of private landowners or other surface-management agencies. Information from the 2016 EA (BLM 2016) is incorporated by reference throughout this Supplemental EA. The 2016 EA and information incorporated by reference can be found at: https://eplanning.blm.gov/eplanning-ui/project/53939/570.

It is important to note that this Supplemental EA, like the 2016 EA it supplements, was conducted at a level of detail appropriate for land-use-planning. Oil and gas leasing and

development of federal mineral estate occurs in multiple stages of federal-government environmental analysis and authorization. Consideration of environmental impacts is required at each of the following three stages in the leasing and development of federal mineral estate:

1. Stage 1 - Identification of areas that are available or closed to oil and gas leasing in the Forest Plan (USFS 2006a);
2. Stage 2 - Environmental review prior to conducting a competitive lease sale for parcels that are available for leasing and nominated in an EOI; and
3. Stage 3 - Environmental review of specific development proposals once the agency receives an APD for a leased area.

The Forest Plan (USFS 2006a) identified areas as available for or closed to oil and gas leasing and adopted appropriate stipulations that limit surface use. The Forest Plan also adopted other standards and guidelines that could be applied to areas identified as available for leasing (Stage 1 review). The environmental review for leasing parcels identifies which parcels should be offered for leasing and the conditions under which leasing and eventual development should occur (Stage 2 review). The environmental review for the development of leased parcels, including well-completion techniques, such as high-volume hydraulic fracturing, consists of the site-specific analysis of potential impacts from a specified proposal (Stage 3 review).

This Supplemental EA completes the Stage 2 environmental review for the WNF Marietta Unit for future BLM lease sales and for the BLM lease sales challenged in the *CBD case*. It will also support USFS's review of its consent authorizations to BLM leasing proposals that were remanded to the agency by the *CBD* Court, and its consideration of consent authorizations to future BLM proposals to lease on the Marietta Unit. Assessing and issuing consents to BLM proposals to lease is part of USFS's regulatory duties (36 C.F.R. 228.102(e)). The consent review consists of verifying whether leasing of specific lands has been adequately addressed in a NEPA document and is consistent with the governing Forest Plan, ensuring that any conditions of surface occupancy are included in the lease stipulations, and confirming that surface use is permitted somewhere on the lease (except in no surface occupancy [NSO] leases). This document supplements the NEPA analyses used for this verification in accordance with *CBD*. The WNF's process for performing the verification and other reviews for a consent to proposal to lease under 36 C.F.R. 228.102(e) does not typically include the performance of additional NEPA analysis, but such additional analysis is being undertaken in this instance at the direction of the court in accordance with the *CBD Decision Court Orders* (Appendix C).

For leases that proceed to development, developers or operators who secured leases are required to submit APDs as part of the Stage 3 review, which typically include an initial on-the-ground, site-specific field evaluation by BLM, and USFS if the project is on NFS surface, resource specialists, in addition to a site-specific environmental analysis. Not all leases that are issued proceed to development. The environmental review performed during Stage 3 allows site-specific information regarding local resource conditions to be evaluated and potential impacts disclosed. During the Stage 3 project-specific analysis, the BLM would finalize design features, COAs, and BMPs that would be applied to a site-specific project, which would include standards and guidelines from the Forest Plan where a project proposes to occupy NFS surface (USFS 2006a). If surface occupancy on NFS lands is proposed, a Surface Use Plan of Operations

(SUPO) would be submitted and reviewed by the BLM and USFS. See Section 2.2, *Proposed Action,* for more information.

1.3. Legal and Regulatory Authorities

Refer to Appendix E (*Legal and Regulatory Authorities*) for a description of legal and regulatory authorities relevant to the Proposed Action.

CHAPTER 2. ALTERNATIVES

CEQ's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (CEQ 2016) and their *Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act* (CEQ 2020) establish policies for federal agencies, including "using the NEPA process to identify and assess reasonable alternatives to the Proposed Action that would avoid or minimize adverse effects of these actions on the quality of the human environment" (40 CFR 1500.2(e)). In addition, 40 CFR 1502.14(a) requires agencies to evaluate "reasonable alternatives to the proposed action, and, for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination" in NEPA documents. This chapter provides a detailed description of the Proposed Action and alternatives considered from the 2016 EA for analysis in this Supplemental EA.

2.1. Alternative A – No-Action Alternative

CEQ guidelines require that a No-Action Alternative be analyzed to assess environmental consequences that may occur if the Proposed Action is not implemented. The No-Action Alternative also serves as a baseline for comparing the potential impacts of the Proposed Action in Chapter 3, *Affected Environment and Environmental Impacts*. The No-Action Alternative in this Supplemental EA is generally the same as the No-Action Alternative included in the 2016 EA (BLM 2016).

Under the No-Action Alternative, the BLM would not make federal minerals in the Marietta Unit available for oil and gas leasing, including both the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit. Selecting the No-Action Alternative would necessitate rescinding any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Rescinding the leases is necessary because the *CBD* court, in in its 2021 remedy order (Appendix C, *CBD Decision Court Orders*), expressly declined to vacate the leases, so they remain in effect, although they are subject to certain use restrictions specified by the remedy order. Without any leases (the No-Action Alternative), operators would not be authorized to access federal minerals resulting in stranding of federal minerals and loss of potential future royalties but could develop adjacent, privately owned minerals, potentially resulting in drainage of federal minerals. However, in the absence of a land use plan amendment closing the lands to leasing, they could be considered for inclusion in future lease sales, if they are renominated.

2.2. Alternative B – Proposed Action

The BLM is responding to the *CBD* Court Order Decision to remand the 2016 EA and associated decision by proposing potential leasing of up to 40,000 acres of federally owned mineral estate in the WNF, Athens Ranger District, Marietta Unit, in Monroe, Noble, and Washington Counties in Ohio. This acreage represents the total amount of federally owned minerals that have been leased or could be nominated and potentially made available for leasing on the Marietta Unit. Although this Supplemental EA assumes that both oil and gas may be produced in the future within the Marietta Unit, natural gas is more likely to be produced.

The Proposed Action from the 2016 EA remains the same for this Supplemental EA. However, in 2018, USFS announced plans to revise the 2006 Forest Plan (USFS 2006a). In response to a

USFS request, the BLM prepared an updated RFDS in 2020 to support the anticipated 2006 Forest Plan (USFS 2006a) revision. Although the Forest Plan revision was not completed, this Supplemental EA nonetheless incorporates the updated projections made in the 2020 RFDS (Appendix D) to characterize environmental impacts rather than the 2006 RFDS (USFS 2006a) and the 2012 SIR (USFS 2012) because the 2020 RFDs incorporates more current information.

According to the BLM's 2020 RFDS, all wells in the WNF are projected to be primarily gas wells, many of which would also produce some oil. No oil-only wells are projected in the WNF. Most of these wells are projected to be horizontally drilled gas wells from non-federal surface pads using hydraulic fracturing. For reader reference, an overview of the drilling process, hydraulic fracturing, and how it is practiced is provided in the 2016 EA (BLM 2016), Section 2.2.1, as well as in Section 9.2 of the BLM's 2020 RFDS (Appendix D). That information is incorporated by reference into this Supplemental EA.

The BLM's 2020 RFDS (Appendix D) also identified the potential leasing area as all lands (federal and non-federal) within the Proclamation Boundary of the WNF plus 4 miles into other portions of Ohio, though the Marietta Unit is the only unit in the WNF determined to have reasonably foreseeable development. This area encompasses the extent of where potential surface impacts associated with drilling could occur because hydraulic fracturing technologies that are reasonably foreseeable allow private landowners up to 4 miles outside of the Marietta Unit to access federal subsurface minerals in the WNF. Coordination with the Ohio Department of Natural Resources (ODNR) indicates it is not realistic for an operator to drill from West Virginia into Ohio minerals. Wells drilled from West Virginia cannot enter mineral estate owned by the State of Ohio, and any West Virginia drill hole would have to pass through Ohio minerals before entering federal minerals underlying the WNF. Since drilling into Ohio minerals from West Virginia would not be authorized, there is no reasonable chance for someone to drill from West Virginia under the Ohio River and access federal minerals (Holzel and Grubaugh, pers. comm.). Based on recent drilling activity, the 2020 RFDS (Appendix D) forecast of proposed wells estimated that all wells would be developed within the Marietta Unit and a 4-mile buffer, where operators can access the underlying Point Pleasant/Utica formations, Marcellus Shale, and Clinton sandstone. For this reason, the Analysis Area analyzed for the Proposed Action is the Marietta Unit, plus a 4-mile buffer into Ohio.

Of the approximately 855,532 acres within the WNF Proclamation Boundary, USFS manages approximately 244,265 acres of surface estate (29 percent). When the 2020 RFDS (Appendix D) was prepared, approximately 172,157 acres of federal minerals were within the WNF Proclamation Boundary (BLM 2020). The Proposed Action only applies to the leasing of federal minerals, regardless of the amount of federal surface interest. USFS has authority to purchase lands, and some mineral rights owned by private parties may revert to United States ownership after a set period of time, which may add to the total acreage of federal minerals available for lease.

The BLM EOI process is used to review federal minerals nominated for leasing. To date, interested parties have submitted more than 89 EOIs, totaling approximately 29,000 acres, for parcels on the Marietta Unit (Figure 3). To date, 65 total leases have been executed, including 36 leases being litigated under the *CBD* Court Order Decisions (Appendix C) that were issued from December 2016 to March 2017 and 29 leases that were remanded by the *CBD* Court Order

Decisions (Appendix C) that were issued from June 2017 through December 2019 until the NEPA deficiencies identified by the court decisions are addressed.

As leasing nominations are received, the BLM and USFS review specific information about the lands nominated to ensure they contain federal minerals and are administratively available for lease (are not already leased, not within incorporated towns). If the Proposed Action is approved, the BLM would affirm the issuance of the leases, and make "eligible and available" determinations for those parcels that have not yet been offered for competitive lease. Prior to offering any parcels for lease, the BLM would need to request and receive USFS consent. Additionally, if the Proposed Action is approved, the Forest Service will undertake an analysis under 36 C.F.R. § 228.102(e) for the consent authorizations remanded by the *CBD* Court, including those consent authorizations underlying leases issued pursuant to the 2016 EA.

In accordance with 43 CFR Part 3120.4-1, prior to a lease sale, parcels proposed for leasing at a given quarterly lease sale would be identified, along with any attached stipulations and notices, through a Notice of Competitive Lease Sale. Under 43 CFR 3120.4-2, the notice must be posted at the BLM office having jurisdiction over the lands at least 45 days prior to a lease sale. Oil and gas leases are issued for a 10-year period and continue for as long thereafter as oil or gas is produced in paying quantities.

A federal oil and gas lease is a legal contract that grants exclusive rights to the lessee to develop federally owned oil and gas resources, but it does not immediately authorize surface-disturbing activities, nor does it obligate the lessee to drill a well on the parcel or into the oil and gas below the parcel in the future. For leases that proceed to development, developers or operators who secured leases are required to submit APDs as part of the Stage 3 environmental review, which typically includes an initial on-the-ground, site-specific field evaluation by the BLM, and USFS if the project is on NFS surface, resource specialists, in addition to a site-specific environmental analysis. Based on past experience, not all leases that are issued proceed to development. The environmental review performed during Stage 3 allows site-specific information regarding local resource conditions to be evaluated and potential impacts disclosed. During the Stage 3 project-specific analysis, the BLM would finalize design features, COAs, and BMPs that would be applied to a site-specific project, which would include standards and guidelines from the Forest Plan where a project proposes to occupy NFS surface (currently USFS 2006a).

If surface occupancy on NFS lands is proposed, a SUPO would be submitted by the lessee and reviewed by the USFS. No permit to drill on a federal oil and gas lease on NFS lands may be granted without the analysis and approval of a SUPO covering proposed surface disturbing activities. An operator must obtain an approved SUPO before conducting operations that will cause surface disturbance on NFS Lands. Refer to 35 CFR 228.106 for additional information on the USFS oil and gas leasing regulations associated with SUPOs.

There will be no surface disturbance from the action of leasing, but this EA will analyze reasonably foreseeable impacts of leasing to determine whether significant environmental impacts will require further environmental analysis in the form of an EIS, or whether a FONSI may be issued. As such, this Supplemental EA analyzes the 2020 RFDS (BLM 2020) to address the possible environmental effects from potential future oil and gas development on existing and future leases. Estimates can be made about the most likely number of wells that could be constructed, but the specific locations and other important factors cannot be determined until

site-specific APDs are submitted by operators. At this stage (Stage 3), additional analysis of potential impacts associated with surface disturbance and other project-related activity for specific development proposals will occur.

2.2.1. Reasonably Foreseeable Development Scenario for Potential Oil and Gas Development

This Supplemental EA relies on the scenarios in the 2020 RFDS (Appendix D) to estimate the amount and extent of future oil and gas development and anticipated impacts associated with that development in the Action Area. The 2016 EA relied on the 2006 RFDS (Appendix G of the 2006 Forest Plan [USFS 2006a]) and the 2012 SIR (USFS 2012) to consider the anticipated impacts, both of which included lower estimates of horizontal well development and surface disturbance compared to the 2020 RFDs. The 2012 SIR noted that horizontal wells were becoming an economically feasible approach to mineral development in the area. The 2020 RFDS (BLM 2020) acknowledged the feasibility of the use of high-volume hydraulic fracturing based on improved technology and other factors and projected an increased level of well development and surface disturbance compared to the 2006 RFDS. Because the 2020 RFDS provided a more current and accurate estimate of the potential for future development of leases, this Supplemental EA applies the information and estimates in the 2020 RFDS.

2.2.1.1. Number of Wells and Well Pads

The 2020 RFDS (Appendix D) projected that up to 29 well pads for horizontal drilling would be constructed to support up to 81 unconventional (horizontally drilled) wells within the Action Area between 2020 and 2034 (Appendix D, p. 2). Based on this forecast of proposed wells, construction of up to two well pads is anticipated each year, with two to three wells estimated per pad, for up to six wells per year (Appendix D, pp. 36–38).

2.2.1.2. Surface Disturbance

The 2020 RFDS (Appendix D) predicts that 81 new horizontally drilled wells (some potentially drilled from well pads containing multiple wells) would be drilled in the Action Area. Some of these wells would target the Marcellus Shale, but most were projected to target the deeper Point Pleasant/Utica formations. Well pads used to support horizontally drilled wells in southeastern Ohio have ranged in disturbance acreage from 6 to 35 acres, depending on topography, access, pipelines, and the number of wells proposed per pad. After initial construction of a well pad, access roads, and any pipelines, most of the associated disturbance is typically regraded and seeded as interim reclamation measures for preventing erosion. Well pads, access roads, and other disturbance remaining after interim reclamation range from 3 to 10 acres and typically remain until final reclamation is complete.

All reclamation activities accessing federal minerals from federal and private surface would be performed in accordance with the *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (commonly referred to as the Gold Book) (BLM and USFS 2007), which provides information about the requirements for obtaining permit approval and conducting environmentally responsible oil and gas development, operation, and reclamation on federal lands and private surface overlying federal minerals. Interim reclamation consists of reducing the original disturbance footprint by reclaiming portions of the well site not needed for production

operations. Final reclamation requires the well site be recontoured to original contour or to a contour that blends with the surrounding landform, with stockpiled topsoil evenly redistributed and the site revegetated (BLM and USFS 2007). Refer to Section 9.2.3 in the 2020 RFDS (Appendix D) for additional information about reclamation.

Based on recently installed well pads and wells in the Action Area, it is estimated that oil and gas activity in the Action Area for the 15-year planning period would result in between 171 and 998 new acres of initial disturbance and 86 to 285 acres of longer-term disturbance remaining after interim reclamation and until final reclamation of the pad, access roads, and other infrastructure is complete (Table 2-1). The projected surface disturbance in the 2020 RFDS (Appendix D) included all acreage potentially affected by future oil and gas development activities, such as road construction, well-pad construction, water storage tanks, construction of turnaround/production facility areas, pipelines, staging areas, water impoundments, and other related activities (Appendix D).

Table 2-1. Potential Disturbance in the Action Area Projected by the Reasonably Foreseeable Development Scenario

SURFACE DISTURBANCE DESCRIPTION	15-YEAR PLANNING PERIOD
Total Initial Acres of Surface Disturbed by Oil and Gas Drilling before Reclamation	171 to 998
Total Acres of Surface Needed to Support Long-Term Production (Disturbance Remaining After Interim Reclamation)	86 to 285

Source: BLM 2020.
Note: As described in the 2020 RFDS (Appendix D), unconventional well pads in southeastern Ohio have ranged in disturbance acreage from 6 to 35 acres, depending on topography, access, pipelines, and the number of wells proposed per pad. After initial construction of a well pad, access roads and any pipelines, most of the associated disturbance is typically regraded and seeded as interim reclamation to prevent erosion. Well pads and access disturbances remaining after interim reclamation range from 3 to 10 acres and typically remain until final reclamation (i.e., when wells plugged).

2.2.2. Phases of Oil and Gas Development

For a characterization of the phases of oil and gas development for both conventional (i.e., vertical) and unconventional (i.e., horizontal) drilling techniques, refer to Section 2.2.1 of the 2016 EA and Section 9.2 of the 2020 RFDS (Appendix D). In addition, Table 3-2 of this Supplemental EA provides a comparison of techniques, equipment, and impacts resulting from conventionally (vertically) completed wells versus hydraulically fractured wells using horizontal drilling.

2.2.3. Best Management Practices, Environmental Protection Measures, and Lease Stipulations

In order to lease and develop federal minerals, operators must execute a standardized lease form (BLM Form 3100-011, *Lease for Oil and Gas* [BLM 2023]) regardless of whether the operator intends to drill on federal or private surface.

Form 3100-011 defines 14 lease terms, including Section 6, *Conduct of operations*, which directs:

> Lessee must conduct operations in a manner that minimizes adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to other land uses or users. Lessee must take reasonable measures deemed necessary by lessor 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.… Lessee may be required to complete minor inventories or short term special studies under guidelines provided by lessor. If in the conduct of operations, threatened or endangered species, objects of historic or scientific interest, or substantial unanticipated environmental effects are observed, lessee must immediately contact lessor. Lessee must cease any operations that would result in the destruction of such species or objects (BLM 2023).

Under Section 6, the lessee agrees to minimizing environmental impacts and the BLM has authority as the lessor to require the lessee to do so. Inventories and technical studies may be requested to ensure impacts are minimized and operations may be suspended if sensitive resources are identified (BLM 2023).

2.2.3.1. Environmental Protections Required for a Federal Minerals Lessee Applying to Drill on NFS Lands

Appendix F (*Existing Stipulations, Notifications, Guidelines, and Standards*) contains existing SFWs, guidelines, stipulations, and notices for NFS lands. SFWs and forest-wide guidelines (GFWs) are required components for every lease that would be issued under the Forest Plan (USFS 2006a) that proposes accessing federal minerals from federal surface. If an operator desires to depart from a notification or stipulation, an analysis, and a signed decision by a USFS Responsible Official would be required. All stipulations (1 through 17) in the Forest Plan (USFS 2006a) were adopted as SFW-MIN-9, SFW-MIN-10, and SFW-MIN-11. As such, a Forest Plan Amendment would be required to depart from one or more notifications or stipulations.

Standards set limits for management activities. These limitations are designed to help USFS attain desired Forest conditions and fulfill management objectives for the WNF. Standards also ensure compliance with laws, regulations, Executive Orders (EOs), and policy direction. Deviations from standards must be analyzed and documented in a Forest Plan Amendment. In contrast to standards, guidelines are preferred limits to management actions and are expected to be followed. They help USFS attain desired forest conditions and fulfill objectives for the WNF, while permitting some operational flexibility to respond to specific situations. Deviations from guidelines must be analyzed during environmental review at the APD stage and documented in a project decision document. However, these deviations do not require a Forest Plan Amendment.

2.2.4. Avoidance and Minimization Measures for Species Protected under the Endangered Species Act (Applicable to All Lands)

Pursuant to Section 7 of the Endangered Species Act (ESA), the BLM and USFS are consulting with the U.S. Fish and Wildlife Service (USFWS) on potential impacts on federally listed threatened, endangered, proposed, and candidate species. Agency coordination with the USFWS to date has resulted in identification of avoidance and minimization measures designed to avoid and minimize potential impacts on federally listed species and are hereby incorporated into the Proposed Action as required measures (Appendix G, *USFWS Recommended Measures for*

Avoiding and Minimizing Adverse Impacts to Federally Listed Species). They include measures for federally protected bats, mussels, and plants that have potential to occur in the Analysis Area. These measures apply to federal land and private land development activities that access federal minerals associated with the Proposed Action, except in cases where disturbance would occur to access private minerals, but no further surface disturbance would be needed to access federal minerals. These measures may be further refined as consultation with USFWS continues as part of the ESA consultation process. The final measures may be included in the Biological Opinion (BO) for the project and the Decision Record.

2.3. Alternatives Considered, but Eliminated from Detailed Analysis

2.3.1. No Surface Occupancy

Offering all leases with an NSO stipulation was suggested during internal discussions between the agencies. Such stipulations would prohibit the surface use of USFS lands to access federal minerals. As indicated in the BLM Planning Handbook (BLM 2005; H-1624-1) designating an area as NSO is a land use planning decision. The Forest Plan did not designate the Action Area as NSO and as such an NSO designation alternative for the area would not conform to the Forest Plan and would require a Forest Plan amendment. This alternative would also not fulfill the purpose and need described in Chapter 1 for two reasons. First, requiring all future drilling to take place off the federal surface may force operators to use locations that result in greater adverse impacts on natural resources compared to impacts on the federal surface. The leasing stipulations provided in the Forest Plan (USFS 2006a) would mitigate impacts from oil and gas development on federal surface. Second, the federal government has more authority to protect natural resources on federal lands than on private lands. As nominated parcels are reviewed, the BLM, in coordination with USFS, determines which stipulations and notices must be attached to approved lease parcels, including, where appropriate, NSO stipulations.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter contains the impacts analysis for the Proposed Action and No-Action Alternative, organized by resource issue. Section 3.1, *Resources Considered for Analysis*, describes all resources considered in the evaluation of the Proposed Action and No-Action Alternative and their treatment in this Supplemental EA. Each resource section begins with a description of the existing conditions within a specified review area, followed by an analysis of the potential impacts (as defined in 40 CFR 1508) that could result from the Proposed Action and No-Action Alternative. The administrative act of offering parcels for oil and gas leasing and the subsequent issuing of leases would have no direct impacts. All anticipated resource impacts would be associated with the potential impacts of future oil and gas development of federal mineral leases during the APD process on both NFS lands in the Marietta Unit and private lands within the Analysis Area (the Marietta Unit plus a 4-mile buffer into Ohio). The 4-mile buffer is used to account for the lateral reach of horizontal wells that could be used to access the federal minerals in the Action Area.

3.1. Resources Considered for Analysis

The *CBD* Decision Court Orders (Appendix C) found deficiencies in the following areas, which are the basis of issues analyzed in detail in this Supplemental EA:

- Surface area disturbance associated with hydraulic fracturing including well pads, gathering pipelines, water impoundments, staging areas, access roads, and other typical infrastructure associated with hydraulic fracturing development,
- Cumulative impacts on Indiana bat and Little Muskingum River, and
- Impacts on air quality

Table 3-1 presents the issues analyzed in detail in this Supplemental EA. Refer to Appendix A (*Issues Not Included in Further Detail in this Environmental Assessment*) for a description of resource issues that were considered but not carried forward in this Supplemental EA and the rationale.

Table 3-1. Issues Analyzed in Detail

RESOURCE	ISSUE STATEMENT
Air Resources	How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing techniques impact local air quality?
Climate Impacts	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact climate change and greenhouse gas emissions?
Vegetation and Rare Plants	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact vegetation communities and rare plant species in the region?
Water Resources	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact water resource quantity and quality, wetlands, and riparian areas in the region, including the Little Muskingum River watershed?

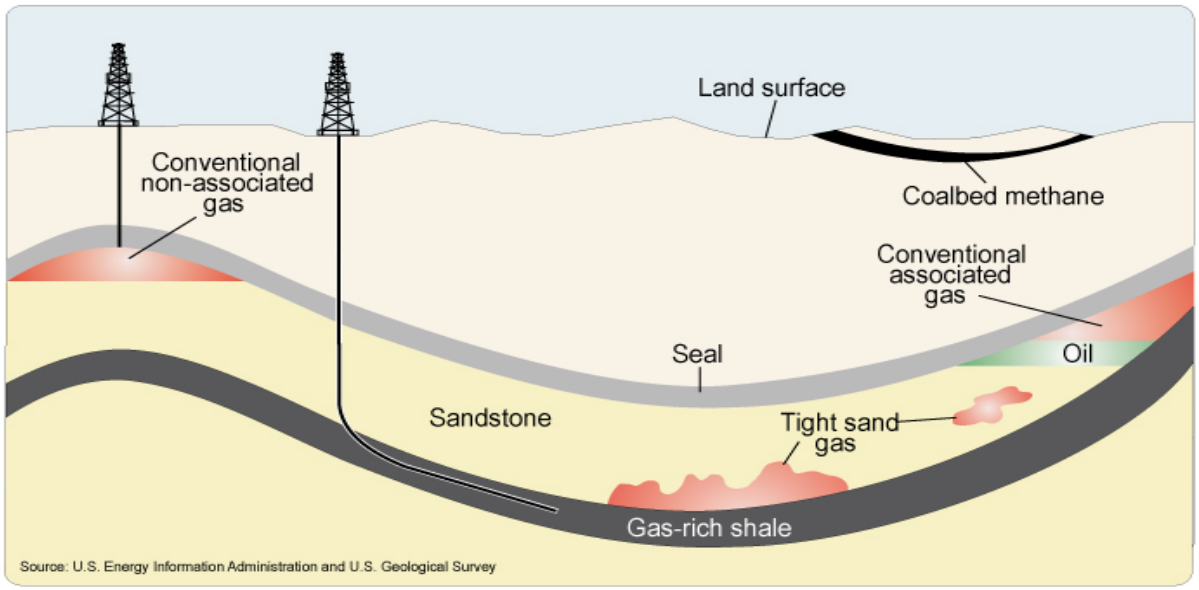
RESOURCE	ISSUE STATEMENT
Aquatic Wildlife	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact aquatic wildlife species in the region, including federally protected mollusk species?
Terrestrial Wildlife	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact terrestrial wildlife species in the region, including Indiana bat, northern long-eared bat, and tricolored bat?
Transportation	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact transportation in the region?
Socioeconomics and Environmental Justice	How would increases in surface disturbance and use of high-volume hydraulic fracturing drilling techniques impact social and economic conditions and environmental justice communities in the region?

3.2. Scope of the Analysis

In this Supplemental EA, the 2020 RFDS (Appendix D) has been used to estimate the extent of future oil and gas development in the Analysis Area and the associated potential impacts from reasonably foreseeable oil and gas development as a result of leasing federal minerals in the Marietta Unit. *Short-term impacts* from potential development are considered those that would be stabilized or mitigated within 5 years, and *long-term impacts* are those that would substantially remain for more than 5 years. *Cumulative impacts* include the combined impact of past projects, specific planned projects, and other reasonably foreseeable future actions, such as siting infill wells (wells drilled between producing wells for the purpose of more efficient recovery of petroleum from the reservoir). BMPs, standard operating procedures, and mitigation measures that could be implemented are also discussed within the context of each resource section. If actual mineral development on a lease parcel(s) were proposed, then additional site-specific environmental analysis would be conducted at the APD stage.

3.2.1. Vertically Drilled/Vertical Completions versus Horizontally Drilled/Hydraulically Fractured Completions

Horizontal drilling and hydraulic fracturing completions technologies have made it possible to commercially develop gas reserves, particularly shale gas reserves. The 2020 RFDS (Appendix D) assumed that most new wells in the WNF would be horizontally drilled, natural-gas wells, with high-volume hydraulic fracturing the predominant well-stimulation technique (BLM 2020). Therefore, Table 3-2 compares the general activities associated with horizontally drilled, hydraulically fractured wells to vertically drilled and completed wells. The parameters described for vertical well completions are provided for comparison purposes only as the only types of wells projected in the RFDS are unconventional horizontally drilled wells. The horizontally drilled, hydraulically fractured well-parameter values summarized in Table 3-2 are considered in the impact analysis described in this Chapter. Figure 4, below, depicts oil and gas drilling using vertical (the drill on the far left of Figure 4) and horizontal drilling techniques (the drill second to the left on Figure 4).



Source: U.S. Energy Information Administration 2011.

Figure 4. Oil and Gas Drilling Using Vertical and Horizontal Drilling Techniques

Table 3-2. Representative Differences between Vertically Drilled Wells and Horizontally Drilled Wells Completed using Hydraulic Fracturing

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Disturbance Area	**Short-term Disturbance[1]:** • The total acreage of surface disturbance by oil and gas drilling activity before interim reclamation averages approximately 0.7 to 1.1 acres (USFS 2012). • Short-term disturbance lasts approximately 2 to 4 weeks (Lioudis 2022). • Vertical wells require tighter spacing and are typically drilled from individual well pads. **Long-term Disturbance[2]:** • The total acreage of surface needed to support drilled wells that were completed for production (excess disturbance reclaimed) averages approximately 0.6 to 0.7 acre (USFS 2012). • Long-term disturbance lasts approximately 20 to 30 years, until the well is plugged (BLM 2020).	**Short-term Disturbance:** • The total acreage of surface disturbance by oil and gas drilling activity before interim reclamation averages approximately 6 to 35 acres (BLM 2020). • Short-term disturbance lasts approximately 8 to 10 weeks (Lioudis 2022). • Horizontal wells can be dispersed more than vertical wells (due to longer lateral reach) and typically include multiple wells per pad. **Long-term Disturbance:** • The total acreage of surface needed to support drilled wells that were completed for production (excess disturbance reclaimed) averages approximately 3 to 10 acres (BLM 2020). • Long-term disturbance lasts approximately 20 to 30 years, until the well is plugged (BLM 2020).
Well Depth	• Well depth varies from less than 1,000 feet to more than 10,000 feet (BLM 2020).	• Horizontal wells in the Marcellus and Utica Shales can reach from 5,000 to 10,000 feet below the surface (BLM 2020). • Horizontal wells in the area are around 10,000 feet deep.

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Well Lateral Reach	• There is no lateral reach associated with vertical wells as the well bore is generally vertical as depicted on Figure 4.	• In 2017, the average length of laterals in the Utica formation (located primarily in Ohio) was 8,628 feet (EIA 2018). • The reasonably foreseeable extent of lateral reach for a horizontal well in this EA is assumed to be up to 4 miles (BLM 2020). There are examples of longer lateral reaches. For example, in Monroe County, Ohio, a horizontal well reached a total well length of approximately 30,676 feet (5.8 miles) in Utica/Point Pleasant Shale (ODNR 2018). However, these longer lateral reaches are not common.
Process Duration (Days of continuous 24-hour drilling activity)	• Although many variables can affect drilling time, a typical vertical well takes about 3 days to drill (BLM 2020).	• Although many variables can affect drilling time, a typical horizontal well takes from 5 days to 25 days to drill. • Multiple wells may be drilled in succession, thus increasing the number of consecutive drilling days. Well pads used for horizontal drilling in the area of the WNF may contain one to eighteen or more wells, with three wells per well pad being common (BLM 2020). • Completing a well using hydraulic fracturing typically takes additional 10 days. If there are multiple wells on a pad, completions would take longer to complete each well.

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Noise Impacts per Pad	• Drilling is a continuous operation until the total depth of the well is reached, typically about 3 days (BLM 2020). • Noise levels at drilling sites measured at approximately 63 decibels at 200 feet from the source (BLM 1999)	• Drilling is a continuous operation until the total depth of the well is reached, typically about 5 days (BLM 2020). As such, duration of noise impacts during drilling is typically longer than for vertical drilling. • Noise levels at drilling sites generally average 65 decibels at 350 feet from the source (Radtke 2016). • Noise levels at hydraulic fracturing sites generally average 69 decibels at 350 feet from the source (Radtke 2016). • Noise levels at production sites generally average 47 decibels at 350 feet from the source (Radtke 2016). • Increased amounts of heavy-truck traffic, mainly for hydraulic fracturing waste transport, would result in increased noise levels along access routes.
Visual Impacts per Well	**Short-Term[2]**: • Disturbance averages 0.7 to 1.1 acres and lasts in the landscape 2 to 4 weeks (USFS 2012; Lioudis 2022). • The height of the drilling rig (its tallest component) is typically 80 to 100 feet, depending on well depth (BLM 2020). • Because drilling is a continuous operation until the total depth of the well is reached, sites are lit at night, and the rig masts are lit for aircraft safety (BLM 2020).	**Short-Term**: • Disturbance averages 6 to 35 acres and stays in the landscape for 8 to 10 weeks (BLM 2020; Lioudis 2022). • The height of the drilling rig (its tallest component) is typically 80 to 100 feet, depending on well depth (BLM 2020). • Because drilling is a continuous operation until the total depth of the well is reached, sites are lit at night, and the rig masts are lit for aircraft safety (BLM 2020).

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
	• Short-term impacts associated with construction also would include heavy equipment and employee vehicles (stationary and traveling to/from well pad locations) and fugitive dust. **Long-Term[1]**: • Disturbance averages 0.6 to 0.7 acre and lasts in the landscape 20 to 30 years (USFS 2012). • Wells might produce for many years, depending on the resource; drilling rigs are typically in place only during the drilling phase.	• Short-term impacts associated with construction would also include heavy equipment, heavy-truck traffic, employee vehicles (stationary and traveling to/from well pad locations), and fugitive dust. • The tallest hydraulic fracturing–related unit on site is typically a 43-foot-tall pump in place for limited days needed to conduct hydraulic fracturing on all wells (BLM 2019). • Short-term impacts are associated with increased amounts of heavy-truck traffic, mainly for hydraulic fracturing waste transportation. **Long-Term**: • Disturbance averages 3 to 10 acres and lasts 20 to 30 years in the landscape (BLM 2020). • Wells might produce for many years, depending on the resource; drilling rigs are typically in place only during the drilling phase. • Hydraulic fracturing could occur at any time during a well's productive life (typically lasting 1 to 2 days). To help retain a consistent production rate, a well may need to be hydraulically fractured on a periodic basis, which necessitates additional heavy equipment, water storage, and vehicle traffic (OEPA 2020).

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Air Emissions	• In addition to contributing to the formation of ozone, VOC emissions from the oil and gas industry include air toxics, such as benzene, ethylbenzene, and n-hexane (USEPA 2022).	• In addition to contributing to the formation of ozone, VOC emissions from the oil and gas industry include air toxics, such as benzene, ethylbenzene, and n-hexane (USEPA 2022). • During hydraulic fracturing's gas-collection process, it is estimated that 3.6 to 7.9 percent of methane leaks into the atmosphere during the service life of a hydraulically fractured well (Mrdjen and Lee 2016). • Additional vehicle trips required for hydraulic fracturing would increase tailpipe emissions (see Vehicle Trips per Pad, below).
Water Use	• Conventional drilling activities typically use approximately 44,000 to 85,000 gallons (or 0.044 to 0.085 Mgal) of water per well (BLM 2012).	• Horizontal wells in Monroe, Washington, and Noble Counties have been reported to use between 19 and 27 Mgal of water per well during drilling and completion (OEPA 2020). During operations, horizontal wells have been found to use between 2 and 6 Mgal of water per well (University of Michigan 2013). If recompletion of a well is required additional water would be needed. • Because horizontal completions take longer and require more water, the timeframe during which water is drawn is longer than for vertical drilling and conventional completions.

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Water Disposal	• Wastewater discharge tends initially to be modest and increases with a well's production age, producing a smaller amount of near-term wastewater volume but a larger amount of water discharge the longer they exist (Xu et al. 2022). • Approximately 98 percent of produced wastewater is disposed of via underground injection into Class II wells that USEPA and the State of Ohio regulates, and 2 percent is spread for dust and ice control subject to local government approval and requirements (ODNR 2023c).	• Wastewater generation is concentrated in the early stage of production and declines with a well's production age, producing a larger amount of near-term wastewater volume and water discharge decreasing the longer they exist (Xu et al. 2022). • Concentrations of inorganic elements and radioisotopes are generally higher (USEPA 2019). • Flowback from hydraulic fracturing is required to be treated separately. It is typically maintained in segregated tanks and disposed of per ODNR-DOGRM regulations. • Approximately 98 percent of produced wastewater and fracturing flowback is disposed of via underground injection into Class II wells that USEPA and the State of Ohio regulates (ODNR 2023c).
Pad Operations	• Pad operations typically have a 20- to 30-year life span (BLM 2019).	• Pad operations typically have a 20-to-30-year life span. • Hydraulic fracturing could occur at any time during a well's productive life and lasts 1 to 2 days. This most frequently occurs as soon as a well drilling is complete, or shortly thereafter (BLM 2019) but additional rounds of hydraulic fracturing may occur on a periodic basis during production to help maintain target production rates (OEPA 2020).

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Pad Construction Vehicle Trips	• Vehicle trips during the construction phase of vertical drilling include equipment trucks, worker trips, water trucks, and product transport. • On average, 287 trips are needed for construction of one well pad with one vertical well that is not hydraulically fractured (CDOT 2015).	• Vehicle trips during the construction phase include equipment trucks, worker trips, water trucks, and product transport. • A study in Colorado found that on average, 1,941 trips are needed for construction of one well pad with one horizontal well that is hydraulically fractured (CDOT 2015) and on average, 6,414 trips are needed for construction of one well pad with three horizontal wells that are hydraulically fractured (CDOT 2015). • If wells require additional rounds of hydraulic fracturing during the production lifetime additional vehicle trips would occur. A study in the Permian Basin estimated that re-fracking a well can require up to 80 percent of the original truck trips needed during initial completions/fracking (Texas A&M 2016).
Well Operations Vehicle Trips	• Vehicle trips during the operational phase of vertical drilling could include trucking water to dispose of produced water.	• Increased vehicle trips during the operational phase of horizontal drilling could include trucking water to dispose of produced water. A study in the Permian Basin estimated that up to 349 truck trips are required during well operation/production activities for a single horizontal well (Texas A&M 2016)

CATEGORY	VERTICALLY DRILLED AND COMPLETED WELLS/PADS	HORIZONTALLY DRILLED AND HYDRAULICALLY FRACTURED COMPLETED WELLS/PADS
Workers for Well Pad Construction and Drilling	• Crews of two to five daytime workers are typically employed to construct each well pad. Well pad construction typically lasts seven to 10 days (BLM 2019) • Crews of approximately 12 workers are typically employed to drill each well (BLM 2019). BLM data indicates that wells drilled in shallow formations typically take two to four days to drill (BLM 2019).	• Crews of two to five daytime workers are typically employed to construct each well pad. Well pad construction typically lasts seven to 10 days (BLM 2019) • Crews of approximately 12 workers are typically employed to drill each well (BLM 2019). BLM data indicates that wells drilled in shallow formations typically take two to four days to drill (BLM 2019) with longer/deeper wells taking longer.
Workers for Well Pad Operations/Production	• Typically, five to eight employees for a standard 12-hour shift (BLM 2019).	• Typically, eight to 15 employees are required for each shift (typically a 12-hour standard shift), and usually no more than one shift is required per day. Additional personnel from the owner/operator may be on site to observe and run ancillary equipment, as necessary (BLM 2019).

Notes:
[1] *Short-term surface disturbance impacts* are defined as disturbance associated with well-pad construction (including access roads, staging areas, water impoundments, pipelines) and well completion (when well is ready to produce oil or gas). Interim reclamation occurs following these activities.
[2] *Long-term surface disturbance impacts* are defined as disturbance associated with well operation.
DOGRM = Division of Oil and Gas Resources Management; EIA = U.S. Energy Information Administration; Mgal = million gallons; OEPA = Ohio Environmental Protection Agency; USEPA = U.S. Environmental Protection Agency; VOC = volatile organic compound.

3.2.2. Cumulative Impacts

To estimate the potential for and significance of cumulative impacts, the impacts of each alternative were considered in conjunction with past and present actions and those of the reasonably foreseeable actions. See Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions)* for a list of all actions considered in the cumulative analysis.

The BLM NEPA Handbook (BLM 2008) recommends the establishment of geographic and temporal boundaries for cumulative impacts analysis. For the majority of resource categories in this Supplemental EA, the Cumulative Impact Analysis Area (CIAA) includes the Marietta Unit of the WNF and a 4-mile buffer surrounding the unit. This area encompasses the extent of where potential impacts associated with the Proposed Action could overlap impacts from reasonably foreseeable future actions and result in cumulative impacts (Figures H-1 and H-2 in Appendix H). This area also includes other notable development activities that could contribute to cumulative impacts. Certain resource categories, as specified in their respective discussions, include a larger CIAA based on the nature of potential impacts on that resource, such as water resources, which includes a CIAA that encompasses the extent of the Hydrologic Unit Code (HUC-) 12 watersheds that intersect the Action Area (Figure 7).

The cumulative impacts analysis timeframe (temporal scope) considered is 55 years, including 20 years into the past and 35 years into the future. Oil and gas leases are typically issued for a 10-year period and continue for as long as oil or gas is produced in paying quantities. The potential for projects to occur more than 35 years in the future would be speculative, as the average life expectancy of producing unconventional wells is 25 to 40 years (BLM 2020). Aside from air quality and climate impacts, the cumulative impacts analysis does not consider potential leasing in other areas of the WNF, such as the Athens Unit or Ironton Unit. This is because the RFDS (BLM 2020) and the Proposed Action in this EA is associated solely with potential development in the Marietta Unit. Any future leasing in the Athens Unit or Ironton Unit would require a separate NEPA review.

3.3. Air Resources

3.3.1. Affected Environment

The affected environment for air resources is summarized in Section 3.2 of the 2016 EA (BLM 2016), and that summary is incorporated here by reference. As was the case in 2016, Monroe and Noble counties remain designated as attainment areas for all National Ambient Air Quality Standards (NAAQS). Waterford Township in Washington County has been designated as a nonattainment area for the primary sulfur dioxide (SO_2) NAAQS since 2010, although the SO_2 nonattainment area does not include and is not adjacent to the Marietta Unit. All of Washington County, including part of the Marietta Unit, is designated as attainment-maintenance for the ozone (O_3) and particulate matter 2.5 micrometers or less in diameter ($PM_{2.5}$) NAAQS issued in 1997 (USEPA 2023a). Additional information regarding the existing climate and air quality within the area potentially impacted by the parcels under consideration for leasing is provided in Appendix I (*Air Quality and Climate)* of this Supplemental EA.

3.3.2. Environmental Impacts

Potential impacts on air resources from all activities in the oil and gas program were summarized in Section 4.2 of the 2016 EA (BLM 2016), and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because the analysis of air resources in the 2016 EA did not quantify estimated air quality emissions or consider the updated reasonably foreseeable development and associated emissions in the 2020 RFDS (Appendix D).

3.3.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including both the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on air resources from oil and gas management, as analyzed in Section 4.2 of the 2016 EA (BLM 2016).

3.3.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact local air quality?

The administrative act of offering parcels for oil and gas leasing and the subsequent issuing of leases would have no impacts on air quality. Any potential impacts on air quality from the sale of lease parcels would occur at such time that any issued leases are developed and not at the leasing stage itself. The Proposed Action does not authorize or guarantee the number of wells analyzed herein. If leased, drilling of wells on a lease would not be permitted until the BLM approves an APD. Any APD received would be subject to site-specific environmental review. However, reasonable development estimates have been made in this Supplemental EA to better inform decision makers and the public of potential impacts on air quality if the leases were developed.

Potential impacts on air quality would occur only if existing and future leases were developed. Future development of leased parcels could lead to air quality impacts from the emissions of air pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter 10 micrometers or less in diameter (PM_{10}), $PM_{2.5}$, SO_2, and volatile organic compounds (VOCs). O_3 is not directly emitted by oil and natural gas production; rather, it is formed from a photochemical atmospheric reaction between oxygen, VOCs, and NO_2. VOC emissions are regulated to control O_3 formation, so VOC emissions are included in this analysis as a precursor that can contribute to O_3 formation.

Hazardous air pollutants (HAPs) are known or suspected to cause cancer or other serious health effects, such as reproductive effects, birth defects, or adverse environmental impacts. The USEPA has classified 188 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde, benzene, toluene, ethyl benzene, isomers of xylene compounds, and normal-hexane (n-hexane). Additional information for HAP impacts within Ohio are included in Appendix I (*Air Quality and Climate Impacts)*.

Air pollutant would be emitted from developing leased parcels and from the subsequent combustion and end-use of oil and gas resources that may be produced. However, at the leasing stage, the BLM cannot reasonably determine whether, when, and in what manner a lease would be explored or developed. The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual emissions and associated impacts, including the future feasibility of developing the lease, well density, geological conditions, development type (vertical or horizontal), hydrocarbon characteristics, specific equipment used during construction, drilling, production, abandonment operations, production, and transportation, scale, and mitigation measures that a future operator may propose in their development plan, and potential regulatory changes over the expected 30 year well life if the leases are brought into production.

For the purposes of analyzing and estimating impacts from future development associated with the Proposed Action, the BLM developed the 2020 RFDS, which includes the potential impacts of the Proposed Action on air quality. This analysis estimates potential air pollution from projected oil and natural-gas development on the parcels proposed for leasing using available information from existing oil and natural-gas development within Monroe, Noble, and Washington counties in Ohio. The RFDS projects the construction of up to 81 wells distributed across approximately 29 well pads within the Marietta Unit, resulting from the leasing of federal oil and gas minerals. This projection encompasses the development of new wells over the next 15 years, involving both federal and private lands associated with federal minerals in the Marietta Unit.

Four general phases of post-lease development would generate air pollutants.

1. **Well Development**: Well site construction, well drilling, and well completion
2. **Well Production**: Oil and gas mineral extraction, separation, and gathering
3. **Mid-Stream**: Refining (oil), processing (natural gas), storage, and transport/distribution
4. **Downstream Consumption**: Combustion or other uses of the fuels produced

Although well development and production emissions occur on-lease within the BLM's program authority, emissions from midstream and consumption activities are not within lease parameters. The BLM has no programmatic authority to regulate emissions from activities associated with midstream and consumption oil and gas use. Criteria pollutant emissions would also occur outside the impact analysis area from the transport, processing, distribution, and end-use of produced oil and gas. Given the vast multitude of potential mid-stream and downstream emissions sources, the BLM is not able to accurately quantify criteria pollutant or HAP emissions from these sources. Downstream emissions, whether in stationary facilities and motor vehicles/airplanes are subject to regulations by the USEPA, other federal agencies, and delegated state agencies. In Ohio, Clean Air Act permitting authority is the responsibility of the Division of Air Pollution Control of the Ohio Environmental Protection Agency (OEPA). This regulatory framework is designed to minimize downstream impacts on regional and local air quality and to ensure compliance with existing national and state ambient air quality standards and hazardous air pollutant emission standards.

To estimate reasonably foreseeable on-lease emissions (i.e., well construction, development, and production) at the leasing stage, the BLM uses estimates of well numbers and required equipment from similar lease developments within the area. The amount of oil or natural gas that may be produced if the offered parcels were developed is unknown. For purposes of estimating development and production greenhouse gas (GHG) emissions for this analysis, potential wells were assumed to produce oil and natural gas in similar amounts as existing nearby wells. Emissions vary annually over the production life of a well due to declining production over time. Table 3-3 provides a range of maximum-year and average-year emissions for direct air pollutants and HAPs resulting from well site construction, development, and production activities. The minimum estimated emissions range from a low-development scenario of 29 wells (the RFDS predicted number of well pads, with one well on each well pad) to a high-development scenario of 81 wells (the RFDS predicted maximum number of wells based off three wells on each of 29 well pads).

Table 3-3. Range of Estimated Maximum-Year, Average-Year, and 40-Year Total Air Pollutant Emissions (tons) for Reasonably Foreseeable Development Scenario During Well Development and Production

ACTIVITY	PM_{10}	$PM_{2.5}$	VOC	NO_2	CO	SO_2	HAPS
Max Year Low Scenario 29 wells	177.2	29.0	564.2	52.6	42.0	0.270	33.188
Max Year High Scenario 81 wells	501.4	81.9	1,576.2	152.2	118.6	0.753	92.711
Average Year Low Scenario 29 wells	120.0	20.2	432.9	27.1	28.6	0.207	25.498
Average Year High Scenario 81 wells	335.1	56.4	1,209.2	75.6	79.9	0.577	71.219
40-Year Total Low Scenario 29 wells	4,679.0	787.0	16,885.0	1,056.0	1,116.0	8.0	994.0
40-Year Total High Scenario 81 wells	13,069.0	2,198.0	47,160.0	2,949.0	3,117.0	22.0	2,778.0

Source: BLM Lease Sale Emissions Tool. Emissions include well construction, development, and production activities.
CO = carbon monoxide, HAPs = hazardous air pollutants; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; RFDS = Reasonably Foreseeable Development Scenario; SO_2 = sulfur dioxide; VOC = volatile organic matter.

Environmental review during APD permitting would assess specific equipment types, numbers, and methodologies proposed in order to analyze air emissions and identify site-specific COAs

that may be included in the approval, to meet Forest Plan (USFS 2006a) objectives (Appendix F, Reference Number GFW-AIR-1) and to reduce emissions.

3.3.3. Cumulative Impacts

The cumulative impacts analysis area includes industrial oil and gas sources within Ohio, including lands that the BLM's Northeastern States District Office manages with active leases for oil and natural-gas development as well as nearby counties in West Virginia (Tyler, Pleasants, and Wood counties). As part of a leasing decision, it is not possible to predict or model the geographic extent of emissions and associated impacts in a particular area because the scale, location, and types of equipment associated with subsequent development are unknown. The potential for impacts on occur in a larger area (e.g., in West Virginia) may be further assessed during the environmental review process for APDs when specific development proposals, locations, and associated emissions are known.

To assess cumulative impacts, the BLM reviewed direct air pollutant emissions from the operation of industrial oil and gas sources in Ohio including private and federal oil and natural gas wells. For this analysis, the BLM used national, per-well average air pollutant emissions estimates, which may underestimate or overestimate actual emissions on a per well basis within Ohio; however, cumulative emissions are overestimated since it is assumed that all federal mineral ownership (FMO) leases would be placed into production in a single year (i.e. the maximum number of wells on each lease would be developed).

As of 2021, there were 291 FMO leases in Ohio, with 581 wells on 233 FMO leases that were producing oil or natural gas[2] (BLM 2022). Cumulative direct air pollutant emissions from the Proposed Action scenarios are estimated in Table 3-4 and include on-lease emissions for well development and production but exclude construction-related emissions to allow for comparison to the existing wells that have already been constructed and do not include construction or well-development emissions in their reported totals. Emissions for the current 581 producing wells in FMO were estimated using the BLM Single Well Emissions Tool which allows for multiple wells to be included on a single pad. This is consistent with the total number of active wells (581) compared to the number of (233) leases the wells and indicates each existing lease has two to three wells per pad. Emissions for the low and high development scenarios associated with the RFDS were estimated using the BLM Lease Sale Emissions Tool. The tool assumes a single well is developed on each pad under each scenario-29 wells on 29 pads for the low scenario and 81 wells on 81 pads for the high scenario. This methodology is the most conservative and likely overestimates the emissions, since it is more likely that two to three wells will be drilled on a single pad which would result in lower overall emissions due to half the number of pads being developed. Estimated emissions for the existing 581 wells only include current operating and production emissions, since these wells have already been constructed and drilled. USEPA's 2020 National Emissions Inventory (USEPA 2020) was used to determine air pollutant emissions from other oil and gas activities and sources in the state. The NEI does not include emissions from well construction and most drilling activities since those emissions are not required to be reported. Emissions for Ohio Oil and Gas include nonpoint emission sources and facility point

[2] 80.1 percent of effective FMO leases were producing with an average of 2.5 wells per lease (BLM 2022).

source emissions. Nonpoint sources include emissions from oil and gas sources located on well pads such as heaters, dehydrators, wellsite compressors, tanks, fugitive emissions and some drilling emissions that have been reported. Facility point sources include gas plants, refineries, compressor stations, and bulk fuel storage facilities. Ohio Fossil Fuel Electric Power Generation emissions represent emissions from combustion of fossil fuels at Ohio power plants for the purpose of electricity generation. Emissions for oil and gas sources in the neighboring West Virginia counties of Tyler, Pleasants and Wood are combined and included for comparison purposes.

Table 3-4. Comparison of Estimated Direct Air Pollutant Emissions (tons/year) for the Reasonably Foreseeable Development Scenarios in Ohio to Existing Sources

ANALYSIS AREA	PM_{10}	$PM_{2.5}$	VOC	NO_2	CO	SO_2	HAPs
Low Scenario 29 wells	146.00	25.00	562.00	27.00	35.00	0.27	33.00
High Scenario 81 wells	407.00	70.00	1,570.00	75.00	98.00	0.75	93.00
Current Ohio FMO Emissions[1]	68.15	37.60	679.25	354.28	504.20	0.25	156.80
Ohio Oil and Gas[2]	497.00	485.00	24,197.00	9,521.00	3,973.70	787.40	920.00
Ohio Fossil Fuel Electric Power Generation from Power Plants[3]	5,556.50	4,830.00	694.50	40,744.00	5,775.00	75,639.00	430.1.00
West Virginia Counties, Oil and Gas[4]	15.68	15.47	24,796.80	1,000.30	1,947.60	1.85	2,453.41

Source: BLM 2023, USEPA 2023g, NEI 2020.
[1] Annual operational emissions for existing 581 producing wells estimate using BLM Singe Well Emission Tool (BLM 2023).
[2] 2020 NEI Data Retrieval Tool: https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data. Includes nonpoint and facility source emissions for associated with oil and gas production and refining.
[3] 2020 NEI Data Retrieval Tool. Emissions from existing fossil fuel power plants in Ohio.
[4] Emissions for oil and gas sources in Tyler, Pleasants, and Wood Counties only.
CO = carbon monoxide, HAPs = hazardous air pollutants; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic matter.

3.4. Climate Impacts

3.4.1. Affected Environment

The affected environment for climate is summarized in Section 3.2 of the 2016 EA (BLM 2016), and is incorporated here by reference. Since the release of the 2016 EA, the U.S. Environmental Protection Agency (USEPA) has issued updated standards for emissions from oil and natural-gas production and natural-gas processing activities (GPO 2020). Additional information regarding the existing climate and air quality within the area that the Proposed Action could potentially impact is provided in Appendix I (*Air Quality and Climate Impacts)*.

3.4.2. Environmental Impacts

Potential climate change impacts from all activities in the oil and gas program were summarized in Sections 4.2 of the 2016 EA (BLM 2016), and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because the analysis of climate change in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D). Thus, the 2016 EA did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing.

3.4.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on climate from oil and gas management, as analyzed in Section 4.2 of the 2016 EA (BLM 2016).

3.4.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact climate change?

The administrative act of offering and leasing parcels for oil and gas in the Action Area, and the subsequent development of leases, could lead to emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), the three most-common GHGs associated with oil and gas development. These GHG emissions would be emitted from equipment and vehicles used for construction and operation and from drilling, production, and processing activities associated with oil and gas development, transmission, distribution, and combustion.

The BLM cannot reasonably determine at the leasing stage whether, when, and in what manner a lease would be explored or developed. The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual GHG emissions and associated impacts, including but not limited to the future feasibility of developing the lease, well density, geological conditions, development type (vertical, directional, or horizontal), hydrocarbon characteristics, specific equipment used during construction, drilling, and production, abandonment operations, product transportation, and potential regulatory changes over the 10-

year primary lease term. Actual development on a lease is likely to vary from what is analyzed in this EA and will be evaluated through a site-specific NEPA analysis when an operator submits an APD or plan of development to the BLM.

Further discussion of climate change science and predicted impacts, as well as the reasonably foreseeable and cumulative GHG emissions associated with BLM's oil and gas leasing actions and methodologies are included in the 2021 *BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (Annual GHG Report, BLM 2021). This report presents the estimated emissions of greenhouse gases attributable to development and consumption of fossil fuels produced on lands and mineral estate managed by the BLM. The Annual GHG Report is incorporated by reference (BLM 2021).

For the purposes of this analysis, the BLM evaluated the potential climate impacts that could result from development of the Proposed Action leases by estimating and analyzing potential GHG emissions from projected oil and natural gas development based on the RFDS (Appendix D), past oil and natural gas development, and available information from existing development within Ohio.

For the purposes of this analysis, the BLM evaluated the potential impacts on climate that could result from development of the Proposed Action leases by estimating and analyzing potential GHG emissions from projected oil and natural gas development based on the RFDS (Appendix D), past oil and natural gas development, and available information from existing development within Ohio.

Although the leasing action does not directly result in development that would generate GHG emissions, emissions from potential future development of the leased parcels are reasonably foreseeable and can be estimated for the purposes of this Supplemental EA. Four general phases of post-lease development would generate GHG emissions: (1) well development (well site construction, well drilling, and well completion); (2) well production operations (extraction, separation, and gathering); (3) midstream operations (refining, processing, storage, and transport/distribution); and (4) downstream end-use (combustion or other uses) of the fuels produced. Although well development and production operational emissions occur on-lease, and the BLM has programmatic authority over these activities, midstream and downstream end-use emissions typically occur off-lease, where the BLM has no programmatic authority.

Table 3-5 lists the estimated GHG emissions from well development, well production, midstream, and downstream consumption/end use in metric tons (MT) for the subject leases over the average 30-year production life of the lease as well as the CO_2 equivalent (CO_2e) for all GHG emissions. Refer to Appendix I (*Air Quality and Climate)* for additional information on the methods used to estimate the emissions in Table 3-5.

Table 3-5. Estimated Life of Lease Greenhouse Gas Emissions from Well Development, Well Production Operations, Mid-Stream, and Downstream End-Use (Metric Tonnes) – Low and High Scenarios

ACTIVITY TYPE	CO_2	CH_4	N_2O	CO_2E (100 YR)
Low Well Development Scenario (29 wells)	–	–	–	–
Well Development	30,234	25.83	0.237	31,069
Well Production Operations	276,355	6,404.94	1.834	467,723
Midstream	207,410	1,553.52	3.213	254,582
Downstream End-Use	1,397,178	45.17	8.059	1,400,724
Total (Low Scenario)	**1,911,178**	**8,029.46**	**13.342**	**2,154,099**
High Well Development Scenario (81 wells)	–	–	–	–
Well Development	84,448	72.15	0.661	86,779
Well Production Operations	771,889	17,889.65	5.123	1,306,399
Midstream	579,319	4,339.15	8.974	711,075
Downstream End-Use	3,902,463	126.15	22.509	3,912,367
Total (High Scenario)	**5,338,119**	**22,427.11**	**37.27**	**6,016,620**

Source: BLM 2023.
CH_4 = methane; CO = carbon monoxide, CO_2e = carbon dioxide equivalent; MT = metric tons; N_2O = nitrous oxide; YR = year.

Tables 3.6 and 3.7 show the estimated maximum year and average year GHG emissions over the life of the lease for both 100-year and 20-year global warming potentials (GWP). Additional information on global warming potentials can be found in Section 3.4 of the BLM 2021 Annual GHG Report.

Table 3-6. Estimated Direct and Indirect Greenhouse Gas Emissions from the Lease Parcels on Annual Basis (Metric Tonnes)

LOW SCENARIO (29 WELLS)	CO_2	CH_4	N_2O	CO_2E (100-YR)	CO_2E (20-YR)
Max Year	178,054.00	364.77	1.259	189,268.00	208,491.00
Average Year	49,005.00	205.88	0.342	55,233.00	66,083.00

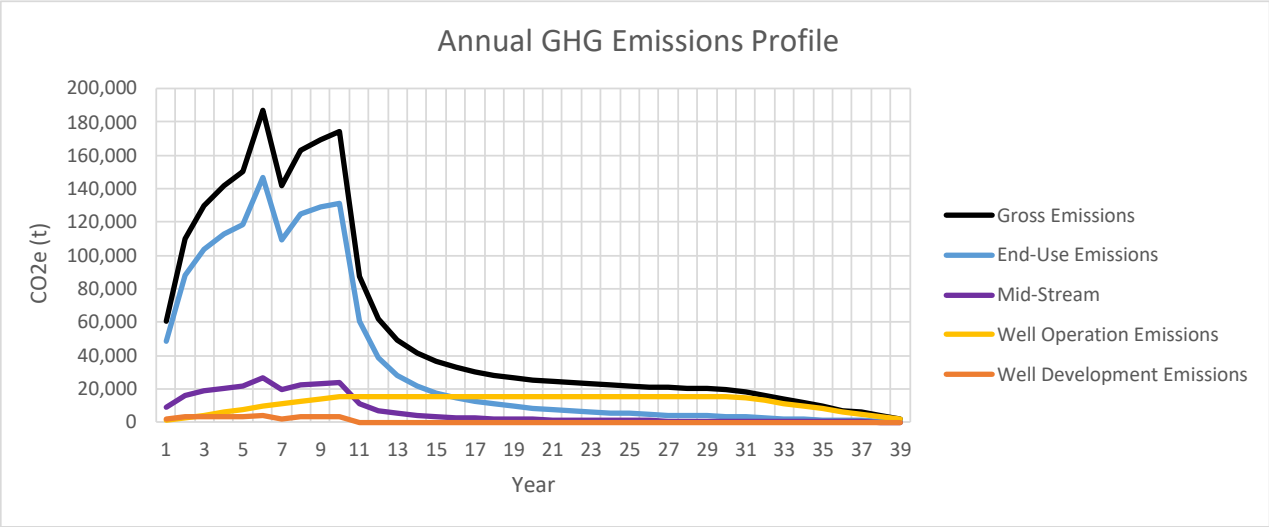
Source: BLM 2023.
CH_4 = methane; CO = carbon monoxide, CO_2e = carbon dioxide equivalent; MT = metric tons; N_2O = nitrous oxide; YR = year.

Table 3-7. Estimated Direct and Indirect Greenhouse Gas Emissions from the Lease Parcels on Annual Basis (Metric Tonnes)

HIGH SCENARIO (81 WELLS)	CO_2	CH_4	N_2O	CO_2E (100-YR)	CO_2E (20-YR)
Max Year	468,235.00	1,031.34	3.298	499,869.00	554,221.00
Average Year	136,875.00	575.05	0.956	154,272.00	184,578.00

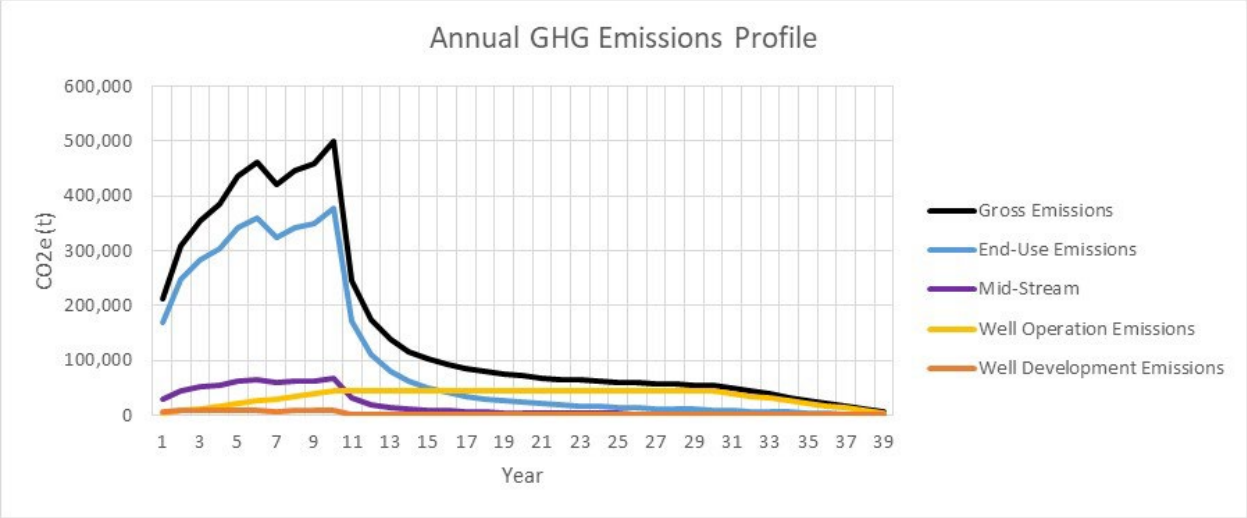
Source: BLM 2023.
CH_4 = methane; CO = carbon monoxide, CO_2e = carbon dioxide equivalent; MT = metric tons; N_2O = nitrous oxide; YR = year.

GHG emissions vary annually over the production life of a well because of declining production rates over time. Figure 5 and Figure 6 show the estimated GHG emissions profile over the production life of a typical lease, including well development, well-production operational, midstream, downstream end-use, and gross (total of well development, well production, midstream, and downstream end-use) emissions.



Source: BLM 2023.

Figure 5. Estimated Greenhouse Gas Emissions Profile over the Life of a Lease (Low Scenario – 29 Wells)



Source: BLM 2023.

Figure 6. Estimated Greenhouse Gas Emissions Profile over the Life of a Lease (High Scenario – 81 Wells)

To put the estimated GHG emissions for the Proposed Action into a relatable context, potential emissions that could result from development of the lease parcels for the Proposed Action can be compared to other common activities that generate GHG emissions and to emissions at the state and national level. The USEPA GHG equivalency calculator can be used to express the potential average-year GHG emissions on a scale relatable to everyday life. For example, the projected average annual GHG emissions from potential development of the subject lease were equivalent to a range of 11,094 to 33,248 gasoline-fueled passenger vehicles driven for 1 year, or the emissions that could be avoided by operating 15 to 42 wind turbines for a year as an alternative energy source or offset by the yearly carbon sequestration of 65,754 to 183,658 acres of forest land.

Table 3-8 compares the estimated average annual lease sale emissions to existing federal and state fossil fuel (oil, gas, and coal) emissions.

Table 3-8. Comparison of Lease Sale Emissions to Other Sources (megatonnes)

REFERENCE	MT CO_2E[1] (PER YEAR)
Lease Sale Emissions: Average Year – 29 wells	0.055
Lease Sale Emission: Average Year – 81 wells	0.154
Ohio Onshore Federal (oil and gas)[2]	0.100
United States Onshore Federal (oil and gas)[2]	465.630
United States Federal – All (oil and gas)[2]	844.270
United States Onshore Federal (oil, gas, and coal)[2]	1,292.570
Ohio Total (all sectors)[3]	**232.400**

[1] Estimates were based on 100 year-Global Warming Potential values.

[2] Federal values come from the 2021 BLM Specialist Report on Annual Greenhouse Gas Emissions Tables ES-1 and ES-2. U.S federal – All includes offshore oil and natural gas production (BLM 2021).
[3] Values comes from the BLM Specialist Report on Annual Greenhouse Gas Emissions (BLM 2021, Table 6-3). Mt (megatonne) = 1 million metric tons.

As detailed in the Annual GHG Report (BLM 2021), the BLM also looked at other tools to inform its analysis, including the Model for the Assessment of Greenhouse Gas Induced Climate Change tool (see Chapter 7 of the Annual GHG Report). This model suggests that 30-plus years of projected federal emissions would raise average global surface temperatures by approximately 0.0158 °C, or 1 percent of the lower carbon budget temperature target (BLM 2021). Because this is an assessment of what the BLM has projected could result from the entire federal fossil-fuel program, including projected emissions that could result from development of oil and gas leases issued as part of the Proposed Action over the next 30 years the reasonably foreseeable lease sale emissions discussed in this Supplemental EA are not expected to substantially affect the rate of change in climate impacts, bring forth impacts that were not already identified in existing literature, or cause a change in the magnitude of impacts from climate change at the global, national, or state scales.

3.4.3. Monetized Impacts from Greenhouse Gas Emissions

The social cost of carbon dioxide (SC-CO_2), social cost of nitrous oxide (SC-N_2O), and social cost of methane (SC-CH_4)—together, the social cost of GHGs (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

In accordance with existing guidance, this subsection provides estimates of the monetary value of changes in GHG emissions that could result from the alternative. For federal agencies, the best currently available estimates of the SC-GHG are the interim estimates of SC-CO_2, SC-CH_4, and SC-N_2O developed by the Interagency Working Group (IWG) on the SC-GHG. The IWG was established in 2009 for the purpose of ensuring federal agencies use the best science and to promote consistency in the social cost of carbon values used across agencies. Select estimates are published in the Technical Support Document (IWG 2021) and the complete set of annual estimates are available on the Office of Management and Budget's website (OMB 2021).

The SC-GHGs associated with estimated emissions from future potential development of leased parcels are reported in Table 3-9 for the low-development scenario of 29 wells (one well per pad) and Table 3-10 for the high-development scenario of 81 wells (multiple wells per pad). These estimates represent the present value (from the perspective of 2022) of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions from potential well development and operations and potential end-use, as described in Section 3.4.2.2 of this Supplemental EA. Discount rates represent the future value of an investment in terms of its present value. A high discount rate means that future impacts are considered much less significant than present impacts, whereas a low discount rate means the present and future impacts are closer to equally significant. The SC-GHGs represents the total market and nonmarket costs to society associated with the predicted level of GHG emissions, rather than direct monetary costs to the Analysis Area.

Table 3-9. Social Cost of Greenhouse Gases Associated with Future Potential Development (Low Scenario – 29 Wells)

Phase	SC-GHGs (2023 $)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Development and Operations (CO_2e)	$6,323,974	$21,868,202	$32,264,847	$63,203,804
Midstream and End-Use (CO_2e)	$21,548,026	$79,260,448	$119,307,531	$238,105,624
Total (CO_2e)	**$27,872,000**	**$101,128,000**	**$151,573,000**	**$301,310,000**

Sources: IWG 2021; BLM 2021.
CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SC-GHG = social cost of greenhouse gases.

Table 3-10. Social Cost of Greenhouse Gases Associated with Future Potential Development (High Scenario – 81 Wells)

Phase	SC-GHGs (2023 $)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Development and Operations (CO_2e)	$17,674,935	$61,097,682	$90,139,115	$176,581,342
Mid-Stream and End-Use (CO_2e)	$60,221,641	$221,447,958	$333,320,373	$665,211,540
Total (CO_2e)	**$77,897,000**	**$282,546,000**	**$423,459,000**	**$841,793,000**

Source: IWG 2021; BLM 2021.
CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SC-GHG = social cost of greenhouse gases.

The BLM cannot meaningfully estimate the net impacts across all energy markets to understand the mix of energy resources that would meet demand and therefore cannot provide an estimate of SC-GHG for the No-Action Alternative.

3.4.3.1. Best Management Practices, Standard Operating Procedures, and/or Mitigation Measures for Climate Impacts

GHG emissions contribute to changes in atmospheric radiative forcing resulting in climate change impacts. GHGs act to contain solar energy loss by trapping longer wave radiation emitted from the Earth's surface and act as a positive radiative forcing component. The buildup of these gases has contributed to the current changing state of the climate equilibrium towards warming.

Chapters 8 and 9 of the 2021Annual GHG Report provides a detailed discussion of climate change science, trends, and impacts (BLM 2021). The relationship between GHG emissions and climate impacts is complex, but a project's potential to contribute to climate change declines as its net emissions decline. When net emissions approach zero, the project has little or no contribution to climate change. Net-zero emissions can be achieved through a combination of controlling and offsetting emissions. Emission controls (e.g., vapor recovery devices, no-bleed pneumatics, leak detection and repair requirements, etc.) can substantially limit the amount of GHGs emitted to the atmosphere, while offsets (e.g., sequestration, low carbon energy substitution, plugging abandoned or uneconomical wells, etc.) can remove GHGs from the atmosphere or otherwise reduce emissions. Chapter 10 of the 2021 Annual GHG Report provides a more detailed discussion of GHG mitigation strategies (BLM 2021).

The majority of GHG emissions resulting from federal fossil fuel authorizations occur outside of the BLM's authority and control. These emissions are referred to as indirect or downstream emissions and generally occur off-lease during the transport, distribution, refining, and end-use of the produced federal minerals. The USEPA regulations and performance standards apply to all oil and gas facilities regardless of surface or mineral ownership. The BLM's regulatory authority is limited to those activities authorized under the terms of the lease and applicable regulations, which primarily occur in the "upstream" portions of oil and gas development (wellsite construction and production). This decision authority is applicable when development is proposed on public lands and the BLM assesses the specific location, design, and plan of development. In carrying out its responsibilities under NEPA, the BLM has developed BMPs designed to reduce emissions from field production and operations. BMPs may include limiting emissions from stationary combustion sources, mobile combustion sources, fugitive sources, and process emissions that may occur during development of the lease parcel. Analysis and approval of future development may include the application of BMPs within the BLM's authority, included as COAs in APDs or Records of Decision, to reduce or mitigate GHG emissions. Additional measures proposed at the project development stage may be incorporated as applicant-committed measures by the project proponent or added to necessary air quality permits. Additional information on mitigation strategies, including emissions controls and offset options, are provided in Chapter 10 of the Annual GHG Report (BLM 2021).

3.4.4. Cumulative Impacts

The analysis of GHGs contained in this Supplemental EA includes estimated emissions from existing and potential leases, as described in Section 3.4.2.2. An assessment of GHG emissions from other BLM fossil-fuel authorizations, including coal leasing and oil and natural gas leasing and development, is included in Chapter 5 of the Annual GHG Report (BLM 2021). The Annual GHG Report also includes estimates of reasonably foreseeable GHG emissions related to the BLM's lease sales that are anticipated during the 2021 fiscal year, as well as the best estimate of emissions from ongoing production and development of parcels sold in previous lease sales. This analysis is, therefore, an estimate of cumulative GHG emissions from the BLM's national fossil fuel–leasing program, based on actual production and statistical trends presently known at the time of the report.

Table 3-11 shows estimates of the aggregate GHG emissions that would occur nationwide from federal leases, existing and foreseeable, between the years 2022 and 2050, using the methodology described above. The 5-year lease averages include all types of oil and natural gas leases, including leases granted under the MLA and other authorities, that have been issued over the last 5 years. As such, the projections made from the 5-year averages represent the potential for all types of future oil and natural gas development activity, and, although not at exact acreages, include emissions that would be associated with the Proposed Action. However, these projections may also overestimate the potential emissions from the 12-month cycle of competitive oil and natural gas–leasing activities if the projected lease sale or development activity did not actually occur.

Table 3-11. Reasonably Foreseeable Projected Emissions from Federal Lease Development (megatonnes of CO_2e)

STATE (BLM ADMINISTRATIVE UNIT)	30-YEAR CUMULATIVE GHG EMISSIONS FROM PAST, PRESENT, AND FORESEEABLE FEDERAL LEASE DEVELOPMENT (MT CO_2E)
Alabama (ES)	9.34
Alaska	136.90
Arkansas (ES)	9.34
California	51.49
Colorado	243.10
Idaho	0.17
Illinois (ES)	0.31
Kansas (ES)	3.32
Kentucky (ES)	0.19
Louisiana (ES)	43.29
Michigan (ES)	1.95
Mississippi (ES)	2.89
Montana	58.82
Nebraska (WY)	0.21
Nevada	2.74
New Mexico	1,939.52
New York	0.01
North Dakota (MT)	379.63
Ohio (ES)	0.37
Oklahoma (NM)	20.43
Pennsylvania (ES)	0.46
South Dakota (MT)	2.31
Texas (NM)	49.55

STATE (BLM ADMINISTRATIVE UNIT)	30-YEAR CUMULATIVE GHG EMISSIONS FROM PAST, PRESENT, AND FORESEEABLE FEDERAL LEASE DEVELOPMENT ($MT CO_2E$)
Utah	187.84
Virginia (ES)	0.15
West Virginia (ES)	0.45
Wyoming	1,487.65
Total	**4,614.81**

Source: BLM 2021.
BLM = Bureau of Land Management; CO_2e = carbon dioxide equivalent; ES = Eastern States; GHG = greenhouse gas; MT = metric tons; NM = New Mexico; WY = Wyoming.

The most recent short-term energy outlook (STEO) projections published by the U.S. Energy Information Administration (EIA) predicts that the world's oil and gas supply and consumption will increase over the next 18–24 months (EIA 2023). The STEO projections provide useful context for the No Action discussion. The global forecast models used for the STEO are not dependent on whether the BLM issues onshore leases but are based on foreseeable short-term global supply and demand and include oil and gas development /operations on existing U.S. onshore leases. The most recent STEO includes the following projections for the next 2 years:

- **U.S. liquid fuels consumption** is projected to increase to 20.35 million barrels per day (b/d) in 2024 up from 20.15 million b/d in 2023.
- **U.S. crude oil production** is expected to average 12.9 million b/d in 2023 and rise to 13.5 million b/d in 2024.
- **U.S natural gas consumption** is expected to average 89.42 billion cubic feet/day (Bcf/d) in 2023, decreasing slightly to 89.0 Bcf/d in 2024.
- **U.S. liquified natural gas** (LNG) **exports** are expected to increase from 11.8 Bcf/d in 2023 to 12.29 Bcf/d in 2024.
- **U.S. coal production** is expected to total 585 million short tons (MMst) in 2023 and 480 MMst in 2024 and decrease to 15 percent of total U.S. electricity generation in 2024 compared to 16 percent in 2023 driven by ongoing retirement of coal-fired generating plants.

Recent events, both domestically and internationally, have resulted in abrupt changes to the global oil and gas supply. EIA studies and recent U.S. analyses (associated with weather impacts, etc.) regarding short-term domestic supply disruptions and shortages or sudden increases in demand demonstrate that reducing domestic supply (in the near-term under the current supply and demand scenario) will likely lead to the import of more oil and natural gas from other countries, including countries with lower environmental and emission control standards than the United States (EIA 2021). Recent global supply disruptions have also led to multiple releases from the U.S. Strategic Petroleum Reserve in order to meet consumer demand and curb price surges.

The most recent STEO published by the EIA predicts that the world's oil and gas supply and consumption will increase over the next 18–24 months (EIA 2023). The latest STEO projections provide useful context for the No Action discussion. The global forecast models used for the STEO are not dependent on whether the BLM issues onshore leases but are based on foreseeable short-term global supply and demand and include oil and gas development /operations on existing U.S. onshore leases. The most recent STEO includes the following projections for the next 2 years:

- **U.S. liquid fuels consumption** is projected to increase to 20.45 million b/d in 2023 up from 20.28 million b/d in 2022 and further increase to 20.76 million b/d in 2024.
- **U.S. LNG exports** are expected to increase from 10.59 Bcf/d in 2022 to 12.07 Bcf/d in 2023 and 12.73 Bcf/d in 2024.
- **U.S. coal production** is expected to total 552 MMst in 2023 and 502.6 MMst in 2024 and decrease to 17 percent of total U.S. electricity generation in 2023 compared to 20 percent in 2022, driven by ongoing retirement of coal-fired generating plants.
- **Generation from renewable sources** will comrise an increasing share of total U.S. electricity generation, rising from 22 percent in 2022 to 24 percent in 2023 and 26 percent in 2024.

Recent events, both domestically and internationally, have resulted in abrupt changes to the global oil and gas supply. EIA studies and recent U.S. analyses (associated with weather impacts, etc.) regarding short-term domestic supply disruptions and shortages or sudden increases in demand demonstrate that reducing domestic supply (in the near-term under the current supply and demand scenario) will likely lead to the import of more oil and natural gas from other countries, including countries with lower environmental and emission control standards than the United States (EIA 2021). Recent global supply disruptions have also led to multiple releases from the U.S. Strategic Petroleum Reserve in order to meet consumer demand and curb price surges.

The EIA 2023 Annual Energy Outlook projects increases in energy consumption through 2050, as population and economic growth outweighs efficiency gains (EIA 2023). As a result, U.S. production of natural gas and petroleum and liquids will rise amid growing demand for exports and industrial uses. U.S. natural gas production is projected to increase by 15 percent from 2022 to 2050. However, renewable energy will be the fastest-growing U.S. energy source through 2050 as electricity generation shifts to using more renewable sources. Domestic natural gas consumption for electricity generation is expected to decrease from 2022 to 2050. As a result, energy-related CO_2 emissions are expected to fall 25 percent to 38 percent below the 2005 level, depending on economic growth factors. Further discussion of past, present, and projected global and state GHG emissions may be found in Chapter 6 of the 2021 Annual GHG Report (BLM 2021).

EO 14008 (Tackling the Climate Crisis at Home and Abroad) (January 27, 2021), directs the executive branch to establish policies or rules that put the United States on a path to achieve carbon neutrality, economywide, by no later than 2050. This goal is consistent with the Intergovernmental Panel on Climate Change's (IPCC's) recommendation to reduce net annual

global CO_2e emissions between 2020 and 2030 in order to reach carbon neutrality by mid-century. Federal agencies are still in the process of developing policies that align with a goal of carbon neutrality by 2050. In the short-term, the order has a stated goal of reducing economy-wide GHG emissions by 50-52 percent relative to 2005 emissions levels, no later than 2030.

Carbon budgets are an estimate of the amount of additional GHGs that could be emitted into the atmosphere over time to reach carbon neutrality while still limiting global temperatures to no more than 1.5°C or 2°C above preindustrial levels. The IPCC Special Report on Global Warming of 1.5ºC is the most widely accepted authority on the development of a carbon budget to meet the goals of the Paris Agreement. None of the global carbon budgets or pledges that countries have committed to as part of the Paris Agreement are binding. Carbon budgets were originally envisioned as being a convenient tool to simplify communication of a complex issue and to assist policymakers considering options for reducing GHG emissions on a national and global scale. Carbon budgets have not yet been established on a national or smaller scale, primarily due to the lack of consensus on how to allocate the global budget to each nation. As such, the global budgets that limit warming to 1.5 ºC or 2 ºC are not useful for BLM decision making, particularly at the lease sale stage, as it is unclear what portion of the carbon budget applies to emissions occurring in the United States.

Nonetheless, stakeholders and members of the public have requested that the BLM consider comparing its predicted emissions in the context of global carbon budgets. Table 7-4 in the 2021 Annual GHG Report provides an estimate of the potential emissions associated with BLMs fossil fuel authorizations in relation to IPCC carbon budgets (BLM 2021). Total federal fossil fuel authorizations including coal, natural gas and oil represent approximately 1.75 percent of a suggested global carbon budget of 400-500 $GtCO_2$ needed to limit global warming to 1.5 C.

While continued fossil fuel authorizations will occur over the next decade to support energy demand and remain in compliance with the leasing mandates in the Inflation Reduction Act of 2022 (IRA), the EIA International Energy Outlook expects renewable energy consumption to double between 2020 and 2050 and nearly equal liquid fuels consumption by 2050. The United States has committed to the expansion of renewable energy through infrastructure investments in clean energy transmission and grid upgrades included in the Bipartisan Infrastructure Investment and Jobs Act of 2022 as well as clean energy investments and incentives included in the IRA. The Department of Energy's Office of Policy developed a preliminary assessment that found the IRA and Bipartisan Infrastructure and Jobs Act, in combination with past actions, are projected to reduce 2030 economy-wide GHG emissions to 40 percent below 2005 levels, even with continued oil and gas leasing in the near term.

3.5. Vegetation and Rare Plants

3.5.1. Affected Environment

The affected environment for vegetation is summarized in Section 3.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. The 2016 EA indicates that four federally listed plant species have the potential to occur in the Action Area and be potentially impacted: northern monkshood (*Aconitum noveboracense*), small whorled pogonia (*Isotria medeoloides*), Virginia spirea (*Spirea virginiana*), and running buffalo clover (*Trifolium*

stoloniferum). A final rule to delist running buffalo clover due to recovery efforts was published in the *Federal Register* and took effect on September 7, 2021 (USFWS 2021a), and it is now considered a Regional Forester Sensitive Species (RFSS). The subsections below provide a description of occurrences and suitable habitat for northern monkshood, small whorled pogonia, and Virginia spirea.

The BLM and USFS are conducting consultation with USFWS under ESA Section 7 with respect to federally listed plant species. The BLM is preparing a Biological Assessment (BA) to analyze impacts on listed plant species that are anticipated to occur in the Analysis Area. The USFWS will utilize the BA to inform the possible preparation of a BO regarding potential impacts on federally listed species and which would include required mitigation measures to be considered and applied in APD approvals. In addition, the USFWS has provided avoidance and minimization measures as part of the ongoing consultation that are incorporated into the Proposed Action and are considered in the analysis of impacts in the sections below.

3.5.1.1. Northern Monkshood

Three populations of northern monkshood are known to exist in Ohio: one each in Summit, Portage, and Hocking Counties. None of the known populations occur on WNF lands. The closest known population to the WNF is approximately 6.5 miles from the Athens Unit boundary in the Hocking Hills area of Hocking County (approximately 50 miles west of the Action Area). All known Ohio populations reside in shaded, cliff-lined habitat with cold air drainage and occur on moist shelfs and lower slopes near the cliff base (USFS 2022).

Suitable habitat for northern monkshood is relatively restricted on the WNF. Most of the natural habitat occurs on sandstone features on the Ironton and Marietta Units. There is artificially created habitat for Northern monkshood at mine portals, but only if those areas have cold air or water flow (USFS 2022).

3.5.1.2. Small Whorled Pogonia

Ohio has two known small whorled pogonia populations in western Scioto and western Hocking Counties. The closest population is about 4 miles from the WNF Athens Unit boundary in Hocking County, approximately 50 miles west of the Action Area. The Scioto County population is a record of a single plant found in 1985, but this occurrence has not produced another individual since the 1985 record (USFS 2022). The Hocking County population was discovered in 1998 and consists of few infrequently flowering individuals (USFS 2022)

Small whorled pogonia suitable habitat occurs primarily in second- and third-growth hardwood and mixed hemlock-hardwood forests with sparse understory, scattered tree-fall canopy gaps, and adjacent, permanent canopy gaps such as stream corridors. This habitat occurs across the WNF on the Ironton, Marietta, and Athens Units (USFS 2022).

3.5.1.3. Virginia Spirea

The closest known Virginia spiraea population to the WNF is approximately 13 miles from the Ironton Unit boundary along Scioto Brush Creek in Scioto County, which is approximately 70 miles west of the Action Area. Streams throughout the area are largely unsuitable for Virginia

spiraea. This is largely due to human-caused impacts, including past mining, farming, and land clearing that have resulted in siltation of regional streams. As a result, most streams on the WNF lack gravel bars, gravel/cobble substrate, rocky banks, and sufficient stream flow. However, upper portions of the Little Muskingum River in Washington and Monroe Counties share similarities with the Scioto Brush Creek site. In this section, the Little Muskingum River is not overly silted; has gravel, cobble, and some boulder substrate; has some gravel bars and rocky banks; and has higher stream flows than lower sections of the river. As such, this section of the Little Muskingum River contains assumed suitable habitat for Virginia spiraea on the WNF (USFS 2022).

3.5.1.4. Regional Forester Sensitive Species

Table 3-12 presents the 2024 Regional Forester Sensitive Plant Species List in the Action Area along with their typical habitat association and potential to occur. Since publication of the 2016 EA, five new plant species have been added to the RFSS list (USFS 2024).

Table 3-12. Regional Forester Sensitive Plant Species in the Action Area

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Little-flowered Alumroot (*Heuchera parviflora*)	Added	Moist crevices of sandstone cliffs and rock shelters in rolling bottomland mixed-hardwood forest and mixed-mesophytic and cove forest habitats.	**Low.** This species occurs in the Ironton District of the WNF. Suitable habitat occurs in the Action Area but is at the northern limit of its known range.
Buttercup Scorpionweed (*Phacelia covillei*)	Added	Dry to mesic well-drained open woodlands and small stream terraces in dry oak forest, dry/mesic mixed–oak hardwood forest, dry/mesic oak forest, rolling bottomland mixed-hardwood forest, and dry/mesic oak forest habitats.	**Moderate**. The species occurs in the on the Ironton District of the WNF but is not known to occur in the Marietta Unit. Suitable habitat for this species occurs in the Action Area.
Rock-loving Swan-necked Moss (*Campylostelium saxicola*)	Added	Moist sandstone rocks/cliffs in rolling bottomland mixed-hardwood forest and mixed-mesophytic and cove forest habitats.	**Moderate.** The species occurs in the Ironton District and Athens District of the WNF but is not known to occur in the Marietta Unit. Suitable habitat for this species occurs in the Action Area.

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Porter's Reedgrass (*Calamagrostis porteri* ssp. *insperata*)	Added	Found in dry oak forests with open conditions and disturbances such as fire. Well-drained, typically acidic ridgetops and clifftops exposed to direct sun and semi-shade	**Low.** This subspecies occurs in the Ironton District of the WNF. Suitable habitat occurs in the Action Area but is the northern and eastern limit of its range.
Running Buffalo Clover (*Trifolium stoloniferum*)	Added	Moist, semi-shaded area associated with mowing, cattle grazing, trampling, logging, or other moderate ground disturbance occurs	**Moderate**. Known to occur in the WNF in the Ironton Unit and Athens Unit but no known occurrences in the Marietta Unit. The Action Area contains suitable habitat.
Fernleaf Yellow False Foxglove *(Aureolaria pedicularia)*	Retained	Thin sandy or rocky soils, under oaks within dry oak forests	**Moderate.** This species occurs in the Athens District of the WNF but it is not known to occur in the Marietta Unit. Suitable habitat occurs in the Action Area.
Giant Sedge *(Carex gigantea)*	Retained	Large stream floodplains; wetland-obligate species found in vernal pools within flatwoods/floodplain swamps within rolling bottomland hardwoods	**Moderate.** The species occurs on the WNF in the Ironton District, but it is not known to occur in the Marietta Unit. Suitable habitat for this species occurs in the Action Area.
Juniper Sedge *(Carex juniperorum)*	Retained	Open dry oak forests, dry openings, glades	**Moderate.** This species occurs in the Athens District of the WNF, but it is not known to occur on the Marietta Unit. Suitable habitat occurs in the action area.
Caroline/Soft Thistle *(Cirsium carolinianum)*	Retained	Open/semi-open woods in dry oak forests, bluffs, ravines, and thickets	**Moderate.** Known to occur in the Ironton and Athens Districts of the WNF, but it is not known to occur on the Marietta Unit. The Action Area contains suitable habitat**.**

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Yellow/Plain Gentian *(Gentiana alba)*	Retained	Moist meadows/prairies; open woods; edges	**Moderate.** Known to occur in the Ironton and Athens Districts of the WNF, but it is not known to occur in the Marietta Unit. The Action Area contains suitable habitat**.**
Butternut *(Juglans cinerea)*	Retained	Moist woods, field edges, and riparian corridors in dry-mesic, mixed mesophytic, and cove forests	**High.** The WNF contains several populations across the Ironton, Athens, and Marietta Unit. The Action Area contains suitable habitat.
Yellow-fringed Orchid *(Platanthera ciliaris)*	Retained	Wet, sandy bogs & meadows, fields & woods; sandy open mixed pine woods	**High.** The Marietta Unit of the WNF has two known populations. The Action Area contains suitable habitat
(Smooth) Rock Skullcap (Trifolium stoloniferum)	Retained	Moist banks/woods also dry slopes & openings; often associated with thin soils and rock outcroppings	**High.** The WNF contains several populations across the Ironton and Marietta Units. The Action Area contains suitable habitat.

Source: USFS 2024.
WNF = Wayne National Forest.

3.5.2. Environmental Impacts

Potential impacts on vegetation from activities in the oil and gas program are summarized in Section 4.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because the analysis of vegetation management in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D) and therefore did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing.

3.5.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on vegetation from those impacts analyzed under the No-Action Alternative in Section 4.3 of the 2016 EA (BLM 2016).

3.5.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high volume hydraulic fracturing impact vegetation communities and rare plant species in the region?

The Proposed Action would result in up to 998 acres of surface disturbance (0.2 percent of the Action Area) during well construction and development and up to 285 acres of long-term surface disturbance during the productive life of wells. Increased surface disturbance, truck traffic, and potential for hazardous spills associated with horizontal drilling and hydraulic fracturing could intensify impacts on vegetation and rare plants compared to vertical drilling. Increased surface disturbance can result in increased mortality of individual plants from uprooting, disruption, or removal. Additionally, increased surface disturbance can lead to increased exposure and changes in vegetative conditions along the edge of cleared areas (i.e., *edge effects*). Creation of an abrupt transition between two adjacent ecosystems (or an edge) causes changes in local biotic and abiotic conditions that can negatively impact vegetation. Abiotic changes along the edge such as the temperature, moisture, and light intensity can create an environment that is no longer suitable for native or rare plant species to survive. Because of the varied physiological tolerances of species, such changes can alter biotic factors such as stem density and species composition, which can result in increased competition for resources (Murcia 1995). Furthermore, increased surface disturbance can lead to increased erosion, runoff, and sedimentation that may impact vegetation and rare plants by washing away individuals, eroding, or destabilizing soils, or reducing soil quality. These factors could ultimately reduce plant productivity.

Increased truck traffic required for horizontal drilling and hydraulic fracturing (Table 3-2 and Section 3.9, *Transportation*) would result in potential impacts on vegetation due to dust deposition on plants along roadways and near construction sites. Dust has been documented to affect plant photosynthesis, respiration, and transpiration, leading to decreased plant productivity (Farmer 1993). Potential impacts may also include the possibility of fluid spills (e.g., diesel, lubricants, oil, produced water) and associated contamination of soils, which could cause reduction in or loss of plant productivity.

Impacts from loss of vegetation could include an increased risk of establishment and spread of nonnative, invasive plant species and noxious weeds that may outcompete native flora and reduce the overall diversity of native vegetation. Ohio maintains a list of prohibited and restricted noxious weeds (Ohio Administrative Code [OAC] Rule 901:5-27-06), and the 2016 EA identifies garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), and multiflora rose (*Rosa multiflora*) as known invaders of the WNF that were not on the Ohio noxious weeds list (BLM 2016). Many nonnative species and noxious weeds are opportunistic colonizers that respond particularly well to disturbance and prevent native plants from establishing successive communities (Sieg et al. 2003). Because horizontal wells require increased surface disturbance, more opportunities would be created for the establishment and spread of invasive species compared to vertical drilling and completions. Furthermore, additional vehicle trips associated with horizontal well development and hydraulic fracturing (Table 3-2) would increase the risk of transporting invasive, nonnative vegetation and noxious weeds to and from well-development sites. USFWS avoidance and minimization measures (see below) would

reduce potential impacts resulting from invasive and noxious weeds by requiring equipment to be washed to remove potential plant propagules prior to entering any work site.

The Proposed Action could result in potential impacts on RFSS species described above, especially for RFSS known to occur in the Analysis Area including butternut, yellow-fringed orchid, and rock skullcap. However, application of stipulations and notifications from the Forest Plan for RFSS and implementation of USFS avoidance and minimization measures (see below) would reduce the potential impacts on RFSS. In addition, due to the overall minimal amount of surface disturbance that could occur in the Action Area (0.2 percent of the Action Area) overall impacts on RFSS are expected to be minimal.

Impacts from project actions on undiscovered listed plants could include injury or death by crushing or uprooting from equipment utilization during road and trail creation or rehabilitation of old access routes, site clearing, earth moving, or well pad construction. Materials placed in staging areas could also crush or kill federally listed or RFSS plants if they were to occur. However, potential impacts on federally listed plant species is unlikely due to the relatively small amount of surface disturbance that would occur at each well site, the lack of known populations of federally listed plant species in the Analysis Area, and requirements to avoid suitable habitat or conduct site-specific surveys for federally listed plant species during APD permitting.

In accordance with BLM's Section 6 lease term (BLM 2023), all adverse impacts on biological resources must be minimized. Additionally, site-specific environmental reviews would be required for APDs proposing surface disturbance on both federal and private land to analyze the impacts of proposed development on vegetation and rare plants. Design features, COAs, and BMPs would be applied to the APD as appropriate to minimize impacts on vegetation and rare plants. Processing an APD would also require site-specific surveys for federally listed plants and potentially for RFSS within suitable habitat on both private and federal land and if individuals or populations are identified during surveys appropriate measures would be applied as COAs to the APD to avoid and minimize potential impacts. For example, SFW-MIN-11 requires a controlled surface use (CSU) stipulation for locations where federally listed species and RFSS are known to occur.

As part of the ongoing Section 7 consultation process, the USFWS has provided measures to avoid and minimize potential impacts on federally listed plants associated with the Proposed Action. The avoidance and minimization measures are included as Appendix G (*USFWS Recommended Measures for Avoiding and Minimizing Adverse Impacts to Federally Listed Species*) of this Supplemental EA, and include the following requirements:

- During site-specific permitting of APDs, a desktop analysis will be conducted to determine if potentially suitable habitat for Virginia spiraea, northern monkshood, and small whorled pogonia occur within proposed development areas. In general, suitable habitat for federally listed species would be avoided. Identifying suitable habitat and avoiding disturbance in these areas would avoid direct mortality to species and reduce suitable habitat removal and degradation.
- In cases where suitable habitat for federally listed species cannot be avoided when siting wells, the BLM would coordinate with the USFWS on appropriate protection measures at the

site-specific level that would be informed by desktop level analysis of suitable habitat and the potential for seasonally appropriate on-the-ground plant surveys.

- Clean vehicles and equipment prior to entering a project site to prevent the establishment and spread of invasive species that can reduce habitat quality and outcompete federally listed plant species.
- Revegetate disturbed areas with a mix of noninvasive annual ground cover and perennial native species to encourage native species, reduce erosion, and lessen the germination of weed seeds. Requirements for revegetating with noninvasive groundcover and perennial species would reduce the potential for the establishment and spread of invasive species that could outcompete rare plants and would reduce erosion and runoff that can displace rare plants or degrade their habitat.

Application of the measures described above would substantially reduce the potential for impacts on vegetation and rare plants.

3.5.3. Cumulative Impacts

The CIAA for vegetation encompasses the Marietta Unit of the WNF and a 4-mile buffer, which includes the area where vegetation could be impacted by fluid spills, movement of soils and runoff, and by deposition of dust from project-related activities. Due to limitations on current drilling technology, impacts on vegetation beyond this buffer would be unlikely, except in the case where noxious weeds and invasive species could be transported by project-related vehicles and dispersed outside the 4-mile buffer. Historical activities, current ongoing projects, and reasonably foreseeable future actions that could result in vegetation impacts in the CIAA are outlined in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions)*. Cumulative impacts on vegetation associated with the Proposed Action could result from increased surface disturbance and equipment in the natural landscape of the WNF when considered in conjunction with ongoing projects in the WNF.

In addition to discrete USFS projects throughout the Marietta Unit, existing and future oil and gas development on private land is expected to be the largest contributor to cumulative vegetation impacts in the CIAA. There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells located on private land. This could amount to anywhere between 11,988 and 171,250 acres of existing surface disturbance depending on whether these wells were vertically or horizontally drilled. The Proposed Action would result in an incremental increase in surface disturbance, with 998 acres projected in the short term during well development and 285 acres in the long term during well production (BLM 2020). Furthermore, increased surface disturbance, truck traffic, and potential for hazardous spills associated with drilling could exacerbate impacts on vegetation and rare plants in the CIAA.

However, considering reclamation requirements and site-specific analysis of drilling locations (both on federal and private land) during the APD phase, as well as the comparatively minimal acreage of estimated surface disturbance compared to undisturbed surface acreage, cumulative impacts on vegetation and rare plants are likely to be minimal. Short-term surface disturbance under the Proposed Action is estimated only to affect up to 0.01 percent of the Action Area. Maximum long-term surface disturbance (following interim reclamation, prior to final

reclamation) would impact 0.004 percent of the Action Area per year. By the end of the RFDS's 15-year analysis period, the long-term surface disturbance for 29 well pads is predicted to be, at most, 0.05 percent of the Action Area (BLM 2020). Design features, COAs, and BMPs would be applied at the APD stage as appropriate to minimize impacts on vegetation.

3.6. Water Resources

3.6.1. Affected Environment

The affected environment for water quality, water quantity, wetlands, and riparian zones within the Marietta Unit only is summarized in Section 3.6 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. The affected environment for the Analysis Area in this Supplemental EA is described below. Additional information is provided in detail in the *Wayne National Forest Aquatic Ecosystems and Watersheds Assessment Supplemental Report* (USFS 2020b), which is incorporated into this EA by reference.

HUCs assigned by the U.S. Geological Survey (USGS) are used to classify watersheds in the United States and the Caribbean. HUCs consist of 12 digits based on six levels of classification: Region (first-level, 2-digit HUC), Subregion (second-level, 4-digit HUC), Accounting Unit (third-level, 6-digit HUC), Cataloging Unit (fourth-level, 8-digit HUC), Watershed (fifth-level, 10-digit HUC), and Subwatershed (sixth-level, 12-digit HUC). The Analysis Area for water resources includes the 12-digit HUC, or HUC-12, watersheds overlapping the Marietta Unit and the surrounding 4-mile buffer (Analysis Area) (Figure 7). A total of 32 HUC-12 watersheds are within the Analysis Area. The acreage of each HUC-12 watershed within the Analysis Area is shown in Table 3-13 below. This HUC level was chosen because water-quality reporting to USEPA and water withdrawals reported to ODNR are performed at the HUC-12 level.

As noted, the *CBD* Decision Court Orders (Appendix C) found that the analysis of impacts on the Little Muskingum River was deficient. As such, information in this section focuses on the Little Muskingum River and Little Muskingum watershed units. All portions of the Little Muskingum River within the Analysis Area are in the Little Muskingum–Middle Island cataloguing unit (HUC-8 05030201; Figure 8). This unit is comprised of 574,048 acres of the entire 627,351-acre Analysis Area (91.50 percent) as shown in Table 3-13 below.

Wetlands and riparian zones in the Analysis Area largely follow the Little Muskingum and Ohio Rivers. Most wetlands found in the WNF are palustrine emergent, forested, or shrub-scrub wetlands, as described in the USFWS classification system (Cowardin et al. 1979; FGDC 2013). Although wetlands can be groundwater dependent, they do not always receive groundwater discharge. Many of the larger wetlands in the WNF were artificially constructed, and there is little evidence to suggest that they are heavily dependent on groundwater (USFS 2020b). Additional regional information about goals and objectives related to wetlands and riparian zones for the WNF is provided in the aquatic and riparian resources section of the Forest Plan Final EIS (USFS 2006b).

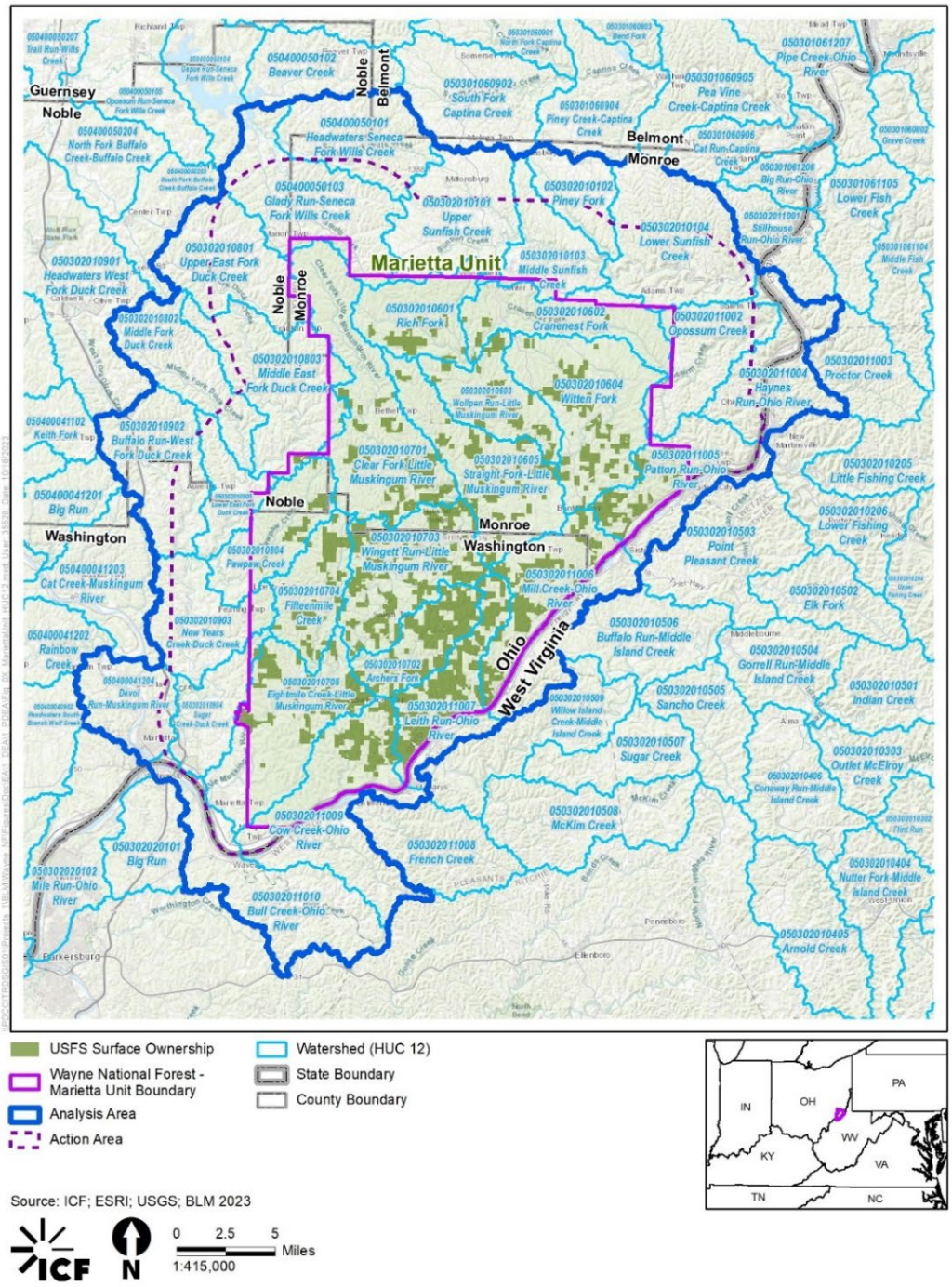


Figure 7. HUC-12 Watersheds within the Marietta Unit, Plus a 4-Mile Buffer (Analysis Area)

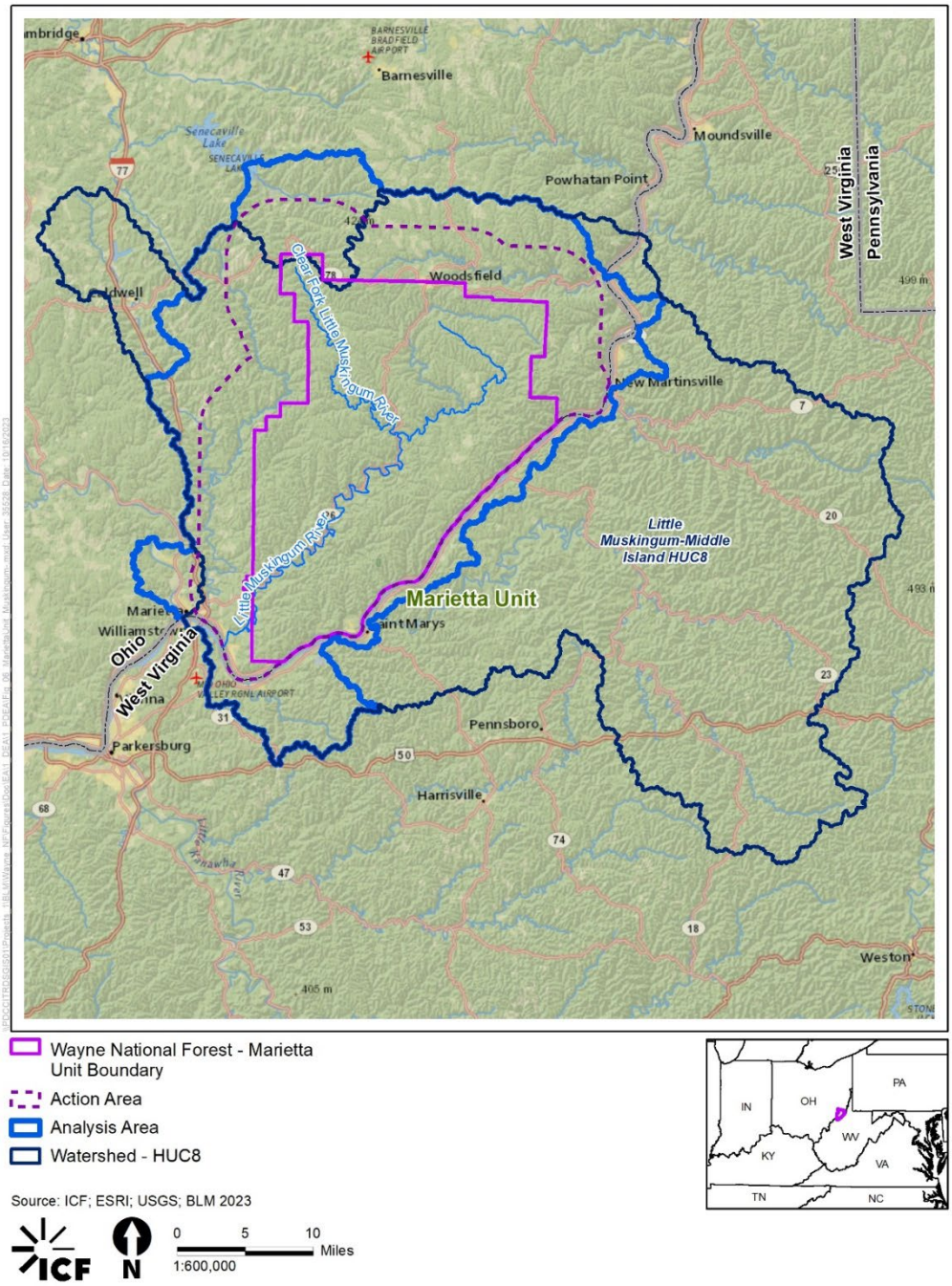


Figure 8. Little Muskingum Watershed in Relation to the Analysis Area

Table 3-13. HUC-12 Watersheds within the Analysis Area

Watershed Name	State	HUC-12	Acres within the Analysis Area	Percentage of the Analysis Area
Little Muskingum–Middle Island	–	–	–	–
Archers Fork	Ohio	050302010702	11,875	1.89%
Buffalo Run–West Fork Duck Creek	Ohio	050302010902	20,358	3.24%
Bull Creek–Ohio River	Ohio	050302011010	27,573	4.40%
Clear Fork Little Muskingum River	Ohio	050302010701	31,245	4.98%
Cow Creek–Ohio River	Ohio	050302011009	30,817	4.91%
Cranenest Fork	Ohio	050302010602	16,841	2.68%
Eightmile Creek–Little Muskingum River	Ohio	050302010705	26,680	4.25%
Fifteenmile Creek	Ohio	050302010704	13,136	2.09%
Haynes Run–Ohio River	Ohio	050302011004	19,386	3.09%
Leith Run–Ohio River	Ohio	050302011007	18,682	2.98%
Lower East Fork Duck Creek	Ohio	050302010805	17,154	2.73%
Lower Sunfish Creek	Ohio	050302010104	9,172	1.46%
Middle East Fork Duck Creek	Ohio	050302010803	27,597	4.40%
Middle Fork Duck Creek	Ohio	050302010802	25,815	4.11%
Middle Sunfish Creek	Ohio	050302010103	16,960	2.70%
Mill Creek–Ohio River	Ohio	050302011006	12,725	2.03%
New Years Creek–Duck Creek	Ohio	050302010903	27,702	4.42%
Opossum Creek	Ohio	050302011002	16,304	2.60%
Patton Run–Ohio River	Ohio	050302011005	16,199	2.58%
Pawpaw Creek	Ohio	050302010804	20,574	3.28%
Piney Fork	Ohio	050302010102	14,992	2.39%
Rich Fork	Ohio	050302010601	9,993	1.59%
Straight Fork–Little Muskingum River	Ohio	050302010605	14,345	2.29%
Sugar Creek–Duck Creek	Ohio	050302010904	23,491	3.74%

WATERSHED NAME	STATE	HUC-12	ACRES WITHIN THE ANALYSIS AREA	PERCENTAGE OF THE ANALYSIS AREA
Upper East Fork Duck Creek	Ohio	050302010801	11,343	1.81%
Upper Sunfish Creek	Ohio	050302010101	20,250	3.23%
Wingett Run–Little Muskingum River	Ohio	050302010703	22,465	3.58%
Witten Fork	Ohio	050302010604	23,260	3.71%
Wolfpen Run–Little Muskingum River	Ohio	050302010603	27,114	4.32%
Little Muskingum–Middle Island Subtotal	**–**	**–**	**574,048**	**91.50%**
Muskingum	**–**	**–**	**–**	**–**
Devol Run–Muskingum River	Ohio	050400041204	13,251	2.11%
Wills	**–**	**–**	**–**	**–**
Glady Run–Seneca Fork Wills Creek	Ohio	050400050103	26,453	4.22%
Headwaters Seneca Fork Wills Creek	Ohio	050400050101	18,682	2.98%
Analysis Area Total	**–**	**–**	**627,351**	**100.00%**

Sources: OEPA 2022

3.6.1.1. Water Quality

The Clean Water Act (CWA) imposes duties on states, including Section 303, which requires states to adopt and revise water quality standards for waters within the state (33 USC Sections 1313(a)–(c)(1)). Section 303(d) requires states to identify and make a list of those surface waterbodies that are polluted. These impaired waterbodies, referred to as "water quality limited segments," do not meet water quality standards even after discharges of wastes from point sources have undergone pollution-control treatment. Section 303(d) also requires states to develop Total Maximum Daily Loads (TMDL) to improve the water quality. States report on their assessed waterbodies under Section 305(b) and those listed as impaired per CWA Section 303(d) in a single Integrated Report. States submit an Integrated Report to fulfill reporting requirements under both CWA Sections 303(d) and 305(b) every 2 years. Water quality standards designate the use of the particular waterbody (e.g., recreation, protection of aquatic life), establish water quality criteria to protect the waterbody, and implement requirements to protect and maintain healthy waters (USEPA 2022).

Table 3-14 outlines the 32 HUC-12 watersheds that occur in the Analysis Area and indicates whether the Section 303(d) water quality standards are being met for each watershed. The majority of HUC-12 watersheds within the Analysis Area (78 percent) are not meeting current water quality standards. The data for five of the 32 watersheds—Clear Fork Little Muskingum River, Leith Run–Ohio River, Lower Sunfish Creek, Opossum Creek, and Piney Fork—indicate that they are attaining some designated beneficial uses under the CWA. These watersheds support aquatic life (warmwater habitat and coldwater habitat) and their condition allows for recreational use. Additionally, 12 of the 32 watersheds listed as impaired were fully supporting beneficial uses (OEPA 2022). *Impairment* refers to a condition in which the waterway does not meet the water quality standards for the designated beneficial use. A waterway can be impaired and still be fully supporting some beneficial uses because the water quality requirements vary depending on the beneficial use.

Of the 32 watersheds in the Analysis Area, 19 (59 percent) are impaired as a result of bacteria and other microbes, 11 (34 percent) are impaired as a result of metals, nine (28 percent) are impaired as a result of polychlorinated biphenyls), and nine (28 percent) are impaired as a result of low oxygen. Other impairments in the Analysis Area include algae, toxic chemicals, sediment, abnormal flow, dioxins, murky water, degraded habitat, degraded aquatic life, and other known and unknown causes (Table 3-14).

The ODNR protects Ohio's groundwater resources by regulating the disposal of brine and other wastes produced from the drilling, stimulation, and production of oil and natural gas in Ohio. Within the State, approximately 98 percent of all brine is disposed of by underground injection into brine-bearing or depleted oil and gas formations deep below the surface (ODNR 2024a, ODNR 2024b). The other 2 percent is spread for dust and ice control and used with local government approval. There are seven Class II brine injection wells within the Marietta Unit of the WNF: five in Washington County, one in Monroe County, and one in Noble County (ODNR 2024b). In accordance with Ohio Administrative Code 1501:9-3-07(G), Class II disposal well owners must file Quarterly Reports as well as Annual Reports, documenting the total volume of brine or other waste substances received, the maximum injection pressure reached, the average daily injection pressure, the volume and delivery date for each shipment of brine or other waste substances, and proof of the lawful disposal of waste.

Table 3-14. Water Quality Descriptions in HUC-12 Watersheds within the Analysis Area

WATERSHED NAME	HUC-12	MEETING 303(D) STANDARDS?[1]	IMPAIRMENT CATEGORIES
Little Muskingum–Middle Island	–	–	–
Archers Fork	050302010702	No	Bacteria and Other Microbes
Buffalo Run–West Fork Duck Creek	050302010902	No	Total Toxic Chemicals; Sediment; Low Oxygen; Abnormal Flow; Cause Unknown
Bull Creek–Ohio River	050302011010	Unknown	PCBs; Metals; Bacteria and Other Microbes; Dioxins; Total Toxic Chemicals; Sediment; Low Oxygen; Abnormal Flow; Impaired, Other Cause
Clear Fork Little Muskingum River	050302010701	Yes	N/A
Cow Creek–Ohio River	050302011009	No	Bacteria and Other Microbes; Metals; PCBs; Degraded Aquatic Life; Dioxins
Cranenest Fork	050302010602	No	Bacteria and Other Microbes
Eightmile Creek–Little Muskingum River	050302010705	No	Bacteria and Other Microbes; PCBs
Fifteenmile Creek	050302010704	No	Bacteria and Other Microbes; Impaired, Other Cause
Haynes Run–Ohio River	050302011004	Unknown	Bacteria and Other Microbes; PCBs; Dioxins; Metals
Leith Run–Ohio River	050302011007	Yes	Bacteria and Other Microbes; PCBs; Dioxins; Metals
Lower East Fork Duck Creek	050302010805	No	Murky Water; Total Toxic Chemicals; Sediment; Low Oxygen; Metals; Abnormal Flow; Degraded Habitat; Cause Unknown
Lower Sunfish Creek	050302010104	Yes	N/A
Middle East Fork Duck Creek	050302010803	No	Murky Water; Total Toxic Chemicals; Sediment; Low Oxygen; Metals; Abnormal Flow; Degraded Habitat; Cause Unknown
Middle Fork Duck Creek	050302010802	No	Murky Water; Total Toxic Chemicals; Sediment; Low Oxygen; Metals; Abnormal Flow; Degraded Habitat; Cause Unknown
Middle Sunfish Creek	050302010103	No	Bacteria and Other Microbes
Mill Creek–Ohio River	050302011006	No	Bacteria and Other Microbes; Metals; PCBs; Dioxins; Degraded Aquatic Life

WATERSHED NAME	HUC-12	MEETING 303(D) STANDARDS?[1]	IMPAIRMENT CATEGORIES
New Years Creek–Duck Creek	050302010903	No	Total Toxic Chemicals; Sediment; Low Oxygen; Abnormal Flow; Cause Unknown
Opossum Creek	050302011002	Yes	N/A
Patton Run–Ohio River	050302011005	Unknown	PCBs; Bacteria and Other Microbes; Metals; Dioxins
Pawpaw Creek	050302010804	No	Murky Water; Total Toxic Chemicals; Sediment; Low Oxygen; Metals; Abnormal Flow; Degraded Habitat; Cause Unknown
Piney Fork	050302010102	No	N/A
Rich Fork	050302010601	No	Bacteria and Other Microbes
Straight Fork–Little Muskingum River	050302010605	No	Bacteria and Other Microbes
Sugar Creek–Duck Creek	050302010904	No	Total Toxic Chemicals; Sediment; PCBs; Low Oxygen; Abnormal Flow
Upper East Fork Duck Creek	050302010801	No	Murky Water; Total Toxic Chemicals; Sediment; Low Oxygen; Metals; Abnormal Flow; Degraded Habitat; Cause Unknown
Upper Sunfish Creek	050302010101	No	Algae
Wingett Run–Little Muskingum River	050302010703	No	Bacteria and Other Microbes
Witten Fork	050302010604	No	Bacteria and Other Microbes
Wolfpen Run–Little Muskingum River	050302010603	No	Bacteria and Other Microbes
Muskingum	–	–	–
Devol Run–Muskingum River	050400041204	No	Bacteria and Other Microbes; Impaired, Other Cause; PCBs
Wills	–	–	–
Glady Run–Seneca Fork Wills Creek	050400050103	No	Sediment; Bacteria and Other Microbes
Headwaters Seneca Fork Wills Creek	050400050101	No	Bacteria and Other Microbes

Sources: USEPA 2023i.
[1] Yes = use attaining or available data indicate some uses attaining; Unknown = use attainment unknown/insufficient information; No = impaired.
N/A = not applicable; PCBs = polychlorinated biphenyls

3.6.1.2. Water Quantity

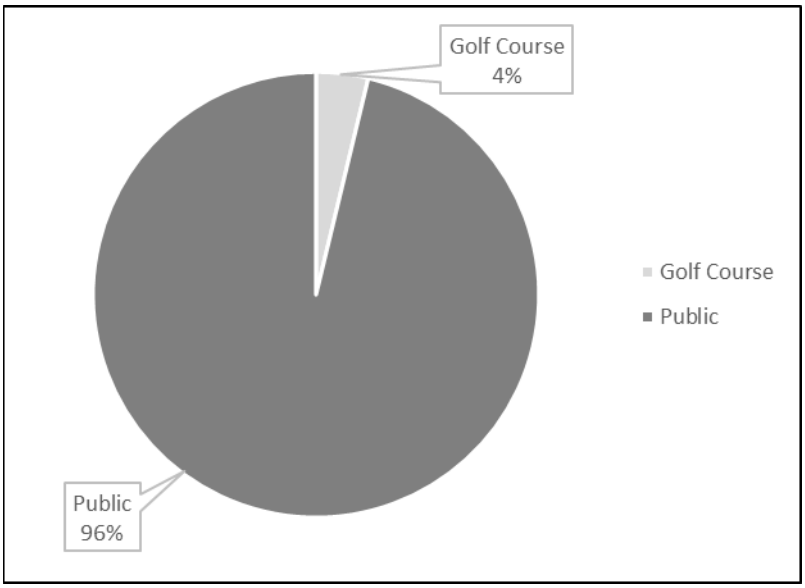
Owners of land in Ohio adjacent to lakes or watercourses possess riparian water rights, entitling them to make reasonable use of the groundwater underlying their land or the water in an adjacent lake or watercourse. These rights are protected by Article 1, Section 19b, of the Ohio Constitution. ODNR's Water Withdrawal Facilities Registration Program requires the owner of any facility with the capacity to withdraw more than 100,000 gallons of water per day (70 gallons per minute) must register the facility with the ODNR, Division of Water Resources (Ohio Revised Code [ORC] § 1521.16). Facilities registered with ODNR's Division of Water Resources must complete and submit an annual report of all water withdrawn in a calendar year. This reporting requirement applies to groundwater withdrawals, surface water withdrawals, or any combination of the two (ODNR 2021). Withdrawals in the Analysis Area that were reported from 2017 and 2021 are outlined in Table 3-15 and Table 3-16 below. All groundwater and surface water withdrawals reported in the Analysis Area during this time are within the Little Muskingum–Middle Island HUC-8 cataloguing unit.

Table 3-15. Registered Groundwater Withdrawals in the Analysis Area from 2017 to 2021

		Water Withdrawals (Mgal)					
Watershed Name	**HUC**	**2017**	**2018**	**2019**	**2020**	**2021**	**HUC Avg**
Patton Run–Ohio River	050302011005	238.0	269.7	262.9	272.0	278.3	264.2
Mill Creek–Ohio River	050302011006	35.5	34.6	26.6	24.3	22.3	28.7
Cow Creek–Ohio River	050302011009	52.2	56.4	65.4	60.7	52.4	57.4
Little Muskingum–Middle Island	**05030201**	**325.7**	**360.7**	**354.9**	**357.0**	**353.0**	**350.3**

Source: ODNR 2023a.
Avg = Average; HUC = Hydrological Unit Code; Mgal = million gallons.

As seen in Table 3-15, Facilities registered with ODNR withdrew an average of 350.3 million gallons (Mgal) of groundwater from the Little Muskingum–Middle Island HUC-8 between 2017 and 2021. These withdrawals were from three HUC-12s, with the majority of water withdrawn from the Patton Run–Ohio River watershed. None of the reported groundwater withdrawals are associated with hydraulic fracturing or mineral extraction; they were all associated with public uses (96 percent) or golf courses (4 percent; see Figure 9). Records from existing well logs in the WNF and surrounding area indicate that groundwater is unlikely to exist in sufficient quantities to support hydraulic fracturing operations (Thompson 2012).



Source: ODNR 2023a.

Figure 9. Groundwater Uses for Registered Withdrawals in the Analysis Area

Most groundwater drinking wells in the Action Area produce less than 10 gallons per minute and, because of this low production rate, it is unlikely operators involved in high-volume hydraulic fracturing would utilize groundwater wells (BLM 2016). While groundwater wells along the Ohio River and the Muskingum River valleys can produce up to several hundred gallons per minute, both Monroe and Washington Counties, which make up a majority of the Marietta Unit, lie within the Nonglaciated Central hydrogeologic setting and wells within this area are only capable of producing low-flow groundwater yields. The geologic formations beneath the Little Muskingum and its tributary streams are primarily consolidated bedrock, which generally provide low-producing aquifers (averaging less than three gallons a minute), although yields can be slightly higher if wells are drilled within stream valleys (ODNR 2016, 2002).The groundwater yield is dependent on other factors besides the value of the aquifer, such as the number and type of wells drilled. Occasionally within the Unit area, bedrock zones can intersect with several aquifers and bedding planes. In these locations, the result can be a decrease in depth to water and the wells can produce slightly higher groundwater yields. In many places along the tributaries of the Little Muskingum, depth to water averages less than 30 feet. However, even in these areas, groundwater wells within the Marietta Unit connect to low-producing aquifers, with averages between three and ten gallons per minute. For this reason, domestic wells are typically smaller in diameter and are low-producing wells (ODNR 2016, 2002).

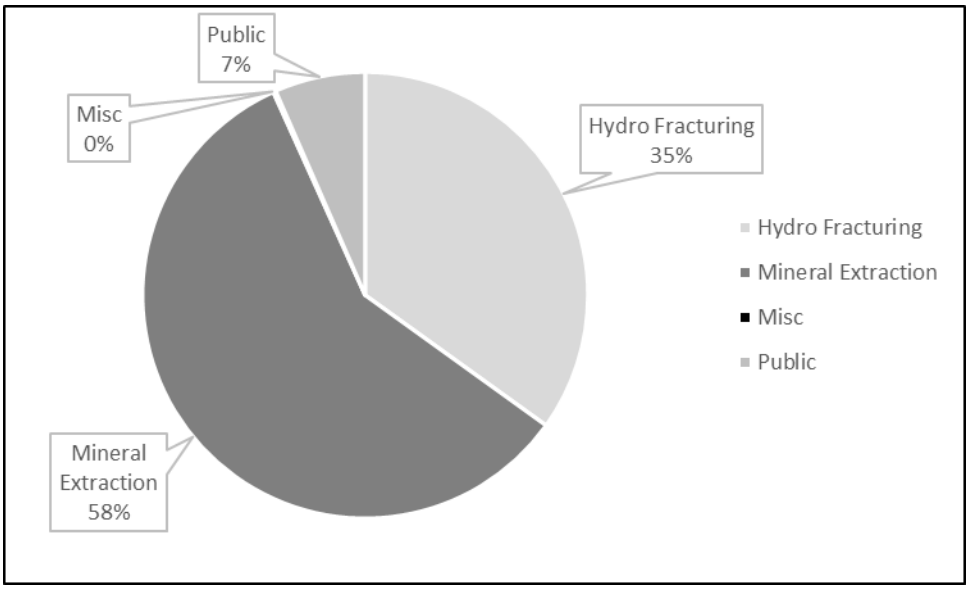
Reported surface water withdrawals in the Little Muskingum–Middle Island HUC-8 averaged 1,570.9 Mgal between 2017 and 2021 (Table 3-16). These withdrawals are from 14 different HUC-12 watersheds, with approximately 58 percent of water withdrawn during this time coming from the Cow Creek–Ohio River HUC-12 for mineral extraction (ODNR 2022).

Table 3-16. Registered Surface Water Withdrawals in the Analysis Area from 2017 to 2021

Watershed Name	HUC	Water Withdrawals (Mgal)					
		2017	2018	2019	2020	2021	HUC Avg
Upper Sunfish Creek	050302010101	109.0	105.8	96.4	122.6	151.2	117.0
Piney Fork	050302010102	7.7	0.0	NDA	NDA	NDA	3.9
Middle Sunfish Creek	050302010103	0.0	35.2	152.3	47.9	0.0	47.1
Lower Sunfish Creek	050302010104	132.4	164.4	189.3	84.4	151.8	144.5
Wolfpen Run–Little Muskingum River	050302010603	27.7	45.2	0.0	69.3	0.0	28.4
Witten Fork	050302010604	0.0	82.9	94.0	0.0	16.6	38.7
Straight Fork–Little Muskingum River	050302010605	44.7	0.0	37.4	0.0	68.3	30.1
Clear Fork Little Muskingum River	050302010701	120.0	0.0	0.0	0.0	0.0	24.0
Upper East Fork Duck Creek	050302010801	9.1	8.3	9.7	3.8	2.4	6.7
Lower East Fork Duck Creek	050302010805	5.1	7.5	8.6	2.5	2.1	5.2
Haynes Run–Ohio River	050302011004	0.0	7.8	52.8	105.0	0.0	33.1
Patton Run–Ohio River	050302011005	127.2	104.8	283.9	154.1	87.8	151.6
Mill Creek–Ohio River	050302011006	3.5	53.3	6.8	5.9	50.9	24.1
Cow Creek–Ohio River	050302011009	894.8	1532.2	647.7	808.7	667.0	910.1
Little Muskingum–Middle Island	**05030201**	**1,525.9**	**2,147.5**	**1,579.0**	**1,404.1**	**1,198.1**	**1,581.2**

Source: ODNR 2023a.
Avg = Average; NDA = no data available.

Of the surface water withdrawals reported between 2017 and 2021, an average of 921.9 Mgal (58 percent) of water were used for solid mineral extraction (coal, salt, sand and gravel, limestone), 552.1 Mgal (35 percent) for hydraulic fracturing, 104.1 Mgal (7 percent) for public uses, and 3.0 Mgal (0.2 percent) for miscellaneous uses (Figure 10). Withdrawals for solid mineral extraction and hydraulic fracturing during these years came from 23 different facilities.



Source: ODNR 2023a.

Figure 10. Surface Water Uses for Registered Withdrawals in the Analysis Area

3.6.2. Environmental Impacts

Potential impacts on water resources, water quality, wetlands, and riparian zones from all activities in the Marietta Unit in the oil and gas program are summarized in Section 4.3.6 and Section 4.6 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. An expanded analysis of potential impacts on water resources from all potential activities in the Analysis Area are described in Section 3.6.2.2, *Impacts of Alternative B – Proposed Action*, below. New and relevant information was used to support this Supplemental EA because the analysis of water resources in the 2016 EA did not have the information and the projections in the 2020 RFDS available (Appendix D), and therefore did not capture the full range of impacts that could result from horizontal drilling with high-volume hydraulic fracturing. The analysis below uses a watershed approach to review potential impacts associated with increased horizontal drilling and hydraulic fracturing within all HUC-12 watersheds overlapping with the Marietta Unit and a four-mile buffer into Ohio.

3.6.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action

Alternative would not result in any substantive change to the estimated impacts on water resources from those impacts analyzed under the No-Action Alternative in Section 4.6 of the 2016 EA (BLM 2016).

3.6.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high volume hydraulic fracturing impact water resources, wetlands, and riparian areas in the region, including the Little Muskingum River Watershed?

Increased water required for horizontal drilling and hydraulic fracturing could impact water resources by increasing withdrawals of surface water and groundwater and may reduce available quantities of water for wetlands and riparian areas, public drinking water, aquatic habitat, and recreational uses. However, at the current leasing stage, the specific water sources that would be used for horizontal drilling and hydraulic fracturing are unknown. Water sources proposed for future activities would be described as part of the APD. Nonetheless, this analysis takes a conservative approach by assessing potential impacts on surface water, groundwater and wetlands and riparian areas in the Analysis Area based on an assumption that all water needed for hydraulic fracturing would be withdrawn from sources within the Analysis Area. Two factors could potentially reduce the demand for surface water and groundwater in the Analysis Area. First, water withdrawn from sources outside of the Analysis Area may be trucked into the Analysis Area for well development and production under the Proposed Action, but because the location of this water is not reasonably foreseeable at this time, it is not reviewed as part of this analysis. Secondly, while not a requirement, oil and gas wastewater is increasingly being treated at facilities with advanced technologies, such as desalination, producing reusable water at rates approaching 90 percent reuse (Jackson et al. 2014). Thus, trucked-in water for drilling could result in decreased impacts if treated, reusable wastewater is used instead of withdrawals from surface water or groundwater sources. The location and siting of Oil and Gas Waste Facilities (which includes wastewater recycling) is outlined under the Ohio Administrative Code (Ohio administrative Code 2022). Applicants who meet the siting requirements may submit a permit to construct an oil and gas waste facility that must be designed, constructed, and operated in a manner that supports the proposed operations as well as protects public health and prevents damage to the environment.

Groundwater and surface water quality may be impacted because of increased potential for accidental spills and contamination, erosion, and runoff. Additionally, a decrease in surface water quantity can exacerbate impacts on surface water quality from contamination due to the overall lower volume of water in the resource depending on the amount of water withdrawal, the hydraulic connection of groundwater and surface water resources, and other factors. Accidental spills, contamination, erosion, and runoff can impact wetlands and riparian areas by degrading water quality and affecting the vegetative and biological health of these areas. Wastewater generation and disposal activities associated with horizontal drilling and hydraulic fracturing are discussed in detail in Sections 3.6, 3.7, 4.6, and 4.7 of the 2016 EA, and impacts resulting from the Proposed Action are not anticipated to be greater than those previously discussed. Please refer to the 2016 EA for that analysis.

During site-specific development of oil and gas resources, impacts on wetlands and riparian zones may occur from physical disturbance to these habitats, such as filling or draining. Impacts from removal of vegetation and soil may cause an increased risk of hydrologic alteration, erosion, runoff, and offsite sedimentation, which could lead to a decline in wetland and riparian ecological functions.

Dredging or filling of wetlands is not anticipated for wells on federal land; however, private landowners accessing federal minerals may seek to perform these activities that could affect water resources and riparian and wetland areas. In Ohio, any construction activity that could create an impact on a wetland hydrologically connected to Waters of the United States requires a CWA Section 404 Dredge and Fill permit from the U.S. Army Corps of Engineers (USACE) and a CWA Section 401 Water Quality Certification permit from OEPA, regardless of whether the activity would occur on private or public property.

Water Quality

Following the issuance of leases, subsequent site-specific development could result in increased surface disturbance and removal of vegetation and soil, resulting in impacts on surface water and groundwater, including in the Little Muskingum watershed, that could also impact wetlands and riparian areas. The 2020 RFDS (Appendix D) projected 29 horizontal well pads (containing up to 81 wells) compared to the 10 well pads previously analyzed in the 2016 EA. The majority of these 29 well pads would support horizontal drilling with high-volume hydraulic fracturing. Construction of such pads results in disturbance of up to an estimated 35 acres more surface in the short term and up to 10 acres more surface per well pad in the long term than vertical drill pads (Table 3-2). The 2020 RFDS (Appendix D) estimated a total of up to 998 acres of short-term disturbance (lasting 8 to 10 weeks) and up to 285 acres of long-term disturbance (lasting 20 to 30 years) across the entire Analysis Area. Impacts from removal of vegetation and soil compaction within the watershed and Analysis Area may cause hydrological disruption and could cause increased risks of erosion, runoff, and offsite sedimentation. These processes may lead to a measurable increase in total dissolved solids (TDS) and total suspended solids (TSS) in water resources throughout the Analysis Area, indicating a decline in water quality that could also affect wetlands and riparian areas. Short-term disturbance would typically last 8 to 10 weeks, followed by interim reclamation to reduce water quality impacts on the greatest extent possible (Lioudis 2022). Long-term surface disturbance would exist in the landscape for 20 to 30 years, until well abandonment, at which time operators must return disturbed land to its pre-development state in accordance with ODNR – Division of Oil and Gas Resources Management (DOGRM) and Gold Book requirements (Lioudis 2022; BLM and USFS 2007).

Certain oil and gas exploration, production, processing, or treatment operations or transmission facilities are conditionally exempt from construction and industrial stormwater permitting requirements under the CWA's National Pollutant Discharge Elimination System (NPDES). The CWA permitting provisions are only applicable if there is a discharge of stormwater resulting in a discharge of a reportable quantity of oil or hazardous substances, or if the facility contributes to a water quality violation, or has a general permit for oil and gas operations that requires operators to develop and implement a stormwater pollution prevention plan. These operators must include in drilling plans measures to prevent and control discharge of pollution to

stormwater, and OEPA must review and approve the stormwater pollution prevention plan before operations can begin (OEPA 2022). Additionally, operators developing wells on private or NFS lands must include in drilling plans preventive measures for stormwater runoff and erosion from well-pad construction activities.

Although instream construction work is not anticipated, Section 404 of the CWA and OAC Chapter 3745-1 require authorization from USACE and OEPA for any construction activity impacting a wetland, stream, river, or other Waters of the United States (WOTUS) or state. On September 8, 2023, the USACE promulgated a new rule (88 FR 61964), amending its prior regulatory definition of WOTUS. The new rule conforms the USACE's definition of WOTUS to the U.S. Supreme Court's May 25, 2023, decision in *Sackett v. Environmental Protection Agency*, and is referred to as the "Conforming Rule." The Conforming Rule establishes that wetlands are only considered WOTUS if they have a hydrological surface connection to other WOTUS (88 FR 61964). However, the State continues to define wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration that are sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (OAC § 3745-1-02(B)(97)). Regulated activities include: (1) excavating or placing fill material in the waterway to construct pad sites, access roads, water lines, or production lines; (2) stream piping, rerouting, or straightening for construction; (3) dredging a wetland to create a pond; and (4) culverting streams or filling wetlands for roadway water or wastewater piping. These projects require a Section 404 Dredge and Fill permit from USACE and a Section 401 Water Quality Certification permit from OEPA, regardless of whether the project is on private or public property. Issuance of a Section 404 Dredge and Fill permit requires a separate NEPA analysis to review environmental impacts.

The increase in well-pad numbers over those analyzed in the 2016 EA, and associated increases in well activity, may also increase the risk and severity of accidental discharges, such as surface spills or leaks of hazardous materials, fuels, or fracturing chemicals, which could result in impacts on the Little Muskingum watershed in the Analysis Area. Some spills may be the result of human error (e.g., vehicle collisions, improper handling, improper equipment operation or installation), whereas others could stem from equipment failure (e.g., broken pipes, torn pit liners, leaking tanks) or acts of nature (e.g., fire, flood). The most common causes of spills associated with oil and gas drilling are equipment failure and corrosion (Wenzel 2012). Between 2002 and 2018, oil and gas–related activities resulted in 17 spills of crude oil, oil, brine, or diesel fuel reportedly occurring in the Little Muskingum River watershed (OEPA 2020). Though these spilled materials are common to both vertical and horizontal drilling, the frequency at which the spills occur could increase with more wells developed.

The chemicals associated with hydraulic fracturing fluid and wastewater can also be more toxic and/or higher in concentration than fluids used in vertical drilling. The USEPA has compiled a list of 1,606 chemicals associated with hydraulic fracturing, including 1,084 chemicals that are used in hydraulic fracturing fluid and 599 chemicals that have been detected in produced water. Of these chemicals, the USEPA found a median of 14 chemicals are used for one well with 90 percent of wells using from four to 28 chemicals (USEPA 2016). Hydraulic fracturing wastewaters are generally high in TDS, especially those from shales and tight formations. The TDS in wastewaters from shale formations is typically dominated by sodium and chloride and

may also include elevated concentrations of bromide, bicarbonate, sulfate, calcium, magnesium, barium, boron, strontium, radium, organics, and heavy metals. Hydraulic fracturing wastewater typically contains some heavy metals, as well as barium and strontium, in concentrations that can reach hundreds or even thousands of milligrams per liter (USEPA 2016). Infiltration or runoff of spilled hazardous materials and chemicals results in potential groundwater and surface water contamination.

As seen in Table 3-14, the majority of watersheds within the Analysis Area are not currently meeting water quality standards set under section 303(d) of the CWA due to bacteria and other microbes, metals, polychlorinated biphenyls, and low oxygen. Developing up to 29 well pads and up to 81 wells in the Action Area could further contribute to these watersheds (including the Little Muskingum) not meeting water quality standards due to potential impacts described above. For the five watersheds in the Analysis Area meeting water quality standards, or the 12 watersheds fully supporting designated uses, developing up to 29 well pads in the Analysis Area could pose a risk to these watersheds of retaining their functional status, especially if accidental spills of hydraulic fracturing fluid and wastewater occur that can have high heavy metal concentrations. Potential spills and contamination could impact water quality in the Little Muskingum River if they were to occur close to the river or upstream of the river. The Little Muskingum River bisects the Action Area in the northeast/southwest direction (Figure 8). During site-specific permitting of APDs, further analysis of potential impacts on the Little Muskingum River would be conducted based on the specific location of proposed development, especially if development is proposed in close proximity to or upstream of the river. Decreases in water quality can impact wetlands and riparian areas by degrading water quality and affecting the vegetative and biological health of these areas.

Several federal and State regulations are currently in place to prevent and respond to hazardous material spills resulting from oil and gas development. Federal oil and gas regulations applicable to oil and gas operations on federal lands (43 CFR 3160) impose requirements and standards for safe drilling and well abandonment, as well as methods for responsible disposal of produced waters associated with oil and gas operations. During well-pad permitting on private land, ODNR-DOGRM geologists perform a complete and thorough review of every permit application. Detailed examinations verify that wells are designed to minimize environmental impacts, that proper environmental safeguards are in place, and that all legal requirements are met. One of these safeguards involves lining the surface extent of well pads with a secondary containment system for spill control, and then topping that lining with gravel. The BLM also promotes the proper management of hazardous and non-hazardous substances by requiring the preparation of a Spill Prevention, Control, and Countermeasure Plan.

A concern surrounding oil and gas drilling is how individual subsurface oil and gas activities could potentially impact groundwater. Static groundwater levels in the Marietta Unit range from 0 to 183 feet below the surface. The mean depth of drinking-water wells in the Marietta Unit is 86 feet, with a maximum depth of 475 feet (BLM 2016). Horizontal wells in the Marcellus and Utica Shales can reach from 5,000 to 10,000 feet below the surface (BLM 2020). Most horizontal wells in the area were estimated to be around 10,000 feet deep. During hydraulic fracturing, the potential for fluid migration between the fractured formation and drinking-water resources is related to the vertical distance between these formations and the presence of fluid-

migration pathways (Reagan et al. 2015; Jackson et al. 2013). The likelihood of a fluid-migration pathway occurring from the fractured formation to the drinking-water resource decreases as the distance between these two areas increases (Birdsell et al. 2015).

To protect groundwater in the long-term, the normal and legally required practice is to install various types of casing as the borehole reaches certain depths or encounters changes in geological/hydrogeological conditions. Each type of casing is set inside the previously installed one. Typically, the initial casing is the "conductor" casing which is set through soils and other near surface materials that may cave into the borehole. "Surface" casing is set from the ground surface to a point below the lowest groundwater zone, as specified by regulations. Depending on regulatory requirements and subsurface conditions below the groundwater zone, "intermediate" casing may be set next. Once the target zone is reached, "production" casing is set to the top of or into the producing formation. With the exception of conductor casing (casing set through unconsolidated material above bedrock to keep it out of the wellbore) and perhaps production casing, after each type of casing is set cement is pumped up between the casing and the walls of the borehole (the annular space) to create an annular space seal. Under Ohio regulations production casing is only required to be cemented in place where it crosses a subsurface interval with characteristics (i.e. corrosive fluids) that could degrade the casing and cause it to fail and leak or that have an enhanced potential for causing fluid migration along the outside of the casing (Thompson 2012).

Improper placement of the annular space seal or cement is the main cause of leaks of well fluids into freshwater aquifer zones. There are methods for testing the integrity of an installed seal, but unless required by regulation, those tests are not always run. Leaks of well fluids can also occur if there is a casing defect that causes it to fail. However, the chances of this occurring in a way that impacts groundwater is small given that there are typically at least two sets of casing across the groundwater zone (Thompson 2012).

If groundwater contamination were to occur it could impact surface water expressions if there is a hydraulic connection. Although wetlands can be groundwater dependent, they do not always receive groundwater discharge. Many of the larger wetlands in the WNF are artificially constructed and there is little evidence that they rely on groundwater (USFS 2020b). As such, if groundwater were to be contaminated it may not affect the larger and artificially constructed wetlands in the Analysis Area.

Water Quantity

Horizontal wells in Monroe, Washington, and Noble Counties have been reported to require approximately 19 Mgal to 27 Mgal of water to drill and complete each well, as compared to only 0.044 to 0.085 Mgal per vertical well (Table 3-2). In addition, during operations, horizontal wells have been found to use between 2 and 6 Mgal of water per well (University of Michigan 2013).

In general, the source of the water for hydraulic fracturing is either surface water, groundwater, or reused hydraulic fracturing wastewater. As seen on Figure 9, above, no groundwater was withdrawn from HUC-12s in the Analysis Area for solid mineral extraction or hydraulic fracturing between 2017 and 2021. Local groundwater aquifers within the Marietta Unit do not yield sufficient water to support industrial activities within the Marietta Unit (BLM 2016). Most

groundwater drinking wells produce less than 10 gallons per minute and, because of this low production rate, it is unlikely that operators engaged in high-volume hydraulic fracturing would utilize water withdrawn from groundwater aquifers in the Marietta Unit (BLM 2016). Therefore, the likelihood that issuing leases under the Proposed Action would impact groundwater quantity is negligible.

Surface water is the primary source for well development in the Analysis Area, with 93 percent of surface water withdrawals between 2017 and 2021 having been used for solid mineral extraction or hydraulic fracturing. The RFDS (BLM 2020) predicts one oil and gas well in Noble County and up to 80 wells in Monroe County.

Based on the assumption that one well in Monroe County or Noble County requires 19 to 27 Mgal, and on the 2020 RFDS (Appendix D) projection that five to six wells would be developed each year over the 15-year development period, it is predicted that approximately 114 to 162 Mgal of water would be required each year during well development, or total water use of to 1,539 Mgal to 2,187 Mgal during well development). Considering that the surface water withdrawals in the Analysis Area averaged 1,581.2 Mgal per year between 2017 and 2021, the development of wells projected in the 2020 RFDS would result in an approximate 10-percent increase in withdrawal per year if all water used for drilling and hydraulic fracturing activities is surface water withdrawn from the Analysis Area. In addition, during operations horizontal wells have been found to use between 2 and 6 Mgal of water per well (Table 3-2). Assuming that all 81 wells are developed, operation of these wells could result in total water use of 486 Mgal during the operation/production phase. The annual distribution of this total estimated water use of 486 Mgal during operation/production would be spread out over the productive lifetime of the wells, which can range from 20 to 30 years (16.2 Mgal per year if production lasts 30 years and 24 Mgal per year if production lasts 20 years and). This amount of water use during operation equates to an approximate increase of 1 to 1.5 percent of total annual water withdrawals per year if all water withdrawals for operation come from surface water in the Analysis Area.

Considering that all surface water withdrawals in the Analysis Area between 2017 and 2021 were within the Little Muskingum–Middle Island HUC-8, future withdrawals for mineral development are expected to also be from this watershed. Concentration of withdrawals in this HUC-8 could result in impacts on water quantity associated with HUC-12 watersheds. To determine the extent of impacts, this analysis uses publicly available streamflow data from the USGS (2023b). In the Little Muskingum–Middle Island HUC-8, USGS maintains seven streamflow-monitoring stations that provide flow data. Because the *CBD* decision found the analysis of impacts on the Little Muskingum River watershed deficient, this analysis uses streamflow data from Little Muskingum River Site 03115400 as a representative case study for surface waters in the HUC-8. Additionally, this monitoring site provides the largest available dataset, with measurements taken from October 1958 through September 1981, and from October 1995 to today. Other surface-water monitoring stations only provide data from as early as 2012.

Using Site 03115400 stream gage data, USGS (2023b) calculated various streamflow measurements in the Little Muskingum River as presented in Table 3-17, below. The predicted volumes of water passing through the river annually were then calculated based on streamflow.

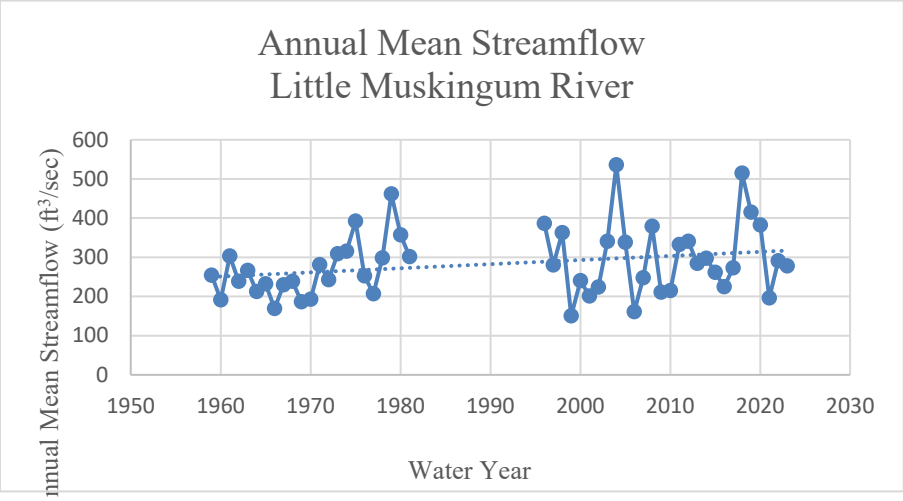
Table 3-17. Streamflow Summary for the Little Muskingum River from 1959 to 2022

Measurement	Streamflow (ft^3/s)	Annual Water Volume (Mgal/year)	Date Recorded
Annual Mean	284.1	67,020.8	–
Highest Annual Mean	535.7	126,374.7	2004
Lowest Annual Mean	150.7	35,551.0	1999
Highest Daily Mean	28,000.0	–	September 18, 2004
Lowest Daily Mean	0.0	–	September 18, 1967
Annual 7-day Minimum	0.047	–	September 23, 1999
10% Exceeds	658.0	155,225.9	–
50% Exceeds	96.8	22,835.7	–
90% Exceeds	4.80	1,132.3	–

Source: USGS 2023b.
ft^3/s = cubic feet per second

Annual streamflow of the Little Muskingum River over the past 63 years averaged 284.1 cubic feet per second (ft^3/sec). In 2004, the river saw its highest annual mean streamflow at 535.7 ft^3/sec and in 1999 its lowest annual mean flow at 150.7 ft^3/sec. The highest daily mean streamflow for the Little Muskingum River was recorded on September 18, 2004, at 28,000 ft^3/sec, and the lowest daily mean was recorded on September 18, 1967, at 0 ft^3/sec (Table 3-17).

Figure 11 presents the annual mean streamflow in the Little Muskingum River from 1959 to 2023. The annual stream flow, a metric of water quantity, in the Little Muskingum River has been variable over time since 1959, mostly reflecting annual precipitation patterns. The overall trend line indicates that the Little Muskingum River has been gaining flow since 1959.



Source: USGS 2023b.

Figure 11. Annual Mean Streamflow in the Little Muskingum River from 1959 to 2023.

Projected surface-water usage during well drilling and development based on development estimates in the 2020 RFDS (Appendix D) is approximately 114 to 162 Mgal of water needed annually. Based on the average streamflow rate of 284.1 ft^3/sec, the Little Muskingum River carries about 183.6 Mgal per day (approximately 67,020.8 Mgal per year). If all the water required for proposed horizontal drilling and hydraulic fracturing in the 2020 RFDS (Appendix D) were withdrawn directly from the Little Muskingum River, then this use would equate to approximately 0.17 to 0.24 percent of the river's average annual water total. In 1999, the year with the lowest annual mean streamflow rate (150.7 ft^3/sec) over the past 63 years, approximately 35,551.0 Mgal passed through the Little Muskingum River. If all the water for horizontal drilling and hydraulic fracturing were withdrawn from the Little Muskingum River, then projected surface-water usage would equate to removing about 0.32 to 0.46 percent of the river's water in the lowest streamflow year. Removal of this percentage of the river's water, even during low-streamflow years, is anticipated to have minimal impacts on the Little Muskingum River's streamflow given the total streamflow in the river. If all water used during operations (estimated at 16.2 Mgal per year if production lasts 30 years and 24 Mgal per year if production lasts 20 years) were taken from the Little Muskingum River potential impacts on streamflow would be correspondingly minimal. Moreover, water needs associated with operation of a well are generally concentrated in the early stage of production and decline with a well's production age (Table 3-2) and thus the minimal streamflow impacts during operation would further decline with time. In addition, as depicted on Figure 11, the trendline for annual mean streamflow in the Little Muskingum River indicates that the river has generally been gaining flow since 1959.

Nonetheless, Harmon et al. (2023) modeled and calculated the potential impacts of hydraulic fracturing–related water withdrawals on daily flow in HUC-12 watersheds of the Ohio River Basin and concluded that extreme withdrawals (withdrawals that are substantially above average withdrawal levels) could result in episodic and relatively short-lived, but potentially harmful, reduced streamflow depending on location and timing, and in the absence of appropriate mitigation measures. The Little Muskingum River experienced the lowest mean streamflow for a 7-consecutive-day period in 1999, at 0.047 ft^3/sec (Table 3-17). This streamflow equates to approximately 0.03 Mgal per day, which is not enough water to support the 0.31 Mgal to 0.44 Mgal required per day (based on 114 to 162 Mgal per year) for horizontal drilling and hydraulic fracturing. As seen in Table 3-17, these low-flow events are infrequent, with 90 percent of water years experiencing streamflow above 4.80 ft^3/sec, totaling 1,132.3 Mgal through the river per year. Although withdrawals are unlikely during these low-flow events due to the decreased quantity of flowing of water, if withdrawals did occur, streamflow reductions in the Little Muskingum River and other surrounding surface waters within the Little Muskingum–Middle Island HUC-8 could occur.

Poorly timed water withdrawal, such as extreme withdrawals during drought or low-flow periods, could deplete minimum flows or shorten the duration of periods of inundation for wetlands, and lower levels in lakes, ponds, and reservoirs. This could impact ecosystem functions like primary productivity and leaf litter processing (Poff et al. 1997). Increased water withdrawals could also create "simplified" streams and rivers by reducing flow in one or several sites, resulting in the loss of branches and stream features in riparian areas. Simplified streams lose their ability to adapt to disturbances like floods, fires, or landslides (Penaluna et al. 2017). However, as noted above these low flow events are infrequent and as such the potential impacts

on water resources, wetlands, and riparian areas from poorly timed withdrawals is expected to be minimal.

The Forest Plan (USFS 2006a) contains a guideline that would allow USFS to prevent water withdrawals from waterways or groundwater on NFS lands if that activity were proposed as part of a SUPO or special-use permit request associated with oil and gas development (Appendix F, Reference Number GFW-WSH-1). This guideline states that water should not be diverted from streams, lakes, or springs when instream flow needs or water-level assessments indicate that diversion would impact stream processes, aquatic and riparian habitats and communities, or recreation and aesthetic values. However, USFS does not have the ability to prevent surface water or groundwater withdrawals occurring on non-NFS lands, even if the oil or gas well were located on NFS surface and would access federal minerals. Ohio landowners have the right as riparian water rights owners (protected by Article 1, Section 19b, of the Ohio Constitution) to make reasonable use of the groundwater underlying their land or the water in a lake or watercourse located on or flowing through or along their riparian land. While this allows USFS to prevent withdrawals of water on, in, or flowing through NFS lands, it allows other landowners to sell water to oil and gas companies.

Withdrawal from lakes, rivers, and reservoirs requires approval from the source owner/manager and water withdrawal registration with ODNR and may entail potential requirements from USACE (ODNR 2014). The ODNR registration requirement is triggered by capability of withdrawal, not actual withdrawal. However, registration with ODNR is not a permit to withdraw water, nor does it place any restrictions on withdrawals such as during droughts or low-flow conditions (OEPA 2020; ODNR 2020).

Under ORC Section 1521.23, facilities with new or increased consumptive uses of more than 2 Mgal of water per day, averaged over any 30-day period (60 Mgal per month), must obtain a permit from the Chief of the Division of Water Resources. *Facilities* are defined in ORC Section 1522.10 as any site, installation, or building at which water withdrawal and consumptive use activities take place or are proposed to take place, that is located at a property or on contiguous properties. *Consumptive uses* are defined in ORC Section 1521.01 as a use of water resources, other than a diversion, that results in a loss of that water to the basin from which it is withdrawn and includes “incorporation of water into a product” (ORC § 1521.01). For oil and gas operations, this can include the incorporation of water into drilling fluids and hydraulic-fracturing fluids (ODNR 2020). Therefore, with a consumptive use of 19 to 27 Mgal predicted for development of each horizontal well, resulting in about 114 Mgal to 162 Mgal of water use each year, it is possible that wells projected in the 2020 RFDS would trigger the requirement for a consumptive use permit. In order to receive a consumptive use permit, the owner or operator of a facility is required to declare and document potential impacts on water resources. Failure to consider the impacts of the requested withdrawal on water resources and conservation practices to protect these resources would result in denial of the permit. Therefore, impacts on surface waters resulting from water withdrawals on private lands are anticipated to be reduced through the permit process.

BLM’s Section 6 lease term (BLM 2023) requires that adverse impacts on water resources, including water quality and quantity, be minimized. If the conduct of operations results in

substantial unanticipated environmental impacts, the lessee must immediately contact the BLM (BLM 2023). Additionally, site-specific environmental reviews would be required for APDs proposing surface disturbance on both federal and private land to analyze the impacts of proposed development on water resources, wetlands, and riparian areas. Design features, COAs, and BMPs would be applied to each approved APD, as appropriate, to minimize impacts on water resources, wetlands, and riparian areas. For example, stipulations and guidelines in the Forest Plan require that operators avoid adverse impacts on ephemeral wetlands during ground-disturbing activities and require application of a Controlled Surface Use stipulation for development on NFS lands in proximity to riparian areas and wetlands (Appendix F, Reference Number GFW-ARR-23 and SFW-MIN-11). Stipulation GFW-WSH-1 states that water should not be diverted from streams, lakes, or springs when instream flow needs or water-level assessments indicate that diversion would impact stream processes, aquatic and riparian habitats and communities, or recreational and aesthetic values (Appendix F, Reference Number GFW-WSH-1). The BLM also requires all operators on private lands to enter into a land use agreement with the private landowner, which would contain minimum reclamation requirements in accordance with the Gold Book (BLM and USFS 2007). Additionally, application of USFWS recommended avoidance and minimization measures (Appendix G) for federally-listed species could reduce potential impacts on certain water resources, including prohibiting well pads within 1,000 feet of a mussel stream, establishment of a 300-foot no-disturbance buffer along each side of a designated mussel stream, and prohibition of water withdrawals from the Little Muskingum River, Muskingum River, and certain other streams during drought conditions that exceed a severe drought category.

3.6.3. Cumulative Impacts

The CIAA for water resources, wetlands, and riparian areas includes the extent of the HUC-12 watersheds overlapping the Marietta Unit and a 4-mile buffer into Ohio and West Virginia. Historical activities, current ongoing projects, and reasonably foreseeable future actions that could result in water-related impacts in the CIAA are outlined in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions)*. Cumulative impacts on water resources associated with subsequent development of mineral leases issued under the Proposed Action could result from increased surface disturbance, increased surface water withdrawals, increased subsurface drilling and hydraulic fracturing, and increases in the potential for inadvertent spills and contamination when considered in conjunction with ongoing and reasonably foreseeable future projects in the WNF.

Existing and future oil and gas development on private land is expected to be the largest contributor to cumulative impacts on water quality, water quantity, wetlands, and riparian areas in the CIAA. There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells located on private land. This could amount to anywhere between 11,988 acres and 171,250 acres of existing surface disturbance depending on whether these wells were horizontally or vertically drilled. It is difficult to predict how much water is being used to support these wells, as they are in various phases of their lifecycles. It is likely most wells have been drilled for some time and no longer have large water requirements, while others are actively being hydraulically fractured. On private lands within the CIAA it is assumed that future land use will remain similar to current land use and would continue to contribute to erosion and

sedimentation at rates similar to what occurs in the current baseline. An exception to this would be horizontal well drilling on private lands, where it is assumed that there will be increased activity until the limit of available drillable acreage is reached. Existing and future oil and gas development on private land is expected to be the largest contributor to cumulative impacts on wetland and riparian zones in the CIAA.

Climate change could also contribute to cumulative impacts on water resources, wetlands, and riparian zones. In general, climate change is predicted to increase the potential for extreme weather events including flooding and drought (IPCC 2021). Flooding and drought can both impact water quality and water quantity and affect wetlands and riparian zones and these impacts can also be exacerbated by warmer temperatures associated with climate change.

3.6.3.1. Water Quality

On private lands within the CIAA, it is assumed that future land use will remain similar to current land use and would continue to contribute to erosion and sedimentation at rates similar to what occurs in the current baseline. An exception to this would be horizontal well drilling on private lands, where it is assumed that there will be more activity than there is currently, until the limit of available drillable acreage is reached.

There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells located on private land. This could amount to anywhere between 11,988 acres and 171,250 acres of existing surface disturbance depending on whether these wells were horizontally or vertically drilled). This amount of surface disturbance has cumulatively contributed to erosion, runoff, and sedimentation that impacts water quality, wetlands, and riparian areas in the CIAA, including the Little Muskingum watershed. Short-term surface disturbance during well development of the Proposed Action is estimated to cumulatively contribute up to 998 acres, or 0.2 percent of the Action Area and up to 285 acres (.05 percent of the Action Area) of long-term disturbance during well production. This equates to a total short-term cumulative disturbance of anywhere between 12,986 acres and 172,248 acres during well development and anywhere between 12,273 and 171,535 acres of long-term cumulative disturbance during well production. The total cumulative surface disturbance likely contributes to cumulative impacts on water quality, including increased sedimentation that may contribute to the impairment status of watersheds, especially those where sediment is already an impairment factor (see Table 3-14). However, the Proposed Action would contribute to a minimal incremental increase in surface disturbance and associated erosion, runoff and sedimentation to waterways due to the limited amount of surface disturbance in relation to the total cumulative disturbance.

Operators developing wells on private or NFS surface lands must include in drilling plans preventive measures for stormwater runoff and erosion from well-pad construction activities. GFW-WSH-11 also requires actions on NFS lands to plan for and implement erosion control measures for management activities that create bare mineral soil conditions. The guideline also requires stabilization of disturbed areas based on direction in SFW-WSH-6, and GFW-WSH 7 and GFW-WSH-8.

Given the minimal incremental contributions of surface disturbance associated with the Proposed Action, and application of resource protection measures, the Proposed Action is not expected to notably contribute to cumulative impacts and the impairment status of the Little Muskingum watershed.

3.6.3.2. Water Quantity

Table 3-18 below presents estimates of the cumulative water withdrawals in the Little Muskingum watershed during the development phase and production phase of reasonably foreseeable development associated with the Proposed Action. These estimates assume that all water withdrawals for reasonably foreseeable development and production are from surface water resources in the Analysis Area and annual water withdrawal trends for ongoing and future development are consistent with average water withdrawals from 2017 to 2021 in the Little Muskingum watershed. As indicated in Table 3-18, cumulative water withdrawal during well development is estimated at up to 1,743.2 Mgal (10 percent maximum increase over average annual water use in the watershed) and up to 1,597.4 Mgal during well production (one percent increase over average annual water use in the watershed). These cumulative estimates represent a worst-case scenario where the maximum number of reasonably foreseeable wells are developed each year.

Past and ongoing development and production of the 17,125 existing oil and gas wells in the CIAA has likely contributed to cumulative reductions in water quantity in the CIAA. As indicated in Section 3.6.1, *Water Resources – Affected Environment,* annual surface water withdrawals in the Little Muskingum watershed average an estimated 1,581.2 Mgal, which is inclusive of water for oil and gas operations and other activities. Development and production of the reasonably foreseeable 29 well pads and up to 81 wells under the Proposed Action would incrementally add to the cumulative surface water withdrawals, especially if all of the water withdrawals come from surface water sources in the Little Muskingum watershed.

A 10 percent annual increase in cumulative water withdrawals in the watershed would represent a notable increase in total water use in the watershed; however, there are no indications that this increased water use would affect water flows in streams and rivers or affect the availability of water for other water uses in the watershed. For example, the Little Muskingum River carries approximately 183.6 Mgal per day (approximately 67,020.8 Mgal per year) (USGS 2023b). If all the water required for reasonably foreseeable horizontal drilling and hydraulic fracturing in the 2020 RFDS (Appendix D) were withdrawn directly from the Little Muskingum River, then this use would equate to approximately 0.17 to 0.24 percent of the river's average annual water total. Removal of this percentage of the river's water, even during low-streamflow years, is anticipated to have minimal impacts on the Little Muskingum River's streamflow given the total streamflow volumes in the river.

Table 3-18. Cumulative Surface Water Withdrawals Estimated in the Analysis Area

Watershed Name	Average Annual Withdrawal from 2017 to 2021 (Mgal)	Reasonably Foreseeable Development Annual Withdrawals (Mgal)	Cumulative Annual Withdrawals During Development (Mgal)	Reasonably Foreseeable Production Annual Withdrawal (Mgal)	Cumulative Annual Withdrawal During Production (Mgal)
Little Muskingum–Middle Island Total	**1,581.2**	162	**1,743.2**	16.2	**1,597.4**

Source: ODNR 2023a.
Note: Reasonably foreseeable development withdrawal estimates assume up to six wells would be developed annually with up to 27 Mgal per well during the development phase. The reasonably foreseeable production estimates assume that all 81 of the reasonably foreseeable wells would be in production at the same time with each well requiring a total of up to six Mgal of water for production during an up to 30-year production phase (16.2 Mgal per year for well production water withdrawals).
Mgal = million gallons.

3.7. Aquatic Wildlife

3.7.1. Affected Environment

The affected environment for wildlife, including aquatic wildlife, is summarized in Section 3.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. The affected environment for water resources and water quality is discussed in Section 3.6 of the 2016 EA. Updates to the affected environment for water resources are included in Section 3.6.1.1, *Water Resources – Affected Environment*. As with water resources and wetlands, the Analysis Area for aquatic wildlife is the full extent of the HUC-12 watersheds overlapping the Marietta Unit and the surrounding 4-mile buffer.

Since publication of the 2016 EA, several changes have occurred to the list of federally protected species under the ESA. Some new species are evaluated under the ESA for the potential to occur in the Analysis Area. Specifically, the round hickorynut (*Obovaria subrotunda*) mussel was listed as threatened under Section 4(d) of the ESA on April 10, 2023, and three species of mussels not previously analyzed are considered to potentially occur within the current Analysis Area: clubshell (*Pleurobema clava*), northern riffleshell (*Epioblasma rangiana*), and purple cat's paw (*Epioblasma obliquata*) (USFWS 2023). Furthermore, USFWS announced the proposed listing of salamander mussel (*Simpsonaias ambigua*) as endangered on August 21, 2023 (USFWS 2023). The updated list of threatened and endangered aquatic species with potential to occur in the Analysis Area is shown in Table 3-19.

Table 3-19. Potential Federally Protected Aquatic Species in the Analysis Area[1]

SPECIES	STATUS	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Clubshell (*Pleurobema clava*)	FE	Small to medium streams with gravel and sand substrate with little silt content.	**Moderate**. No known populations in the WNF or Little Muskingum River watershed. Although population numbers are relatively high in a few localized areas, the remaining clubshell populations are now sparsely distributed across the range of the species. Of 100 streams once known to be occupied by clubshell, the species is now limited to 11 extant populations occupying 19 streams. The USFWS introduced the species into the Ohio River Islands National Wildlife Refuge within the Analysis Area between 2014 and 2018 (USFWS 2022d). The reintroduction sites have not shown evidence of successful reproduction as of 2018; however, club shells take a number of years to reach a size likely to be detected.
Fanshell (*Cyprogenia stegaria*)	FE	Medium to large rivers; buries itself in the gravel or sand of deep water with moderate current. *Addressed in 2016 EA*	**Low**. Species mainly occurs in larger sections of rivers (historically in the Ohio River and in many of its larger tributaries), while streams in the WNF are mostly small headwater streams (USFS 2022). No known populations exist in the WNF or Little Muskingum River watershed. Limited populations exist in the upper reaches of the Muskingum River. However, the lower portion of the Muskingum River within the Analysis area is unlikely to support this species due to the system of 10 dams located upstream (USACE 2018) and associated impacts on flow, sedimentation, water quality, and interconnectedness of aquatic habitats. Dams and reservoirs are known to cause periods of flooding that reduce gravel and sand habitat and act as barriers that isolate upstream populations from migrating downstream (USFWS 2024a) and impoundments are known to be fatal to most riverine mussel species (USFWS 2024c). In addition, according to the Ohio EPA, sampling of the water quality on the Muskingum River near Devol (in the Analysis Area) indicates that this portion of the river is in partial attainment status for aquatic life use designations and is below target biological criteria for warmwater habitat and coldwater habitat as measured by the Index of Biotic Integrity (OEPA 2019).

SPECIES	STATUS	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Northern Riffleshell (*Epioblasma rangiana*)	FE	A wide variety of streams in various sizes. This species buries itself in firmly packed gravel or sand.	**Moderate**. Remaining populations of this species occur in large and small rivers and streams (USFWS 2024b) and existing populations are very small. No known populations occur in the WNF or Little Muskingum River watershed. This species has been reintroduced in the Ohio River Islands National Wildlife Refuge within the Analysis Area (USFWS 2024e).
Pink Mucket Pearlymussel (*Lampsilis abrupta*)	FE	Sand and mud, as well as shallow riffles free of silt in major rivers or tributaries. This species buries itself in gravel or sand. *Addressed in 2016 EA*	**Low**. No known populations exist in the WNF or Little Muskingum River watershed (USFS 2022). There are 29 streams in the United States considered to have extant populations, including one of the two Ohio River subpopulations in the Ohio River between Ohio and West Virginia. There are historical observations of eight live individuals since 1989 in the Belleville, Byrd, and Greenup Pools, all outside the Analysis Area. No individuals have been found since 1995 (USFWS 2018b) and none have been observed in the Analysis Area. Appropriate habitat and individuals more likely occurs downstream of the Analysis Area near the confluence of the Mississippi River where the river is more free flowing (USFWS 2018b). The potential to occur in the Muskingum River within the Analysis Area is low due to the same factors as noted above for Fanshell (USFWS 2024c).
Purple Cat's Paw (*Epioblasma obliquata*)	FE	Large to medium-large rivers in the Ohio River Watershed; prefers shallow water and requires a swift current. Found on bottom substrates ranging from sand to boulders.	**Moderate**. No known populations exist in or near the WNF or Little Muskingum River watershed. The species occurs in the Ohio River and four of its tributaries including Killbuck Creek (OH), Walhonding River (OH), Green River (KY), Licking River (KY). This species has been reintroduced in the Ohio River Islands National Wildlife Refuge within the Analysis Area (USFWS 2022d, 2024e). The reintroduced populations contain only young individuals. While some of these may have reached sexual maturity, evidence of reproduction has not yet been documented (USFWS 2022d). Limited habitat available in the Ohio River and Muskingum River in the Analysis Area due to habitat being degraded from historic dams and for the reasons noted above for Fanshell.

SPECIES	STATUS	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Round Hickorynut (*Obovaria subrotunda*)	FT	Medium to large rivers in areas with slow to swift currents over a mixture of sand and gravel substrates.	**High**. Currently occupied and potentially suitable habitat in the Marietta Unit is limited to the Little Muskingum River mainstem and Ohio River within Washington County and represents a small portion of the historical distribution.
Salamander Mussel (*Simpsonaias ambigua*)	PE	Swift-flowing rivers and streams with areas of shelter under rocks or in crevices.	**High**. Salamander mussel is known to occur within the past decade in and near the WNF and represents a small portion of the historical distribution. Known populations are in the lower reaches of the mainstem of the Little Muskingum River in the Little Muskingum–Middle Island watershed, and in the New Years Creek-Duck Creek watershed within the Aquatic Analysis Area.
Sheepnose Mussel (*Plethobasus cyphyus*)	FE	Larger rivers and streams in shallow areas with moderate to swift currents that flow over gravel or coarse sand; also may be found in areas of cobble, boulders, or mud, or deep areas of rivers. *Addressed in 2016 EA*	**Moderate**. Occurs in the vicinity of the WNF, but not known within the WNF or Little Muskingum River watershed. However, there is potential for this species to occur within the Ohio River and Muskingum River in the Aquatic Analysis Area and be affected by water withdrawals. The closest known extant population is in the Belleville pool, which starts at the Willow Island Locks and Dam, just south of the Marietta Unit.
Snuffbox Mussel (*Epioblasma triquetra*)	FE	Small to medium creeks in areas with swift current; also found in Lake Erie and other larger rivers. This species buries deep in sand, gravel, and cobble substrates. *Addressed in 2016 EA*	**Low**. No known populations exist in or near the WNF or Little Muskingum River watershed. A small population exists in the Muskingum River upstream from the Analysis Area, but the potential to occur within the Analysis Area is low due to the same factors as noted above for Fanshell.

Source: Badra 2001; USFWS 1997a, 1997b, 1997c, 2012a, 2012b, 2018a, 2018b, 2019a, 2019b, 2019c, 2022a, 2022d, 2023, 2024a, 2024b, 2024c, 2024d; USFS 2020a; USACE 2018; OEPA 2019.

[1] Species added since publication of 2016 EA.

FE = federally listed as endangered, FT = federally listed as threatened, PE = federally proposed for listing as endangered

The BLM and USFS are conducting consultation with USFWS under ESA Section 7 with respect to federally listed species. The BLM is preparing a BA to analyze impacts on listed species that are anticipated to occur in the Analysis Area. Those species with low likelihood to occur in the Analysis Area or that are unlikely to be impacted by well development and production activities as determined through agency coordination are not carried forward in the BA analysis. The USFWS will utilize the BA to inform the preparation of a BO regarding potential impacts on federally listed species and critical habitat and which would include required mitigation measures to be considered and applied in APD approvals. The BO would provide a tiered approach to the ESA Section 7 consultation that can be applied during subsequent site-specific development proposals and associated consultation at the APD stage. Agency coordination with the USFWS to date has resulted in identification of avoidance and minimization measures designed to avoid and minimize potential impacts on federally listed mussel species and are incorporated into the Proposed Action (see Appendix G, *USFWS Recommend Measures for Avoiding and Minimizing Impacts to Federally Listed Species*).

Table 3-20 presents the 2024 Regional Forester Sensitive Aquatic Species List in the Action Area along with their typical habitat association and potential to occur. Since publication of the 2016 EA, two new aquatic species have been added to the RFSS list (USFS 2024).

Table 3-20. Regional Forester Sensitive Aquatic Species in the Analysis Area

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Fish	–	–	–
Ohio Lamprey (*Ichthyomyzon bdellium)*	Retained	Primary headwater streams with fast moving clear water and sand or cobble substrates connected by free-flowing stretches to larger, slower-moving streams and rivers to meet all life stages.	**High.** Well-distributed in the Little Muskingum River and its tributaries and connected to the Ohio River.
Mollusks	–	–	–
Creek Heelsplitter *(Lasmigona compressa)*	Added	Typically high-quality headwater streams in sand and cobble, in a current or in slackwater.	**High**. It is found sporadically throughout the entire Ohio River drainage and is known from the mainstem of the Little Muskingum River.
Insects	–	–	–
Uhler's Sundragon (*Helocordulia uhleri*)	Added	Located near small, rapid forest streams, often with impeded flow, and occasionally lakes.	**Low**. Periphery of range is in Ohio, where it is rare. One observation in the Marietta Unit from 2019.

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Green-faced Clubtail *(Hylogompus viridifrons)*	Retained	Egg-laying: medium to large, clear-flowing rivers with mixture of gravelly sand and silt among rocks; feeding (in and around breeding habitat): larvae burrow in silt; adults forage in trees.	**Moderate.** Rare but known from the lower Little Muskingum River watershed.
Rapids Clubtail *(Phanogomphus quadricolor)*	Retained	Egg-laying: clear streams with strong currents and riffles over clean gravel, cobbles, or bedrock; feeding (in and around breeding habitat): larvae burrow in silt; adults forage in trees.	**Low.** Rare but known from the Little Muskingum River watershed; Ohio Odonata Survey (2017) reports it is primarily distributed in the northern half of Ohio.
Amphibians	–	–	–
Green Salamander (*Aneides aeneus)*	Retained	In Ohio: south-facing or unshaded, moist crevices in rock outcrops, within 7 miles of the Ohio River, which is the northern limit of this species' range.	**Low**. Extensive range that includes the southern tip of Ohio, but no populations known from the Marietta Unit.
Eastern Hellbender *(Cryptobranchus alleganiensis)*	Retained	Large slabs of rock or other shelter-providing objects (logs and boards) with loose sand and gravel (not silt) on the bottom of large to medium streams or rivers with fast-moving water.	**Low**. Extensive range that includes Ohio, but extremely limited in the WNF with possibility of presence in the Little Muskingum River watershed.
Mud Salamander (*Pseudotriton montanus)*	Retained	Stream bank burrows or muddy areas under large, flat stones or logs along shallow, sluggish woodland streams, springs, and seeps.	**Low**. Extensive range that includes Ohio, but no populations known from the Marietta Unit.

Source: USFS 2024.

3.7.2. Environmental Impacts

Potential impacts on aquatic wildlife from previously reviewed activities in the oil and gas program are summarized in Section 4.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because of changes to the list of federally protected species and RFSS species and the analysis of aquatic wildlife management in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D) and therefore did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing.

3.7.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on aquatic wildlife from those impacts analyzed under the No-Action Alternative in Section 4.3 of the 2016 EA (BLM 2016).

3.7.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact aquatic wildlife species in the region, including federally protected mollusk species?

During any site-specific development that may occur subsequent to a lease being sold, impacts on aquatic wildlife could result from physical disturbance to, or removal of, aquatic wildlife individuals and habitats as well as from water withdrawals during low-flow conditions or through contaminants from spills or run-off. During site-specific development, impacts could also occur from introduction of nonnative or invasive species, decreased aquatic habitat quality, and increased surface water withdrawals. As discussed in Section 3.6.2.2, compliance with all applicable regulations and implementation of lease stipulations and BMPs would minimize risks associated with hazardous material spills and associated impacts on water resources and aquatic species.

Instream work is not anticipated as part of development that may arise from the Proposed Action, but, if required, then use of equipment adjacent to and within waterways could result in physical disturbance to aquatic wildlife individuals or long-term destruction of aquatic wildlife habitats, including wetlands, riparian areas, streams, and rivers. In Ohio, any construction activity that could create an impact on a wetland, stream, river, or other Waters of the United States requires a CWA Section 404 Dredge and Fill permit from USACE and a CWA Section 401 Water Quality Certification permit from OEPA, regardless of whether the activity would occur on private or public property. Despite the recent Conforming Rule (88 FR 61964), the State continues to protect wetlands "inundated or saturated by surface or ground water at a frequency and duration that are sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (OAC § 3745-1-02(B)(97)).

Issuance of a CWA Section 404 permit requires its own NEPA analysis to review environmental impacts. Although oil and gas activities are typically exempt from the NPDES program, CWA Section 402 permitting provisions are applicable if there is a discharge of stormwater resulting in a discharge of a reportable quantity of oil or hazardous substances, or the facility contributes to a water quality violation, or has a general permit for oil and gas operations that requires operators to develop and implement a stormwater pollution prevention plan. The potential presence of federally listed species on either federal or private land would also trigger the need for additional analysis under ESA and consultation with USFWS during site-specific permitting of APDs, with the potential for additional required conservation measures.

Increased surface disturbance projected in the 2020 RFDS (Appendix D) may result in impacts on aquatic wildlife, such as soil compaction, introduction of nonnative and invasive species, and increased sedimentation from erosion and runoff. These impacts may cause declines in suitable aquatic habitat for native species and reduce aquatic wildlife habitat quality. Nonnative and invasive plant species in particular can outcompete native aquatic vegetation and clog waterways (Ailstock et al. 2001; Gabriel et al. 2018). Short-term surface disturbance would last 8 to 10 weeks, followed by interim reclamation to reduce water quality impacts on the greatest extent possible. Long-term surface disturbance would exist in the landscape for 20 to 30 years, until well abandonment, at which time operators must return disturbed land to its pre-development state in accordance with ODNR-DOGRM and Gold Book requirements (BLM and USFS 2007).

Sedimentation of waterways is one of the most harmful impacts on aquatic wildlife species, causing smothered eggs, young, and habitat, which can result in a loss of viability of the population. Sediment entering streams in the Analysis Area could potentially alter the survival of mussels by disrupting filter-feeding, burying them, or displacing suitable habitat by filling in the interstitial spaces between stable substrates (NatureServe 2023). Mussels, such as round hickorynut, salamander mussel, sheepnose and others, that rely on sight-feeding organisms as part of their life cycles are especially sensitive to sedimentation of habitat because cloudy water at critical reproductive periods (late spring to early summer) may affect reproductive success. These impacts would be mostly like to occur in the Little Muskingum River and other rivers and streams if disturbance occurs in close proximity to or upstream of the river or stream.

Operators developing wells on private land must also include preventive measures for stormwater runoff and erosion from well-pad construction activities in drilling plans they submit to ODNR. For APDs and SUPOs proposing development on NFS lands, compliance with Forest Plan standards and guidelines and federal and State regulations would further limit the potential for surface-water contamination. There are several standards and guidelines for the protection of aquatic resources, such as GFW-ARR-5 that requires the establishment of filter strips along perennial, intermittent, and ephemeral waterbodies where earth-disturbing activities expose mineral soil on NFS lands and GFW-WSH-8 and Stipulation #8 that are aimed at reducing erosion and sedimentation that can affect water quality (Appendix F).

As described in Section 3.6.2, *Water Resources – Environmental Impacts,* accidental spills and contamination could impact water resources and the aquatic species that rely on those water resources. Potential spills and contamination could affect aquatic species in the Little Muskingum River if they were to occur close to the river or upstream of the river. The Little

Muskingum River bisects the Action Area in the northeast/southwest direction (Figure 8). During site-specific permitting of APDs, further analysis of potential impacts on the Little Muskingum River and aquatic species in the river would be conducted based on the specific location of proposed development, especially if development is proposed in close proximity to or upstream of the river.

Withdrawal of surface water for hydraulic fracturing and horizontal well drilling may also impact aquatic species by depleting water sources essential to their habitats. USFWS identified several primary threats to salamander mussels including changes in water flow and depth, contaminants, landscape alteration, lack of connectivity, invasive species, and risks to its host species, the mudpuppy (*Necturus maculosus*). The Little Muskingum River case study (Section 3.6.2.2) shows that the majority of the time (approximately 90 percent) withdrawals are not expected to result in substantial streamflow reductions, even in low-flow years. Nonetheless, Harmon et al. (2023) modeled and calculated the potential impacts of hydraulic fracturing–related water withdrawals on daily flow in HUC-12 watersheds of the Ohio River Watershed and concluded that extreme withdrawals could result in episodic and relatively short-lived reduced streamflow that could potentially be harmful to aquatic organisms dependent on that streamflow in the absence of appropriate mitigation measures. These events are considered uncommon (occurring less than 10 percent of the time) but depending on location and timing and in the absence of appropriate mitigation measures, substantial streamflow reduction in surface waters could occur.

Additionally, withdrawals on private land are subject to ORC Section 1521.23, which requires facilities with new or increased consumptive uses of more than 2 Mgal of water per day, averaging over any 30-day period (60 Mgal per month), to obtain a permit from the Chief of the Division of Water Resources. It is likely that wells projected in the 2020 RFDS would trigger the requirement for a consumptive use permit, as described in Section 3.6.2.2. Failure to consider the impacts of the requested withdrawal on water resources and conservation practices to protect these resources would result in denial of the consumptive use permit. Therefore, impacts on aquatic wildlife resulting from water withdrawals on private lands are anticipated to be minimized through the permit process.

Processing an APD would also require site-specific assessments of federally listed aquatic species within suitable habitat on both private and federal land. Although the BLM does not have the authority to enter the non-federal lands without the landowner's consent, the BLM may deny the APD if the inability to access the surface prevents the BLM from meeting its obligations under ESA. During site-specific permitting of APDs, standards and guidelines for watershed health, aquatic and riparian resources (riparian corridors), wildlife, and plants from the Forest Plan (USFS 2006a) would be applied to maintain watershed and aquatic-ecosystem health, which would, in turn, protect aquatic wildlife species. GFW-WSH-1 requires avoidance of water diversions from streams, lakes, or springs when instream flow needs or water-level assessments indicate that diversion would adversely impact stream processes, aquatic and riparian habitats and communities, or recreational and aesthetic values (Appendix F).

Pursuant to Section 7 of the ESA, the BLM consulted with the USFWS on potential impacts on federally listed threatened, endangered, proposed, and candidate aquatic species. The USFWS

provided measures that will be incorporated into all approved APDs to avoid and minimize potential impacts associated with the Proposed Action, which are included as Appendix G (*USFWS Recommended Measures for Avoiding and Minimizing Adverse Impacts to Federally Listed Species*) and summarized below.

- Prohibiting in-water work in Group 2 and 4 mussel streams or requiring a mussel survey prior to in-water work would reduce direct mortality of mussels through crushing, would reduce the generation of silt and sedimentation that can suffocate mussels, and would reduce the destruction and degradation of in-stream mussel habitat.
- Prohibiting construction of well pads within 1,000 feet of a mussel stream and applying a 300-foot no disturbance buffer along mussel streams would reduce sedimentation and erosion that can run-off into streams and suffocate mussels or affect feeding and reproduction, and decrease downstream contamination of streams if accidental spills or releases occur.
- Prohibiting water withdrawals during drought conditions that exceed the severe drought category from the Little Muskingum River, Muskingum River, or any other Group 2 and 4 streams that may be identified in the future would reduce mortality to mussels from stranding and predation during low flow and would reduce impacts on mussels from increases in temperature, decreases in oxygen levels, and increases in contaminant concentrations that can result during low flow conditions.
- Encouraging the use of recycled water to minimize the amount of water withdrawals from surface sources would reduce potential impacts on aquatic species from decreased water quantity in the watershed.

While the measures above were developed to address potential impacts on federally protected mussel species, they would also help to avoid and minimize potential impacts on other aquatic species and habitats.

In order to reduce the amount of runoff and sedimentation after construction, USFS and the BLM would also require well operators to reclaim all disturbed areas as soon as possible. The BLM requires operators on private lands to enter into a land use agreement with the private landowner, which would contain minimum reclamation requirements in accordance with the Gold Book (and USFS 2007).

Due to the limited amount of surface disturbance associated with the Proposed Action and application of the avoidance, minimization, and protection measures described above, potential impacts on aquatic are anticipated to be minimal. If potential impacts are identified during APD permitting additional resource protection measures would be applied to avoid and minimize potential impacts on the aquatic species.

3.7.3. Cumulative Impacts

The CIAA for aquatic wildlife encompasses the Analysis Area, which includes the extent of HUC-12 Watersheds within the Marietta Unit, plus a 4-mile buffer in Ohio and West Virginia. Historical activities, current ongoing projects, and reasonably foreseeable future actions that could result in impacts on aquatic wildlife in the CIAA are outlined in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions)*. Cumulative impacts on aquatic wildlife

associated with the Proposed Action could result from increased surface disturbance and surface-water withdrawals when considered in conjunction with ongoing projects in the WNF.

As previously discussed, existing and future oil and gas development on private land is expected to be the largest contributor to cumulative impacts in the CIAA. There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells located on private land. This could amount to anywhere between 11,988 and 171,250 acres of existing surface disturbance depending on whether these wells were vertically or horizontally drilled. It is difficult to predict how much water is being used to support these wells, as they are in various phases of their lifecycles. It is likely most wells have been drilled for some time and no longer have large water requirements, while others are actively being hydraulically fractured. On private lands within the CIAA it is assumed that future land use will remain similar to current land use and would continue to contribute to erosion and sedimentation at rates similar to what occurs in the current baseline. An exception to this would be horizontal well drilling on private lands, where it is assumed that there will be increased activity.

Additional surface disturbance and removal of vegetation from the Proposed Action could exacerbate the lingering impacts of past resource extraction in the Action Area and cause declines in habitat quality for aquatic species. Natural flood events that lead to surface disturbance and increased erosion rates also have the potential to cumulatively impact aquatic wildlife. Furthermore, climate change may cause more severe or frequent floods in some places. As warmer temperatures cause more water to evaporate from the land and oceans, changes in the intensity and frequency of heavy precipitation events may in turn affect the intensity and frequency of flooding (IPCC 2021).

Nonetheless, initial surface disturbance associated with the Proposed Action is estimated to be up to 998 acres, or 0.2 percent of the Action Area. This estimate represents an unlikely scenario where all 81 wells are developed at the same time, with surface disturbance not yet offset by interim reclamation. The 2020 RFDS (Appendix D) projects that realistically two horizontal well pads would be developed per year over 15 years, disturbing up to 0.01 percent of the Action Area (70 acres) per year. Interim reclamation would therefore reduce some surface disturbance from year to year. Maximum long-term surface disturbance for 29 well pads is predicted to be, at most, 0.05 percent of the Action Area (285 acres) (BLM 2020). Therefore, issuing leases under the Proposed Action and subsequent development of those leases would result in a minimal cumulative impact on aquatic wildlife in the CIAA.

Surface water withdrawals from the CIAA, particularly the Little Muskingum–Middle Island HUC-8, are likely to increase as more wells are permitted in the Analysis Area. As shown in Section 3.6.2, *Water Resources – Environmental Impacts*, streamflow reductions related to the Proposed Action's horizontal oil and gas activities are expected to result in a minor reduction (from 0.32 percent to 0.46 percent) in surface-water availability, based on the Little Muskingum River case study. However, withdrawals during rare (less than 10 percent of the time), extreme, low-flow events could potentially harm the biology of streams and their adjacent riparian zones (Harmon et al. 2023). Implementation of 2006 Forest Plan stipulations for actions on NFS lands, application of the USFWS avoidance and minimization measure (Appendix G), and compliance with federal and State regulations (e.g., ORC § 1521.23) would mitigate the likelihood of

substantial drawdown of surface waters in the Analysis Area. However, increased mineral extraction on private lands could contribute to cumulative impacts on aquatic wildlife and their habitats if future withdrawals do not trigger the need for a consumptive use permit under ORC Section 1521.23.

3.8. Terrestrial Wildlife

3.8.1. Affected Environment

The affected environment for terrestrial wildlife, including the Indiana bat and other threatened or endangered species, is summarized in Section 3.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference.

Since publication of the 2016 EA, several changes have occurred to the list of federally protected species. The northern long-eared bat (*Myotis septentrionalis*) was federally listed as endangered as of March 31, 2023. The tricolored bat (*Perimyotis subflavus*), not analyzed in the 2016 EA, was proposed for listing as endangered (September 14, 2022) and may occur in the Action Area. The American burying beetle (*Nicrophorus americanus*) was downgraded from endangered to threatened in 2020 and was not listed in the USFWS Information for Planning and Consultation report generated in 2023 because no populations have been identified in the WNF (USFWS 2023; USFS 2022). The updated list of threatened and endangered terrestrial species with potential to occur in the Action Area is shown in Table 3-21.

Table 3-21. Potential Federally Protected Terrestrial Species in the Action Area

SPECIES	STATUS	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Bats	–	–	–
Indiana Bat (*Myotis sodalis*)	FE	Forested areas in the summer months; roosts in wooded areas, mainly in snags with exfoliating bark or crevices. Overwinters in abandoned mines. *Addressed in 2016 EA*[1]	**Low**. Habitat for the species is found throughout the WNF, and it is thought to occur year-round, but numbers are very low and there have not been any documented occurrences in the Marietta Unit of the WNF. The single documented hibernaculum is not on the Marietta Unit of the WNF. No maternity roost sites were identified on the WNF. The species has experienced population declines from white-nose syndrome.

SPECIES	STATUS	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Northern Long-Eared Bat (*Myotis septentrionalis*)	FE	Forested areas during the summer; roosts in trees with exfoliating bark and other crevices, as well as cavities in live and dead trees. *Addressed in 2016 EA*	**Unknown**. Suitable habitat is available across the WNF. The species is highly affected by white-nose syndrome, and no hibernacula have been identified in the Marietta Unit. Roost trees have been identified in the WNF and specifically in the Marietta Unit in 2014 (just prior to the white-nose syndrome population crash).
Tricolored Bat (*Perimyotis subflavus*)	PE	In summer, roosts mainly in deciduous tree foliage, but also sometimes in humanmade structures (e.g., beneath porch roofs, under bridges, in barns). Hibernates singly in winter in the most humid and warm parts of caves and mines.	**Unknown**. The species was common in Ohio and well-distributed across the WNF but has experienced severe population declines from white-nose syndrome.
Insects	–	–	–
Monarch Butterfly (*Danaus plexippus*)	C	Breeds on milkweed plants. Occurs in habitats supporting a diversity of flowering plants in summer and during spring and fall migration.	**High**. The species is common throughout Ohio and the WNF during the summer months. Likely to occur where milkweed or a diversity of flowering plants is found. Populations are experiencing decline.
Birds	–	–	–
Bald Eagle (*Haliaeetus leucocephalus*)	BGPA, MBTA	Forested areas with large trees adjacent to waterbodies. Frequently hunts over water; can also be found in other habitats. *Addressed in 2016 EA*	**High**. The species is common throughout Ohio.

Source: eBird 2023; USFWS 2021b, 2022b, 2022c, 2023; USFS 2022.
[1] The 2016 EA indicated that the Indiana Bat was present and well documented in the Action Area. However, upon further investigation during the preparation of this Supplemental EA, the BLM, USFS, and USFWS have determined that the statement was in error in the 2016 EA and current evidence suggests there have not been documented occurrences in the Marieta Unit of the WNF.
BGPA = Bald and Golden Eagle Protection Act; C = federal candidate; FE = federally listed as endangered; MBTA = Migratory Bird Treaty Act; PE = proposed for listing as endangered

The Marietta Unit supports habitat for the Indiana bat, and the species is thought to occur year-round on the WNF (BLM 2016). The Marietta Unit, however, was not subject to underground mining, nor does it support any karst, that is, eroded subsurface limestone promoting ridges and fissures and sinkholes; therefore, it is not expected that any bat hibernacula would be impacted by potential drilling. Known fall swarming sites in abandoned mines in the Athens Unit or

Ironton District will not be impacted given their distance from the Action Area. Northern long-eared bat populations have experienced severe declines over recent decades from white-nose syndrome (WNS) and populations across the WNF have declined precipitously (USFS 2020a). Tricolored bat populations have experienced declines from WNS, and populations across the WNF have declined precipitously (USFS 2020a). Tricolored bat was not analyzed in the 2016 because it was not federally proposed as endangered until September 2022, and the final listing decision is expected in 2024.

Monarchs are a widespread species in North America and have been petitioned for listing because of severe declines in population numbers that resulted from the use of pesticides, loss of habitat and native milkweed (*Asclepias syriaca L.*) plants, and global environmental change (USFS 2020a).

The BLM and USFS are conducting consultation with USFWS under ESA Section 7 with respect to federally listed species. The BLM is preparing a BA to analyze impacts on listed species that are anticipated to occur in the Analysis Area. The USFWS will utilize the BA to inform the preparation of a BO regarding potential impacts on federally listed species and critical habitat and which would include required mitigation measures to be considered and applied in APD approvals. The BO would provide a tiered approach to the ESA Section 7 consultation that can be applied during subsequent site-specific development proposals and associated consultation at the APD stage. Agency coordination with the USFWS to date has resulted in identification of avoidance and minimization measures designed to avoid and minimize potential impacts on federally listed bat species and are incorporated into the Proposed Action (see Appendix G, *USFWS Recommend Measures for Avoiding and Minimizing Impacts to Federally Listed Species*).

Table 3-22 presents the 2024 Regional Forester Sensitive Wildlife Species List in the Action Area along with their typical habitat association and potential to occur. Since publication of the 2016 EA, seven new bird species and one new bat species have been added to the list (USFS 2024).

Table 3-22. Regional Forester Sensitive Terrestrial Species in the Action Area

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Birds	–	–	–
Eastern Whip-poor-will (*Antrostomus vociferus*)	Added	Associated with forested landscapes. Prefers dry deciduous and mixed coniferous-deciduous with little or no underbrush or regular disturbances.	**Moderate**. Occurs in all three units of the WNF, with official State surveys documenting the species in the Athens and Ironton Units.

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Ruffed Grouse (*Bonasa umbellus*)	Added	Relies on a diversity of forest age classes.	**Moderate**. Rare in the WNF, but in recent years, while still low, the Marietta Unit has the most recorded activity.
Northern Bobwhite (*Colinus virginianus*)	Added	Inhabits a wide variety of vegetation types, particularly early-forest successional stages of mixed-hardwood forests occurring in habitat mosaics, including woody edge habitats.	**Low**. Extensive range that includes Ohio, but no populations known from the Marietta Unit.
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	Added	Prefers open deciduous woodlands (especially oak), including riparian forest, rural farmland with scattered trees, parkland, or mature forest with sufficient canopy openings and snags.	**Moderate**. Extensive range that includes Ohio but it may be relatively less common in the Marietta Unit compared to western and northern Ohio.
Prairie Warbler (*Setophaga discolor*)	Added	Uses shrub-sapling habitats, reclaimed grasslands, and early successional forest.	**High**. Extensive range that includes all of Ohio.
Eastern Meadowlark (*Sturnella magna*)	Added	Grasslands such as lightly grazed pastures, hayfields, fallow fields, reclaimed strip-mine grasslands, and roadsides within agricultural landscapes.	**High**. Extensive range that includes all of Ohio.
Grasshopper Sparrow (*Ammodramus savannarum*)	Added	Medium to large, dry upland grass habitats such as hayfields, lightly grazed pastures, and reclaimed surface mines.	**Moderate**. Extensive range that includes Ohio but it may be relatively less common in the Marietta Unit where surface mining was not common; however, species is common in suitable habitat.

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Henslow's Sparrow *(Centronyx henslowii)*	Retained	Large grasslands with minimal woody invasion, including reclaimed surface mines and some hay or fallow fields, depending on management regimes	**Moderate.** Extensive range that includes Ohio but it may be relatively less common in the Marietta Unit where surface mining was not common; however, species is common in suitable habitat.
Cerulean Warbler *(Setophaga cerulea)*	Retained	Large tracts of open to semi-open mature mixed oak forest with a heterogeneous canopy layer.	**High.** Extensive range that includes Ohio, especially the eastern half where densities are highest and the species is widespread.
Mammals	–	–	–
Hoary Bat (*Lasiurus cinereus*)	Added	Mature forest, often in areas with scattered trees or at the edges of clearings.	**High**. Extensive range that includes all of Ohio.
Little Brown Bat *(Myotis lucifugus)*	Retained	Mature forest, often near buildings or barns for roosting and lakes and streams for foraging; underground habitats in winter.	**Low.** Extensive range that includes all of Ohio but was decimated by white-nose syndrome. It is yet unclear how well-distributed they are after substantial declines, but survivors do exist and are expected to occur in the Marietta Unit.
Reptiles and Amphibians	–	–	–
Timber Rattlesnake *(Crotalus horridus)*	Retained	Den: rock outcrops; summer: mixed deciduous or coniferous forests with closed canopy, heavy leaf litter and little herbaceous cover, and a few rocks or fallen trees.	**Low**. Extensive range that includes Ohio, but no populations known from the Marietta Unit.

SPECIES	RETAINED OR ADDED SINCE 2016 EA	HABITAT ASSOCIATION	POTENTIAL TO OCCUR
Northern Metalmark *(Calephelis borealis)*	Retained	In open habitat, such as roadsides that have dappled sunlight; larval host plant, *Packera obovata* (formerly *Senecio obovatus*), round-leaved ragwort, must be present along with adult nectar food sources such as *Rudbeckia hirta*, black-eyed susan, and *Asclepias tuberosa,* butterfly weed	**Moderate.** Considered well-distributed across southeastern Ohio but no known populations in the Marietta Unit; however, little dedicated survey work has occurred.
Appalachian Grizzled Skipper *(Pyrgus wyandot)*	Retained	Disturbed openings in mature oak forests where host plant *Potentilla canadensis*, Canada cinquefoil grows, including open hillsides, disturbed ridgetops, powerline cuts, and roadsides; especially drier south-facing sites	**Low.** Extremely rare in Ohio; no known populations from the Marietta Unit.

Sources: eBird 2023; USFWS 2021b, 2022b, 2022c, 2023; USFS 2022, 2024.

3.8.2. Environmental Impacts

Potential impacts on terrestrial wildlife from all activities in the oil and gas program are summarized in Section 4.3 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because of changes to the list of federally protected species and RFSS species and the analysis of terrestrial wildlife management in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D) and therefore did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing. Additionally, the *CBD* Decision Court Orders (Appendix C) found that the analysis of impacts on the Indiana Bat in the 2016 EA were deficient.

3.8.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on terrestrial wildlife from those analyzed under the No-Action Alternative in Section 4.3 of the 2016 EA (BLM 2016).

3.8.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact terrestrial wildlife species in the region, including Indiana bat, northern long-eared bat, and tricolored bat?

During site-specific development, impacts on terrestrial wildlife could result because of surface-disturbance and associated habitat removal, increased potential for take resulting from wildlife-vehicle collisions, exposure of wildlife to contaminants from water impoundments and other sources, and disturbance from noise and human presence. Depending on when pad and well development occur, vegetation removal and disturbance could negatively impact courtship and reproduction for wildlife species. During site-specific development, other impacts could result from habitat fragmentation (although limited at the scale of disturbance in an otherwise heavily forested landscape) and decreased availability and quality of food and water sources as a result of water withdrawals.

Direct loss of habitat is caused when habitat-supporting resources, such as vegetation, soil, cover, structure, or food sources, are removed. Habitat loss can be temporary if areas are restored and operations discontinued, although wildlife would be displaced during this time and suitable habitat may take many years to regrow. Individuals and young that are unable to flee may be killed during habitat removal. Additionally, horizontal wells require more heavy-truck trips and passenger vehicle trips compared to vertical wells (Table 3-2). Increased vehicle trips introduce more opportunity for incidental wildlife take as a result of wildlife-vehicle collisions. These incidental take events may ultimately impact terrestrial wildlife population numbers.

The Proposed Action would result in the loss of terrestrial habitat through surface disturbance and the placement of both short-term and long-term facilities and infrastructure such as well pads, roads, pipelines, and other development. Suitable habitat for terrestrial species has not been specifically delineated in the WNF and at this time specific development locations are not known so it is not possible to quantify impacts on particular terrestrial species and their suitable habitat from surface disturbance at this stage. Initial surface disturbance associated with the Proposed Action is estimated to be up to 998 acres, or 0.2 percent of the Action Area. This estimate represents an unlikely scenario where all 81 wells are developed at the same time, with no surface disturbance offset by interim reclamation. The 2020 RFDS (Appendix D) projects that, reasonably, two horizontal well pads would be developed per year, impacting up to 0.01 percent of the Action Area. Interim reclamation would reduce some surface disturbance from year to year and following interim reclamation and prior to final reclamation, maximum long-term surface disturbance would impact 0.004 percent of the Action Area per year. The long-term surface disturbance (disturbance that persists for 20 to 30 years) for 29 well pads is predicted to be, at most, 0.05 percent of the Action Area. Surface disturbance associated with the Proposed Action is therefore projected to result in minimal impacts on terrestrial habitats.

The RFDS predicts that well pads would be multi-well pads with up to two well pads developed per year that contain two to three horizontal wells. In contrast to vertical drilling where there is typically a larger number of single-well pads required to effectively extract oil and gas resources, multi-well pads allow effective extraction of oil and gas resources from a single larger pad. In general, this results in a development pattern of a fewer number of larger well pads across the

landscape, compared to vertical drilling where there are more well pads spread across the landscape. As a result, horizontal drilling and larger multi-well pads can have a different effect on habitat fragmentation than vertical drilling depending on the size of the well pads, the location of the well pads in relation to wildlife habitat and movement corridors, and other factors.

Increased vehicle trips and workers in operation at drilling sites can also increase the risk for transport of invasive, nonnative vegetation to areas, especially if native vegetation has been damaged or lost through surface disturbance (see Section 3.5, *Vegetation and Rare Plants*). Nonnative vegetation may outcompete native vegetation that acts as a food source for terrestrial wildlife species. Terrestrial wildlife may also be impacted by increases in visual elements, such as light or physical structures, as well as by noise that may cause stress or reduce prey sources and habitat. If disturbance occurs during the spring and early summer breeding or nesting season, then breeding behavior and territorial defense of birds may also be impacted by noise, visual changes, or other sources of stress (Bötsch et al. 2017).

Additionally, horizontal wells require an estimated 19 to 27 Mgal of water per well, as compared to only 44,000 to 85,000 gallons per vertical well (Table 3-2). This additional use of water for hydraulic fracturing and horizontal well drilling may impact terrestrial wildlife species by reducing availability of water sources and reducing insect production during rare and extreme low-flow events (see Section 3.6.2, *Water Resources – Environmental Impacts*).

BLM's Section 6 lease term (BLM 2023) requires that all adverse impacts on biological resources and land be minimized. If in the conduct of operations threatened or endangered species or substantial unanticipated environmental impacts are observed, the lessee must immediately contact the BLM (BLM 2023). Further, the lessee must cease any operations that would result in the destruction of such species (BLM 2023). Additionally, the act of processing an APD is a federal action that requires ESA Section 7 consultation and NEPA compliance. Therefore, processing of an APD may require site-specific surveys within habitat for federally listed wildlife and RFSS on both private and federal land. Although the BLM does not have the authority to enter the non-federal lands without the landowner's consent, the BLM may deny the APD if the inability to access the surface prevents the BLM from meeting its obligations under ESA. If listed species are recorded or potential habitat is identified during these surveys, further consultation with the USFWS may be required. Additional design features, COAs, and BMPs would be applied to each approved APD, as appropriate, to minimize impacts on other terrestrial wildlife species.

In order to reduce the area of surface disturbance remaining after construction on NFS surface lands and private lands, USFS and the BLM would also require well operators to reclaim all disturbed areas as soon as possible in order to reduce the area of surface disturbance remaining after construction and to reduce long-term impacts on wildlife from the presence and impacts associated with construction-related disturbance areas and corridors (e.g., increased runoff). The BLM requires operators on private lands to enter into a land use agreement with the private landowner, which would contain minimum reclamation requirements in accordance with the Gold Book (BLM and USFS 2007).

In addition, the avoidance and minimization measures for bats that are included as part of the Proposed Action described in Appendix G of this Supplemental EA, and summarized below

under the impacts on the bat species, would reduce potential impacts on terrestrial wildlife and their habitat, especially the measures that minimize the clearing/cutting of mature trees, limit the annual removal of forest habitat, and the requirements for a closed system for produced water that would minimize wildlife exposure to contaminated water sources.

Impacts on the Endangered Indiana Bat, the Endangered Northern Long-Eared Bat, and the Proposed for Listing Tricolored Bat

Populations of the three bat species may be affected through loss of habitat including up to 998 acres of short-term surface disturbance during well construction and development and up to 285 acres of long-term surface disturbance during well production. Suitable habitat for the bat species has not been delineated in the Action Area and specific development locations are not known at this stage so it is not possible to quantify impacts on bat suitable habitat. However, if all surface disturbance were to occur in suitable habitat, the total habitat loss would only account for 0.2 percent of the Action Area during well development and 0.05 percent of the Acton Area during well production. A variety of avoidance and minimization measures have been incorporated into the Proposed Action for the protection of bat species (see below and Appendix G, *USFWS Recommended Measures for Avoiding and Minimizing Adverse Impacts to Federally Listed Species).* As a result, the Proposed Action is expected to have negligible impacts on bat habitat in the Action Area.

Impacts during drilling-site construction could also include loss of unknown roost trees, short-term impacts from noise or human presence, and alteration of foraging habitat (USFS 2006a). Loss of roost trees can have implications for reproductive females (USFS 2006a). Bats typically form maternity colonies in trees known as maternity trees where groups of females rear their young together. If a maternity tree were removed during the maternity period, when flightless young are potentially present, then young bats could be killed due to their inability to fly away. The three bat species are known to prey extensively on aquatic insects. Increased water withdrawals for hydraulic fracturing could affect or reduce insect production. Indiana bats may be forced to expend more energy searching for food, impacting individual fitness rather than causing population-level impacts.

The avoidance and minimization measures for bats that are included as part of the Proposed Action described in Appendix G (*USFWS Recommended Measures for Avoiding and Minimizing Adverse Impacts to Federally Listed Species)* of this Supplemental EA would reduce potential impacts on federally listed and proposed bat species, including:

- Season clearing/cutting of all trees greater than 3-inches diameter at breast height would only be allowed from October 1 and March 31 so that tree clearing is limited to winter when bats are hibernating and not present on the landscape.
- Clearing/cutting of mature trees would be limited to 10 acres or less for each new federal project which would reduce the likelihood of removing a substantial portion of maternity roost areas or key foraging habitat of bats.
- Prohibiting clearing/cutting of trees within ¼ mile of a hibernaculum and limiting clearing/cutting of trees from November 15 to March 15 in areas over ¼ mile but less than 5

miles away from a hibernaculum would reduce potential impacts on hibernating bats and their habitat, decrease potential for vandalism, and decrease impacts on hibernacula areas during the spring and fall where bats tend to congregate.

- Limiting the cumulative of removal of forest habitat to no more than 105 acres of deciduous forest a year and 998 acres total over the next 10 years would reduce impacts on roost trees, foraging habitat, prey base, and would help retain mature trees on the landscape that are important for bats.
- Requiring a closed system for the containment of produced water would reduce contaminant exposure to bats from foraging over these waters and from drinking potentially contaminated water.

In addition, stipulations and notifications from the Forest Plan would reduce potential impacts on NFS lands such as requirements that trees with suitable Indiana bat maternity-roost characteristic only being removed during the hibernation period (outside of the summer maternity season). Refer to Appendix F *(Existing Stipulations, Notifications, Guidelines and Standards)* for additional information.

Due to the limited amount of surface disturbance associated with the Proposed Action and application of the avoidance, minimization, and protection measures described above, potential impacts on the three bat species are anticipated to be minimal. If potential impacts are identified during APD permitting additional resource protection measures would be applied to avoid and minimize potential impacts on the bat species.

Impacts on the Monarch Butterfly

The monarch butterfly may be impacted through loss of habitat including up to 998 acres of surface disturbance during well construction and development and up to 285 acres of long-term surface disturbance during the productive life of wells. Suitable habitat for the monarch butterfly has not been delineated in the Action Area and specific development locations are not known at this stage so it is not possible to quantify impacts on monarch butterfly suitable habitat. However, if all surface disturbance were to occur in suitable habitat, the total habitat loss would only account for 0.2 percent of the Action Area during well development and 0.05 percent of the Acton Area during well production. As a result, the Proposed Action is expected to have negligible impacts on monarch butterfly habitat in the Action Area.

Actual impacts of drilling and other development activities on the monarch butterfly would be further assessed at the APD stage through additional NEPA review and ESA Section 7 consultation when specific development plans are known, but maximum potential surface disturbance and habitat loss would be similar to that discussed above and limited on an annual basis by the avoidance and minimization measures in Appendix G.

Implementation of design features, COAs, BMPs, and 2006 Forest Plan (USFS 2006a) standards/guidelines (for APDs on NFS lands) that minimize surface disturbance impacts and spread of invasive plants would help protect monarch habitat in the Action Area. For example, impacts on monarchs could be limited further by avoiding construction from June 1 to September 30, during monarch migration, in areas of open prairie or meadow that supply monarch habitat,

such as native nectar plants and milkweed. Reclaimed areas of disturbance could also be planted with forb species that support monarchs. Refer to Appendix F *(Existing Stipulations, Notifications, Guidelines and Standards)* for additional information.

Impacts on Bald Eagle

Bald eagles may be impacted through loss of habitat including up to 998 acres of surface disturbance during well construction and development and up to 285 acres of long-term surface disturbance during the productive life of wells. Bald eagles have seen population rebounds after experiencing severe declines in the 1950s and 1960s. Although the bald eagle is no longer a federally listed species, it is protected through the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act.

The avoidance and minimization measures for bats that are included as part of the Proposed Action described in Appendix G of this Supplemental EA, and summarized above under the impacts on the bat species, would reduce potential impacts on bald eagles and their habitat, especially the measures that minimize the clearing/cutting of mature tree and that limit annual removal of forest habitat that would help retain potential bald eagle habitat and the requirements for a closed system for produced water that limits bald eagle exposure to contaminated water sources. Site-specific review during the APD process is a federal action requiring compliance with ESA, the Bald and Eagle Protection Act, the Migratory Bird Treaty Act, and for any proposed development on NFS lands the protection measures from the Forest Plan (see Appendix F). Design features, COAs, and BMPs would be applied to each approved APD as necessary to avoid and minimize impacts on the species.

3.8.3. Cumulative Impacts

The CIAA for terrestrial wildlife encompasses the Marietta Unit of the WNF and a 4-mile buffer in both Ohio and West Virginia. Beyond this buffer, the projected oil and gas facilities would be unlikely to impact wildlife resources. Historical activities, current ongoing projects, and reasonably foreseeable future actions that could result in impacts on terrestrial wildlife in the CIAA are summarized in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions).* Cumulative impacts on terrestrial wildlife associated with the Proposed Action could result from increased surface disturbance and human activity in the WNF when considered in conjunction with past and ongoing projects in the WNF.

As discussed above, existing and future oil and gas development on private land is expected to be the largest contributor to cumulative impacts in the CIAA. There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells located on private land. This could amount to anywhere between 11,988 and 171,250 acres of existing surface disturbance depending on whether these wells were vertically or horizontally drilled. Additional surface disturbance and removal of vegetation from the Proposed Action may exacerbate the impacts of resource extraction in the Action Area and cause cumulative declines in wildlife habitat quantity and quality.

Suitable habitat for terrestrial species has not been specifically delineated in the WNF and at this time specific development locations are not known so it is not possible to quantify cumulative

impacts on particular terrestrial species and their suitable habitat from surface disturbance at this stage. In general, short-term surface disturbance during well development of the Proposed Action is estimated to be up to 998 acres, or 0.2 percent of the Action Area and up to 285 acres (.05 percent of the Action Area) of long-term disturbance during well production. This equates to a total short-term cumulative disturbance of anywhere between 12,986 acres and 172,248 acres during well development and anywhere between 12,273 and 171,535 acres of long-term cumulative disturbance during well production. The total cumulative impacts on terrestrial wildlife associated with past and ongoing development and associated surface disturbance has removed and degraded habitat and likely increased habitat fragmentation in the CIAA. However, reasonably foreseeable development associated with the Proposed Action would contribute to a minimal incremental increase in surface disturbance and habitat impacts due to the limited amount of surface disturbance in relation to the total cumulative disturbance in the CIAA.

Surface water withdrawals from the CIAA are likely to increase as more wells are permitted in the Action Area. As discussed in Section 3.6.2, *Water Resources – Environmental Impacts*, streamflow reductions related to the Proposed Action's horizontal oil and gas activities are expected to result in a minor reduction (from 0.32 percent to 0.46 percent) in surface-water availability, based on the Little Muskingum River case. However, withdrawals during rare (less than 10 percent of the time), extreme, low-flow events could reduce the quality and quantity of water used by terrestrial wildlife as drinking sources as well as affect insect production for species such as the Indiana bat. Implementation of Forest Plan stipulations (Appendix F) and compliance with federal and State regulations (e.g., ORC § 1521.23) would avoid substantial drawdown of surface waters in the Action Area. However, increased mineral extraction on private lands could lead to moderate cumulative impacts on wildlife and their habitats if future withdrawals do not trigger the need for a consumptive use permit under ORC Section 1521.23.

3.8.3.1. Cumulative Impacts on Listed Bat Species

Existing threats to the Indiana bat, the northern long-eared bat, and the tricolored bat include habitat loss and fragmentation, white-nose syndrome, human disturbance, pollution from historical and existing mining and oil and gas developments, and climate change trends such as increased drought, more severe/extreme precipitation events, and wildfires.

Temperate zone bats may be more sensitive than many other groups of mammals to climate change because their reproductive cycles and success, hibernation patterns, and migration are closely linked to temperature (Loeb and Winters 2012). Bats may be particularly impacted by drought and extreme weather events because most insectivorous bats must drink to maintain water balance, and water needs increase considerably during pregnancy and lactation. Thus, severe droughts, particularly when coupled with unusually cold or hot temperatures, may have impacts on bat reproductive success. Additionally, insect populations often decline during drought resulting in increased foraging costs and decreased annual survival for bats (Loeb and Winters 2012).

There are 17,125 existing oil and gas wells in the CIAA as of October 2023, with 82 percent of those wells being on private land. This could amount to anywhere between 11,988 and 171,250 acres of existing surface disturbance depending on whether these wells were vertically or horizontally drilled. This historic and ongoing oil and gas development contributes to cumulative

impacts on listed bat species habitat in the CIAA. The Proposed Action is estimated to result in up to 998 acres of short-term disturbance during well development and up to 285 acres of long-term disturbance during well production. This equates to a total short-term cumulative disturbance of anywhere between 12,986 acres and 172,248 acres during well development and anywhere between 12,273 and 171,535 acres of long-term cumulative disturbance during well production.

Existing and future development of oil and gas resources on private land to access private and federal minerals may contribute to cumulative impacts in cases where federal agency BMPs, COAs, and other resource protection measures do not apply. For example, if an operator previously developed a surface well pad on private land to access private minerals and then secures a federal mineral lease and proposes an APD to develop that lease using the same well pad, the BLM would only be assessing the "down hole" impacts of accessing the federal minerals. In this case, federal BMPs, COAs, and other resource protection measures for listed species may not have been applied because the surface disturbance occurred prior to federal agency involvement. It would have been up to operators on private lands to contact the USFWS to request and follow technical assistance under Section 9 of the ESA and any resulting effects of their actions would have been outside of BLM or USFS control, and as such, the surface activities may contribute to cumulative impacts. Such activities could include removal of unknown occupied roost trees that, depending on the season, could result in the death of flightless pups or other individuals unable to flee in time. Such activities could also remove a portion of a bat or maternity colony's home range or key foraging habitat, resulting in unexpected energy demands and fragmentation of roost networks (e.g., Silvis et al. 2014, Silvis et al. 2015). Over time, such undocumented and unknown losses may contribute to cumulative impacts on local bat populations in the CIAA.

Surface-water withdrawals in the CIAA are likely to increase over time as more oil and gas wells are permitted and other activities occur that require water withdrawal. Streamflow reductions related to the Proposed Action's horizontal oil and gas activities are expected to result in a minor reduction in surface-water availability. However, withdrawals during rare (less than 10 percent of the time), extreme, low-flow events could reduce the quality and quantity of freshwater used by terrestrial wildlife as drinking sources and affect insect production for species such as Indiana bat. Implementation of 2006 Forest Plan stipulations, application of the USFWS avoidance and minimization measures (Appendix G) and compliance with federal and State regulations (e.g., ORC § 1521.23) would avoid significant drawdown of surface waters in the Analysis Area. However, increased mineral extraction on private lands could contribute to cumulative impacts on wildlife and their habitats if future withdrawals do not trigger the need for a consumptive use permit under ORC Section 1521.23.

Forest structure and canopy changes can be especially harmful for these listed bats because the species rely on forest habitats for roosting and foraging during the summer. The three listed bat species also form maternity colonies in wooded areas (USFWS 2021b). Historic and ongoing oil and gas development may have impacted canopy cover in the WNF and associated forested habitat for bats and other wildlife in the CIAA. However, as described in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions*) a remote sensing and GIS analysis indicates that only 1.67 acres of canopy cover in the CIAA has been impacted by existing oil and

gas development. This limited loss of canopy cover has likely resulted in negligible cumulative impacts on forested bat habitats. The minimal amount of surface disturbance and well development under the Proposed Action, compared to the total development in the CIAA, would contribute to a negligible incremental increase in canopy cover loss that would correspondingly result in negligible cumulative impacts on forested habitat, canopy cover, and associated bat and wildlife habitat.

Reduction in aquatic insect production resulting from water withdrawals could also affect listed bat foraging success.

3.9. Transportation

3.9.1. Affected Environment

The affected environment for transportation is summarized in Section 3.9 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference.

3.9.2. Environmental Impacts

Potential impacts on transportation from activities in the oil and gas program are summarized in Section 4.9 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because the analysis of transportation management in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D) and therefore did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing.

3.9.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on transportation from those analyzed under the No-Action Alternative in Section 4.9 of the 2016 EA (BLM 2016).

3.9.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact transportation in the region?

The increased level of development associated with horizontal drilling using high-volume hydraulic fracturing described in the 2020 RFDS would likely increase the amount of new access roads needed to support those wells and well pads compared to the 2016 EA. As such, the Proposed Action could result in an increased network of access roads in the Analysis Area that would be used for oil and gas development, but could also be utilized by the BLM, private landowners, and other entities.

Horizontal drilling and hydraulic fracturing would also increase heavy-truck (defined as four or more axles) traffic on surrounding roadways as compared to vertical drilling because of increased amounts of drilling and fracturing materials being transported to wellhead and disposal facilities (Patterson and Maloney 2016). A 2015 report prepared by the Colorado Department of Transportation (CDOT 2015) compiled truck-trip estimates for vertical and horizontal drilling from a variety of independent studies and industry feedback (Table 3-23). For vertical well drilling, two EIS studies were obtained from western Wyoming and the Marcellus Shale region of New York. Studies obtained for horizontal drilling estimates were conducted by the National Park Service, NTC Consultants, Utah Department of Transportation, North Dakota State University, and Economic Advisors, Inc. For this study, vertically drilled and hydraulically fractured wells were compared to horizontally drilled and hydraulically fractured wells. The Colorado Department of Transportation's truck trip estimates are summarized in Table 3-23 below.

Table 3-23. Average Truck Trip Generation Estimates for Vertical and Horizontal Drilling Techniques

DEVELOPMENT PHASE	VERTICAL WELL TRUCK TRIPS (1 PAD, 1 WELL)	HORIZONTAL WELL TRUCK TRIPS (1 PAD, 1 WELL)	HORIZONTAL WELL TRUCK TRIPS (1 PAD, 3 WELLS)
Construction	–	–	–
Pad and Road Construction	63	87	87
Drilling Rig	66	67	67
Drilling	–	–	–
Drilling Fluid and Materials	45	79	316
Drilling Equipment (e.g., casing, drill pipe)	59	65	260
Completion Rig	22	33	33
Completion Fluid and Minerals	24	32	128
Completion Equipment (e.g., pipe, wellhead)	8	13	13
Completion	–	–	–
Fracturing Equipment (e.g., pump, trucks, tanks)	147	250	250
Fracture Water	246	923	3,692
Fracture Sand	15	84	336
Flowback Water Disposal	103	308	1,232
Totals	**798**	**1,941**	**6,414**

Source: CDOT 2015.

On average, 798 truck trips are needed for construction of one well pad with a single vertical well that is hydraulically fractured; 1,941 trips are needed for construction of one well pad with a single horizontal well that is hydraulically fractured; and 6,414 trips are needed for construction of one well pad with three horizontal wells that are hydraulically fractured (Table 3-23). Horizontal drilling and hydraulic fracturing is therefore anticipated to require more than double the truck trips for construction of one well pad with a single well, and approximately eight times the truck trips for construction of one well pad with three wells (CDOT 2015). Furthermore, when considering a vertically drilled well that is not hydraulically fractured, approximately 287 trips are needed for construction of one well pad with one vertical well (Table 3-23). The 2020 RFDS (Appendix D) assumed that up to two wells pads with two to three producing wells on each pad would be developed in the Action Area per year (BLM 2020); therefore, a substantial increase in heavy truck traffic could result from horizontal drilling using high-volume hydraulic fracturing compared to vertical drilling. This increase in traffic could lead to impacts on the WNF transportation system, such as increased congestion and potential risk for roadway accidents (Patterson and Maloney 2016).

Increased heavy-truck traffic required for horizontal well development has also been documented to increase the expected rate of road deterioration (Quiroga et al. 2012; Gannett Fleming Freight Solutions 2011). Roads and bridges are designed and constructed based on projected traffic frequency and weight. Interstate highways are constructed to withstand higher volumes of traffic, including heavy-truck traffic and heavier loads than local roads. Therefore, local roads are more susceptible to deterioration as a result of increased heavy truck traffic due to developing horizontal wells using high-volume hydraulic fracturing (Patterson and Maloney 2016). In Texas, 1 year of heavy-truck traffic associated with the development of 100 new wells reduced the design life of a typical rural road by 40 percent (Quiroga et al. 2012).

Per ORC Section 1509.06(A)(11)(b), ODNR requires that all applications for a horizontal well permit include a road use maintenance agreement (RUMA) between the operator and local jurisdiction concerning maintenance and safe use of the local roads, streets, and highways. If a RUMA is not included, the operator must provide a form attesting that they attempted in good faith to enter into an agreement under division (A)(11)(b), but that no agreement was executed (ORC § 1509.06). RUMAs require operators to outline which roads are expected to be used for hauling and document existing conditions of those roads prior to construction. After completion of each well, an engineer from the local jurisdiction typically inspects the haul roads for damage done during the well-construction period including damage to road base, culverts, bridges, ditches, guardrails, signs, or other road appurtenances. A list of damages is provided to the operator, who is required to make the necessary repairs based on local jurisdiction and Ohio Department of Transportation specifications.

Although implementation of RUMAs would help reduce impacts associated with road deterioration, increased unconventional drilling and hydraulic fracturing projected in the 2020 RFDS (Appendix D) could lead to transportation impacts. Deteriorating roadways could further intensify congestion and risk for roadway accidents throughout the Action Area.

Design features, COAs, and BMPs would be applied to each approved APD, as appropriate, to minimize potential impacts on transportation. APDs on NFS lands would also identify COAs

from the Forest Plan that should be placed on the application, which could include placing load limits on roads susceptible to damage (Appendix F, Reference Number GFW-TRANS-5) and requiring travel only on WNF roads at Maintenance Levels 2 to 5 (Appendix F, Reference Number GFW-TRANS-7).

3.9.3. Cumulative Impacts

The CIAA for transportation encompasses the Marietta Unit of the WNF and a 4-mile buffer into Ohio and West Virginia. Beyond this buffer, the projected oil and gas facilities would be unlikely to impact transportation in the WNF, unless produced water or other products were trucked to sites outside the 4-mile buffer for disposal, or water is trucked in from sources outside of the CIAA; however, specific locations for disposal would not be known until APDs are received. Historical activities, current ongoing projects, and reasonably foreseeable future actions that could result in transportation impacts in the CIAA are outlined in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions*).

Cumulative impacts on the subsequent development of leases issued under the Proposed Action could result from increased heavy-truck traffic, expansion of the road network, and road deterioration in the Marietta Unit when considered in conjunction with ongoing projects in the WNF. In addition to discrete USFS projects throughout the Marietta Unit, existing and future oil and gas development on private land is expected to be the largest contributor to cumulative transportation impacts in the CIAA. There are 17,125 existing oil and gas wells in the CIAA as of September 2023, with 82 percent of those wells being on private land). Although it is difficult to predict the level of traffic associated with existing wells since they are at various stages of development, increased truck traffic resulting from the Proposed Action may exacerbate existing transportation issues in the CIAA. These impacts would result in cumulative impacts on the transportation system, such as increased congestion and potential risk for roadway accidents.

3.10. Socioeconomics and Environmental Justice

3.10.1. Affected Environment

The affected environment for socioeconomics and environmental justice is summarized in Section 3.15 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. However, the 2016 EA used 2010 decennial Census data, as well as 2016 data from the Appalachian Regional Commission (ARC). For this Supplemental EA, all data tables have been updated to include the 2020 decennial Census, 2021 American Community Survey 5-year estimates, and the addition of 2017–2022 to the ARC data table.

3.10.1.1. Population

Southeastern Ohio and the adjacent portion of West Virginia are largely rural, with Marietta the largest city. Based on U.S. Census Bureau projections between 1990 and the 2020 decennial Census, the population in Ohio increased by 8.78 percent and the population in West Virginia increased by 0.01 percent (see Table 3-24). Of the five counties considered in this analysis, Noble County, Ohio, experienced the greatest population increase, of 26.71 percent, and Tyler County, West Virginia, experienced the greatest population decrease, of -12.90 percent.

Table 3-24. Population in Southeastern Ohio and West Virginia

AREA	1990	2000	2010	2015 (ESTIMATE)	2020	DIFFERENCE IN POPULATION FROM 1990–2020
United States	248,709,873	281,421,906	308,745,538	321,418,820	334,735,155	34.59%
States	–	–	–	–	–	–
Ohio	10,847,115	11,353,140	11,536,504	11,613,423	11,799,448	8.78%
West Virginia	1,793,477	1,808,344	1,852,994	1,844,128	1,793,716	0.01%
Counties	–	–	–	–	–	–
Monroe County, Ohio	15,497	15,180	14,642	14,409	13,586	-12.33%
Noble County, Ohio	11,336	14,058	14,645	14,326	14,364	26.71%
Washington County, Ohio	62,254	63,251	61,778	61,112	59,652	-4.18%
Pleasants County, West Virginia	7,546	7,514	7,605	7,674	7,438	-1.43%
Tyler County, West Virginia	9,796	9,592	9,208	8,975	8,533	-12.90%

Source: U.S. Census Bureau 2020.

3.10.1.2. Race and Ethnicity

Evaluating race and ethnicity of an area can aid in determining whether minority populations are present in a community and a community has environmental justice concerns. CEQ defines *minorities* as individuals in the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. Minority populations can be further identified when "minority population of the affected area exceeds 50 percent" or when "the minority population percentage of the affected area is meaningfully greater" (CEQ 1997); additionally "minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds" (CEQ 1997). As shown in Table 3-25, below, all the counties considered in this analysis have a primarily white population (90.97–96.44 percent). This is higher than the average of Ohio (75.89-percent white population), West Virginia (89.14-percent white population), and the United States (57.84-percent white population). Overall, the counties have a lower percentage of minority populations (3.06–7.81 percent) in comparison to Ohio (19.70 percent), West Virginia (8.92 percent), and the United States (23.43 percent). Of all the counties, Noble County, Ohio, has the largest percentage of a single minority population (5.33-percent Black or African American).

Table 3-25. Distribution of Ethnicity in Southeastern Ohio and West Virginia

Area	Ethnicity							Totals	
	White alone	Black or African American	Asian Alone	American Indian and Alaska Native	Native Hawaiian/ other Pacific Islander	Other	Two or More Ethni-cities	Total Minority Population (%)	Total Population
Monroe County, OH	96.44%	0.14%	0.16%	0.09%	0.02%	0.14%	2.50%	3.06%	13,385
Noble County, OH	90.97%	5.33%	0.16%	0.22%	0.00%	0.08%	2.03%	7.81%	14,115
Washington County, OH	93.13%	1.00%	0.52%	0.19%	0.01%	0.26%	3.68%	5.67%	59,771
Pleasants County, WV	94.28%	1.24%	0.22%	0.29%	0.00%	0.13%	3.02%	4.90%	7,653
Tyler County, WV	95.80%	0.05%	0.04%	0.18%	0.00%	0.16%	3.14%	3.56%	8,313
Ohio	75.89%	12.35%	2.51%	0.16%	0.04%	0.38%	4.25%	19.70%	11,799,448
West Virginia	89.14%	3.61%	0.83%	0.18%	0.02%	0.26%	4.02%	8.92%	1,793,716
United States	57.84%	12.05%	5.92%	0.68%	0.19%	0.51%	4.09%	23.43%	331,449,281

Source: U.S. Census Bureau 2020.
OH = Ohio; WV = West Virginia

3.10.1.3. Employment and Income

Several data sources were used to assess the economic characteristics near the WNF; these sources include ARC and data from the U.S. Census Bureau.

ARC is a regional economic development agency that seeks to build community capacity and strengthen economic growth in the 420 counties of the 13 Appalachian states. The counties considered in this Supplemental EA analysis are within the purview of ARC, which ranks the Appalachian counties on a continuum, ranging from distressed to attainment, using unemployment, per-capita income, and poverty data. These rankings are defined as follows.

- **Attainment**: Ranking among the nation's top 10 percent
- **Competitive**: Ranking in the top quartile, but not in the top 10 percent
- **Transitional**: Ranking in the middle two quartiles
- **At-Risk**: Ranking in the bottom quartile, but not in the bottom 10 percent
- **Distressed**: Ranking in the bottom 10 percent

Table 3-26 lists the rankings of the counties in or adjacent to the Action Area since 2002 (ARC 2023). As shown in Table 3-26 only Tyler County, West Virginia, is currently ranked as "at-risk," and Washington County, Ohio, and Pleasants County, West Virginia, are currently ranked as "transitional."

Table 3-26. Economic Status as Ranked by the Appalachian Regional Commission

Fiscal Year	Noble County, OH	Monroe County, OH	Washington County, OH	Pleasants County, WV	Tyler County WV
2002	Transitional	Distressed	Transitional	Transitional	Transitional
2003	Transitional	Distressed	Transitional	Transitional	Transitional
2004	Transitional	Transitional	Transitional	Transitional	Transitional
2005	Transitional	Transitional	Transitional	Transitional	Transitional
2006	Transitional	Transitional	Transitional	At-Risk	Transitional
2007	At-Risk	At-Risk	Transitional	Transitional	At-Risk
2008	At-Risk	At-Risk	Transitional	Transitional	At-Risk
2009	At-Risk	Distressed	Transitional	Transitional	At-Risk
2010	At-Risk	Distressed	Transitional	Transitional	At-Risk
2011	At-Risk	At-Risk	Transitional	Transitional	At-Risk
2012	Distressed	At-Risk	Transitional	Transitional	At-Risk
2013	Distressed	At-Risk	Transitional	Transitional	At-Risk
2014	Distressed	At-Risk	Transitional	At-Risk	At-Risk
2015	At-Risk	Transitional	Transitional	Transitional	At-Risk
2016	At-Risk	At-Risk	Transitional	Transitional	At-Risk
2017	Transitional	At-Risk	Transitional	Transitional	At-Risk

Fiscal Year	Noble County, OH	Monroe County, OH	Washington County, OH	Pleasants County, WV	Tyler County WV
2018	Transitional	At-Risk	Transitional	Transitional	At-Risk
2019	Transitional	Distressed	Transitional	Transitional	At-Risk
2020	At-Risk	Distressed	Transitional	At-Risk	At-Risk
2021	Distressed	Distressed	Transitional	Transitional	At-Risk
2022	Distressed	Distressed	Transitional	Transitional	At-Risk

Source: ARC 2023.
OH = Ohio; WV = West Virginia

Additionally, U.S. Census Bureau data indicate that the median household income for the five counties ranged from $46,144 (Noble County, Ohio) to $58,433 (Pleasants County, West Virginia) and poverty levels ranged from 15.1 percent (Washington County, Ohio) to 16.6 percent (Monroe County, Ohio), as shown below in Table 3-27 and Table 3-28. As shown in Table 3-27, the five counties had a lower median household income than the U.S. average. Poverty levels for the counties in Ohio are comparable to the State average of 15.8 percent, although the individual counties ranged from 15.1 percent for Washington County, Ohio, to 16.6 percent for Monroe County, Ohio. Poverty levels for the counties in West Virginia are slightly below the State average of 17.8 percent (15.5 percent for Pleasants County, West Virginia, and 15.9 percent for Tyler County, West Virginia). All the counties had a slightly higher poverty level than the U.S. average (14.1 percent).

Table 3-27. Median Household Income in Southeastern Ohio and West Virginia

Area	Median Household Income
United States	$69,021
Ohio	$61,938
West Virginia	$50,884
Monroe County, Ohio	$50,503
Noble County, Ohio	$46,144
Washington County, Ohio	$54,167
Pleasants County, West Virginia	$58,433
Tyler County, West Virginia	$50,601

Source: U.S. Census Bureau 2021.

Table 3-28. Poverty Levels in Southeastern Ohio and West Virginia

Area	Percent below Poverty Level
United States	14.1%
Ohio	14.5%
West Virginia	17.8%
Monroe County, Ohio	16.6%
Noble County, Ohio	15.4%

AREA	PERCENT BELOW POVERTY LEVEL
Washington County, Ohio	15.1%
Pleasants County, West Virginia	15.5%
Tyler County, West Virginia	15.9%

Source: U.S. Census Bureau 2021.

3.10.1.4. Environmental Justice

In accordance with EO 14096, *Revitalizing Our Nations Commitment to Environmental Justice for All,* Environmental justice refers to the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Native American Tribal affiliation, or disability, in agency decision-making and other federal activities that impact human health and the environment so that people: (1) are fully protected from disproportionate and adverse human health and environmental impacts (including risks) and hazards, including those related to climate change, the cumulative impacts of environmental and other burdens, and the legacy of racism or other structural or systemic barriers; and (2) have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices.

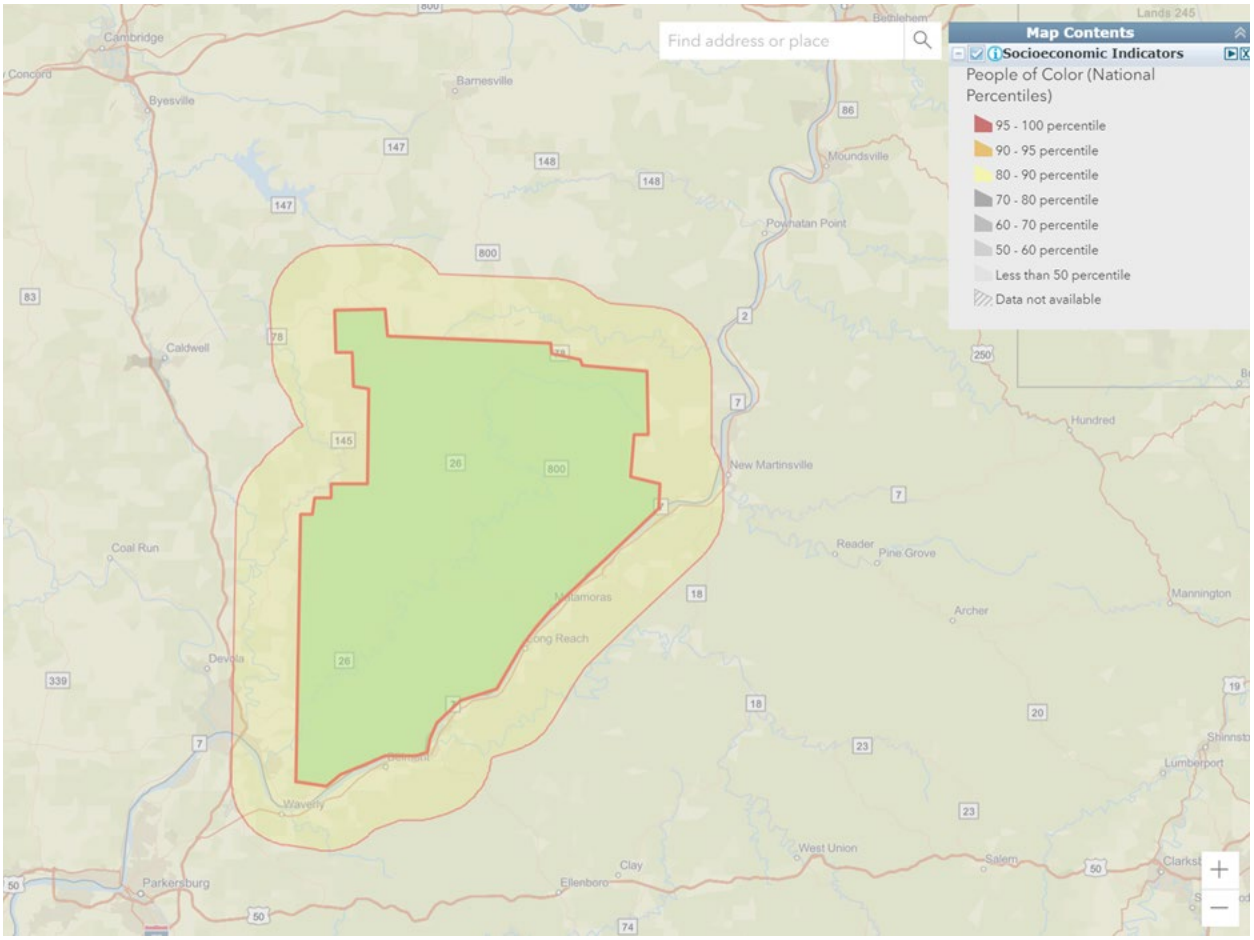
EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, formally requires federal agencies to incorporate environmental justice as part of their missions. Specifically, it directs federal agencies to address, as appropriate, any disproportionately high and adverse human health or environmental impacts of their actions, programs, or policies on minority or low-income populations. Please refer to the description of CEQ's definition of minority populations in Section 3.10.1.2, *Race and Ethnicity*, above. EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, issued in April 2023, reaffirmed the importance of environmental justice considerations in federal decision-making and reiterated the requirements for consideration of environmental justice under NEPA that were detailed in EO 12898. Because guidance on implementation of EO 14096 is still forthcoming from CEQ, the environmental justice analysis in this Supplemental EA includes definitions and methods established for compliance with the EO.

The CEQ's 1997 Environmental Justice guidelines state that a minority population is present if: "(a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis." CEQ does not define "meaningfully greater." For the purpose of this analysis, "meaningfully greater" is defined as 10 percentage points or more above that of the reference population. A minority is a person who self-identifies as one or more of the following racial or ethnic groups: Hispanic or Latino of any race, Black or African American, Asian American, American Indian, and Native Hawaiian.

Low-income populations are defined by comparing the percentage of households at or below the poverty level in a geographic unit of analysis with a reference area. CEQ guidelines state that low income should be determined based on annual poverty thresholds but do not provide a

specific definition for the percentage of population required to determine a population a low-income population (c). For the purposes of analysis, the same criteria are used as those established for the minority population (over 50 percent of the population below poverty or 10 percentage points or more above the reference population).

Each of the five counties analyzed generally have lower percentages of minority populations than that of Ohio, West Virginia, and the United States. USEPA's EJScreen tool was used to visualize the demographic composition of the Marietta Unit and its surrounding communities within a four-mile buffer (Figure 12) (USEPA 2023h). Using the state as a reference community, there were no minority environmental justice communities identified within the Analysis Area according to the CEQ threshold (more than 50 percent or meaningfully greater than the reference population).

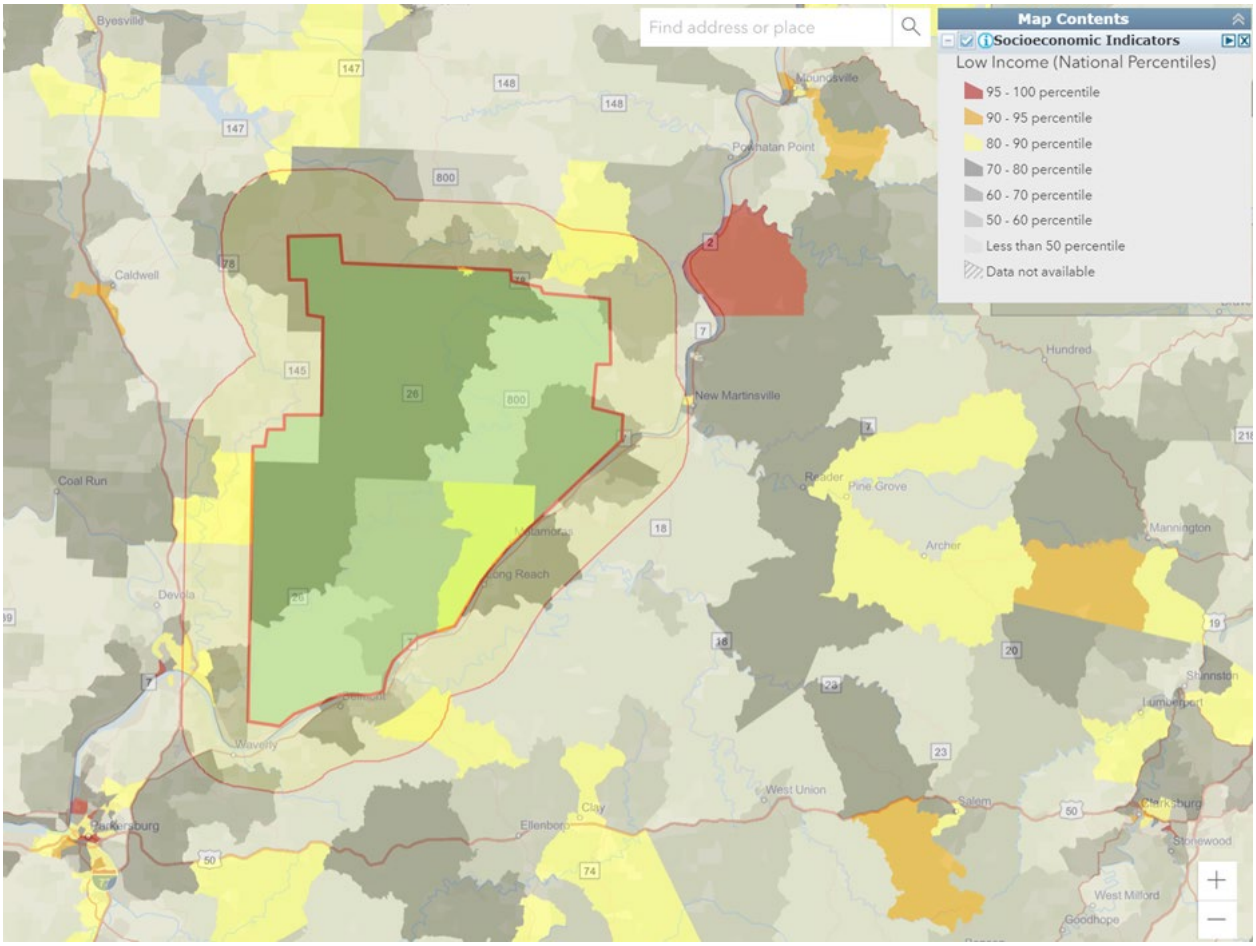


Source: EJScreen (EPA 2023h).

Figure 12. Minority Population Percentiles within the Analysis Area (EJ Screen)

Based on a review of socioeconomic data for the five counties analyzed (ARC 2023), the potential for communities with low-income environmental justice concerns near the Action Area exists because incomes are lower than national and State averages. Median household incomes for the five counties are lower than the national average, are lower for the Ohio counties than the

State average, and are lower for Tyler County, West Virginia, than the State average; however, Pleasants County, West Virginia, has a higher median household income ($58,433) than the State average ($50,884). As such, four of the five counties included in the Analysis Area would be classified as communities with low-income environmental justice concerns. USEPA's EJScreen was used to visualize low-income communities at the county level in relation to the Marietta Unit and surrounding 4-mile buffer (Figure 13).



Source: EJScreen (EPA 2023h).

Figure 13. Low Income Percentiles within the Analysis Area (EJ Screen)

EJScreen identified low-income communities within both the Marietta Unit and the 4-mile buffer. In these specific locations, the counties rank in the 80-90 percentile for low-income individuals compared to the state, highlighted in yellow on Figure 13. The majority of the Marietta Unit falls within, at minimum, the 60th percentile for low income. This indicates that there are low-income populations in the Analysis Area and a potential for disproportionate impacts on low-income environmental justice communities due to project activities within the areas represented on Figure 13. The higher percentile ranking in certain regions suggests increased vulnerability, emphasizing the need for additional analysis to address potential socioeconomic disparities resulting from project activities. Because of the presence of

communities at the county-level that are above the CEQ threshold for environmental justice communities, additional analysis at the census tract level was conducted.

All census tracts within the Action Area adjacent counties evaluated in Table 3-29 were analyzed. Census tracts that exceed the threshold of either 50 percent low-income or greater than 10 percent above the poverty level in the reference areas[3] have been identified in Table 3-29 as environmental justice communities. These communities are visually depicted within the Marietta Unit and its 4-mile buffer on Figure 14.

As seen in Table 3-29, there are three census tracts that were designated as low-income environmental justice communities within the Ohio portion of the counties because of a poverty level that was greater than 10 percent of the reference area. No environmental justice communities were identified within the West Virginia portion of the Analysis Area. As seen on Figure 14, no census tracts within the Marietta Unit exceeded the 50 percent threshold. Two of the census tracts in Washington County within southwestern portion of the 4-mile buffer were identified as low-income environmental justice communities and one census tract in Noble County just outside of the western portion of the 4-mile buffer was identified as a low-income community.

Table 3-29. Poverty Levels within Action Area Census Tracts

AREA	PERCENT BELOW POVERTY LEVEL	EJ COMMUNITY (Y/N)
State of Ohio (Reference Area)	**14.50%**	**N/A**
Census Tract 9666; Monroe County	10.00%	N
Census Tract 9667; Monroe County	12.70%	N
Census Tract 9668; Monroe County	19.10%	N
Census Tract 9669; Monroe County	16.20%	N
Census Tract 9683; Noble County	20.70%	N
Census Tract 9684.01; Noble County	14.60%	N
Census Tract 9684.02; Noble County	40.40%	Y
Census Tract 9685; Noble County	12.20%	N
Census Tract 201.01; Washington County	10.70%	N
Census Tract 201.02; Washington County	21.20%	N
Census Tract 202.01; Washington County	4.20%	N
Census Tract 202.02; Washington County	10.30%	N
Census Tract 203; Washington County	5.80%	N
Census Tract 204; Washington County	17.20%	N
Census Tract 205; Washington County	21.80%	N

[3] Census tracts that have a poverty level greater than 24.5 percent in Ohio or greater than 27.8 percent in West Virginia.

AREA	PERCENT BELOW POVERTY LEVEL	EJ COMMUNITY (Y/N)
Census Tract 208; Washington County	15.70%	N
Census Tract 209; Washington County	39.10%	Y
Census Tract 210; Washington County	27.40%	Y
Census Tract 211; Washington County	14.00%	N
Census Tract 212.01; Washington County	16.60%	N
Census Tract 212.02; Washington County	6.50%	N
Census Tract 213; Washington County	14.90%	N
Census Tract 214; Washington County	4.90%	N
Census Tract 215; Washington County	7.40%	N
Census Tract 216; Washington County	9.20%	N
Census Tract 217; Washington County	10.20%	N
State of West Virginia (Reference Area)	**17.80%**	**N/A**
Census Tract 9621; Pleasants County	7.90%	N
Census Tract 9622; Pleasants County	7.20%	N
Census Tract 9618; Tyler County	15.00%	N
Census Tract 9619; Tyler County	10.30%	N
Census Tract 9620; Tyler County	9.90%	N

Source: U.S. Census Bureau 2021. Table S701.

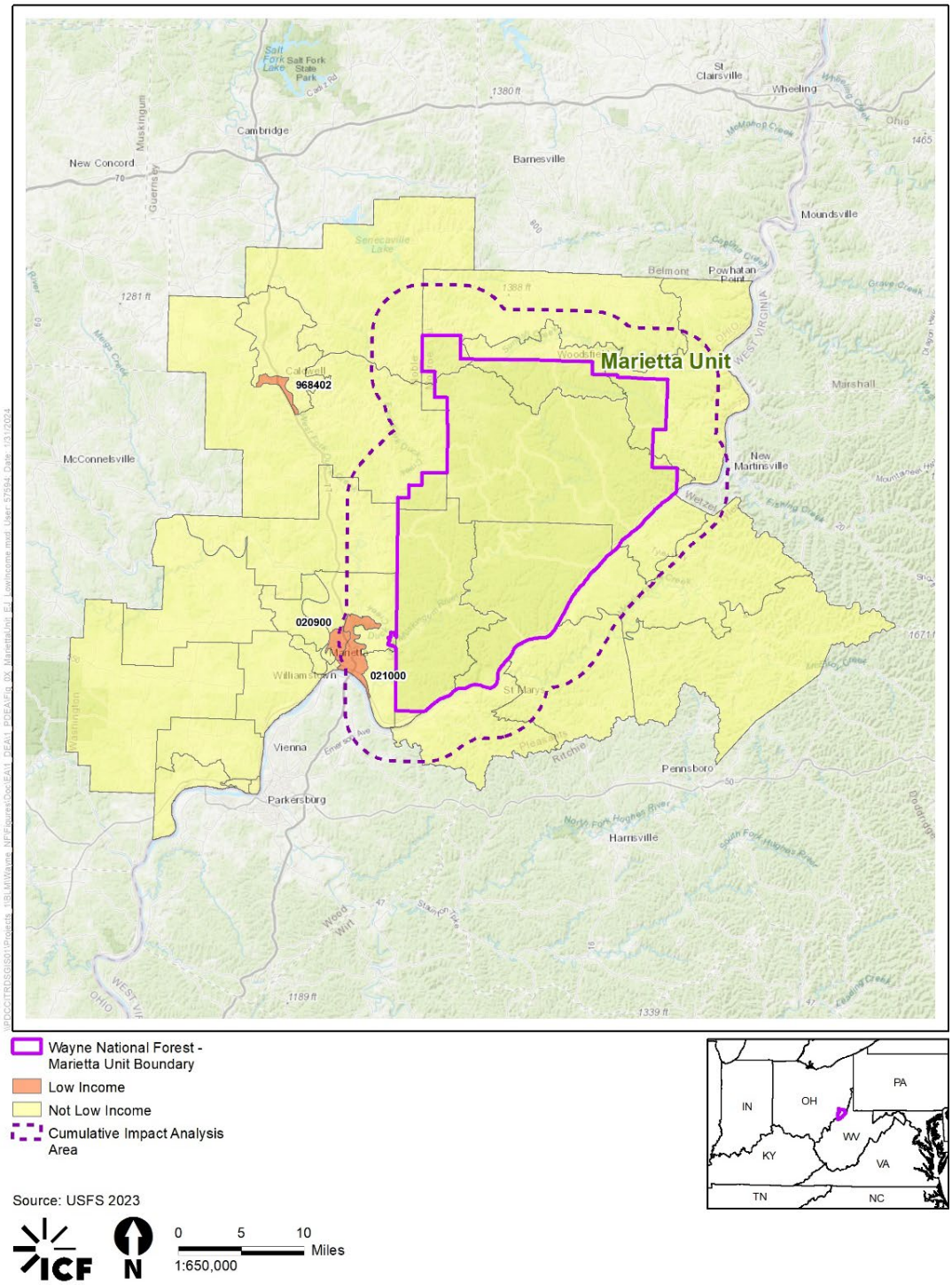


Figure 14. Low-Income Environmental Justice Community Census Tracks within the Analysis Area and Surrounding Counties

3.10.2. Environmental Impacts

Potential impacts on social and economic conditions and communities with environmental justice concerns from all activities in the oil and gas program were summarized in Section 3.15 of the 2016 EA (BLM 2016) and that summary is incorporated here by reference. New and relevant information is needed to support this Supplemental EA because the analysis of potential impacts on communities with environmental justice concerns in the 2016 EA did not consider the projections in the 2020 RFDS (Appendix D) and therefore did not capture the full range of impacts that could result from horizontal drilling with hydraulic fracturing.

3.10.2.1. Impacts of Alternative A – No-Action Alternative

Under the No-Action Alternative, the BLM would not offer federal minerals in the Marietta Unit for oil and gas leasing, including the parcels requested in currently pending EOIs and all other federal minerals in the Marietta Unit and would rescind any leasing decisions that were supported, for NEPA-compliance purposes, by the 2016 EA. Therefore, the No-Action Alternative would not result in any substantive change to the estimated impacts on social and economic conditions from those impacts analyzed under the No-Action Alternative in Section 4.15 of the 2016 EA (BLM 2016).

3.10.2.2. Impacts of Alternative B – Proposed Action

Issue: How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact social and economic conditions and communities with environmental justice concerns in the region?

Impacts on social and economic conditions and communities with environmental justice concerns could result from decreased air quality (Section 3.3, *Air Resources),* increased heavy-truck traffic and light pollution (Section 3.9, *Transportation*), and increased potential for surface water and groundwater contamination (Section 3.6, *Water Resources*), which can result in possible safety concerns, health concerns, traffic, noise, and other effects on social conditions.

As described in Section 3.10.1, *Socioeconomics – Affected Environment,* there are no minority environmental justice communities identified within the Action Area according to the CEQ threshold (more than 50 percent or significantly greater than the reference population). As such, there are no anticipated impacts or disproportionate impacts on minority environmental justice communities. However, four of the five counties included in the Analysis Area would be classified as communities with low-income environmental justice concerns. At the census tract level, there are two census tracts in Washington County within the southwestern portion of the 4-mile buffer identified as low-income environmental justice communities (Table 3-29 and Figure 14). Due to the presence of these communities in the Action Area, there is potential for these environmental justice communities to be impacted by the Proposed Action, particularly due to impacts on air quality, traffic and transportation, accidental spills and releases of hazardous materials, impacts on water resources, and impacts on social and economic conditions (e.g., housing, community services). These potential impacts are further described below.

The current conditions for the affected counties that may relate to surface disturbance, air quality, traffic, and potential for water contamination vary among the counties in the Analysis Area (USEPA 2023h).

- **Monroe County, Ohio**, has a $PM_{2.5}$ value of 7.81 and is in the 29th percentile for $PM_{2.5}$ pollution in the United States, has a 41.8 value for O_3 and is in the 45th percentile for O_3 in the United States, and has a 0.094 value for diesel particulate matter and is in the less-than 50th percentile for diesel particulate matter in the United States.
- **Washington County, Ohio**, has a $PM_{2.5}$ value of 8.24 and is in the 40th percentile for $PM_{2.5}$ pollution in the United States, has a 41.4 value for O_3 and is in the 41st percentile for O_3 in the United States, and has a 0.136 value for diesel particulate matter and is in the less-than 50th percentile for diesel particulate matter in the United States.
- **Pleasants County, West Virginia**, has a $PM_{2.5}$ value of 7.94 and is in the 32nd percentile for $PM_{2.5}$ pollution in the United States, has a 40.8 value for O_3 and is in the 37th percentile for O_3 in the United States, and has a 0.090 value for diesel particulate matter and is in the less-than 50th percentile for diesel particulate matter in the United States.
- **Tyler County, West Virginia**, has a $PM_{2.5}$ value of 7.71 and is in the 27th percentile for $PM_{2.5}$ pollution in the United States, has a 40.8 value for O_3 and is in the 37th percentile for O_3 in the United States, and has a 0.094 value for diesel particulate matter and is in the less-than 50th percentile for diesel particulate matter in the United States.

The Proposed Action would result in increased emissions during well development and production of up to 29 well pads and 81 wells in the Analysis Area. This increase in development and the relatively low emissions associated with development and production would not be expected to notably impact social and economic conditions. Potential impacts on social and economic conditions and environmental justice communities would be further analyzed at the APD stage when specific development locations are known.

Regarding traffic proximity (daily traffic counts/distance to the road), Monroe County, Ohio, has a value of 14 and is in the 11th percentile in the United States. Washington County, Ohio, has a value of 130 and is in the 38th percentile in the United States. Pleasants County, West Virginia, has a value of 140 and is in the 40th percentile in the United States. Tyler County, West Virginia, has a value of 65 and is in the 27th percentile in the United States. An increase in traffic and related air pollutants may impact communities with environmental justice concerns by adding more transportation-related pollution to the area, increasing the risk for negative health impacts, and increasing demands on maintaining roads and road conditions.

Surface disturbance in proximity to hazardous-waste facilities may have groundwater impacts on communities with environmental justice concerns if the hazardous-waste facilities leak or an underground storage tank is disturbed through drilling or other puncturing activities. The subject counties have proximity and underground storage tank values as listed below (USEPA 2023h).

- **Monroe County, Ohio**, has a hazardous waste proximity value of 0.12 and is in the 42nd percentile in the United States and an underground storage tank value of 0.63 and is in the 42nd percentile in the United States.

- **Washington County, Ohio**, has a hazardous waste proximity value of 0.28 and is in the 37th percentile in the United States and an underground storage tank value of 1.1 and is in the 49th percentile in the United States.
- **Pleasants County, West Virginia**, has a hazardous waste proximity value of 0.2 and is in the 31st percentile in the United States and an underground storage tank value of 0.22 and is in the 32nd percentile in the United States.
- **Tyler County, West Virginia**, has a hazardous waste proximity value of 0.25 and is in the 36th percentile in the United States and an underground storage tank value of 0.5 and is in the 39th percentile in the United States.

Required health and safety measures per federal and State regulations help reduce potential impacts on communities with environmental justice concerns. In accordance with ORC Chapter 1509 and OAC Chapter 1501, a permit would be required whenever an operator planned to drill, deepen, reopen, plug back, convert, or plug a well. ODNR-DOGRM would oversee this process through notification and requirements found in the ORC and OAC. Additionally, ODNR-DOGRM considers restoration measures prior to authorization of any gas or oil operations. Compliance with these measures is secured via bonding.

OEPA's Division of Air Pollution Control requires a Permit-to-Install and Operate, which includes requirements such as emission limits, operating restrictions, monitoring requirements, and reporting requirements. This permit would address emissions associated with internal-combustion engines, generators, dehydration systems, storage tanks, and flaring use in oil and gas operations. ORC 3745.50 requires reporting any amount of petroleum that causes a film/sheen on top of a waterway or any spill/release to the environment of 25 gallons or more (when not contained on the spiller's property). Reporting is also encouraged if the spill amount is unknown. Emergency Planning and Community Right-to-Know is a federal reporting requirement that may apply to oil and gas operators that store hazardous chemicals on site and would assist in early detection of contaminated waterways that may impact local water sources.

The potential for the Proposed Action to impact the two identified low-income environmental justice communities within the 4-mile buffer in the southwest portion of the Action Area would depend on the specific development locations proposed during the APD stage. Disproportionate impacts could occur if specific development locations are located close to the identified environmental justice communities (Figure 14) and/or the communities are utilized for housing, workforce, community services, or the purchase of equipment or other expenditures associated with Proposed Action development. If the environmental justice communities are impacted by the Proposed Action, the impacts may be disproportionate as environmental and health risks and health disparities can be higher in low-income communities (Evans and Kantrowitz 2002).

3.10.3. Cumulative Impacts

The CIAA for socioeconomic and environmental justice encompasses the Marietta Unit of the WNF and a 4-mile buffer. Social and economic conditions in the CIAA have been impacted and continue to be impacted by historic and ongoing oil and gas development in the area, including the approximately 17,125 oil and gas wells in the CIAA that existed as of September 2023. The Proposed Action would incrementally contribute to cumulative social and economic impacts

through the development and production of 29 well pads and 81 wells and associated work force, housing needs, tax revenue, vehicle trips and traffic, demands on community services (e.g., schools, fire, police), air emissions, and impacts on water quality and quantity. In addition, the Proposed Action could incrementally increase the potential for accidental spills and contamination that can impact soils, water, and air quality and associated health risks in the CIAA. These incremental contributions to cumulative impacts could disproportionately impact the identified low-income environmental justice communities in the CIAA, especially if specific development locations are located close to the identified environmental justice communities (Figure 14) and/or the communities are utilized for housing, workforce, community services, or the purchase of equipment or other expenditures associated with Proposed Action development. Potential cumulative impacts on the identified low-income environmental justice communities in the CIAA would be further analyzed during the APD stage when specific development locations are proposed.

Reasonably foreseeable actions that may contribute to cumulative impacts on social and economic conditions and communities with environmental justice concerns include other ongoing oil and gas development in the area, future timber-harvest operations, mining operations, and development on private inholdings within or surrounding the Marietta Unit. In addition, climate change and associated impacts such as increased drought, flooding, change in temperatures, changes in water quality and quantity, and increased health risks can contribute to cumulative impacts on social and economic conditions, especially for environmental justice communities. In most cases, vulnerability to climate change impacts is determined by a community's ability to anticipate, cope with, resist, and recover from the impact of major weather events and other impacts of climate change, which can be lower in low-income and minority communities (Shonkoff et al. 2011).

CHAPTER 4. CONSULTATION, COORDINATION, AND LIST OF PREPARERS

4.1. Agency and Tribal Consultations

4.1.1. National Historic Preservation Act and Tribal Consultation

The BLM is conducting required consultation with the Ohio State Historic Preservation Office (SHPO) and Native American Tribes. The BLM received a response from the Ohio SHPO dated May 2, 2023, concurring with the BLM's determination that lesaing federal mineral rights within the WNF would result in No Adverse Effects on Historic Properties and that it looks forward to additional coordination and consultation when site-specific Section 106 reviews are conducted at the APD stage of development. Further consultation would occur at the APD phase, prior to commencement of ground-disturbing activities.

The BLM sent certified letters to 16 federally recognized Native American Tribes who have a known connection to the area, notifying them of the Proposed Action and asking them to identify any concerns with respect to the Proposed Action. The following tribes were contacted.

- Delaware Tribe of Indians
- Delaware Nation
- Shawnee Tribe
- Eastern Shawnee Tribe of Oklahoma
- Absentee Shawnee Tribe of Indians
- Wyandotte Nation
- Peoria Tribe of Indians of Oklahoma
- The Miami Tribe of Oklahoma
- The Osage Nation
- Citizen Potawatomi Nation
- Forest County Potawatomi Community of Wisconsin
- Hannahville Indian Community
- Ottawa Tribe of Oklahoma
- Peoria Tribe of Indians of Oklahoma
- Prairie Band Potawatomi Nation
- Seneca–Cayuga Tribe of Oklahoma
- Turtle Mountain Band of Chippewa

To date, the BLM has received two responses, from the Shawnee Tribe (May 12, 2023) and the Eastern Shawnee Tribe of Oklahoma (May 26, 2023), indicating no concerns with the Proposed

Action at this time but requesting additional consultation during oil and gas development phases or in the event archaeological materials are encountered during construction.

The BLM also hosted information sessions regarding the oil and gas leasing process on the WNF on May 30 and June 1, 2023. Tribal Historic Preservation Officers or staff from six Tribal nations attended, including the Delaware Tribe of Indians, the Osage Nation, the Miami Tribe of Oklahoma, the Forest County Potawatomi Community of Wisconsin, the Peoria Tribe of Indians of Oklahoma, and the Absentee Shawnee Tribe of Indians. During these sessions, the BLM, USFS, and Tribes discussed potential sensitive site types that may occur in the Action Area and ways to facilitate early coordination and consultation for pre-construction surveys and site-specific Section 106 reviews at the APD stage of development. Consultation will be ongoing throughout the implementation stages of oil and gas development.

4.1.2. Endangered Species Act Section 7 Consultation

The BLM and USFS are conducting consultation with USFWS under ESA Section 7 with respect to federally listed species. The BLM is preparing a BA to analyze impacts on listed species that are anticipated to occur in the Analysis Area. The USFWS will utilize the BA to inform the preparation of a BO regarding potential impacts on federally listed species and critical habitat and which would include required mitigation measures to be considered and applied in APD approvals. The BO would provide a tiered approach to the ESA Section 7 consultation that can be applied during subsequent site-specific development proposals and associated consultation at the APD stage. When the BLM analyzes individual projects at the APD stage and pursuant to the Forest Plan (USFS 2006a), the BLM is responsible for reinitiating consultation and providing USFWS with additional information; this process is called *Tier II consultation*. If the BLM determines that potential impacts on federally listed species or their critical habitat could occur as part of APD review process, then the agency would coordinate further with the USFWS and additional consultation between the BLM, USFS, and USFWS would occur.

Agency coordination with the USFWS has resulted in identification of avoidance and minimization measures designed to avoid and minimize potential impacts on federally listed species and are hereby incorporated into the Proposed Action as required measures (see Appendix G, *USFWS Recommend Measures for Avoiding and Minimizing Impacts to Federally Listed Species*). They include measures for federally protected bats, mussels, and plants that have potential to occur in the Analysis Area. These measures may be further refined as consultation with USFWS continues as part of the ESA consultation process.

4.2. Public Involvement

As part of the 2016 EA, the BLM conducted scoping to solicit input from the public and interested agencies about the nature and extent of issues and impacts on be addressed. In November 2015, prior to publication of the 2016 EA in April 2016, the BLM held three public meetings and solicited input from the public and interested agencies. A detailed description of the public scoping performed is included in Section 1.7.5 of the 2016 EA. Because the general scope and purpose of this Supplemental EA is the same as for the 2016 EA, additional public scoping was not conducted.

4.3. List of Preparers

The BLM, USFS, and a contractor team prepared this Supplemental EA. Table 4-1 identifies the staff who contributed to preparation of this Supplemental EA and their roles.

Table 4-1. List of Preparers

NAME	ROLE
U.S. Department of the Interior, Bureau of Land Management	–
Dominique Wood	Assistant District Manager (Acting) – Resources
Kurt Wadzinski	Project Manager, Planning and Environmental Coordinator
Stephanie Carman	District Manager, Senior Advisor
Lindy Nelson	Assistant District Manager, Program Manager
Oksana Rollins	Contracting Officer
Danielle Donkersloot	Contracting Officer Representative/Natural Resource Specialist
Donna Charleston	Planning and Environmental Specialist
Wesley Willoughby	Archaeologist
Nicole Carter	Natural Resource Specialist
Fred Holzel	Geologist
Martha Malik	Public Relations Specialist
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Lee Stewart	WNF Forest Supervisor
Jason Reed	WNF Athens District Ranger
Mathias Wallace	WNF Ironton District Ranger
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Autumn Coffey	WNF Forest Botanist
Andy Tremayne	WNF Forest Archaeologist
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NAME	ROLE
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Appendix A – Issues Not Included in Further Detail in this Environmental Assessment

APPENDIX A:

Issues not Included in Further Detail in this Environmental Assessment

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
Soil Resources *How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing impact soils in the region?*	The act of offering, selling, and issuing federal oil and gas leases does not impact soils; however, soils could be affected by reasonably foreseeable development of leases. Soil impacts resulting from future development of leases and associated surface disturbance include exacerbating processes like erosion, displacement, and compaction, which can reduce soil quantity and quality with resultant impacts on vegetative communities and their composition. Impacts to soil would generally be proportional to the amount of new surface disturbance (increased disturbance would result in a proportionate increase in adverse impacts to soils). The potential impacts to soil resources from horizontal drilling with high-volume hydraulic fracturing could be increased over those analyzed in the 2016 EA due to increased surface disturbance. However, initial surface disturbance associated with reasonably foreseeable development of leases is estimated to be up to 998 acres, or 0.2 percent of the Action Area (BLM 2020). This estimate represents an unlikely scenario where all 81 wells are developed at the same time, with surface disturbance not yet offset by interim reclamation. The 2020 RFDS (BLM 2020) projects a more likely scenario where about two horizontal well pads would be developed per year over the RFDS's 15-year development period, impacting up to 0.01 percent of the Action Area (70 acres). Interim reclamation would reduce some surface disturbance from year to year; following interim reclamation and prior to final reclamation, maximum long-term surface disturbance would impact 0.004 percent of the Action Area (20 acres) per year. By the end of the RFDS's projected 15-year development period, the long-term surface disturbance for 29 well pads is predicted to be up to 285 acres or 0.05 percent of the Action Area, or 285 acres (BLM 2020).

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
	Additional impacts from future development of issued leases may include the potential for accelerated erosion following well-pad or access-road construction on slopes or other unstable geography. Soils exceeding 40-percent slopes are present across approximately 17 percent of the Action Area and these locations would be most susceptible to accelerated erosion rates. However, there are a variety of existing requirements, stipulations, notifications, and other protection measures in place that would avoid and limit potential impacts to soils from reasonably foreseeable development. For example, forest-wide standards in the Forest Plan (USFS 2006a) allow for oil and gas development on steep slopes (35- to 55-percent grade) only on a case-by-case basis (Appendix F, Reference #SFW-MIN-11) and with implementation of appropriate mitigation measures and NSO stipulations may be imposed on slopes greater than 55-percent grade (Appendix F, Reference #SFW-MIN-10). Site-specific permitting of APDs would include an analysis of potential impacts to soils based on specific development locations and additional protection measure could be applied as COAs to the APDs to reduce impacts to soils. In addition, reclamation would be implemented for all surface-disturbing activities in accordance with the BLM policies, such as the Gold Book, which requires restoration of the character and productivity of the land and water following operations. Given the application of resource protection measures for soils, the relatively negligible increase in surface disturbance in relation to the size of the Action Area, and the existing and developed nature of the Action Area (see Appendix H of the Supplemental EA), reasonably foreseeable development of the leases is not expected to notably impact soils beyond the analysis that was conducted in the 2016 EA and is not expected to notably affect long-term soil function following reclamation.

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
Cultural Resources *How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing affect cultural resources in the region, including Native American religious concerns?*	All parcels in the Marietta Unit of the WNF have the potential to contain surface and buried archaeological materials or be in an area where development could affect the setting of known or unknown historic sites, and/or Traditional Cultural Properties. The action of offering, selling, and issuing federal oil and gas leases does not in itself impact cultural resources. Reasonably foreseeable development of the leases could result in impacts on cultural resources from surface disturbance associated with the construction of well pads, regional gathering/production facilities, roads, pipelines, and other infrastructure. The potential impacts to cultural resources from horizontal drilling with high-volume hydraulic fracturing could be increased over those analyzed in the 2016 EA due to increased surface disturbance, increased development activities, and increased effects on the visual and auditory environment from horizontal drilling compared to vertical drilling. However, there are a variety of existing requirements, stipulations, notifications, and other protection measures in place that would avoid and limit potential impacts to cultural resources. The application of lease terms, cultural resource lease stipulations and the cultural resource lease notifications, as well as standards set for mineral development by the 2006 Forest Plan provides protection to cultural and heritage resources, traditional cultural properties, and historic trails (see Appendix F in this Supplemental EA). Generally, an on-the-ground cultural inventory will be required as part of the APD permitting process before new surface disturbance occurs and all historic and archaeological sites that are eligible for listing in the National Register of Historic Places would be either avoided by the undertaking, have adverse effects to sites minimized or mitigated, or have the information in the sites extracted through archaeological data recovery (Notification 1; Appendix F). The BLM will not approve any surface-disturbing activities that may affect such properties or resources until it completes its obligations associated with the stipulations that are applied to each respective APD as well as applicable requirements of the National Historic Preservation Act and any other authorities. The BLM may require modification to exploration or development proposals to protect such

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
	properties or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated. As such, while potential impacts to cultural resources from horizontal drilling with high-volume hydraulic fracturing could be minimally increased compared to vertical drilling, there are a variety of existing requirements in place to minimize and avoid potential impacts. As such, the Proposed action and reasonably foreseeable development of the leases is not expected to notably impact cultural resources beyond the analysis that was conducted in the 2016 EA and this resource is not carried forward for further detailed analysis in the Supplemental EA.
Visual Resources *How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing affect visual resources and scenic qualities of the region*	The types of equipment required for horizontal drilling would be substantially similar in visual appearance as the types of equipment needed for vertical drilling, including comparable drilling-rig heights and night lighting of the well sites and rig masts. Drilling equipment would remain on the landscape for a relatively short duration, with vertically drilled wells requiring approximately three days and horizontally drilled wells requiring approximately five days. Despite the general similarity of equipment needed for vertical and horizontal drilling, the 2020 RFDS (BLM 2020) projects 19 more horizontal well pads than the 10 previously analyzed in the 2016 EA. Therefore, more drilling equipment would be visible in the landscape of the Action Area. The majority of well pads would also support horizontal drilling, which disturbs up to 35 acres more surface in the short term and up to 10 acres more surface in the long term than vertical drill pads, with corresponding increases in visual impacts. However, the total surface disturbance estimated in the 2020 RFDS would include up to 998 acres in the short-term (0.2 percent of the Action Area) and up to 228 acres in the long term (0.05 percent of the Action Area). The Forest Plan includes a variety of stipulations and notifications that would be applied to permits to reduce visual impacts including Stipulation #11 related to visual mitigation at the APD stage and forest-wide guidelines

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
	GFW-SM-21, GFW-SM-23, GFW-SM-24, GFW-SM-25, and GFW-SM-64 that would reduce visual impacts from lighting by using techniques such as directional lighting, tilting, and light fixture shields. In addition, the Forest Plan and the Gold Book include a variety of measures that would support reclamation and would reduce long-term visual impacts on the scenic landscape. Given the relatively minimal increase in surface disturbance associated with reasonably foreseeable development of the leases in relation to the size of the Action Area, the existing developed nature of the Action Area, the short-term nature of well pad construction and development, and the resource protection measures associated with visual resources, visual resources will not be notably impacted beyond the analysis conducted in the 2016 EA and this resource is not carried forward for further detailed analysis in the Supplemental EA.
Recreation *How would increases in surface disturbance and use of horizontal drilling with high-volume hydraulic fracturing affect recreation in the region?*	The potential impacts to recreation from horizontal drilling with high-volume hydraulic fracturing could be increased over those analyzed in the 2016 EA due to increased surface disturbance, increased development activities, and increased effects on the visual and auditory environment from horizontal drilling compared to vertical drilling. Although surface disturbance would increase slightly under a scenario of horizontal drilling with high-volume hydraulic fracturing, the total short-term disturbance would only account for 0.2 percent of the total Action Area and total long-term disturbance would only account for 0.05 percent of the Action Area. Furthermore, the Forest Plan includes a variety of stipulations and notifications that would be applied to permits to reduce impacts to recreation including placing an NSO stipulation within designated areas to protect special management units (e.g., developed recreation areas, trails and associated trailheads, water supply facilities, administrative sites, other recreation areas) (Appendix F, SFW-MIN-9 [Stipulations 1–5]). See Appendix F for a detailed list of potential forest-wide standards, guidelines, and recommendations that would be applied to APDs on NFS lands to reduce impacts to recreation, as appropriate.

ISSUE STATEMENT	RATIONALE FOR NOT FURTHER DISCUSSING IN DETAIL IN THE EA*
	Given the relatively minimal increase in surface disturbance associated with reasonably foreseeable development of the leases in relation to the size of the Action Area, the existing developed nature of the Action Area, the short-term nature of well pad construction and development, and the resource protection measures associated with recreation, recreation will not be notably impacted beyond the analysis conducted in the 2016 EA and this resource is not carried forward for further detailed analysis in the Supplemental EA.

* Supporting documentation for these statements are included in the project record.

Appendix B – References

APPENDIX B:

References

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Appendix C – CBD Decision Court Orders

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

Center for Biological Diversity, *et al.,*

Plaintiffs,

v. **Case No. 2:17-cv-372**

U.S. Forest Service, *et al.,* **Judge Michael H. Watson**
Magistrate Judge Jolson

Defendants.

OPINION AND ORDER

Four non-profit organizations, the Center for Biological Diversity {"the Center"), Heartwood, Ohio Environmental Council {"OEC"), and the Sierra Club {together, "Plaintiffs") move for summary judgment under the Administrative Procedure Act, 5 U.S.C. § 551 *et seq.* **{"APA")** against the United States Forest Service {"USFSn), the United States Bureau of Land Management {"BLM"), the United States Fish and Wildlife Service ("FWS"), Vicki Christiansen in her official capacity as Chief of USFS, William Perry Pendley in his official capacity as acting director of BLM, and Aurelia Skipwith in her official capacity as director of FWS (together, "Defendants").[1] Pis.' Mot. for Summ. J., ECF No. 83. Defendants oppose Plaintiffs' motion and move for summary judgment. ECF No. 92. American Petroleum Institute ("API"), Independent Petroleum Association of America {"IPAA"), and Eclipse Resources I, LP {"Eclipse") have entered the

[1] Pursuant to Federal Rule of Civil Procedure 25(d), the Court substitutes the names of the public officials sued in their official capacities.

action as Intervenor Defendants (collectively, "IntervenorsJ'). *See* ECF Nos. 52, 71. Intervenors echo Defendants' motion for summary judgment and move independently for the same. Eclipse Mot. for Summ. J., ECF No. 97; API & IPAA Mots. for Summ. J., ECF No. 99.

Additionally, Plaintiffs move for judicial notice, ECF No. 84, and the American Forestry Resource Counsel and Ohio Forestry Associate Inc. ("Amici'1) move for leave to file an Amicus Curiae Brief. ECF No. 94. Both motions are opposed.

I. LEGAL BACKGROUND[2]

A. Oil and Gas Leasing in the National Forest System Lands

1. *Governing Law*

The Mineral Leasing Act of 1920 (the "MLAJ'), 30 U.S.C. § 181, *et seq.,* established a permit and leasing system that granted the Secretary of the Interior broad discretion in deciding whether to lease particular federal lands. The Federal Onshore Oil and Gas Leasing Reform Act of 1987, 30 U.S.C. § 226(9}-(h) ("FOOGLRA"), which amends the MLA, divides leasing responsibility between the Secretary of the Interior, acting through BLM, and the Secretary of Agriculture, acting through USFS. *See* 30 U.S.C. § 226(h}-(n); 43 C.F.R. § 3101.7-2(a). Generally, USFS manages the surface of the forest lands, and BLM manages the subsurface of the lands. 30 U.S.C. § 226(g). While BLM has

[2] The Court incorporates, as relevant, the Legal Background Section from its previous Opinion and Order on Plaintiffs' Mot. to Compel. *See* ECF No. 78.

ultimate authority over leasing, it may not issue a lease on forest lands over USFS's objection. 43 C.F.R. § 3101.7-2(c). Prior to issuing a lease on federal land, BLM and USFS must verify that the activity approved by the lease complies with the National Environmental Policy Act ("NEPA"), NEPA's implementing regulations at 43 C.F.R. §§ 1500-08, and USFS policies and procedures. 36 C.F.R. § 228.102(a).

NEPA [11]has twin aims." *Bait.* Gas & *Elec.* Co. *v. NRDC,* 462 U.S. 87, 97 (1983). It obliges an agency "to consider every significant aspect of the environmental impact of a proposed action" and to "inform the public that it has indeed considered environmental concerns in its decisionmaking process." *Id.* "NEPA serves procedural rather than substantive goals, and is not a 'results-driven' statute." *Latin Ams. for Soc. and Econ. Dev. v. Adm'r of Fed. Highway Admin.,* 756 F.3d 447, 462 (6th Cir. 2014). As a result, "[e]ven agency action with adverse environmental effects can be NEPA-compliant so long as the agency has considered those effects and determined that competing policy values outweigh those costs." *Id.* (quoting *Kentuckians for the Commonwealth v. U.S. Army Corps of Eng'rs,* 746 F.3d 698, 706 (6th Cir. 2014)); see a/so *Bait. Gas & E/ec.* Co., 462 U.S. at 97 ("Congress in enacting NEPA ... did not require agencies to elevate environmental concerns over other appropriate considerations."). At bottom, NEPA's procedural requirements exist to ensure that decisions to lease are "fully informed and well-considered." *Latin Ams. for*

Soc. *and Econ. Dev.,* 756 F.3d at 462 (quoting *Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council,* 435 U.S. 519, 558 (1978)).

Under NEPA's procedural requirements, whenever a federal agency endeavors to take "major ... action□significantly affecting the quality of the human environment"-which may include opening up federal lands for oil and gas leasing-the agency must first generate a "detailed statement" reviewing the environmental impacts of the proposed action and alternatives to that action. 42 U.S.C. § 4332(C).[3] This statement is referred to as an environmental impact statement ("EIS"), and it constitutes a "NEPA document." Developing the EIS fulfills NEPA's procedural guarantee of informed decision-making because it compels the agency producing the EIS to take a "hard look at environmental consequences" stemming from its actions. *Ky. Riverkeeper, Inc. v. Rowlette,* 714 F.3d 402, 407 (6th Cir. 2013).

"To spare agencies the hardship of conducting exhaustive review of every" proposed significant federal action, however, federal regulations allow the acting

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[3] Specifically, the statute requires the agency to consider:

(i) the environmental impact of the proposed action,
(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
(iii) alternatives to the proposed action,
(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Id.

agency "to first prepare a less burdensome environmental assessment [("EA")] as a method for determining whether a proposal need[s] an [EIS]." *Id.* at 407-08; 40 C.F.R. § 1501.4(a}-(c). If, after preparing an EA, the agency determines that no EIS is required, the agency must issue a Finding of No Significant Impact, which "briefly present[s] the reasons why an action ... will not have a significant effect on the human environment and" thus does not require an EIS. 40 C.F.R. §§ 1501.4(e), 1508.13.

Finally, an agency must prepare supplements to a draft or final EIS if the agency "makes substantial changes in the proposed action that are relevant to environmental concerns" or if "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c)(1). The agency may also prepare a supplement at any time that it "determines that the purposes of [NEPA] will be furthered by doing so." *Id.§* 1502.9(c)(2).

2. *The Leasing Process*

The leasing process consists of a complex series of procedures during which USFS and BLM share responsibility for ensuring that the leasing decision and subsequently issued permits to drill comply with NEPA, NEPA's implementing regulations, and USFS's Forest Plan. *See Wy. Outdoor Council v. Bosworth,* 284 F. Supp. 2d 81, 83 (D.D.C. 2003) (outlining the process in detail). In 2006, USFS and BLM entered into a memorandum of understanding that further clarifies their shared responsibilities.

At the first step of the leasing process, after conducting a NEPA analysis, USFS determines which forest lands it will make administratively available to BLM for leasing. 36 C.F.R. § 228.102(c). The responsibility then shifts to BLM to determine, out of all forest land USFS made administratively available for leasing, which specific parcels BLM will designate for leasing. 36 C.F.R. § 228.102(d). Once BLM does so, it submits, for USFS's approval and consent, a proposal to lease specific parcels. Before consenting, USFS must verify that the leasing of those specific lands "has been adequately addressed in a NEPA document and is consistent with the Forest land and resource management plan." *Id.§* 228.102(e)(1). Additional environmental analysis must be performed if USFS determines that the leasing has not been adequately addressed or if significant new information or circumstances requires further analysis. *Id.* USFS also verifies that BLM's leasing proposal includes all required stipulations. *Id.* If these conditions are met, USFS may consent to BLM's leasing proposal. Finally, the process shifts back to BLM to offer the specific land for oil and gas leasing through a lease sale and awards leases to the "highest qualified bidder." 43 C.F.R. §§ 3924.5, 3925.10.

3. *Approval of Drilling Operations on Leased Land*

Before a lessee commences drilling operations or other surface-disturbing activities on leased land, the lessee must submit an application for permit to drill ("APD") for each planned well site on the parcel. 43 C.F.R. § 3126.3-1(c). The APD includes a surface use plan of operation ("SUPO[1]") describing the proposed

drilling program and addressing environmental hazards caused by the drilling and efforts to mitigate those hazards. *Id.* § 3162.1-1(c), (d), (e). USFS reviews the SUPO for compliance with NEPA and its implementing regulations as well as USFS policies and procedures. 36 C.F.R. § 228.107(a). USFS may approve the SUPO as submitted, approve it subject to specified conditions, or disapprove it. *Id.§* 228.107(b)(2). USFS then gives public notice of its decision on the SUPO and forwards the decision to BLM. *Id.§* 228.107(c), (d). BLM may approve the APD only after USFS approves the SUPO included therein. 30 U. S.C. § 226(g); 43 C.F.R. § 3162.3-1(h). Finally, even after the APD is approved, the lessee must supplement the SUPO if it seeks to conduct additional surface-disturbing operations on a particular well site that were not previously accounted for in the plan. 36 C.F.R. § 228.106(d).

B. The Endangered Species Act

The Endangered Species Act ("ESA"), 16 U.S.C. §§ 1531, *et seq.* also has bearing on what federal forest lands USFS and BLM may approve for oil and gas leasing. The ESA "is comprehensive legislation for the preservation of endangered species." *Bosworth,* 284 F. Supp. 2d at 83-84 (citing *Tenn. Valley Auth. v. Hill,* 437 U.S. 153, 180 (1978)). It requires the Secretary of the Interior, acting through the FWS to list the fish, wildlife, or plant species that it determines are endangered or threatened. *Id.* at 84; 16 U.S.C. § 1533(a).

The ESA comes into play whenever USFS determines to make forest lands administratively available for leasing and whenever BLM later designates

specific lands from all those administratively available that BLM plans to offer at a lease sale. The relevant agency (the "acting agency") must ensure that its leasing decision "is not likely to jeopardize the continued existence of' a listed species or destroy or adversely modify a species' critical habitat. 16 U.S.C. § 1536(a)(2).

If the acting agency concludes that its planned leasing may jeopardize a listed species or its critical habitat, then the acting agency must engage in formal consultation with FWS. 50 C.F.R. § 402.14(a). At the conclusion of the formal consultation, FWS issues a biological opinion in which FWS discusses in detail the effects of the proposed action on the listed species or critical habitats. *Id.* 402.14(gHh). If FWS concludes that the action will jeopardize the continued existence of a listed species or critical habitat, then "the biological opinion must set forth 'reasonable and prudent alternatives' aimed at avoiding such consequences." *Bosworth,* 284 F. Supp. 2d at 84 (quoting 50 C.F.R. § 402.12(h)(3)).

If, on the other hand, the acting agency concludes that its leasing decision is unlikely to jeopardize a listed species or critical habitat, then it may engage in informal consultation with FWS to verify whether FWS concurs. 50 C.F.R. §§ 402.12(k), 402.13. If FWS agrees with the acting agency's non-jeopardy determination, then no formal consultation is required, and "the consultation process is terminated " 50 C.F.R. §§ 402.12(b), 402.13(a).

Even after consultation terminates, however, whenever "new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered," "[r]einitiation of formal consultation is required and shall be requested by the [acting] agency or by [FWS]." 50 C.F.R. § 402.16.

II. FACTUAL AND PROCEDURAL BACKGROUND

The following facts are taken from Plaintiffs' Amended Complaint, ECF No. 24, and the Defendants' administrative records.

A. The Wayne National Forest and the Marietta Unit

The Wayne National Forest ("WNF" or "the Forest"}, located in the foothills of the Appalachian Mountains in southeast Ohio, is Ohio's only national forest. Unlike other national forests, the Forest is a patchwork of private and federal land, with most of the land within its administrative boundary being privately owned. Nearly 240,000 of the Forest's over 800,000 acres of land is owned and managed by USFS. Approximately 98,858 acres of that federal land are underlain by federally-owned minerals. FS-5534.

Three non-contiguous units-Athens, Ironton, and Marietta-comprise the Wayne National Forest. The Marietta Unit is the easternmost unit and the unit at issue here. It contains approximately 268,000 acres of private and federal lands, of which over three-fourths is privately owned.

B. USFS's 2006 EIS and Forest Plan

In 2006, after more than four years of planning and analysis, USFS approved a Final Revised Land and Resource Management Plan ("2006 Forest Plan" or "Plan"), which guides the management of the Wayne National Forest, and an accompanying EIS ("2006 EIS"). USFS relied on a 2004 Reasonably Foreseeable Development Scenario ("RFDS") created by BLM that projected the total surface disturbance of new oil and gas wells in Wayne National Forest to create the 2006 Forest Plan and EIS. Neither the 2006 Forest Plan, the EIS, or the 2004 RFDS considered effects of horizontal drilling and hydraulic fracturing methods, because those methods did not appear to be economically feasible at the time, rather, they only considered conventional vertical drilling.

Before finalizing its 2006 Forest Plan and 2006 EIS, USFS received substantial public input, as required by NEPA: it held public meetings, developed a draft plan and draft EIS, received feedback on those drafts through public open houses, and responded to over 1,300 public comments on the drafts. Additionally, USFS engaged in formal consultation with FWS. The consultation focused on the 2006 Forest Plan's effect on the endangered Indiana bat and running buffalo clover. USFS engaged in informal consultation on other species believed to be present in the area, but USFS and FWS concurred that the activities incorporated in the 2006 Forest Plan was not likely to adversely affect those species.

On November 22, 2005, at the end of the formal consultation, FWS issued a biological opinion in which it concluded that allowing surface occupancy for oil and gas leases was not likely to jeopardize the Indiana bat and running buffalo clover or critical habitats present in the Wayne National Forest. Specifically, FWS determined that USFS's no-surface-occupancy restriction on 13% of the WNF, incorporated into USFS's proposed 2006 Forest Plan and 2006 EIS, was sufficient to protect scenic, recreational, and wildlife areas and that the 2006 Forest Plan contained sufficiently protective standards and guidelines for the remaining development sites.

In the final 2006 EIS, USFS announced that it would continue to make "all federally owned oil and gas rights within the Forest ... administratively available for oil and gas leasing," and that it would subsequently review and authorize BLM to lease specific lands within the Forest. The EIS allowed surface occupancy on only 13% of the Wayne National Forest, but on up to 96% of the federal land in the Marietta Unit.

C. Horizonal Drilling and Hydraulic Fracturing Overview

Beneath the Forest lies primarily Marcellus and Utica shale-a geological formation thousands of feet below ground that contains oil and gas in its porous rock. FS-3744; BLM-1387-88; 29003-04. When the 2006 Forest Plan and 2006 EIS were prepared, there were no economically viable methods of accessing the oil and gas in the shale. *See* BLM-1387. The combination of hydraulic fracturing

and horizonal drilling, howeverj made access and retrieval of oil and gas in the shale profitable.[4] *Id.*

The horizontal drilling process involves first drilling down then drilling horizontally for lengths up to, and over, a mile. BLM-29005; FS-3853-54, 5180. After drilling, the shale formation is then stimulated by a process called hydraulic fracturing, colloquially known as "tracking," which involves injecting millions of gallons of liquid at a high pressure, to release the oil and gas trapped in the shale rocks.[5] BLM-29004; 29006; FS-4244; 5094. To aid in the recovery of oil and gas, "hydrofrac fluids are treated with proprietary chemicals to increase the viscosity to a gel-like consistency that enables the transport of a *proppant,* usually sand, into the fracture to keep it open after the pressure is released." BLM-29006. Compared to a typical hydrofrac fluid" that contains less than .5% by volume of chemical additives, the 3 million gallons of liquid needed for hydraulic fracturing results in about 15,000 gallons of chemicals in the waste." BLM-29006. Wastewater treatment of such fluid can be difficult and expensive given the sheer volume of liquid required, not to mention that the shale formation often contributes its own materials to the mixture such as: brines containing

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[4] Hydraulic fracturing is not a new technique and has been used "in conventional vertical wells in Ohio for many years." FS-5544. The "new" innovation is the combination of the two methods.

[5] The combination of the two methods generally produces approximately 4 million cubic feet of gas per day. BLM- 29005. Meanwhile, the estimates for vertical wells considered in the 2006 EIS were much less. *See* FS-9565 ("[M]ost wells within the WNF are classified as 'stripper' wells, which produce small volumes of oil, gas, or both with equally small volumes of brine as a waste product. The average stripper gas well in Ohio produces 7.4 Mcf [or thousands of cubic feet] per well each day[.]").

sodium, chloride, bromide, arsenic, barium, other heavy metals, and radionuclides that would exceed drinking water standards. BLM-29007. Although tracking is technically term for only half of the process at issue here, the Court will primarily refer to the combination of horizontal drilling and hydraulic fracturing as "fracking" for ease of reference.

D. Subsequent Information Bearing on the 2006 Forest Plan and 2006 EIS

In November 2011, public concern over fracking led USFS to request that BLM review and update the projections contained in its 2004 RFDS, on which the 2006 Forest Plan and 2006 EIS relied. BLM concluded that USFS's 2006 Forest Plan and 2006 EIS did not require updating because current and anticipated surface disturbance, including that caused by tracking, fell below the 2006 forecast. After receiving this information from BLM, USFS conferred with FWS about whether to reinitiate ESA consultations, but both agencies agreed that further consultation was unnecessary.

In January 2012, USFS issued a Supplemental Information Report ("2012 SIR"), which determined that the environmental effects caused by horizontal drilling and.tracking fell within the surface-disturbance limits analyzed in the 2006 EIS and accounted for in the 2006 Forest Plan. Consequently, USFS concluded that it was not required to conduct additional NEPA analysis on the effects of these oil and gas extraction methods.

E. Oil and Gas Leasing in the Marietta Unit

In accordance with the 2006 Forest Plan and 2006 EIS which made available all federally owned minerals in WNF for leasing, in 2015, BLM proposed to lease up to 40,000 acres of federally owned minerals on specific parcels of the Marietta Unit of the Wayne National Forest. BLM prepared an EA to analyze the effect of its leasing proposal. In April 2016, BLM issued its draft EA for public comment.

On June 15, 2016, USFS consented to BLM's lease sale of approximately 2,718.58 acres of federal land in the Marietta Unit.

In October 2016, BLM issued a final EA and Finding of No Significant Impact ("2016 FONSI") (thus concluding that no additional NEPA analysis was required) for its 40,000-acre leasing proposal.

The Center for Biological Diversity appealed that decision to the Interior Board of Land Appeals ("IBLA") but dismissed the appeal after IBLA denied its request for a stay of the decision. In December 2016, BLM offered approximately 719 acres, spread over 17 parcels, for sale, and in March 2017, BLM offered an additional 1,147.10 acres, spread over 20 parcels, for sale. All Plaintiffs in this action appealed both sale decisions to IBLA but subsequently withdrew the appeals after their requested stay was denied.

F. **This Action**

Plaintiffs instituted this action on May 5, 2017. In their Amended Complaint, Plaintiffs bring claims against USFS for (1) violating NEPA and the

APA by consenting to BLM's leasing proposals without conducting additional NEPA analysis (specifically, without preparing a supplemental EIS), and (2) violating the ESA for failing to consult or complete consultation with FWS prior to consenting to BLM's leasing proposals. They also bring claims against BLM for (1) violating NEPA by preparing an "unlawful" EA and FONSI instead of preparing an EIS prior to making its leasing decisions, and (2) violating the ESA for failing to consult or complete consultation with FWS prior to making its leasing decisions. Finally, Plaintiffs allege that USFS, BLM, and FWS violated the ESA by failing to reinitiate consultation regarding the conclusions reached in FWS's 2005 biological opinion, because new species were designated by FWS as threatened or endangered after USFS issued its 2006 Forest Plan and EIS.

Defendants lodged their administrative records with the Court, and the Court denied supplementation of said records. *See* Op. and Order, ECF No. 78. All parties now move for summary judgment on the administrative records.

III. STANDARD OF REVIEW

Because NEPA does not provide a private right of action, the Court reviews challenged agency action under the APA. *Utah Envtl. Cong. v. Russell,* 518 F.3d 817, 823 (10th Cir. 2008).

"Judicial review of NEPA compliance is limited in scope." *Nat'/ Ass'n of Home Builders v. Defs. of Wildlife,* 551 U.S. 644, 658 (2009). The Court's role in reviewing the administrative record is to "ensure that the agency has adequately considered and disclosed the environmental impacts of its actions and that its

decision is not arbitrary or capricious." *Ky. Riverkeeper, Inc.,* 714 F.3d at 407 (quoting *Bait. Gas & Elec.* Co., 462 U.S. at 97-98}.

> An agency decision is arbitrary and capricious if:
>
> the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

Meister v. U.S. Dep't of Agric., 623 F.3d 363, 371 (6th Cir. 2013} (internal citation omitted).

Put another way, "[t]he duty of a court reviewing agency action under the 'arbitrary or capricious' standard is to ascertain whether the agency examined the relevant data and articulated a rational connection between the facts found and the decision made." *Citizens'* Comm. *to Save Our Canyons v. Krueger,* 513 F.3d 1169, 1176 (10th Cir. 2008} (internal citation and quotation marks omitted}. "When reviewing an agency's factual determinations, the Court **'ask[s]** only whether the agency took a 'hard look' at information relevant to the decision." *High Country Conservation Advocates v. United States Forest Serv.,* 333 F. Supp. 3d 1107, 1119 (D. Colo 2018}.

IV. DISCUSSION

A. Whether BLM and USFS were permitted to defer analysis of tracking impacts until the APD stage

Plaintiffs argue that USFS and BLM should have taken a hard look at the impacts of tracking *prior to* issuing the leases in order to properly consider the

cumulative effects of fracking and assess all available alternatives. Defendants refute this and contend that Plaintiffs are trying to require the agencies to perform site-specific NEPA review despite their discretion to defer analysis of specific environmental impacts until later in the leasing process.[6] Specifically, although Plaintiffs want Defendants to review the specific environmental impacts at the leasing stage, Defendants contend that it is entirely appropriate to defer analysis of "site-specific" environmental effects until the APD stage of the process. Defendants acknowledge, however, whether the Agencies can defer NEPA analysis until the APD stage is one of first impression for the Sixth Circuit. Defs.' MSJ 2, ECF No. 92. Thus, the Court must analyze this question first, before addressing Plaintiffs substantive issues with the 2012 SIR and 2016 EA.

As touched upon earlier, BLM employs a three-step process for oil and gas leasing:

> [Step 1] "At the earliest and broadest level of decision-making, the [BLM] develops land use plans--often referred to as resource management plans ...." *Pennaco Energy, Inc. v. U.S. Dep't of Interior,* 377 F.3d 1147, 1151 (10th Cir. 2004); *see also* 43 U.S.C. § 1712(a).
>
> [Step 2] Next, BLM issues a lease for the use of particular land.[7]

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[6] Defendants and Intervenors raise substantially similar arguments throughout their briefing, so the Court will address and refer to the combined arguments as Defendants' arguments. The Court will only address Intervenors' arguments that are separate and distinct from Defendants.

[7] If the land is managed by USFS, it must authorize or consent to the leasing. *See* 36 C.F.R. § 228.102(e).

> [Step 3] The lessee may then apply for a permit to drill, and BLM will decide whether to grant it.§ 1712(e); *Pennaco Energy,* 377 F.3d at 1151-52, 43 C.F.R. §§ 1610.5-3, 3162.3-1(c).[8]

N.M. ex rel. Richardson v. BLM, 565 F.3d 683, 716 (10th Cir. 2009).

NEPA also permits an agency to "tier" reviews, in that an agency can incorporate by reference previous, and usually broader, NEPA reviews and focus more narrowly on a specific issue. See *San Juan Alliance v. Stiles,* 654 F.3d 1038, 1054 (10th Cir. 2011) (citing 40 C.F.R. § 1508.28).

Here, Defendants argue that the 2006 Forest Plan and 2006 EIS already performed an in-depth analysis of federal mineral availability and environmental impacts of leasing those minerals, and that the agencies relied on the 2006 EIS to conclude that tracking effects were sufficiently addressed in that NEPA analysis. Defs.' MSJ 13, ECF No. 92. Thus, Defendants argue, any more extensive site-specific analysis of tracking impacts can be deferred until the APD phase, when it will be required to prepare another NEPA review. Defendants' deferral argument is not a novel defense for Agency Defendants to invoke. It has been raised in various forms throughout oil and gas litigation. *See e.g. Sierra Club v. Peterson,* 717 F.2d 1409, 1415 (D.C. Cir. 1983); *Pennaco Energy, Inc. v. U.S. Dep't ofInterior,* 377 F.3d 1147, 1151 (10th Cir. 2004); *Richardson,* 565 F.3d at 717-18 (finding no bright-line rule for when an agency can defer site-specific analysis to the APD stage); *WildEarth Guardians v. Zinke,* 368 F. Supp.

[8] Similarly, if the land is managed by USFS, the lessee must submit a surface use plan of operations along with the APO. 30 U.S.C. § 226(g).

3d 41, 64-65 (D. D.C. 2019) (rejecting Defendants' argument that it can defer certain environmental impact analyses until the APD stage). In particular, Defendants here rely heavily on the Tenth Circuit Court of Appeals' decision in *Park County Resources Council, Inc. v. U.S. Department of Agriculture* to support their argument that agencies can defer analysis until the APD stage because ·•oil and gas lease, by itself, does not cause a change in the physical environment," so until an agency knows the specific impacts contained in an APD, a NEPA review is not possible. 817 F.2d 609, 622-24 (1987).

Plaintiffs dispute that *Park County* controls and point to *Pennaco* to support their argument that the reasonably foreseeable impacts of leasing activities must be addressed at the decision-to-lease stage. 377 F.3d at 1160.

These parties are also not the first to argue, respectively, that *Park County* or *Pennaco* control on the deferral issue. Similar arguments were raised in *Richardson,* and the Tenth Circuit engaged in a detailed comparison of the *Pennaco* and *Park County* to determine when, and more importantly in what context, tiering applies. The Tenth Circuit explained that:

> This court first addressed the tiering of impacts analysis in the oil and gas leasing context in *Park County Resource Council, Inc. v. U.S. Department of Agriculture,* 817 F.2d 609 (10th Cir. 1987), *overruled in part on other grounds by Village of Los Ranchos,* 956 F.2d 970. In that case, BLM had prepared an "extensive" EA before issuing leases, concluded that leasing would have no immediate environmental impacts, and issued a FONSI concluding that an EIS was unnecessary at that stage. *Id.* at 612. Reviewing the decision to issue a FONSI rather than an EIS, we noted that no exploratory drilling had occurred in the entire plan area at the time the lease was issued, *id.* at 613, and there was no evidence that full field development was

> likely to occur, *id.* at 623.... We concluded that preparation of both plan-level and site-specific environmental impacts analysis was permissibly deferred until after leasing ....
>
> We next had occasion to consider tiering in the oil and gas context in *Pennaco Energy.* In that case, BLM issued leases for coal bed methane ("CBM") extraction on public lands in Wyoming. 377 F.3d at 1152. A plan-level EIS for the area failed to address the possibility of CBM development, and a later EIS was prepared only after the leasing stage, and thus "did not consider whether leases should have been issued in the first place." *Id.* Because the issuance of leases gave lessees a right to surface use, the failure to analyze CBM development impacts before the leasing stage foreclosed NEPA analysis from affecting the agency's decision. *Id.* at 1160. Accordingly, we held that in the circumstances of that case, an EIS assessing the specific effects of coal bed methane was required before the leasing stage. As in *Park County,* the operative inquiry was simply whether all foreseeable impacts of leasing had been taken into account before leasing could proceed. Unlike in *Park County,* in *Pennaco Energy* the answer was "no."

Richardson, 565 F.3d at 716-17.

Richardson also clarified that there was no "bright line rule that site-specific analysis may wait unit the APD stage[;]" rather, "the operative inquiry was simply whether all foreseeable impacts of leasing had been taken into account before leasing could proceed." *Id.* at 717.

Richardson instructs that the first question to ask when determining if an assessment can be deferred is whether the lease would constitute "an irretrievable commitment of resources." *Id.* at 718 (finding that issuance of an oil and gas lease without an no surface occupancy c•NsO,') stipulation was an irretrievable commitment); *see also Connor v. Burford,* 836 F.2d 1521,1527 (9th Cir. 1988) (finding that "an EIS must be prepared before any irreversible and

irretrievable commitment of resources"); *Peterson,* 717 F.2d at 1414 ("The appropriate time for preparing an EIS is *prior* to a decision, when the decisionmaker retains a maximum range of options." (citation omitted)).

Next, if the Court finds that the decision to lease would constitute an irretrievable commitment of resources, then the second question is whether any environmental impacts were reasonably foreseeable at the leasing stage.

1. **Is the decision to lease an irretrievable and irrevocable commitment of resources?**

As to first question, Defendants state that in this case, and unlike in *Pennaco,* USFS can approve, modify, or deny a surface use plan of operations or withdraw its consent to lease if it believes additional environmental analysis is warranted. Defs.' MSJ 15, ECF No. 92 (citing 36 C.F.R. § 228.102(e)(1)). Defendants concede that the leases at issue are non-NSO leases[9] but argue that

[9] The 2006 Forest Plan EIS discussed NSO stipulations:

> Under all alternatives, approximately 104,955 acres of federally owned minerals are currently available for oil and gas leasing subject to applicable restrictions, referred to as stipulations and notifications. The most restrictive stipulation addressed in the FEIS *is* the No Surface Occupancy (NSO) stipulation. NSO prohibits use or occupancy of the land surface for oil and gas exploration and development. Under Alternative E Modified, NSO applies to 17,260 of the available acres. Time limitation stipulations, controlled surface use stipulations and lease notifications apply to the remaining 87,695 acres.
>
> The 2006 Forest Plan stipulates no surface occupancy on 13% of the Forest, compared to the 1988 Plan, which prohibits surface occupancy on 12% of the Forest. I have selected the alternative that will allow surface occupancy on 96% of the Marietta Unit, which is the area of the Forest that has the highest potential for continued oil and gas development. The 1988 Plan allowed surface occupancy on 82% of the Marietta Unit.

those are not an irretrievable commitment of resources because the lessee must still submit an APO and surface use plan of operations ("SUPO") are before it can use the surface. Defs.' Reply 5, ECF Nol. 107. Thus, they argue that there is no "significant impact" yet to the environment.

But Defendants fail to reassure the Court that the decision to lease in this case is not an irretrievable commitment of resources. Defendants provide no evidence that, if a site-specific NEPA review at the APO phase indicated more serious environmental impacts than initially expected, they could *revoke* altogether a lessee's right to the minerals or prohibit any disturbance or use of the land.

Similarly, the Court is not convinced by Defendants' argument that the significance of an action does not occur and cannot be determined until there are actual physical impacts. Defendants argue that "the act of leasing does not have any ground-disturbing effects," and thus, no actual environmental impacts. Defs.' MSJ 14, ECF No. 92. Rather, they argue that only once the lessee submits an APO and a SUPO are BLM and USFS required to conduct site-specific reviews, because only then will the leases cause a change to the physical environment. *Id.* (citing BLM-1515, 1521; FS-5536). But the problem with Defendants' argument is that the regulatory language does not ask the agencies to review whether any surface disturbance will occur by its action: rather, the agencies are

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FS10361.

tasked with determining whether the proposed action will have "any irreversible and irretrievable commitments of resources(.]" 42 U.S.C. § 4332(C)(v). As such, the lack of immediate physical disturbance cannot equate to "no irretrievable commitments of resources."

Under similar circumstances, other courts have found that an irreversible and irretrievable commitment of resources occurs at the decision-to-lease stage. *See S. Utah Wilderness All. v. Palma,* 707 F.3d 1143, 1159 (10th Cir. 2013) ("issuance of the (mineral] lease represents the irreversible and irretrievable commitment of public resources for private use."); *Richardson,* 565 F.3d at 718 ("issuing an oil and gas lease without an NSO stipulation constitutes such a commitment."); *Pit River Tribe v. United States Forest Serv.,* 469 F.3d 768, 782-83 (9th Cir. 2006) (finding that leases that did not allow the government to preclude oil and gas activities all together were an irretrievable commitment of resources); *Conner,* 848 F.2d at 1451 ("In sum, the sale of a non-NSO oil or gas lease constitutes the 'point of commitment(.]' (A]fter the lease is sold the government no longer has the ability to prohibit potentially significant inroads on the environment . . . . [thus]i unless surface-disturbing activities may be absolutely precluded, the government must complete an EIS before it makes an irretrievable commitment of resources by selling non-NSO leases."); and *Peterson,* 717 F.2d at 1413 (finding that once land was leased without NSO stipulations, "the Department no longer has the authority to *preclude* surface disturbing activities even if the environmental impact of such activity is

significant" and that once that decision is made at the leasing stage, it "is the point at which the environmental impacts of such activities must be evaluated.").[10]

In sum, the Court finds an important distinction exists between the ability to restrict or limit an action and the ability to prohibit or revoke an action altogether. *C.f. Peterson,* 717 F.2d at 1415 (An agency "may delay preparation of an EIS provided that it reserves both the authority to *preclude* all activities pending submission of site-specific proposals and the authority to *prevent* proposed activities if the environmental consequences are unacceptable."). Indeed, after a lessee obtains rights to the minerals, it has "the right to use so much of the lease lands as necessary to explore for, drill for, mine, extract, remove and dispose of all the leased resource in a leasehold." 43 C.F.R. § 3101.1-2. Thus, revocation or denial of the project after a lease is issued would impede on the lessee's rights as a leaseholder. *See Pit River,* 469 F.3d at 783. But waiting to evaluate the environmental impacts of a decision until after the "no action alternative" is off the table would circumvent the very purposes of NEPA, which is "insuring that federal agencies infuse in project planning a thorough consideration of environmental values" including "to consider seriously the 'no action' alternative

[10] Given that both *Palma* and *New Mexico,* decided in 2013 and 2009 respectively, explicitly state that non-NSO leases equate to an irretrievable commitment of resources, the Court rejects Defendants' argument that Plaintiffs' incorrectly rely on cases predating the Federal Onshore Oil and Gas Leasing Reform Act of 1987, 30 U.S.C. § 226(g), such as *Peterson* or *Conner,* for the same proposition. *See* Defs.' Reply 6-7, ECF No. 107.

before approving a project with significant environmental effects." *Conner,* 848 F.2d at 1451.

Moreover, the regulations support NEPA review at the leasing stage. For example, 36 C.F.R. § 228.102(e)(1) states that: "at such time as specific lands are *being considered for leasing,"* USFS shall review the decision, including verifying that the leasing of specific lands has been adequately addressed in the NEPA document. 36 C.F.R. § 228.102(e) and (e)(1) (emphasis added). But if USFS finds that "NEPA has not been adequately addressed, or if there is significant new information or circumstances as defined by 40 CFR 1502.9 requiring further environmental analysis, additional environment analysis shall be done before a leasing decision for specific lands will be made. [Likewise] [i]f there is inconsistency with the Forest land and resource management plan, no authorization for leasing shall be given unless the plan is amended or revised." 26 C.F.R. § 228.102(e)(1). Nowhere does this regulation hold that USFS can withdraw consent at the APD stage, and Defendants do not contend otherwise. Further, all parties agree that USFS can only withdraw its consent to lease at the decision-to-lease step. Thus, this regulation supports Plaintiffs' proposition that the appropriate time to consider the environmental impacts of the decision is prior to the APD step when there is an irretrievable commitment of resources.

Accordingly, the Court finds that BLM's decision to lease, and USFS's consent thereto, *are* decisions to irrevocably commit resources, because only the

manner and method of accessing those committed resources can be regulated at the APO stage.

2. Were the impacts of tracking reasonably foreseeable?

Next, the Court must determine whether the impacts of tracking were reasonably foreseeable. The Court will address specific, potentially foreseeable impacts in subsequent sections of this opinion, but finds the impacts of tracking were reasonably foreseeable at the time such that USFS and BLM had the ability to examine them at the leasing stage.

"In determining what effects are 'reasonably foreseeable, an agency must engage in 'reasonable forecasting and speculation,' with *reasonable* being the operative word..... [t]he agency need not foresee the unforeseeable, but by the same token neither can it avoid drafting an impact statement simply because describing the environmental effects of and alternatives to particular agency action involves some degree of forecasting." *WildEarth,* 368 F. Supp. 3d at 67 (citations and quotations omitted). "An effect is considered reasonably foreseeable if it is 'sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision.'" *Wilderness Workshop v. United* States *BLM,* 342 F. Supp. 3d 1145, 1155 (D. Colo 2018) (citation omitted).

The Court first notes that the parties talk past each other as to the scope of review that Plaintiffs' seek. Defendants characterize Plaintiffs' argument as requiring the Agencies to "examine all site-specific impacts at the leasing or

Forest Plan stage." Defs.' MSJ 13,15, ECF No. 92. Defendants use "site-specific" to refer to more granular, individual parcels for lease. Plaintiffs contend Defendants mischaracterize their argument because they are not seeking parcel-specific review. Instead, they argue the crux of their argument is that Defendants *"underestimated* or *entirely ignored* specific foreseeable and *aggregate forest-wide* consequences" of tracking. Pis.' Reply 1, ECF No. 105.

To the extent Plaintiffs are requesting the Court require parcel-by-parcel environmental impact assessments at the leasing stage, the Court agrees with Defendants that such a review is not required at the leasing stage. *See WildEarth,* 368 F. Supp. 3d at 66-67 (collecting cases for that proposition). However, this does not absolve Defendants from examining reasonably foreseeable environmental impacts of leasing the aggregate of parcels at issue, in this case approximately 40,000 acres.

Here, the Court finds the environmental impacts of leasing the land for tracking, as a whole, were reasonably foreseeable. Notably, Defendants *did* foresee some impacts and were able to extrapolate from them. *See e.g.* FS-5641 (May 2012 letter from BLM to USFS comparing vertical and horizontal drilling).[11] In particular, BLM estimated the number of wells per well pad reasonably expected with fracking, as well as how many well-pads each Unit could accommodate. FS-5641--43. Moreover, USFS and BLM were aware of

[11] The Court will address the substance of these conclusions later in the Opinion and Order.

other forests reviewing the impacts of fracking, in which USFS projected pipeline disturbances from horizontal well development. *See* FS-9-20; FS-48-49. Likewise, Ohio's Department of Natural Resources ("ODNR") issued its recommendations for oil and gas activities on state lands in January 2012, which specifically discussed estimated sizes for well pads, FS-2656, and water storage (estimating that fracking requires 2-6 million gallons water, stored close to the well-site and requires "substantial resources" and noting that "one million gallons of water is equivalent to 3.069 acre feet or 133,685.24 cubic feet").

Similarly, given that substantial oil and gas development had already occurred on private, adjacent lands in the WNF, the likelihood that these federal lands would be developed for tracking was reasonably foreseeable. *See* BLM-1388-89 ("ODNR reported that 15,707,339 barrels of oil and 651,193,106 million cubic feet of gas were produced from Ohio's horizontal shale wells in the first nine months of 2015"); *see also* FS-3815, 26-29; FS-3833 (noting possible productive shale areas could be up to 10,000,000 acres; 200 shale wells estimated drilled in 2012; also estimating 6 acres per well pad and access road for a total of 20,772 acres for access roads and well pads). This information also distinguishes Defendants' primary case, *Park County,* where the proposed action was much more speculative. *See* a/so FONSI, BLM-1755 (noting that there were over 50 "expressions of interest" in leasing federal minerals on approximately 18,000 acres in the Marietta Unit).

Defendants argue that "the reasonably foreseeable impacts can only be meaningfully examined when there is a concrete site-specific proposal in the form of a submitted APD." Defs.' Reply 5, ECF No. 107. But this argument is unpersuasive. *See Kern v. U.S. Bureau of Land Mgmt.,* 284 F.3d 1062, 1072 (9th Cir. 2002) ("An agency may not avoid an obligation to analyze in an EIS environmental consequences that foreseeably arise from an RMP merely by saying that the consequences are unclear or will be analyzed later when an [Environmental Assessment] is prepared for a site-specific program proposed pursuant to the RMP ... NEPA is not designed to postpone analysis of an environmental consequence to the last possible moment."). But Defendants' argument that any environmental impacts will be considered at the APO stage is not particularly reassuring given that USFS and BLM will compare the APO and SUPO against the current 2006 Forest Plan, in which fracking was not even considered. And, more importantly, at the APO stage, the "No Action Alternative" is no longer on the table with respect to the non-NSO leases. Finally, by finding that the Agencies *can be* required to conduct a NEPA analysis at the leasing stage-if there is an irrevocable commitment of resources and reasonably foreseeable environmental impacts-does *not* mean that Defendants will be required to create an EIS at every decision to lease. *See Ctr. for Biological Diversity v. United States BLM,* No. 3:17-CV-553, 2019 U.S. Dist. LEXIS 137955, at *6 (D. Nev. Aug. 15, 2019) (finding that "NEPA does not require BLM to create an EIS whenever it issues non-NSO oil and gas leases. It only requires that BLM

assess all reasonably foreseeable impacts of issuing such leases prior to issuing those leases because once those leases are issued, BLM no longer has the authority to preclude all surface disturbing activity."); *see also WildEarth,* 368 F. Supp. at 53 ("At the leasing stage an EIS may be required, but is not mandated by regulation."). Thus, Defendants' concern over the cost of potentially completing multiple EIS iterations is diminished.

In sum, the Court finds that the examples from the record about specific impacts, either already experienced in Ohio on state or private lands, or known to USFS and BLM from other forest plans in the area, demonstrate that both the impacts of tracking on federal lands, and the likelihood of it actually occurring, were reasonably foreseeable. *See Richardson,* 565 F.3d at 718 (finding it reasonably foreseeable when "[c]onsiderable exploration ha[d] already occurred on parcels adjacent to the [parcel at issue], and a natural gas supply [was] known to exist beneath these parcels."). Defendants' decision not to conduct further review, in large part, was based on the assumption that there was no significant impact at the leasing stage because no surface disturbing activities in furtherance of fracking would occur. *See* Defs.' MSJ 14, ECF No. 92. But this Court joins other courts in finding that this conclusion "fell short of NEPA's requirements with respect to leases lacking NSO stipulations.... because at the leasing stage 'the [agency] made an irrevocable commitment to allow *some* surface-disturbing activities,' and it was therefore required to analyze those

activities before it could no longer preclude them.J' *WildEarth,* 368 F. Supp. 3d at 65 (referencing *Peterson, Conner,* and *Richardson).*

B. USFS's and BLM's "hard look" at forest clearing activities

Having concluded that Defendants were required to perform a NEPA analysis at the leasing stage, the Court considers whether, in this case, Defendants took the requisite "hard look" at the impacts of tracking, and whether their decision to not engage in further NEPA analysis was arbitrary and capricious. Plaintiffs first argue that Defendants did not adequately consider the surface area disturbance impacts that tracking would have in the WNF.

1. NEPA Framework

As mentioned above, an agency must prepare an EIS whenever it endeavors to take "major ... action[] significantly affecting the quality of the human environment," 42 U.S.C. § 4332(C), which this Court finds could include opening up of federal lands for oil and gas leasing. Here, the Agencies complied with that initial requirement at step one of the oil and gas leasing process by preparing the 2006 Forest Plan and 2006 Forest Plan EIS which addressed oil and gas leasing in WNF. The 2006 Forest Plan and EIS decided to make available all federal minerals for oil and gas leasing. *See* Record of Decision, FS-10361.

Although an EIS does not stay relevant forever, a reviewing court must also be mindful that preparing an EIS is a time consuming and expensive process. That is why an agency can first prepare an EA to determine if it needs

to prepare an EIS. *See* 40 C.F.R. § 1501.4(aHc). An EA, also a NEPA document, is "a concise public document ... that serves to . . . [b]riefly provide sufficient evidence and analysis for determining" the effect of the proposed action on the environment and "whether to prepare an [EIS] ...." 40 C.F.R. § 1508.9(a). It includes some of the same content as an EIS-such as a "discussion[] of the need for the proposal, of alternatives . . . [and] of the environmental impacts of the proposed action and alternatives"-but does not require the same depth of analysis as an EIS. *Id.* § 1508.9(b); *see Anglers of the Au Sable v. U.S. Forest Serv.,* 565 F. Supp. 2d 812, 824 (E.D. Mich. 2008) ("An EA is a concise document that allows agencies to consider the environmental concerns associated with a proposed project while conserving agency resources for those projects in which a full EIS is required.").

But, "[a]lthough the discussion may be 'brief,' the Court must still determine whether an EA took a 'hard look' at the environmental consequences of the proposed action." *Mont. Wilderness Ass'n v. Fry,* 310 F. Supp. 2d 1127, 1144 (D. Mont. 2004) (internal citation omitted). If the agency concludes in the EA that no EIS is required, it issues a FONSI summarizing its reasons. 40 C.F.R. §§ 1501.4(e), 1508.13. Conversely, "[i]f the EA establishe[s] that the agency's action 'may have a significant effect upon the ... environment, an EIS must be prepared.'" *Fry,* 310 F. Supp. 2d at 1144 (quoting *Found. for N. Am. Wild Sheep v. United States Dep't of Agric.,* 681 F.2d 1172, 1178 (9th Cir 1982)).

Reviewing courts employ a "rule of reason" to determine whether an agency took the required "hard look" at environmental impacts. *See Friends of the Capital Crescent Trail v. Fed. Transit Admin.,* 877 F.3d 1051, 1058 (D.C. Cir. 2017) (uConsistent with a 'rule of reason,' an agency need not supplement an EIS every time new information comes to light after the EIS is finalized; rather, the need for supplementation 'turns on the value of the new information to the still pending decisionmaking process.'" (quoting *Marsh v. Oregon Nat'/ Res. Council,* 490 U.S. 360, 374 (1989))). The "hard look" requirement applies to EAs as well as EISs. *WildEarth,* 368 F. Supp. 3d at 53.

Whether the agency employed a reasoned-decision-making process is key. "NEPA does not require that an agency discuss every impact in great detail; it simply requires a reasoned evaluation of the relevant factors." *Forest Guardians v. United States Forest Serv.,* 495 F.3d 1162, 1172 (10th Cir. 2007). And, although agency decisions are entitled to deference, and "an agency must have discretion to rely on the reasonable opinions of its own qualified experts," when reviewing a decision not to supplement an EIS, "courts should not automatically defer to the agency ... without carefully reviewing the record and satisfying themselves that the agency has made a reasoned decision based on its evaluation of the significance-or lack of significance-of the new information." *Friends of the Capital Crescent Trail,* 877 F.3d at 1059 (quoting, in part, *Citizens to Preserve Overton Park, Inc. v. Volpe,* 401 U.S. 402,416 (1971)}.

2. Relevant documents at issue

In 2006, USFS prepared and finalized an EIS and Forest Plan for WNF. FS-5528. The 2006 Forest Plan "made all federally-owned minerals administratively available to be leased ... based on projections for oil and gas activity finding that tracking was 'still not yet economically feasible'[.]" 2012 SIR, FS-5528 (citing Record of Decision, p. 14 and EIS, Appendix G). Thus, in USFS's own words, the 2006 decision to make all federal minerals available for leasing did not consider the environmental impacts of tracking.

The RFDS contained in the 2006 EIS projected that a total of 272 acres in the Athens, Marietta, and Ironton Units would be disturbed by conventional oil and gas drilling activity before reclamation, 135 acres of which would be in the Marietta Unit. FS-10244. The types of surface disturbances considered from conventional oil and gas activities in the 2006 RFDS for each Unit included: access roads, road construction, well pad construction, and turnaround/production facility activities to service the wells. *See* Appendix G to 2006 EIS, FS10255, FS10257, FS10259.

In 2012, USFS asked BLM to review the continued viability of the 2006 RFDS, after the public raised concerns about the effects of tracking on the WNF. FS-5641. BLM concluded in a three-page letter, dated May 3, 2012 ("May 2012 Letter"), that the estimated surface disturbances projected for oil and gas activities would not change with the introduction of tracking to WNF because total surface disturbance would still be "well within the levels forecast in the 2006

RFDS.IJ FS-5643. Specifically, BLM reiterated that the 2006 RFDS projected a total surface area disturbance of 272 acres in the entire WNF for conventional, vertical drilling. For horizontal drilling, BLM estimated that the Marietta Unit could have up to ten horizontal drilling sites, the Athens Unit up to three, and the Ironton Unit none. FS-5641--42. It further estimated that each well pad site would require approximately 3-5.5 acres. Table 2, FS-5642.[12] The May 2012 letter further noted that the only significant differences between vertical and horizontal drilling were the size of each well pad and the volume of water used by each method. FS-5642. BLM acknowledged that the horizontal well pads would be larger than vertical well pads but reasoned that because "up to 8 wells can be drilled off of a single pad [fracking] actually reduces the level of surface disturbance associated with well pads, roads and pipelines." FS-5642. BLM found it "difficult to estimate road and pipeline acreageslJ but nevertheless found that "it is reasonable to assume that fewer well pads would result in less road and pipeline disturbance." FS-5642. BLM concluded that:

> while a change in technology has now made horizontal drilling in portions of the WNF economically viable, the level of on-the-ground activity that has occurred and is yet anticipated, including any horizontal drilling operations, is still well within the levels forecast in the 2006 RFDS. Therefore, the 2006 RFDS is still applicable and does not need to be revised.

[12] Extrapolating from those to estimations, the maximum estimated surface area disturbance from horizontal well pad sites would be 71.5 acres (13x5.5).

FS-5643. The May 2012 Letter is devoid of citations or references to support any of its reasoning or conclusions.

The 2012 SIR was prepared specifically to address public concerns over fracking. *See* FS-5530-32. USFS's 2012 SIR relied almost exclusively on that May 2012 Letter to find the 2006 RFDS's projections for total surface area disturbance for conventional drilling was unchanged by the addition of fracking. In the 2012 SIR, USFS compared vertical and horizontal well pad sites by acreage, (Table 8), and remaining affected road acreage, (Table 9). FS5577-78. It viewed the 272-acre estimate as a "upper limits of projected outputs" for the Forest Plan. FS5577. The 2012 SIR concluded, it appears based only on the 2006 EIS Appendix G's RFDS and BLM's May 2012 letter, that "[t]otal surface disturbance acres of anticipated activity will not increase above those acres described within Appendix G." FS5578.

Finally, BLM's 2016 EA explained that the surface disturbance estimation of 135 acres for the Marietta Unit encompassed "all acreage potentially affected by oil and gas activities, including road construction, well pad construction, construction of turnaround/production facility areas, pipelines, and other related activities." BLM-1355. It went on to summarize its findings for horizontal wells, noting that "the surface disturbance projected for 10 horizontal well pads is approximately 55 acres, substantially less than [the total surface area disturbance that] was initially projected under the 2006 RFDS." BLM-1355.

Thereafter, BLM issued its 2016 FONSI, concluding that:

> First, the amount of surface disturbance projected on the WNF with the use of high-volume, horizontal fracturing technology is within the amount of surface disturbance analyzed in the 2006 Forest Plan Final EIS. Second, the regulations enforced by the BLM and Ohio Department of Natural Resources (ODNR) and measures prescribed by the 2006 Forest Plan reduce impacts from land clearing and other activities that may impact wildlife habitat and populations. Post-lease actions/authorizations (e.g. APDs, rights of way), could be encumbered by further restrictions on a case-by-case basis, as required through project-specific NEPA analysis or other environmental review. The use of BMPs, SOPs, and lease stipulations, as well as potential conditions of approval at the APD stage, would lessen the potential for significant cumulative effects.

2016 FONSI, BLM-1758.

In other words, BLM concluded that the advent of tracking in WNF was not a significant impact and did not require preparation of an EIS because the 2006 Forest Plan sufficiently accounted for oil and gas activities generally, and the tracking impacts did not exceed the projected surface disturbance in the WNF.

3. USFS failed to take a "hard look" at surface disturbing activities

Plaintiffs contend that USFS's conclusion in its 2012 SIR that the 2006 Forest Plan and EIS adequately addressed the impacts of tracking was arbitrary and capricious because it did not analyze or consider the full scope of forest clearing activities, including construction of pipelines, water impoundments, and staging areas. Pis' MSJ 18, ECF No. 83.

"When new information comes to light the agency must consider it, evaluate it, and make a reasoned determination whether it is of such significance as to require [an SEIS]." *Friends of the Clearwater v. Dombeck,* 222 F.3d 552,

558 (9th Cir. 2000). One mechanism by which agencies determine whether additional NEPA analysis is required is through SIRs. SIRs are not expressly provided for by NEPA and are not mentioned in the Counsel on Environmental Quality's ("CEQ") regulations implementing NEPA. *See Idaho Sporting Cong., Inc. v. Alexander,* 222 F.3d 562, 566 (9th Cir. 2000). But, "courts have upheld agency use of SIRs and similar procedures for the purposes of determining whether new information or changed circumstances required the preparation of a supplemental EA or EIS." *Id.* However, if an agency determines that an action or new information is significant, a SIR does not suffice-an SEIS must be prepared. *Id.*

Plaintiffs point to USFS employee statements indicating that USFSJs decision to not prepare a. supplement EIS could be different if the total surface disturbance acreage was greater than what was considered in the 2006 Forest Plan and 2006 EIS. *See* 2012 SIR, FS-5591 (noting that fracking might "create effects that are not covered under the current [2006] Forest Plan and associated planning documents ... if the total acreage likely to be impacted is greater than what was analyzed (i.e. cumulative effects) [or] ... if the activities have effects that are markedly different than what was considered during the Forest Plan development."); *see also* Letter from Anne Carey, Forest Supervisor, FS-5725 (finding that based on BLM's estimates and the actual disturbances to-date accounting for less than half of the projected acreage under the 2006 Forest Plan, concludes that "[i]t is unlikely that, for the foreseeable future, drilling

disturbance will exceed the acreage envisioned in the existing analysis. This is important, since the biological documents for the Forest Plan ... considered the effects of oil and gas activities on wildlife and plant resources up to the projected acres.").

Plaintiffs further argue that, contrary to the assumption that the total surface area will not exceed the limits in the 2006 Forest Plan and 2006 EIS, there is record evidence which contradicts that conclusion. For example, Plaintiffs point out that Defendants were aware that horizontal drilling required larger gathering pipelines in 2012 because at the same time USFS was preparing its 2012 SIR for WNF, it was also reviewing projected pipeline disturbances from horizontal well development for other forests, which did provide estimates for pipeline and access road disturbances. Pis.' MSJ 22, ECF No. 83; citing FS-9 (projecting 13.5 acres of forest clearing in Monogahela "for access roads and pipelines" for each horizontal well cite) and FS-48-49 (projecting an estimated 12.34 acres of pipeline-related disturbance per producing well pad in 2011 for Virginia's George Washington National Forest). BLM and USFS also acknowledge that fracking requires exponentially greater quantities of water than conventional vertical drilling, yet they failed to consider or explain why the increased surface disturbance caused by water impoundments and staging areas potentially associated with a higher water usage would not exceed the 2006 Forest Plan EIS projections for total surface area disturbance.

See Pis.' Mot. 22, ECF No. 83 (citing FS-5531); *see* a/so Table 2, BLM May 2012 Letter, FS-5642 (comparing water usage between vertical and horizontal drilling).

Likewise, the record indicates that USFS was aware in January 2012 of ODNR's specific surface area disturbance projections for tracking activities in the surrounding areas. ODNR issued recommendations for horizontal drilling on state lands, which specifically discussed estimated sizes for well pads, FS-2656 (estimating 3.5-7 acres per well pad, with up to 12 individual wells, and an estimated drainage area of more than 640 acres), and water storage. FS-2659 (estimating that tracking requires 2-6 million gallons water, stored close to the well-site and requires "substantial resources"[1] noting that "one million gallons of water is equivalent to 3.069 acre feet or 133,685.24 cubic feet"; which results in "the means and location of water storage ha[ving] a significant impact on the amount of land utilized for oil and/or gas development."); *see* a/so BLM-1388-89 ("ODNR reported that 15,707,339 barrels of oil and 651,193,106 million cubic feet of gas were produced from Ohio's horizontal shale wells in the first nine months of 2015;" noting that at that time there were "493 active federal wells" in the WNF); *see* a/so FS-3815, 26-29; FS-3833 (noting possible productive shale areas could be up to 10,000,000 acres; 200 shale wells estimated drilled in 2012; also estimating 6 acres per well pad and access road for a total of 20,772 acres for access roads and well pads).

Finally, even assuming that the total surface area will not exceed the total estimated surface area disturbance projected in the 2006 RFDC, USFS cannot

simply say that the 2006 Forest Plan EIS and 2004 RFDS covered all oil and gas activities, without grappling with the different impacts potentially posed by fracking. *See Los Padres ForestWatch v. United States BLM,* No. CV-15-4378, 2016 U.S. Dist. LEXIS 138782, at **34-35 (C.D. Cal. Sept. 6, 2016) ("Defendants argue that its analysis of the environmental impact of fracking is subsumed under its analysis of the impact of a// oil and gas development. .... [b]ut a "hard look" at the environmental impacts of fracking necessarily requires the Bureau to address the unique risks and concerns associated with fracking .....[which] involves risks and concerns that were not addressed by the PRMP/FEIS' general analysis of oil and drilling development in the area." (internal citations omitted)): *cf. Richardson,* 565 F.3d at 705-76 (rejecting agency's argument that any impacts or changes to surface area disturbance would only differ in degree, not kind, so no further analysis was necessary).

Here, the record reflects that USFS had information at its disposal in 2012 to review when determining the surface area disturbances posed by tracking. But instead of doing so, it relied primarily on BLM's May 2012 Letter, which lacked support for its conclusions. Thus, the Court finds that USFS did not engage in reasoned analysis because it did not consider all reasonably foreseeable impacts of tracking, despite having information available to them for consideration, and acknowledging that an increase in total surface area disturbance could require an EIS.

4. BLM failed to take a uhard look" at surface disturbing activities

Similarly, Plaintiffs argue that BLM failed to take the requisite "hard look" at the impacts of fracking when it prepared its 2016 EA and issued a FONSI.

An agency can prepare an EA "if the agency's proposed action neither is categorically excluded from the requirement to produce an EIS nor would clearly require the production of an EIS. *See* [40 C.F.R. §] 1501.4(a}-(b). The EA is to be a 'concise public document' that '[b]riefly provide[s] sufficient evidence and analysis for determining whether to prepare an [EIS].'§ 1508.9(a)." *Dep't of Transp. v. Public Citizen,* 541 U.S. 752, 757-78 (2004}.

Just as is required for an EIS, "the EA must take a 'hard look' at the environmental consequences of the proposed action ... including its direct, indirect, and cumulative effects." *WildEarth Guardians,* 368 F. Supp. 3d at 53 (internal citations omitted). An EA's analysis is insufficient "if it includes 'virtually no references to any material in support of or in opposition to its conclusions.' ... Conclusions drawn in an EA 'must be supported by some quantified or detailed information, and the underlying environmental data relied upon to support the expert conclusions must be made available to the public' to allow for informed public comment on the project." *Friends of Congaree Swamp v. FHA,* No. 3:06-cv-02538, 2008 U.S. Dist. LEXIS 77563, at **9-10 (D. S.C. Sept. 30, 2008) (internal citations omitted).

"[A]n agency's decision to issue a FONSI and not prepare an EIS ... is a factual determination which implicates agency expertise.,, *Biodiversity*

Conservation Alliance v. U.S. Forest Serv., 765 F.3d 1264, 1267 (10th Cir. 2014). But, [i]n order for a factual determination to survive review under the arbitrary and capricious standard, an agency must 'examine the relevant data and articulate a rational connection between the facts found and the decision made.'" *Richardson,* 565 F.3d at 713 (quoting *Citizens'* Comm. *to Save Our Canyons v. Krueger,* 513 F.3d 1169, 1176 (10th Cir. 2008)).

Again, Defendants rely heavily on the fact that CEQ regulations allow for them to "tier" reviews, meaning in the sort of multi-stage process at play here, an agency can incorporate previous analyses if the prior, broader EIS fully analyzed the issue later under review. 40 C.F.R. §§ 1502.20; 1508.28. "[H]owever, '[t]o the extent that any relevant analysis in the broader [earlier] NEPA document is not sufficiently comprehensive or adequate to support further decisions, the tier[ed] NEPA document must explain this and provide any necessary analysis." *Id.* (quoting 40 C.F.R. § 46.140(b)).

In this case BLM's 2016 EA relies heavily on the 2012 SIR's determinations that tracking would not exceed the estimated 135 acres of surface disturbance in the Marietta Unit, which in turn is based only on BLM's May 2012 Letter that lacks any "quantified or detailed information" underlying its conclusions.

Indeed, BLM's 2016 EA analysis of whether the 2006 RFDS was still applicable, even with the change of tracking, almost entirely relies on USFS's 2012 **SIR:**

> For the Marietta unit, the 2006 RFDS projected up to 11O vertical well pads (2006 Forest Plan EIS, p. G-1), and the 2012 SIR projected 10 horizontal well pads {SIR, p. 3). The 2012 SIR was issued because horizontal wells were becoming more of the standard approach to mineral development on private surface in the area. The surface disturbance projected for 1O horizontal well pads is approximately 55 acres, substantially less than what was initially projected under the 2006 RFDS. As shown in Table 2-1, approximately 10 acres have already been disturbed from oil and gas development in the Marietta Unit; therefore, the remaining acreage of surface disturbance that could occur within the Marietta Unit that is analyzed in this EA, is approximately 70 acres. Of those 70 acres, approximately 40 acres of disturbance would persist for the long term, until final reclamation is completed. This disturbance is still well within the projected disturbance of the RFDS from the 2006 Forest Plan EIS.

2016 EA, BLM-1355. The EA then estimates that approximately two acres will be affected by road construction, and notes that, if the wells are productive, "additional land may be affected by pipeline construction." BLM-1356-57.

From this, Defendants argue that "the records show that the impacts from horizontal drilling are within the scope of the earlier analyses." Def. MSJ 16, ECF No. 92. They also acknowledge that horizontal well pads are larger than vertical well pads but reiterate that overall, because each horizontal well pad site can contain up to eight wells, it reduces the number of overall well pads sites required.

Plaintiffs argue that the 2016 EA improperly limited its calculation of foreseeable tracking disturbances to just well pads and access roads, thereby failing to acknowledge the full scope of foreseeable surface disturbing activities.

For example, Plaintiffs cite to Table 2.1 in BLM's 2016 EA, which states that according to the 2006 RFDS, the total initial acres of surface area in the

Marietta Unit likely to be disturbed by oil and gas drilling before reclamation to be 135 acres. BLM-1355. It then arrives at a "net surface disturbance below 2006 RFDS" of 70 acres by adding together the 2012 SIR projected disturbance from horizontal well pads only (55 acres) and acres disturbed to-date from oil and gas activities (10 acres) and subtracting that total (65 acres) from the 135 acres. *See* Table 2.1, BLM-1355.

Table 2.1. Potential Disturbance In the Marietta Unit Projected by the RFDS

	2006 RFDS projection of c rc!. disturbed	**2012 SIR forecast** of acres disturbed by horizontal wells	**Acres** disturbed to date from oil and gas development	Net surface dlsturban.:e below **2006RFDS**
Total Intt1al **acres of surface disturbed by oil and ces drilling before reclamation**	135	55	10	70 (135-65) = 70
Total acres of surface needed to support long term production li,e. remaining	59	13.8	5	40.2 (59-18.8) = 40.2

BLM-1355.[13]

The problem is that the 55 acre-projection for horizontal wells encompasses *only* surface disturbance from horizontal well pads, whereas the 2006 RFDS's 135-acre estimation included a// acreage potentially affected by oil and gas development caused by vertical drilling. BLM-1355. As Plaintiffs point out, tracking will contribute more than just an increased well pad size-there are other different, associated surface disturbances that will likely occur, such as larger gathering lines, staging areas, and water impoundment facilities, that were

[13] The completed phrase for the bottom left category reads in full: (i.e. remaining disturbance after reclamation). The Table carries over into the next page only to complete that phrase. *See* BLM-1356.

not accounted for in either the BLM's 2016 EA or the 2012 SIR. Nor is it clear from BLM's May 2012 Letter, USFS's 2012 SIR, or BLM's 2016 EA that the same type of surface disturbances associated with conventional vertical drilling would be analogous to fracking. Thus, the Court cannot conclude that BLM engaged in a reasoned decision process when it determined that tracking would cause surface disturbance on only 55 acres because BLM considered in that calculation the surface disturbance caused by well-pads and nothing else.

Likewise, Defendants cannot argue that such information was unavailable, and thus not foreseeable, at the time BLM prepared its 2016 EA. In 2016, there was evidence in the record that greater surface disturbance was likely to occur with tracking activities than estimated in the 2006 Forest Plan and USFS's 2012 SIR, which Plaintiffs raised in the comment period for the 2016 EA. **Pis.'** MSJ 24, ECF No. 83. BLM's response to the public comment concerning surface area disturbance was: "Since the exact design details are not known at the leasing stage, it is not possible to know exactly what supporting infrastructure would be needed if development occurs in the future, other than acknowledging that additional surface disturbance could occur (as identified in the EA) ... further detailed NEPA analysis would be conducted at the Application for Permit to Drill (APD) stage." BLM-1511. Such a response, when information from other sources is attainable and presented to BLM, is insufficient.[14] See *Los Padres*

[14] For example, BLM concludes, without any support, that "there is already a well-developed pipeline infrastructure in place which should minimize the need for lengthy

ForestWatch v. United States BLM, No. CV-15-4378, 2016 U.S. Dist. LEXIS 138782, at **35-36 (Cen. D. Cal. Sept. 6, 2016) (an agency "may not avoid an obligation to analyze in an EIS environmental consequences that foreseeably arise from aO [Resource Management Plan] merely by saying that the consequences are unclear or will be analyzed later when an [environmental assessment] is prepared for a site-specific program proposed pursuant to the RMP.... [u]ncertainty about which specific parcels and wells will employ fracking in the future does not obviate the necessity to evaluate the cumulative environmental consequences to the Bureau's decision to open or maintain ... federal land ... to oil and gas activities." (internal citations omitted) (emphasis removed)). Indeed, there is evidence in the record that demonstrates that BLM *can* and *does* routinely estimate surface disturbances. To not do so when there was reasonably foreseeable impacts from fracking was arbitrary and capricious.

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gather lines to service new wells." FS-5632. But such conclusion is contrary to record information, albeit record information submitted primarily by various organizational Plaintiffs, that demonstrate that gathering pipelines for tracking and conventional vertical drilling cannot be interchanged. *See* FS-2966-67. Plaintiffs move for the Court to take judicial notice of the tracking pipeline perimeter, but the Court need not rule on that motion to arrive at the conclusion that BLM did not consider the appropriate scope that tracking pipelines might have in WNF. Thus, the Court **DENIES** Plaintiffs' motion, ECF No. 84, as moot. Moreover, even if Plaintiffs' argument is primarily from their own comments in the 2016 EA's comment period, Defendants do not argue that Plaintiffs estimates are false, argue that the same pipelines can be used for both conventional and tracking activities, or provide citation to where they otheiwise addressed the comment in their Final EA. Finally, the Court is not tasked with weighing whether Plaintiffs' assertion is true or accurate. Rather, its tasked with reviewing whether the agencies adequately considered the record evidence. And here, the failure to reasonably consider whether the drilling methods would require different pipelines, once presented with the issue, is not a sufficient review.

C. Impacts[15] on Private Land

Plaintiffs next argue that Defendants failed to appreciate and adequately analyze the indirect and cumulative effects, enabled through federal leasing, that tracking on private lands in the Forest would have, even though Defendants were aware of the impacts of tracking on adjacent or nearby private lands and the impacts were reasonably foreseeable. Defendants contend that they adequately considered the effects of tracking on private land, to the extent they were required to do so.

An agency must consider all foreseeable direct, indirect, and cumulative impacts of its decision. *Sierra Forest Legacy v. Sherman,* 646 F.3d 1161, 1180 (9th Cir. 2011}. In evaluating an agency's environmental impact analysis, courts must be cognizant that "[t]here are natural limits to the amount of forecasting that can be done ... and agencies are required only to make a reasonable, good faith, objective presentation of those impacts sufficient to foster public participation and informed decision making." *High Country Conservation Advocates,* 52 F. Supp. 3d at 1188 (quoting *Colo. Env't Coal. v. Domebeck,* 185 F.3d 1162, 1177 (10th Cir. 1999) (further citations omitted}}.

In this case, Plaintiffs generally argue that Defendants should have considered tracking impacts on private land-indirect and cumulative. Plaintiffs

[15] The parties and the caselaw use "impacts" and "effects" interchangeably. The Court will endeavor to use "impacts" unless quoting. But effects and impacts are synonymous in meaning. *See* 40 C.F.R. § 1508.8.

point specifically to Defendants' failure to analyze the impacts on (1) the Little Muskingum River and (2) the Indiana Bat.

1. Indirect Impacts

Plaintiffs argues that many indirect impacts from private land fracking activities were not considered. Although USFS's 2012 SIR did not consider the impacts of leasing on private lands, BLM has discussed the potential impacts, noting in its 2016 EA that:

> Given the highly fragmented nature of land ownership in the Marietta Unit, a well pad on one parcel, federal or private, may be serviced by roads, pipelines, tank batteries, and other infrastructure on other parcels in other ownerships. Second, an operator may use directional drilling to locate a pad on a parcel not directly above the bottom hole location for various reasons, thus enabling federal minerals to be accessed from outside the federal surface.

BLM-1427. BLM also acknowledged that "indirect effects may include development of oil and gas resources on non-federal lands." BLM-1452.

Defendants do not dispute that the 2006 Forest Plan EIS "limited its consideration of direct and indirect effects to National Forest System land," Defs'. MSJ 20, ECF No. 92 (citing FS-9574), but they contend that they are neither required to analyze the indirect impacts because leasing federal land for fracking is not an indirect impact to private land, and even if it was, there is no requirement to discuss indirect impacts in a "distinct section" of the EIS. Defs.' MSJ 22, ECF No. 92.

Indirect impacts are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b). These effects include: "growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." *Id.* "Effects are reasonably foreseeable if they are sufficiently likely to occur that a person of ordinary prudence would take [them] into account in reaching a decision." *Sierra Club v. FERC,* 867 F.3d 1357, 1371 (D.C. Cir. 2017) (citation omitted).

Defendants argue that most of PlaintiffsJ indirect impacts arguments are foreclosed by the Supreme Court's decision in *Department of Transportation v. Public Citizen.* 541 U.S. 752 (2004). The question before the Supreme Court in *Public Citizen* was whether NEPA and the Clean Air Act required the Federal Motor Carrier Safety Administration ("FMCSA") to evaluate the environmental effects of vehicles traveling across the Mexican border when undergoing its NEPA review. *Id.* at 756. FMCSA's EA concluded that any change in volume of Mexican trucks and buses would not be due to its proposed resolution, but rather due to other political decisions outside of FMCSA's control (in this case the North American Free Trade Agreement); and thus, not an "indirect effect" from the issuance of its regulations. *Id.* at 761. The Court of Appeals disagreed and remanded back to the agency for preparation of an EIS. *Id.* at 763. But the Supreme Court reversed, holding that "NEPA requires 'a reasonably close causal

relationship' between the environmental effect and the alleged cause ..."akin to proximate cause. *Id.* at 767 (internal citation omitted). Thus, the Court reasoned that "[s]ince FMCSA ha[d] no ability categorically to prevent the cross-border operations of Mexican motor carriers," or "the power to act on whatever information might be contained in an EIS[,]" analyzing the environmental effects of Mexican trucks would not fulfill NEPA's "twin aims." *Id.* at 768. Defendants argue that this case is similar in that USFS and BLM have no control over what oil and gas activities occur on private land; therefore, Plaintiffs cannot show that the Agencies' decision to lease proximately causes effects {in this case increased tracking) on private lands. Defs.' MSJ 22, ECF No. 92.

Plaintiffs argue *Public Citizen* does not control because here, and unlike in that case, the Agencies have some control over whether to issue leases on federal lands, which in turn will impact whether private land development increases, given the patchwork of private and federal lands interspersed throughout the WNF. **Pis.'** Reply 17, ECF No. 105. Plaintiffs contend that BLM was aware that there would be development on private lands because of federal leasing. *See* BLM-1360 (rejecting the "No Action Alternative"-which would have prohibited surface occupancy on federal land-because that "alternative would unnecessarily constrain oil and gas occupancy, especially in this highly fragmented landscape, where the ability to cross federal land may be critical to enabling an operator to develop."}. Plaintiffs further argue that lack of control does not relieve Defendants from disclosing possible effects. *Id.* at 16. But, if it

is true that Defendants do not have the ability to control what development occurs on private land,[16] i.e. through regulations or stipulations, then it would seem that *Public Citizen* precludes Plaintiffs' argument here, because Defendants would be powerless to act on any information in an EIS about private indirect effects.

Accordingly, the Court agrees with Defendants and finds that *Public Citizen* ultimately controls here. Even if BLM's decision and USFS's approval to lease federal lands will perpetuate growth on private lands, neither agency will have the ability to control the development or other activities on private land. Thus, the Court finds that it was not arbitrary and capricious for BLM and USFS to not consider the indirect effects leasing federal lands would have on private land.

2. Cumulative Impacts

Plaintiffs' discussion of impacts to private lands primarily focused on whether development on private land can be an "indirect impact" of leasing federal land, but the Court will address whether Defendants adequately considered cumulative impacts caused by private land fracking to the extent Plaintiffs developed that additional argument.

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[16] Plaintiffs and Defendants agree on one scenario when Defendants would have some input or control over what happens on private land-if a lessee uses private land to access federal minerals in some way. The Court agrees with Defendants that this is the applicable scenario where deferral until the APO stage makes sense; because only when specific parcels are being leased will Defendants know whether such uses will occur. *See* Defs.' MSJ 21-22, ECF No. 92; Pis.' Reply 16-17, ECF No. 105.

The regulations define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency {Federal or non-Federal) or person undertakes such other actions." 40 C.F.R. § 1508.7. "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." *Id.* "Consideration of cumulative impacts requires some quantified or detailed information' that results in a 'useful analysis,' even when the agency is preparing an EA and not an EIS ... '[g]eneral statements about possible effects and some risk do not constitute a hard look absent justification regarding why more definitive information could not be provided.'" *Ctr. For Envt'l Law & Policy v. United States Bureau of Reclamation,* 655 F.3d 1000, 1007 {9th Cir. 2011) *(quoting Kern,* 284 F.3d at 1075).

> A meaningful cumulative impact analysis must identify five things: (1) the area in which the effects of the proposed project will be felt; {2) the impacts that are expected in that area from the proposed project; {3) other actions-past, present, and proposed, and reasonably foreseeable-that have had or are expected to have impacts in the same area; (4) the impacts or expected impacts from these other actions; and {5) the overall impact that can be expected if the individual impacts are allowed to accumulate.

San Juan Citizens All. v. Stiles, 654 F.3d 1038, 1056 {10th Cir. 2011).

Here, the record reflects that because WNF is a patchwork of parcels with different owners-federal, state, and private-there is a strong likelihood that "a

single wellbore is likely to extend through a patchwork of parcels with different owners of the surface and subsurface minerals, especially as Shale drilling often involves drilling horizontally through areas extending more than a mile." Pis.' MSJ 26, ECF No. 83 (citing BLM-29005); *see* a/so BLM-1360. Thus, Plaintiffs argue that the cumulative impacts of both private and federal tracking are important considerations that were not fully addressed in either the 2012 SIR or the 2016 EA.

The 2006 Forest Plan and 2006 EIS did not consider any cumulative impacts of tracking on private lands as it found that method not viable at that time. FS-10248. Likewise, the 2012 SIR did not consider the cumulative impacts of tracking on private land. *See* FS-5530 (noting that well site estimates "do[] not include private surface lands located within the proclamation boundary."). Thus, to the extent BLM's 2016 EA "tiered" to the 2012 SIR and the 2006 Forest Plan and EIS for cumulative effects of oil and gas leasing, such reliance would be misplaced. Moreover, the lack of discussion elsewhere may trigger a heightened discussion in the EA. See *Kern,* 284 F.3d at 1078 ("If, as is the case here, there is no analysis in the EIS, the scope of the required analysis in the EA is correspondingly increased.").

Defendants contend that the cumulative impacts analysis in BLM's EA sufficiently discussed cumulative impacts from surrounding private lands in the Forest. Defs.' MSJ 20, ECF No. 92. BLM stated in its EA that it considered the cumulative impacts of the Marietta Unit and its surrounding area. BLM-1451.

Section 4.16 of the EA discussed cumulative impacts of tracking on: air; plant and animal habitat and populations; water resources and water quality; soil geology and mineral resources; wastes, public health and safety; transportation; recreation and land use; noise; cultural resources and Native American concerns; visual resources and scenic quality; and socioeconomics. *See* BLM-1451-64.

As an initial matter, Plaintiffs seem to be arguing that Defendants failed to adequately consider *all* cumulative impacts, *see* Pis.' MSJ 28, 30, ECF No. 83, but the Court finds that Plaintiffs failed to adequately develop this argument as to all categories, especially because they often fail to distinguish between their indirect or cumulative impact arguments in their briefing. Instead, the Court will limit its focus on the two private land cumulative impacts sufficiently briefed by Plaintiffs-the Little Muskingum River and Indiana Bat.

a. *Little Muskingum River*

Plaintiffs argue that Defendants overlooked the potential for significant water depletion from the Little Muskingum River. There is no dispute that tracking requires extensive amounts of water-upwards of millions of gallons. *See* FS-4245; BLM-1436. The record is also clear that the 2006 Forest Plan EIS did not consider that amount of water usage.

The 2012 SIR noted that "no agency {federal or state) D regulates water withdrawal from streams and rivers in the State of Ohio." FS-5556. Instead, it explained that water usage is governed by the "reasonable use doctrine" in Ohio.

FS-5556 (citing O.R.C. 1521.17). But it further explained that reasonable use does not govern oil and gas activities; rather, agreements between landowners and mineral owners must be made. FS-5556-57. Despite these acknowledgements, the 2012 SIR concluded that, with respect to groundwater depletion:

> No additional analysis or protections are needed at the Forest Plan level. While the 3.5 - 4 million gallons required for horizontal operations represent a change from the conventional well operations, the level of effect is not anticipated to increase. By using the existing measures in the Forest Plan, *supported by Ohio reasonable use doctrine,* there is no increased effect to groundwater due to depletion, since at the site specific level the WNF will be able to control withdrawals and limit them to periods when water is plentiful.

FS-5557.

USFS made an almost identical conclusion with respect to surface water depletion, relying on the Forest Plan's existing measures and Ohio's reasonable use doctrine to conclude that despite the millions of gallons of additional water required for fracking and not considered in the 2006 Forest Plan and EIS, "the level of effect is not anticipated to increase." FS-5568-69.

Setting aside for a moment the inconsistency as to whether Ohio's reasonable use doctrine aided in water conservation, the USFS's regional office comments support the Court's ultimate conclusion that the 2012 SIR did not actually conduct a reasoned review.

A USFS Regional Office review of an internal draft of the 2012 SIR's water resource overview is rife with comments pointing out how flimsy the 2012 SIR's,

and in turn the 2006 EIS's, water resource review was. For example, when explaining that the Forest Hydrologist considered "a vast amount of information related to oil and gas fracturing activities" the reviewer noted that, "Sounds like the analysis in the Plan EIS was not adequate . . . . Remember, this is an evaluation of the adequacy of the Plan EIS, so all the extra work is NOT a plus." FS-3525.[17] Meaning, the fact that the hydrologist had to consider vast amounts of information leads to the conclusion that the 2006 Forest Plan and EIS did not sufficiently account for the issue of fracking. The water resource overview draft also discussed how Ohio handled fracking developments, including that Ohio enacted additional measures to address the impacts of tracking. To which the commentator noted: "So the State found that it needed to change its requirements after 2006. That DOES NOT support an argument that the Plan EIS and Plan requirements are still adequate." FS-3526. But instead of addressing the potential flaws raised by the comments, USFS removed the paragraphs at issue from the final 2012 SIR and replaced them with general language indicating that Ohio's laws adequately protect water usage or included large block quotes from the 2006 Forest Plan EIS. *See* FS-5550.

Indeed, as the USFS commentator pointed out, "a lot of the material in the groundwater and surface water effects section is a restatement of standards, regulations, etc. rather than an actual effects analysis." FS-3545. The Court

[17] This language was changed to "pertinent information" instead of "vast" in the final 2012 SIR. *See* FS-5544.

could not have said it better. As is highlighted by the USFS reviewer's comments, what is lacking from USFS's review are the actual effects of the increased water needs for tracking in the Forest. What we have is basically a regurgitation of the 2006 EIS's water plan discussion for conventional drilling, but there is no analysis or reasoned discussion of how, or whether, the vast amounts of water needed for tracking will pose different environmental risks. Thus, it is apparent that the direct impacts of water depletion from tracking, let alone the cumulative impacts, have not been rationally and reasonably considered by USFS in the 2012 SIR. The Court finds that the 2006 Forest Plan and EIS did not sufficiently address the new and different impacts of tracking on water usage, particularly how tracking would affect the Little Muskingum River. The 2012 SIR's cursory and conclusory review of the cumulative impacts on water depletion in the Forest from tracking did not cure the deficiency.

Similarly, BLM's 2016 EA fails to adequately consider the cumulative impacts of tracking on federal and private land would have on the Little Muskingum River. BLM's 2016 EA noted that "there is likely not enough surface water in the Marietta Unit for water to be withdrawn and used so [tracking] water would either need to be brought into the area or potentially withdrawn from the Ohio River, although a local waterway may be used if it is determined to be an appropriate water source." BLM-1436-37. Plaintiffs argue that the only feasible local waterway would be the Little Muskingum River and that the depletion effects were foreseeable at the time that BLM prepared its EA. Pis.' Reply 22,

ECF No. 105. Defendants do not dispute that the Little Muskingum River is likely to be used or considered, but they argue that just because BLM did not mention it by name does not mean that its analysis was inadequate. Regardless of whether BLM mentioned the river by name, there is no discussion or analysis of how local waterways will likely be affected by the potential withdrawal of millions of gallons of water from both private and federal lands. The record indicates that the Little Muskingum River is located within the Marietta Unit, *see* BLM-1474, fed by smaller streams in the area. BLM-1390. The EA also noted that, as of 2015, there were a total of 790 active wells in the WNF, but it does not indicate whether those wells are for conventional drilling, fracking, or a combination of both. BLM-1452.[18] There is also no discussion of how that number of wells on private lands would impact the Little Muskingum River or other local waterways, other than to acknowledge that "despite the potential for cumulative effects to water resources, reclamation and other stipulations and best management practices, as described earlier in this EA, would help minimize the potential for significant adverse cumulative effects." BLM-1459. That conclusory justification is meaningless when the record is devoid of any analysis or discussion of how the Little Muskingum River would be impacted by tracking activities in the WNF. The EA relied on the 2006 Forest Plan EIS mitigation efforts, which did not consider the

[18] Elsewhere in Section 3.4.2, the EA does note that "15,707,339 barrels of oil and 651,193,106 million cubic feet (Mcf) of gas were produced from Ohio's horizontal shale wells in the first nine months of 2015." BLM-1388.

impacts of tracking. Accordingly, failure to meaningfully discuss the cumulative impacts on the Little Muskingum River was arbitrary and capricious.

b. Indiana Bat

Plaintiffs argue that by looking only at the impacts of federal land clearing activities, Defendants ignored the potential for destruction of Indiana Bat foraging areas, male roosting trees, and summer maternal roosting trees. Pis.' MSJ 32, ECF No. 83. Plaintiffs further argue that Defendants' reliance on FWS's 2005 Biological Opinion ("2005 BiOp"), in both the 2012 SIR and 2016 EA, is insufficient because the 2005 BiOp only considered potential habitat loss on federal land. *Id.* (citing FS-10079-81; BLM-1431). Defendants argue that Plaintiffs are merely speculating as to harm. They contend that "surveys have never documented the Indiana bat on the Marietta Unit." Defs.' MSJ 26, ECF No. 92 (citing FS-7404--05). However, that argument contradicts the EA, which noted that the Indiana bat [11]is well-documented on all units of the WNF and is present year-round." BLM-1379.

The EA's discussion of the oil and gas impacts on the Indiana Bat is as follows:

> The Forest Service determined that oif and gas activities are likely to adversely affect Indiana bat {2006 Forest Plan Final EIS, p. F1-58). However, the USFWS determined that the 2006 Forest Plan's activities are ***not likely to jeopardize the Indiana bat's continued existence*** {BO, p. 75), and potential negative impacts to individual bats are not expected to have measurable negative impacts on colonies or discrete populations. Based on this finding, the USFWS

> issued an incidental take permit that applies to activities conducted pursuant to the 2006 Forest Plan, including oil and gas activities.

BLM-1431 (emphasis in original).

The problem with reliance on the 2005 BiOp is that just like the 2006 Forest Plan, the BiOp did not consider the impacts of fracking, only conventional vertical drilling oil and gas activities.

Elsewhere the 2016 EA acknowledges generally that there would "likely be an increase in habitat fragmentation and creation of edge habitat, particularly in areas where oil and gas development may be more concentrated." BLM-1457. But it concludes that despite this potential for increased effects, "reclamation and other stipulations and best management practices, as described earlier in this EA, would help to minimize the potential for significant adverse cumulative effects." BLM-1457. Once again, this is a conclusion without record support. The reason for this is a combination of USFS and BLM's failure to adequately address the likely surface disturbance and reliance on the 2005 BiOp and 2006 Forest Plan and EIS, none of which considered the impacts of tracking at all. The Court cannot conclude that impacts of tracking on the Indiana Bat were reasonably considered when the only supporting document-the 2005 BiOp--did not consider it at all, and the total surface disturbances, which impacts their habitats, was not adequately addressed.

Relatedly, Plaintiffs contend that USFS and BLM violated the ESA, and FWS violated the APA, when they failed to reinitiate consultation under Section 7

of the ESA for the Indiana Bat. At this time, given the lack of record evidence one way or another regarding the cumulative impacts on the Indiana Bat, especially without knowing the surface area disturbance on federal land or the cumulative effects generally, the Court cannot conclude that FWS failed to act on information that may impact the Indiana Bat. Accordingly, Plaintiffs' claims as under the ESA are **DENIED.** However, to the extent that an actual cumulative impacts analysis, coupled with another analysis of the total surface area likely to be disturbed are completed, the Court does not find that as a matter of law Defendants can wait until the APD phase to evaluate the potential harm to the Indiana Bat.[19]

D. Air Quality

Plaintiffs next contend that the 2006 Forest Plan and EIS provide "no quantification of criteria pollutant[20] emissions from vertical wells or analysis of their overall contribution to air quality degradation in the region presented" and that subsequent agency documents fail to address the issue in the context of tracking. Pis.' MSJ 37, ECF No. 83; see *also* 2006 Forest Plan EIS, "Air Quality," FS-9338-40. Defendants argue that the agencies considered the effects that oil

[19] Because the Court does not address the merits of Plaintiffs' ESA claim, the Court **DENIES** the motion for leave to file an Amicus brief, as it only addressed whether FWS was required to re-initiate consultation. ECF No. 94.

[20] The EPA established National Ambient Air Quality Standards ("NAAQS") to protect the public health and the environment. The EPA has also established acceptable concentrations for six pollutants in the outdoor air: carbon monoxide, ground-level ozone, lead, nitrogen dioxide, particulate matter, and sulfur dioxide ("criteria pollutants"). 2006 Forest Plan EIS, FS-9338.

and gas leasing would have on air quality "to the extent practical for their respective decisions at this stage of leasing." Defs.' MSJ 30, ECF No. 92. Essentially, Defendants again revert to their standby argument that leasing itself would have no direct impacts on air quality; thus, any specific analysis will be conducted at the APD stage. *Id.* But the Court has already rejected that argument. Separately, Defendants point to BLM's 2016 EA discussion in Section 4.2.1, where BLM noted that "at the leasing stage, there is a degree of speculation and uncertainty with regard to the amount of air emissions (and GHGs) that could occur since specific design details are not yet known." 2016 EA, BLM-1412.

The 2006 Forest Plan EIS's discussion of "Air Quality and the Environmental Consequences" noted that of the twelve counties in southeastern Ohio USFS manages in the WNF, all but one is considered "in attainment," FS-9338, which means the air quality is cleaner than permissible levels is classified as an "attainment" area. Conversely, not being "in attainment" means that "the level of [the criteria pollutants] in the air over the Forest is below the ambient air quality standards set by EPA." FS-9338. However, the 2006 Forest Plan EIS also acknowledges that WNF "has some of the highest levels of air pollution in the nation." FS-9338. Nevertheless, the 2006 Forest Plan and EIS focused primarily on air quality impacts from wildfires and prescribed bums, not from oil and gas extraction. *See* FS-9339.

1. USFS's Review

USFS's 2012 SIR acknowledged that tracking activities could lead to more pollutants in the air but concluded that:

> Because of the low level of horizontal well activity projected to take place for the remainder of the first ten years of Forest Plan implementation (13 well sites) the EIS remains valid in that effects to air quality would be negligible. No other protections at the Forest Plan level are needed, since the Ohio EPA has the jurisdiction to regulate air quality and emissions[.]

2012 SIR, FS-5602.

In support of their argument that the USFS's review was arbitrary, Plaintiffs cite to an USFS regional office critique of the "air quality" section. The reviewer recommended removing some language that essentially described what regulatory authorities and guidelines applied to air quality and noted that the rest of the air quality section "sa[id] nothing substantive about effects. What is needed is a comparison of emissions disclosed in the Plan EIS and those expected from [tracking]." But it does not appear that the drafters implemented the regional officer's feedback because the final 2012 SIR does not add any meaningful comparisons.[21]

[21] Nor do Defendants point to any specific, qualitative or quantitative scientific analysis of air quality in the 2006 Forest Plan or 2006 EIS as it relates to oil and gas activities, despite conventional vertical drilling being considered as part of the 2006 Forest Plan and 2006 EIS.

The Court finds that the 2012 SIR's conclusory statement is insufficient to qualify as a hard look. Moreover, USFS cannot tier its review to the 2006 EIS if the air quality impacts of oil and gas leasing were not analyzed in that document.

2. BLM's review

BLM's 2016 EA provides more analysis of the air quality in WNF. *See* BLM-1361-73. BLM's 2016 EA included a section on foreseeable GHG emissions, relying in large part on the scientific paper, *Life cycle greenhouse gas emissions of Marcellus shale gas,* Jiang et al., 2011. The paper included the following relevant assumptions-"5 acres for wellpad disturbance, approximately 6 wells per well pad (per the 2006 RFDS), approximately 25 years for the lifetime of a well, and use of [fracking]." BLM-1417. Plaintiffs do not dispute that BLM adequately considered GHG emissions, and instead argue that BLM's ability to conduct a quantitative, predictive analysis of GHG emissions demonstrates that their failure to do so on other criteria pollutants was arbitrary and capricious. Plaintiffs also reiterate that delay until the APD phase would "circumvent considerations of cumulative air quality impacts of Forest-wide horizontal well development." Pis.' Reply 27, ECF No. 105. Defendants respond that they quantified GHG emissions because CEQ directed the agencies to do so (at the time) but that Plaintiffs point to no similar requirement for other air pollutants. Defs.' Reply 16-17, ECF No. 107.

Plaintiffs do rely on a 2011 Memorandum of Understanding ("2011 MOU") among the U.S. Departments of Agriculture, the Interior, and the EPA, which

requires the Lead Agency, as "early as possible in its planning process," to "identify the reasonably foreseeable number of oil or gas wells that can be expressed as a range, expected to be located within the planning area . . . [and] prepare an Emissions Inventory of criteria pollutants." 2011 MOU, BLM-45479-80. Defendants counter that the 2011 MOU requires analysis only "where air quality or AQRVs are issues warranting NEPA analysis." Defendants point to BLM's EA which discussed air quality and other NMQS criteria pollutants and determined that all parts of the Marietta Unit were in attainment. *See* 2016 EA, BLM-1361-68. Thus, because the Marietta Unit was in attainment, Defendants argue that BLM was not required to analyze NMQs impacts further at the leasing phase.

Plaintiffs rely on *Colorado Environmental Coalition v. Salazar,* 875 F. Supp. 2d 1233, 1256-59 (D. Colo. 2012) ("CEC") to refute Defendants' air quality deferral argument. In that case, the plaintiffs alleged that BLM failed to take a hard look when it concluded that the proposed plan would not result in any unconsidered cumulative effects on air quality. *Id.* at 1257. The district court agreed, finding BLM's proffered reasons unpersuasive, in part, because BLM was able to estimate certain air quality effects but failed to explain why it could not estimate others, and that BLM's reliance on the lack of ozone violations in the past "[was] of no significance when the purpose of the EIS is to attempt to predict" future environmental effects. *Id.* at 1257. Defendants argue that this case is distinguishable because, unlike in *CEC,* there is no contradictory

evidence to show that BLM's reasons were unsupportable. Defs.' MSJ 32, ECF No. 92. But the Court finds CEC's broader principle helpful. Just like in that case, here, BLM is trying to convince the Court, and perhaps the public, to trust them that they looked at the relevant data and determined that because all of Marietta Unit is "in attainment" now, there is no need to do further analysis. The problem with that is two-fold. First, like in *CEC,* the fact that an area is currently within the permissible air quality limits does not necessarily mean that it will be in attainment in the future, there must be a focus on future estimations as well. Second, if the agency does not show its work, the Court cannot evaluate whether its decision was reasonable. Yes, the Court must defer to scientific methods chosen by the agencies. But "deference must be earned." *Meister,* 623 F.3d at 374. A conclusion that the current estimates cannot be made at the leasing stage, despite the ability to provide estimates for GHGs, is inconsistent. Moreover, at least one case on which Defendants rely, *San Juan Citizens Alliance v. United States BLM,* 326 F. Supp. 3d 1227 (D. N.M. 2018), actually supports this Court's conclusion. In *San Juan Citizens,* the district court found BLM did take a sufficiently hard look at the air quality impacts of the proposed action when it tiered its review to a previous EIS that specifically analyzed emissions under a maximum development scenario number of wells for all six criteria pollutants. *Id.* at 1251. But here, there is no previous analysis on which BLM can rely. Similarly, *Amigos Bravos v. United States BLM,* 2011 WL7701433, at *13 (D. N.M. Aug. 3, 2011) is also distinguishable in that BLM in

that case tiered to a previous NEPA document that had analyzed the NAAQS in some detail. *See id.* at** 4, 11, 13-14; *c.f. Save Our Cumberland Mountains v. Kempthorne,* 453 F.3d 334, 339-40 (6th Cir. 2006) {finding the EA satisfied NEPA when it "discussed at length the environmental effects" and cited to "numerous studies").

Finally, the Court is once again not convinced of the underlying premise of Defendants' main argument-that further analysis can wait until the APD phase. "NEPA is not designed to postpone analysis of an environmental consequence to the last possible moment. Rather, it is designed to require such analysis as soon as it can reasonably be done." *Los Padres ForestWatch,* 2016 U.S. Dist. LEXIS 138782 at *36 (quoting *Save Our Ecosystems v. Clark,* 747 F.2d 1240, 1246 n.9 (9th Cir. 1984)). Without some quantification of the NAAQS associated with the 2006 Forest Plan, quantification of the NAAQS expected from foreseeable tracking activities, or some quantification or analysis of NAAQS in any other agency documents Defendants rely on, the Court cannot determine whether Defendants' argument that tracking will not exceed attainment or have different environmental impacts from those associated with vertical drilling is a rational and reasonable one. See *Gov't of the Province* of *Manitoba v. Norton,* 398 F. Supp. 2d 41, 66 (D. D.C. 2005) ("Federal agencies must comply with the procedural requirements of NEPA and reach reasoned decisions on issues of environmental concern. Because disclosure of information critical to decision-making is a primary function of NEPA, an agency cannot be allowed to avoid

producing a thorough EIS by ignoring a possible, but unexplored, environmental issue in the EA."). Accordingly, the Court finds that USFS,s and BLM's failure to analyze the foreseeable impacts on the air quality from fracking activities was arbitrary and capricious.

E. Whether an EIS is required

Finally, Plaintiffs argue that BLM and USFS not only failed to take a hard look but also failed to prepare an EIS and SEIS, respectively.

"An EIS must be prepared if substantial questions are raised as to whether a project may cause significant degradation of some human environmental factor.', *Ocean Advocates v. United States Army Corps. of Eng'rs,* 402 F.3d 846, 865 (9th Cir. 2005). An agency should assess the significance of an impact by considering both context and intensity. See 40 C.F.R. § 1508.27. "Context" requires the significance of an action be analyzed from different perspectives, including "society as a whole (human, national), the affected region, the affected interests, and the locality." 40 C.F.R. § 1508.27(a). The "intensity" of an impact relates to "the severity of the impact" and requires consideration of ten factors, the following four of which are raised here:

> (3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
>
> (4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

> (5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
>
> (9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

40 C.F.R. § 1508.27(b).

Here, Plaintiffs argue that these four intensity factors are met and require preparation of an EIS and/or SEIS.[22] The Court is not convinced. Although the Court has found that BLM and USFS failed to take sufficiently hard looks at certain aspects of fracking, it also is not finding as a matter of law that fracking *is* a significant action requiring preparation of an EIS. Rather, the Court will give BLM and USFS the opportunity to take the requisite hard look first and, after doing so, proceed accordingly.

F. Conclusion

At bottom, "NEPA does not permit an agency to remain oblivious to differing environmental impacts, or hide these from the public, simply because it understands the general type of impact likely to occur." *Richardson,* 565 F.3d at 707. Here, USFS and BLM demonstrated a disregard for the different types of impacts caused by fracking in the Forest. The agencies made decisions premised on a faulty foundation: that the 2006 Forest Plan's and 2006 EIS's

[22] Plaintiffs acknowledge that USFS and BLM can adopt each other's EIS. *See* Pls.' MSJ 39, ECF No. 83 (citing 40 C.F.R. § 1506.3). Thus preparation of one may negate the responsibility for the other to be prepared.

consideration of vertical drilling sufficiently accounted for the impacts of tracking. Each iteration of agency review built upon that faulty foundation-the 2016 EA relied on the 2012 SIR, which relied on a 2012 BLM Letter, which relied on the 2006 Forest Plan and 2006 EIS-but neither USFS nor BLM stopped to take that "hard look" that was required of them. Specifically, the Court finds that at the decision-to-lease phase, USFS and BLM failed to take a hard look at the impacts of tracking in the WNF, including: (1) surface area disturbance, (2) cumulative impacts on the Indiana Bat and the Little Muskingum River, and (3) impacts on air quality.

G. Remedy

Understandably, Intervenors' arguments center on the appropriate remedy for this case. Plaintiffs seek vacatur of the leases, but Intervenors argue that vacatur constitutes a request for permanent injunctive relief and that Plaintiffs cannot meet the high burden such a request requires. Assn.'s MSJ 20, ECF No. 99; Eclipse MSJ 6-7. Plaintiffs dispute that the permanent injunction standard applies but request bifurcated briefing on the remedies in the event the Court finds that it does. Pis.' Resp. 32, ECF No. 105. Although Intervenors disagree that bifurcation is necessary, Defendants agree with Plaintiffs that additional briefing on remedies would be helpful, especially given that a proper remedy could vary depending on the outcome of the underlying case. Defs.' Reply 20,

ECF No. 107. The Court agrees that additional briefing on remedies is the most prudent course of action to take. Accordingly,

1) Plaintiffs shall file their briefing on remedies within **thirty-five days** of the date of this Order.

2) Defendants and Intervenors shall file their responses within **twenty-eight days** thereafter.

3) Plaintiffs may file one comprehensive reply within **fourteen days** of the last-filed response.

All briefing shall address what standard applies and the applicability or inapplicability of other remedies. The parties should also discuss a range of remedies appropriate for this case, meaning options that fall somewhere between complete vacatur or remand. Finally, each brief **shall not exceed twenty pages.**

V. CONCLUSION

For the reasons addressed above, Plaintiffs' motion for summary judgment is **GRANTED** in **part and DENIED in part;** similarly, Defendants' and Intervenors' motions for summary judgment are **GRANTED** in **PART and DENIED in part.** The Clerk shall terminate all pending motions in this case.

IT IS SO ORDERED.

MICHAEL H. WATSON, JUDGE
UNITED STATES DISTRICT COURT

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
EASTERN DIVISION

Center for Biological Diversity, *et al.,*

Plaintiffs,

v.

U.S. Forest Service, *et al.,*

Defendants.

Case No. 2:17-cv-372

Judge Michael H. Watson
Magistrate Judge Jolson

OPINION AND ORDER

This Court previously found that Defendants United States Forest Service ("USFS") and Bureau of Land Management ("BLM,1' together "Agency Defendants") violated the National Environmental Policy Act C'NEPA") when they failed to take the requisite "hard look" at the impacts of fracking in Wayne National Forest ("WNF") prior to deciding to grant leases. ECF No. 110. Specifically, this Court found that:

> [A]t the decision-to-lease phase, USFS and BLM failed to take a hard look at the impacts of fracking in the WNF, including: (1) surface area disturbance, (2) cumulative impacts on the Indiana Bat and the Little Muskingum River, and (3) impacts on air quality.

Id. at 71.

The Court instructed the parties[1] to brief which remedies other than complete vacatur or mere remand were available and the appropriate test or

[1] Plaintiffs are four non-profit organizations: the Center for Biological Diversity ("the Center"), Heartwood, Ohio Environmental Council ("OEC"), and the Sierra Club (together, "Plaintiffs"). Intervenor Defendants are American Petroleum Institute ("API")

standard to apply. *Id.* at 71-72. Pursuant to that Opinion, the parties filed supplemental briefing as to the appropriate remedy.[2]

I. BACKGROUND

The Court adopts and incorporates the facts and procedural history as discussed in its previous Opinion and Order, ECF No. 110. Any additional facts relevant to remedies will be addressed in the analysis below.

II. ANALYSIS

A. Whether to Apply *Allied-Signal*

The parties disagree as to the appropriate test to apply. Plaintiffs argue that under the Administrative Procedure Act ("APA"), and Sixth Circuit precedent, the Court *must* vacate agency actions that violated NEPA. Pls.' Br. 3, ECF No. 111 (citing 5 U.S.C. § 706(2)(A) and *Ky. Riverkeeper, Inc. v. Rowlette,* 714 F.3d 402, 407, 411 (6th Cir. 2013)); *see also Dine Citizens Against Ruining Our Env't v. Bernhardt,* 923 F.3d 831 (10th Cir. 2019) ("Vacatur of agency action is a common, and often appropriate form of injunctive relief granted by district courts." (internal citation omitted)).

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and Independent Petroleum Association of America ("IPAA," together, "Intervenor Associations"), as well as Eclipse Resources I, LP ("Eclipse"), who has since undergone a name change, but will nevertheless still be referred to as Eclipse in this Opinion and Order. *See* ECF No. 113.

[2] Intervenor Associations filed two separate but identical briefs. *Compare* ECF Nos. 112 and 114. For efficiency's sake, the Court will refer to their arguments jointly as "Intervenor Associations" and cite only ECF No. 112.

Agency Defendants and Eclipse acknowledge that the default is to set aside unlawful agency actions, but they, along with Intervenor Associations, argue that this Court should adopt the vacatur exception test established in *Allied-Signal v. United States Nuclear Regulatory Comm'n,* 988 F.2d 146, 150-51 (D.C. Cir. 1993), which permits remand without vacatur.[3] *Allied-Signal* held that "[a]n inadequately supported rule ... need not necessarily be vacated." *Id.* at 150. Instead, the court can employ a two-factor balancing test which looks at "the seriousness of the order's deficiencies (and thus the extent of doubt whether the agency chose correctly) and the disruptive consequences of an interim change that may itself be changed" to determine whether vacatur is appropriate. *Id.* at 150-51 (internal citation omitted). Neither factor is dispositive; rather, the "resolution of the question turns on the Court's assessment of the overall equities and practicality of the alternatives." *Shands Jacksonville Med. Ctr. v. Burwell,* 139 F. Supp. 3d 240,270 (D.D.C. 2015) (collecting cases).

Here, no party disputes that the "ordinary practice" in situations like this is "to vacate unlawful agency action." *Standing Rock Sioux Tribe v. U.S. Army Corps. of Eng'rs,* 985 F.3d 1032, 1050-51 (D.D.C. 2021). But the Court agrees with Intervenor Associations', Eclipse's, and Agency Defendants' arguments that

[3] The Intervenor Associations also argue that Plaintiffs' requested relief is akin to seeking a permanent injunction and that Plaintiffs have failed to meet their burden under that standard. However, they fail to explain how the *Allied-Signal* factors frt: into the permanent injunction framework, and because all parties address Plaintiffs' arguments within the scope of *Al/led-Signal,* the Court will likewise do so.

Plaintiffs overstate the binding nature of *Kentucky Riverkeepers* regarding mandatory vacatur. Although the Sixth Circuit Court of Appeals did invalidate a permit pursuant to § 706(2)(A), it did not dictate vacatur as the only permissible outcome. *See* 714 F.3d at 413.

Instead, this Court looks to the guidance of many other courts that have considered the value of implementing the *Allied-Signal* test when determining an appropriate remedy and finds it is likewise instructive in this case. *See e.g. Black Warrior Riverkeeper, Inc. v. U.S. Army Corps of Eng'rs,* 781 F.3d 1271. 1290 (11th Cir. 2015) (noting most other courts agree that the "remedy of remand without vacatur is within a reviewing court's equity powers under the APA" and applying the *Allied-Signal* test); Eclipse Resp. 9, ECF No. 113 (collecting cases that have adopted the *Allied-Signal* test); *see also Terry v. Tyson Farms, Inc.,* 604 F.3d 272, 278 (6th Cir. 2010) ("[W]hile we recognize that we are not bound by the law of other Circuits, this court has also routinely looked to the majority position of other Circuits in resolving undecided issues of law."). Although not dispositive of the issue, the Court is persuaded by the fact that most courts to examine the issue have likewise adopted the *Allied-Signal* test. Moreover, Plaintiffs do not point to any caselaw outright rejecting *Allied-Signal* or the Court's ability to fashion an equitable remedy narrower than vacatur. Accordingly, while recognizing that the default is vacatur, the Court will employ the *Allied-Signal* test to determine whether, in equity, complete vacatur is the most appropriate remedy.

Finally, under *A/lied-Signal,* courts have found that the burden is on the party opposing vacatur "to show that compelling equities demand anything less than vacatur." *W. Watersheds Project v. Zinke,* 441 F. Supp. 3d 1042, 1083 (D. Idaho 2020). Thus, the Court places the burden on Defendants to prove that vacatur is an inappropriate remedy.

B. Application of *Allied-Signal*

Intervenor Associations, Eclipse, and Agency Defendants argue that vacatur is a drastic remedy, and that, in this case, a simple remand to the Agency Defendants to undergo the requisite "hard look" would be sufficient. Plaintiffs argue that the opposing parties are trying to make the exception the rule, and that, regardless, even under *Allied-Signal,* vacatur of the challenged decisions and corresponding leases is most in line with NEPA's overarching goal of meaningfully evaluating environmental impacts and alternatives *before* action is taken. Pis.' Br. 5-6, ECF No. 111.

1. Seriousness of the deficiencies

The parties first disagree as to the seriousness of the deficiencies. Intervenor Associations, Eclipse, and Agency Defendants all contend that the inadequacies highlighted by the Court's previous Opinion and Order can be cured on remand. They further argue that in cases where the NEPA analysis was inadequate, as opposed to completely missing, remand without vacatur is the proper course of action because it is likely the NEPA violations can be corrected upon remand. *See* Eclipse Resp. 13-14, ECF No. 113; Agency Defs.'

Resp. 10, ECF No. 12; Int. Ass'n Resp. 7, ECF No. 112. Indeed, BLM's representative avers that he believes the deficiencies outlined by the Court can be cured by additional NEPA analysis on remand. *See* Bobo Decl.1J 7, ECF No. 115-1.

Plaintiffs argue the seriousness of the defect "should be measured by the effect the error has in contravening the purposes of the statute[s] in question," rather than assessing the seriousness based on the likelihood of curing defects on remand. Pis.' Br. 12, ECF No. 111 (quoting *W. Watersheds Project,* 441 F. Supp. 3d at 1083 (further citations omitted)). In Plaintiffs' view, because the purposes of NEPA require the agencies to fully consider the environmental impacts of fracking before deciding to lease parcels, vacatur of the leases is the only way to permit full and fair consideration of alternatives on remand. Pis.' Br. 14, ECF No. 111. Absent vacatur, Plaintiffs caution remanding with the leases remaining in place "could result in a *pro forma* exercise in support of a predetermined outcome." *Id.* at 6 (quotations and citation omitted).

The Court agrees with Plaintiffs that the purposes of NEPA were contravened when the Agencies failed to take the requisite "hard look" at certain impacts of tracking in WNF. The Court is also mindful of Plaintiffs' concern that keeping the leases in place on remand risks the Agency review becoming an exercise in futility with a predetermined outcome. However, the Court likewise acknowledges that this is not a situation in which the Agencies completely abandoned their duties under NEPA. Instead, the Court must consider the risks

vacatur poses to Agency Defendants and Intervenors, especially when there is a strong possibility that a properly supported NEPA review could reach the same result as before.

Thus, despite the serious concerns the Court has with some of the Agencies' review, the Court finds there is ·•a serious possibility that the [agency] will be able to substantiate its decision on remand" such that this factor weighs against complete vacatur." *See Standing Rock Sioux Tribe v. U.S. Army Corps of Eng'rs,* 282 F. Supp. 3d 91, 98 (D.D.C. 2017); *WildEarth Guardians v. Zinke,* 368 F. Supp. 3d 41, 84 (D.D.C. 2019) (applying *Allied-Signal* and declining to vacate leases because "BLM's NEPA violation consists merely of a failure to fully discuss the environmental effects of those lease sales; nothing in the record indicates that on remand the agency will necessarily fail to justify its decisions to issue EAs or FONSIs.").

2. Disruptive consequences of vacatur

Intervenor Associations, Eclipse, and Agency Defendants likewise emphasize the economic impacts of vacatur and the practical difficulties of unwinding agency actions. Plaintiffs acknowledge that some disruption might occur but argue the purely economic consequences are insignificant and can be remedied with a refund. Pis.' Br. 15, ECF No. 111.

Intervenor Associations, Eclipse. and Agency Defendants first argue that the economic harms of vacatur would be disruptive and far reaching. Eclipse highlights the economic harms it might face, including loss of oil and gas

exploration investments of approximately $41,400,000 in WNF and surrounding privately owned areas. Rucker Deel. fflf 9,12, 18, 20, ECF No. 113-1. Eclipse avers that it has taken steps, including partially drilling two wells and commenced well-site construction activities for eight other wells, such that a mere refund of its lease purchase would be insufficient. *See id.* at ,I 20. Eclipse also argues the Court must consider not just the lessees' losses but also the future losses to leaseholders, private landowners adjacent to WNF, and the surrounding community at large. Eclipse Resp. 16-17, ECF No. 113.

Both Eclipse and Agency Defendants likewise highlight the economic losses to federal, state, and local governments if the leases must be refunded. Specifically, Agency Defendants indicate almost half of the payments BLM received went to the State of Ohio, which in turn, uses that money to fund schools, roads, and bridges. Bobo Deel. fflf 6 ,8, ECF No. 115-1. Thust refunding the leases, they argue, would result in an economic loss for the surrounding Ohio communities as well. *See e.g. Mont. Wilderness Ass'n v. Fry,* 408 F. Supp. 2d 1032, 1034 (D. Mont. 2006) (considering greater impacts to community).

Intervenor Associations echo many of the above arguments and point to not only the lessees' lost investments in bids and towards exploration, but also the fact that their bids have been unsealed, thereby revealing the lessees' bidding strategies to competitors, and in turn, harming their prospective chances of winning bids in the future and undermining trust in the greater bidding process.

Second, Intervenor Associations, Eclipse, and Agency Defendants argue that the practical difficulties of implementing vacatur would be equally disruptive. Agency Defendants contend that it is not as simple as just issuing checks for a refund. Instead, vacating the lease sales, returning funds, and rescinding the applications for permit to drill ("APD") would require them to go through the administrative process to cancel the leases, update the land and minerals record system, and process refunds, thereby diverting time and valuable resources away from other environmental programs. Bobo Deel. ,r 8, ECF No. 115-1. Moreover, because almost half of the funds went to the state, it will be that much more difficult and time consuming to fully refund the leases. *Id.* Finally, Agency Defendants argue vacatur risks them exerting all this effort despite the possibility that once the requisite "hard look" is taken, the outcome could still be same. Agency Defendants would then have to go through the entire bidding process again, resulting in duplicative and wasted efforts.

Plaintiffs argue economic harms alone are not enough to prevent vacatur. *See* Pis.' Br. 16, ECF No. 111; Eclipse Resp. 15, ECF No. 113 {both citing *WildEarth Guardians,* 368 F. Supp. 3d at 84 n.35 {indicating that vacatur based on economic harms alone would be insufficient because "the **risk** of economic harm from procedural delay and industrial inconvenience is the nature of doing business, especially in an area fraught with bureaucracy and litigation")). Plaintiffs contend any economic losses cannot be wholly unexpected as all parties were aware of the public concern and opposition to the leasing decisions.

Pls.' Br. 16-17, ECF No. 111. Moreover, Plaintiffs argue that because most of the wells have not been drilled yet, the prospect of future economic losses is speculative at best. *Id.* at 18.

Plaintiffs rely on *W. Watersheds Project* to support their argument that vacatur of leases is not very disruptive. 441 F. Supp. 3d at 1083-84. But as Agency Defendants point out, that vacatur decision was subsequently stayed pending appeal. There is of course a difference between a stay pending appeal and a stay pending remand, but the Court acknowledges Agency Defendants' overall point that some economic harm is concrete, and perhaps irreversible, if vacatur is ordered.

Vacatur always has consequences, and the exception should not supplant the general rule. Nevertheless, the Court finds that the equitable considerations in this case warrant remand without vacatur.

III. CONCLUSION

This decision to remand without vacatur, however, does not mean that all other activities can continue. As the parties acknowledge, there is a spectrum between complete vacatur and mere remand, and the Court has discretion to work within those parameters to craft an equitable remedy under the circumstances. *See WildEarth Guardians,* 368 F. Supp. 3d at 85 (issuing a remedy falling within this spectrum); *Mont. Wilderness Ass'n,* 408 F. Supp. 2d at 1038 (keeping leases intact while enjoining surface disturbing activities on oil and

gas leases pending subsequent NEPA analysis). Accordingly, the Court does the following:

1. **REMANDS** BLM's 2016 EA and corresponding FONSI and USFS's consent to lease to undergo revised NEPA analysis:

2. **ENJOINS** BLM from issuing any new APDs for development of leases at issue and raised in Plaintiffs' Complaint during the pendency of the NEPA review on remand;

3. **ENJOINS** water withdrawal from the Little Muskingum River for any drilling that is occurring pursuant to the already approved APD on the leased parcels; and

4. **ENJOINS** any further surface disturbing activities on the leased parcels pending a decision on remand.

This Order shall remain in effect until Agency Defendants complete their NEPA analysis in accordance with this Court's previous Opinion and Order, ECF No. 110. The Clerk is **DIRECTED** to enter final judgment and close this case.

IT **IS SO ORDERED.**

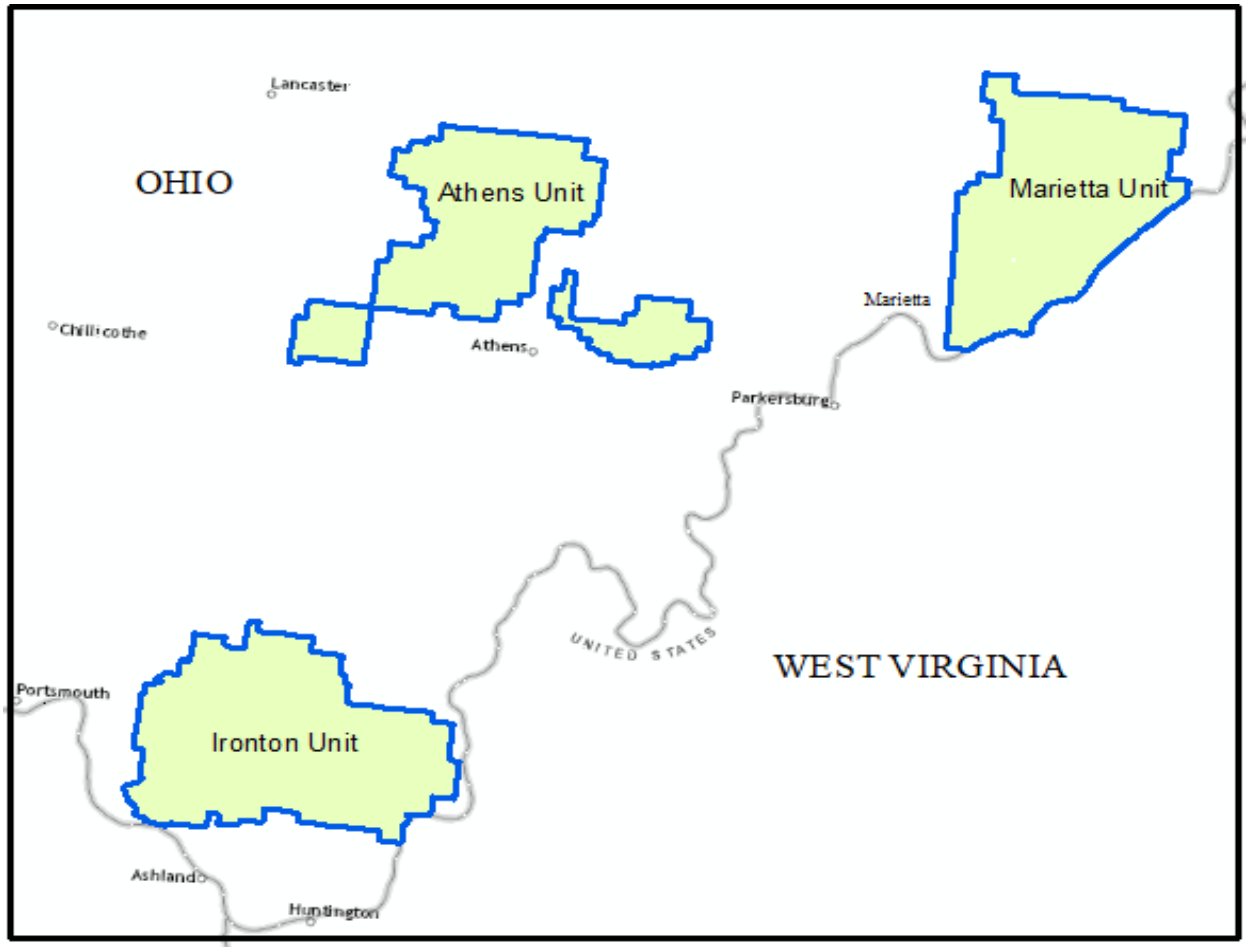
ICHAELH.WATSON.JUDGE
UNITED STATES DISTRICT COURT

Existing Leases that are either being Litigated or Remanded Under the CBD Decision Court Order		
LEASE ID	LEASE ACRES	LEASE SALE
OHES058186	47	Dec. 2016
OHES058187	79.15	Dec. 2016
OHES058188	30.03	Dec. 2016
OHES058190	78.25	Dec. 2016
OHES058191	40.00	Dec. 2016
OHES058198	22.14	Dec. 2016
OHES058199	30.64	Dec. 2016
OHES058200	0.86	Dec. 2016
OHES058201	73.25	Dec. 2016
OHES058202	2.53	Dec. 2016
OHES058203	40.08	Dec. 2016
OHES058204	40.00	Dec. 2016
OHES058205	40.00	Dec. 2016
OHES058213	56.00	Dec. 2016
OHES058215	58.14	Dec. 2016
OHES058216	40.24	Dec. 2016
OHES058217	1.17	Dec. 2016
OHES058226	5.00	Mar. 2017
OHES058227	10.00	Mar. 2017
OHES058228	26.66	Mar. 2017
OHES058229	81.05	Mar. 2017
OHES058230	40.52	Mar. 2017
OHES058231	25.00	Mar. 2017
OHES058232	36.78	Mar. 2017
OHES058233	115.22	Mar. 2017
OHES058234	80.00	Mar. 2017
OHES058235	80.00	Mar. 2017
OHES058236	40.13	Mar. 2017
OHES058237	80.26	Mar. 2017
OHES058240	57.46	Mar. 2017
OHES058249	15.12	Mar. 2017
OHES058251	157.44	Mar. 2017
OHES058252	10.16	Mar. 2017
OHES058254	60.00	Mar. 2017
OHES058256	28.00	Mar. 2017
OHES058257	158.62	Mar. 2017
OHES058296	39.68	Sep. 2017
OHES058298	97.72	Sep. 2017
OHES058299	4.16	Sep. 2017
OHES058308	94.72	Dec. 2017
OHES058309	40.13	Dec. 2017
OHES058310	50.16	Dec. 2017
OHES058311	115.34	Dec. 2017
OHES058312	49.71	Dec. 2017
OHES059251	39.65	Mar. 2018

OHES059252	305.84	Mar. 2018
OHES059388	40.06	Dec. 2018
OHES059389	35.00	Dec. 2018
OHES059478	70.90	Sep. 2019
OHES059479	95.67	Sep. 2019
OHES059480	81.34	Sep. 2019
OHES059481	1.25	Sep. 2019
OHES059482	60.34	Sep. 2019
OHES059483	42.25	Sep. 2019
OHES059484	9.21	Sep. 2019
OHES059485	6.25	Sep. 2019
OHES059486	53.44	Sep. 2019
OHES059487	11.50	Sep. 2019
OHES059488	17.50	Sep. 2019
OHES059489	45.87	Sep. 2019
OHES059490	39.85	Sep. 2019
OHES059491	119.565	Sep. 2019
OHES059520	81.47	Dec. 2019
OHES059521	54.56	Dec. 2019
OHES059522	50.00	Dec. 2019

Appendix D – Reasonably Foreseeable Development Scenario

Reasonably Foreseeable Development Scenario For Oil and Gas Activities



WAYNE NATIONAL FOREST

Prepared By:

U.S. DEPARTMENT OF THE INTERIOR
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JULY 28, 2020

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include air, fish and wildlife, minerals, paleontological relics, recreation, rangelands, scenic scientific and cultural values, timber, water, and wilderness.

Reasonably Foreseeable Development Scenario
For Oil and Gas Activities

2020-2034

WAYNE NATIONAL FOREST

Prepared By:

(Signature)

Geologist
(Title)

Tuly 28, 2020
(Date)

Technical Approval:

Petroleum En eer
(Title)

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Management Acknowledgement:

LANCE BRADY
(Signature)

(Title)

(Date)

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1.0 SUMMARY

A Reasonably Foreseeable Development Scenario (RFDS) is a modeled projection (scenario) of oil and gas exploration, development, production and reclamation activity for a defined area and specified period. The RFDS projects a baseline scenario of activity assuming all potentially productive areas can be open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation, or executive order. An RFDS is not a prediction of activity; it is a possible reasonable scenario of activity under a specified set of assumptions. The RFDS is a technical report presenting a baseline scenario of unconstrained activity based on geology, resource occurrence potential, past and current leasing, exploration and development activity, and engineering technology, with consideration of economics and physical limitations on access to resources. A RFDS is not a decision and does not establish or imply any limits or restrictions on development.

A RFDS is typically developed using a reasonable, technical and scientific estimate of possible oil and gas activity based on the best available information and data at the time of the study. A RFDS may be used for evaluating existing land management plans and/or leasing decisions in order to make informed determinations about any need (or not) for updating and/or revising a management plan and/or leasing decision. A RFDS facilitates determination and analysis of potential effects that discretionary management decisions may have on the development of oil and gas resources, provides technical information necessary for identifying and analyzing potential direct, indirect, and cumulative effects of a proposed leasing action (leasing availability determination), provides information necessary for identification and analysis of alternatives to a proposed leasing action (leasing availability determination). A RFDS facilitates informed decisions on the management of oil and gas resources balanced with management of other resources and provides documentation of technical information in the administrative record of any analysis for which it is used.

In 2018, the United States Forest Service (USFS) announced plans to revise the 2006 Land and Resource Management Plan for the Wayne National Forest (WNF) including a revision of the current Oil and Gas Leasing Analysis. In accordance with a June 4, 2019 USFS request, the Bureau of Land Management Northeastern State District prepared this RFDS for the WNF Land and Resource Management Plan revision.

The proclamation boundary of the WNF is comprised of three separate administrative units located within 12 counties of southeast Ohio: the Athens Unit, the Ironton Unit and the Marietta Unit. These three administrative units comprise two Ranger Districts: the Athens Ranger District (Athens and Marietta administrative units) and the Ironton Ranger District. WNF Federal land acquisitions are intermixed with small communities, roadways and public state-held lands. Of the approximately 855,532 acres within the WNF proclamation boundary approximately 244,265 acres of surface estate, about 29 percent, is owned by the U.S. Forest Service. While most surface land acquisition by the USFS includes the mineral estate, some lands are acquired without the underlying minerals or the minerals are held by a private party for a period of time before reverting to Federal minerals. These later mineral reversions result in an increase in Federal mineral acres over time. Currently there are approximately 172,157 acres of Federal minerals within the WNF proclamation boundary.

The RFDS analysis considered all lands (Federal and non-Federal) within the WNF proclamation boundary and a four-mile buffer zone surrounding Federal lands. This document was prepared during 2019 and early 2020 and the 15 years being analyzed for future potential development is 2020 to 2034. Currently drilling is more prevalent on private lands than Federal lands and Federal minerals are likely to be accessed in the subsurface through private minerals. A four-mile buffer zone around Federal minerals considers potential development of Federal minerals through private minerals. Four miles was selected given a recently drilled

well with almost four miles of horizontal drilling. Included within the buffer zone are two parcels (an approximately one-acre parcel and 180-acre parcel) that were once included and are now beyond the WNF proclamation boundary but, are still considered part of the WNF. The buffer zone accounts for possible unconventional wells (conventional wells are vertically drilled and unconventional wells are drilled vertically and then extend horizontal at target depth) drilled from beyond the WNF but extending into Federal mineral within the proclamation boundary in the subsurface. Potential wells drilled within the buffer zone but that would not impact Federal minerals in the WNF proclamation boundary were beyond the scope of this RFDS. Over the next 15 years, up to 81 wells and up to 29 well pads are projected for the WNF based on resource occurrence potential and assuming minimal constraints on drilling. All wells are projected to be primarily gas wells, many of which would also produce some oil. No oil-only wells are projected in the WNF. Most of these wells are projected to be unconventional drilled gas wells from non-Federal surface pads. The Marietta Unit is projected to receive a majority of drilling interest. Total new surface disturbance is projected to be 171 to 998 acres (including well pads, access roads and pipelines) or about 0.020% to 0.117% of the approximately 855,532 acres within the WNF Proclamation Boundary. Total new longer term (post construction phase) surface disturbance is projected to be approximately 86 to 285 acres (well pads including access after interim reclamation) or about 0.010% to 0.033% of total acres within the WNF Proclamation Boundary. Longer-term disturbance is disturbance that would exist until associated wells are plugged and abandoned in accordance with applicable regulations.

2.0 INTRODUCTION

The Bureau of Land Management (BLM) Northeastern State District (NSD), located in Milwaukee, Wisconsin, has jurisdiction over 20 northeastern states including Ohio. The NSD's principal activities include fluid and solid minerals management.

In 2018, the USFS announced plans to revise its 2006 Plan for the Wayne National Forest (WNF, USFS, 2006). In accord with a 2007 BLM and USFS Memorandum of Understanding (BLM MOU WO3002006-07) and in response to a June 4, 2019 USFS request, the NSD prepared this Reasonably Foreseeable Development Scenario (RFDS) for the revised WNF Land and Resource Management Plan.

This RFDS is intended to support a revised WNF Management Plan and Leasing Analysis and examines oil and gas activities within the WNF Proclamation Boundary for the next 15 years.

Previous RFDS documents including a 2003 WNF RFDS (BLM, 2003) and a 2012 RFDS for Ohio (BLM, 2011) were reviewed for this document. The criteria and methods of analysis used in this RFDS are based on BLM guidance documents, *Policy for Reasonably Foreseeable Development Scenario (RFDS) for Oil and Gas (BLM WO IM No. 2004-089)* and *Planning for Fluid Minerals Supplemental Program Guidance (BLM Handbook H-1624-1)*.

2.1 Background

The Wayne National Forest is in southeastern Ohio. The WNF was established in 1934 as part of a reforestation program. Acquisition of previously lumbered, farmed and mined lands for the WNF began in 1935. The WNF's Proclamation Boundary was set in 1951. The proclamation boundary of the WNF is comprised of three separate administrative units encompassing parts of 12 counties: the Athens Unit, the Ironton Unit and the Marietta Unit. These three administrative units comprise two Ranger Districts: the Athens Ranger District (Athens and Marietta administrative units) and the Ironton Ranger District (Appendix A). Of the approximately 855,532 acres within the Wayne Proclamation Boundary, approximately 244,265 acres, or about 29 percent, are National Forest System lands owned by the U.S. Forest Service (Giannamore, 2019). The National Forest System lands overlie oil and gas resources and are intermixed with small communities, roadways and public county, or state-held lands.

2.1.1 Surface Ownership

Surface ownership within the WNF proclamation boundary is a mixture of Federal and non-Federal (i.e., private ownership, county/township ownership, or state ownership). Federal-owned surface in the WNF is primarily acquired lands, with little public domain lands. Acquired lands were privately owned land acquired by the Federal government. Public domain lands are lands that have always been owned by the United States or the thirteen original colonies. The approximately 244,265 acres of WNF Federal surface includes only a single 40-acre parcel of public domain land. The USFS has discretion over surface disturbing activities on Federal surface overlying the Federal mineral estate (as stipulated in the WNF land management plan); however, it is limited in its ability to control mineral development when development occurs on a Federal surface estate over a non-Federal mineral estate. These limits are described in the U.S. Department of Agriculture, Forest Service Rules of 1911, 1937 and 1963 as well as severance deeds for outstanding and reserved rights and existing lease terms and conditions for private acquired wells.

2.1.2 Mineral Ownership

USFS land acquisitions included underlying mineral estates when possible. Mineral estate ownership within the WNF Proclamation Boundary is either Federal or non-Federal. Presently, of the 244,265 surface acres managed by the USFS, approximately 70percent (172,157 acres) of the underlying mineral estate is Federal-owned and approximately 30 percent (73,278 acres) is non-Federally owned. The 172,157 acres of WNF Federal minerals are all acquired minerals, except for one 40-acre public domain parcel. Federal Minerals acreages does not differentiate between minerals owned entirely or in part by the United States.

Some mineral estate acquisitions conveyed only specific minerals in the underlying estate to the USFS, while other USFS acquisitions provided for delayed mineral conveyance to the United States, in whole or part, until a negotiated length of time had elapsed. These delayed conveyance mineral estates are called mineral reservations. The percentages of mineral ownership in the WNF will change over time as some conveyed minerals revert from non-Federal to Federal ownership and as new mineral estates are acquired by the USFS. For this RFDS's 15-year timeframe, approximately 16,912 additional acres of mineral estate will revert to Federal ownership between January 1, 2020 and December 31, 2034. Reverted minerals will increase the underlying mineral estate over the next 15 years from approximately 70 percent to approximately 80 percent.

An oil and gas lease is a legal instrument that conveys a right to explore, develop and produce oil and/or gas on a specified tract of land. Oil and gas leases may have other terms, royalty rates, and conditions negotiated between the mineral estate holder and the lessee. Federal oil and gas leases may be grouped with other leases and mineral owners in agreements to comply with state spacing requirements or to efficiently explore, develop and produce oil and/or gas resources. As of January 1, 2020, approximately 38,985 acres of Federal minerals are committed under 268 leases and 23 agreements according to the BLM's Legacy Rehost 2000 (LR2000, 2019) database on August 9, 2019 and updated on March 20, 2020 (LR2000, 2020).

Federal-owned minerals include mineral estates that are either unencumbered or partially to 100% encumbered with non-Federal mineral leases (commonly referred to as Private Acquired or PAQ leases). Since there are no required Federal reporting requirements on private mineral leases, the terms and/or status of some private mineral leases within the WNF are unknown (leases may be active, inactive or expired). Additionally, some reverted mineral estates may be subject to existing private oil and gas leases that are not currently be known to the BLM. BLM's 2019 analysis determined an additional 6,785 acres of reverted mineral estates having oil and gas wells with either active or unknown status and potentially committed to an existing oil and gas lease. Until the status of these wells is confirmed, it is difficult to accurately determine the total number of reverted federal mineral estates under private lease. Assuming the additional 6,785 acres of reverted mineral estates having oil and gas wells with either active or unknown status are committed to existing oil and gas leases, then possibly as much as 126,387 acres (about 73%) of Federal minerals within the WNF are currently not leased but may become available for lease in the future.

3.0 DESCRIPTION OF GEOLOGY

The description of the area's geology set out below includes an examination of general physiographic setting, geologic setting and subsurface stratigraphy and structure. It also includes an examination of the area's

"petroleum geology," including reservoirs, traps, source rocks, seals, hydrocarbon generation and migration, and selected oil and gas plays.

3.1 Physiographic Setting

According to the Ohio Division of Geological Survey (ODGS), Ohio is located within three physiographic provinces: the Appalachian Plateau located in the eastern half of the state which includes all three WNF units, the Central Lowland Plateau located in the western half of the state, and the Interior Lowland Plateau located in the southwestern portion of the state (ODGS, 1998). Based on glacial extent during the Pleistocene Epoch, the Appalachian Plateau is split into the Glaciated Allegheny Plateaus Section and the Allegheny Plateaus (unglaciated) Section. The WNF is located near the western margin of the Appalachian Plateau Province and within the Allegheny Plateaus.

The Allegheny Plateau was relatively untouched by glaciers during the ice age. The elevation of the Allegheny Plateau varies from approximately 490 feet up to 1,400 feet. Topographic relief is high, usually 300 feet or more in some areas, especially those in the vicinity of the Ohio River, with as much as 800 feet in relief. When not exposed at the surface, bedrock is overlain mainly by colluvium and some Pleistocene age clay and consists of sandstone, siltstone, shale, and economically important Pennsylvanian-age coal. In this highly dissected plateau, are remnants of a Pleistocene-age Teays River drainage system (ODGS, 1998).

3.2 Geologic Setting

Geology in southeast Ohio in the area of the WNF includes rocks of the Precambrian, Paleozoic, Mesozoic and Cenozoic ages. Precambrian igneous (red granite) and metamorphic (red granitic gneiss) rocks of the Grenville Province are the oldest and deepest rocks in southeastern Ohio. These igneous and metamorphic rocks are relatively flat. During the Paleozoic, marine transgression and regression in the area of the WNF deposited sands, silts, muds and limy muds which predominantly lithified into interlayered limestones (and dolomites), sandstones and shales. Later Paleozoic deposits included evaporates and organic-rich muds and silts. Southeastern Ohio was above sea level during the Mesozoic and Cenozoic Ages and erosion was prevalent. The topography of the WNF may be characterized as an unglaciated, hilly landscape, deeply dissected by well-developed watershed drainages of the Ohio River.

3.3 Stratigraphy and Structure

The stratigraphy of southeast Ohio, in the area of the WNF, is flat lying or gently dipping (less than 5 percent toward the southeast) sedimentary rock. The oldest exposed rocks in Ohio are a sequence of alternating shale and limestone beds deposited during the Ordovician Period (ODGS, 2006). Ohio geology, in general, consist of widespread deposition of dolomite with smaller amounts of shale during the Silurian Period. Carbonate rocks were the dominant rock type deposited in the Early and Middle Devonian, while clastic rocks dominated in the later part of the period. During the Mississippian Period, mainly shale and sandstone were deposited. From the Cambrian Period through the Mississippian Period, all of Ohio's bedrock had a marine origin except for some rocks in the Early Devonian Period, which had an eolian origin. During the Pennsylvanian Period, the Ohio area began shifting from a marine depositional environment to a terrestrial depositional environment. The Pennsylvanian Period included marine, deltaic, and continental sedimentary strata, and by the Permian Period the depositional environment was entirely terrestrial. Ohio has been subject to at least 3 periods of glaciation that covered as much as three quarters of its surface area (ODGS, 2005). Other than these glacial deposits and postglacial Quaternary sediments, there is no record of any other Cenozoic or Mesozoic Era deposits in Ohio (Coogan, 1996).

Surface geology of the Athens and Ironton Units consist of sedimentary rocks dating to the Pennsylvanian and Mississippian Periods. Pennsylvanian and Mississippian Period rocks are mainly marine, limestone, mudstone, shale, siltstone, sandstone and economic beds of coal. Surface geology of the Marietta Unit consists of Permian and Pennsylvanian Period sedimentary rocks and economic coal beds. The Dunkard Group, consisting of non-marine interlayered sandstone, siltstone, shale, limestone and coal, is located in a portion of the Marietta Unit and is the state's youngest sedimentary strata; it is considered to be from the Permian Period, but has not yet been assigned an exact age because of its unique fossil assemblage.

Geologic units in Ohio have been affected by regional structural features, including the Michigan and Appalachian Basins, and the Findlay and Cincinnati Arches located between those two basins (ODGS, 2006). The WNF units are in the Appalachian Basin. Periods of tectonic subsidence within these basins have produced broadly arching structures commonly seen in Ohio's bedrock. Structurally, Ohio has several local, high-angle faults and a four-and-one-half-mile diameter circle of deformed rock known as the Serpent Mound Impact Structure. The gently dipping (less than 5 percent toward the southeast) Early Ordovician to Permian Period rock layers are the only known major structural feature within the Athens and Ironton Units (ODGS, 2006). However, within the Marietta Unit a major structural feature is a north-south trending Burning Springs Anticline, which has smaller features on its flanks. No large faulting is known in the area, although small faults do occur.

3.4 Petroleum Geology of the WNF (reservoirs, traps, source rocks, seals, hydrocarbon generation and migration)

In petroleum geology and exploration, the term "play" refers to a regional group of oil fields or prospects controlled by similar geological parameters. These parameters include specific geologic formations or strata, source rock, structures, traps, seals, tectonic history, reservoir rock type and thermal maturity. The term play may also be used to describe a specific stratigraphic or structural geologic setting and its associated hydrocarbons. Organic-rich marine shale sequences are major source beds of oil and gas in the Appalachian Basin. A younger sequence, Middle Devonian to Early Mississippian in age, is extensive beneath the Appalachian Plateaus from New York to Alabama. An older sequence, Middle to early Late Ordovician in age, is extensive beneath the Appalachian Plateaus from New York to Alabama but more developed in the northern portion of the basin and the Valley and Ridge Province. Other potential source beds of oil and gas exist in the area of the WNF. These potential source beds include other organic-rich (kerogen) marine shales (such as the Utica) and coal beds (USGS, 1993). Many of these source beds may also be reservoir beds. Oil and gas migration from source beds into porous fracture zones and structural traps may have resulted from thrust faulting during the Alleghany Orogeny. Initially, natural gas will show a high content of condensate (wet gas), but with increased temperature the hydrocarbon would convert to light hydrocarbons (dry gas). Shale plays in the eastern portion of the Marietta Unit contain predominantly dry gas while the central and western portions of the Marietta Unit, Athens Unit and Ironton Units contain more wet gas.

Major oil and gas plays in the Appalachian Basin, identified by the United States Geological Survey in a 1993 bulletin, include an Upper Devonian sandstone play, Lower Devonian Oriskany play, Lower Silurian sandstone play, Ordovician carbonate shelf play, Upper Cambrian and Lower Ordovician Knox carbonate shelf play and the Rome trough play (USGS, 1993). The Rome Trough play does not extend into Ohio. Since this bulletin was published two additional major oil and gas plays have become prominent in Ohio: the Marcellus play and the Utica play. Major oil and gas plays within the WNF Proclamation Boundary include the Berea Sandstone, Ohio Shale (Upper Devonian sandstone play), Clinton-Medina Sandstone (Lower Silurian sandstone play), Marcellus Shale and Point Pleasant Formation/Utica Shale (Ordovician carbonate shelf play). Other known oil and/or gas-producing zones (ODGS, 1990) in the area of the WNF include:

- "Goose Run Sand" within the Pennsylvanian Monongahela Group, Upper Sewickley Sandstone
- "1st Cow Run" within the Pennsylvanian Conemaugh Group, Cow Run Sandstone
- "2nd Cow Run" within the Pennsylvanian Allegheny Group, Upper Freeport Sandstone
- "Macksburg 500 feet" within the Pennsylvanian Allegheny Group, Clarion Sandstone
- "Macksburg 700 feet" within the Pennsylvanian Pottsville Group, Homewood Sandstone
- "Salt Sand" within the Pennsylvanian Pottsville Group, Massillon Sandstone
- "Big Injun" within the Mississippian Cuyahoga Formation, Black Hand Sandstone
- "Squaw Sand" within the Mississippian Cuyahoga Formation
- "Weir Sand" within the Mississippian Cuyahoga Formation, Buena Vista Sandstone
- "Coffee Shale" within the Mississippian Sunbury Shale Formation
- "1st Berea" within the Mississippian Berea Sandstone Formation
- "Gantz" within the Devonian Ohio Shale Formation, Chagrin Shale
- "Gordon" within the Devonian Ohio Shale Formation, Chagrin Shale
- "Big Cinnamon" within the Devonian Ohio Shale Formation, Huron Shale
- Unnamed zone within the Devonian Oriskany Sandstone Formation
- Unnamed zone within the Silurian Salina Group, Bass Island Dolomite Formation
- "Newburg" within the Silurian Niagara Group, Lockport Dolomite Formation
- "Clinton" within the Silurian Albion Group, Grimsy Sandstone
- "Medina" within the Silurian Albion Group, Whirlpool Sandstone
- Ohio Shale
- Unnamed zone within the Ordovician Trenton Limestone Formation
- Unnamed zone within the Ordovician Black River Limestone Formation
- "Gull River" within the Ordovician Black River Limestone Formation
- "St. Peter Sand" within the Ordovician Wells Creek Formation
- "Rose Run Sand" within the Cambrian-Ordovician Knox Dolomite Formation
- "Beekmantown" Dolomite
- "Trenton-Black River" Limestone
- "Mt. Simon" Sandstone
- "Buell" Run
- "Keener" Sand
- "Queenston" Shale
- "Maxton" Sand
- "Maxville" Limestone
- "Trempealeau" within the Cambrian-Ordovician Knox Dolomite Formation

In the last approximately 14 years (2006 to 2019) oil and gas exploration targets within counties of the WNF include: Ohio Shale, Berea Sandstone, Clinton Sandstone, Rose Run Sandstone and Beekmantown Dolomite (counties of the Athens Unit), Berea and Cow Run Formation (counties of the Ironton Unit), Ohio Shale, Berea Sandstone, Cow Run Formation, Point Pleasant/Utica Shale and Marcellus Shale (counties of the Marietta Unit). In the last five years the Marcellus Shale, the interlayered limestone and shale of the Point Pleasant Formation/Utica Shale and the Berea Sandstone have become targets through unconventional (horizontal) drilling techniques.

In addition, there are shallow secondary production zones, particularly in the Marietta Unit, that offer operators a chance to complete a producing well even if they fail to find commercial quantities of oil and gas in one of the major targets. Also, there continues to be a possibility for commercial potential in the deeper formations such as the Beekmantown Dolomite and the Rose Run Sandstone. Drilling in the

WNF has generated enough geologic data to suggest there is potential for occurrence of hydrocarbons virtually everywhere within the WNF Proclamation Boundary.

4.0 PAST AND PRESENT OIL AND GAS EXPLORATION ACTIVITY

Oil and gas exploration includes surface and subsurface activities. Surface activities include mapping geologic features and evidence of surface hydrocarbon seepages, such as oil floating in springs, tar pits, and the presence of natural gas odors. Subsurface exploration activities include geophysical methods and exploratory drilling. Surface activities, geophysical methods and exploratory drilling occur in the first phases of mineral development and are used to obtain detailed geologic information to increase the likelihood of drilling a commercially favorable well.

4.1 Surface Exploration

Past and present surface exploration methods include mapping rocks, soils and structural features, such as faults and folds to identify possible hydrocarbon reservoir rocks and structural traps. Mapped surface geologic features are extrapolated to determine possible subsurface geologic features that may contain hydrocarbons. Past surface mapping in the area of the WNF was limited by soil and vegetation to areas of exposed rock, typically in drainages. In more recent times, construction of roads and railroads have exposed additional rocks and structures for analysis.

In the area of the WNF and southeast Ohio, hydrocarbons historically were sometimes observed floating on water bodies or shallow water wells. In 1814, oil in a well was discovered for the first time by a saltwater well driller in Noble County (Ohio Oil and Gas Association, n.d.). Natural gas was also noted in some springs and is recognized in place names, such as nearby Burning Springs, West Virginia. Recently, chemical analytical methods have been used to detect dissolved traces of naturally occurring gas and hydrocarbons in water samples. Surface exploration methods typically do not require permits, so it is difficult to estimate how much surface exploration is currently occurring in the WNF.

4.2 Geophysical Exploration

Geophysical exploration includes gravity, magnetism and seismographic methods. Gravimeters detect differences in gravitational force of various rock types. Magnetometers and gradiometers measure magnetic fields and resistivity meters measure subsurface electrical resistivity. Seismography uses induced sound waves or vibrations to map underground rock and structures. Minimal or no geophysical exploration is expected in the Marietta unit given local geologic conditions and available data from a long history of oil and gas development in the area. There is a greater potential for geophysical exploration occurring in the less explored Athens and Ironton Unit; however, the USFS reported no permits (the USFS require a special use permit for geophysical exploration) for oil and gas geophysical exploration of WNF Federal surface have been issued in the last 10 years (Bodus, 2019). It is not known if geophysical exploration occurred or is occurring on non-Federal surfaces in the WNF.

4.3 Exploratory Drilling

Exploratory drilling is employed to confirm target zones and identify possible impediments to well drilling and completion. Exploratory drilling often utilizes rock coring to analyze basic formation data such as permeability, porosity, total organic content, fracture density and reservoir-related parameters. Exploratory

drilling is classified typically as “wildcat drilling”, meaning they are drilled in an area of no known pool or reservoir. The Ohio Department of Natural Resources (ODNR) typically refers to exploration drilling they permit as either deeper pool wildcats, wildcats or outposts. ODNR annually summarizes wells drilled in Ohio by county. Although current exploration is primarily occurring within the eastern third of the state, commercial quantities of hydrocarbons have been found in 76 of 88 counties in Ohio (OOGA, n.d.). Exploratory drilling information for the previous 13 years is provided in Table 1.

Table 1: Exploratory Drilling from 2006 to 2018

EXPLORATORY WELLS DRILLED IN COUNTIES OF THE WAYNE NATIONAL FOREST 2006-2018														
	2006		2007		2008		2009		2010		2011		2012	
P = Produced hydrocarbons D = dry well	P	D	P	D	P	D	P	D	P	D	P	D	P	D
Athens					1									1
Gallia					9									
Hocking											1			
Jackson					2									
Lawrence		1	1											
Monroe	1		2		4		2		2		1		8	
Morgan													3	2
Noble	1	1	1		2	2	7		1				10	
Perry		2			1			1						
Scioto														
Vinton														
Washington	4	2	7		4	2		1			2			
Total State of Ohio Exploratory Wells	45		53		75		49		38		80		163	
Total WNF Counties Exploratory Wells	6	6	11		23	4	9	2	3	0	4	0	21	3
WNF Counties Exploratory Well Success	50%		100%		85%		82%		100%		100%		88%	

EXPLORATORY WELLS DRILLED IN COUNTIES OF THE WAYNE NATIONAL FOREST 2006-2018												
	2013		2014		2015		2016		2017		2018	
P = Produced hydrocarbons D = dry well	P	D	P	D	P	D	P	D	P	D	P	D
Athens												
Gallia												
Hocking												1
Jackson												
Lawrence												

Monroe	14		15		15		12		15		4	
Morgan	5		2									
Noble	6		6		5		3					
Perry			2		2		1			1		
Scioto												
Vinton												
Washington	3		1		2		2					
Total Ohio Exploratory Wells	153		100		90		58		64		28	
Total WNF Counties Exploratory Wells	28	0	26	0	24	0	18	0	15	1	4	1
WNF Counties Exploratory Well Success	100%		100%		100%		100%		94%		80%	

Note: ODNR lists total wells by county. Wells counted are within the county but might not have been drilled within the Wayne National Forest Proclamation Boundary. ODNR has on occasion revised data after an Annual Report has been issued. ODNR well numbers in this table are based on data presented in ODNR's Annual Reports and do not include possible subsequent ODNR revisions.

In 2006, exploratory drilling in the Clinton Sandstone (56%), Trempealeau Dolomite (16%) and Ohio Shale (11%) accounted for approximately 83% of all exploratory wells drilled in Ohio. In 2018, the Ohio Shale and Clinton Sandstone were not major exploration targets. In 2018, exploratory drilling in the Point Pleasant (39%), Trempealeau Limestone (25%) and Rose Run (25%) accounted for 89% of all exploratory wells drilled in Ohio.

In 2006, exploratory drilling in the counties of the WNF mostly targeted the Clinton Sandstone, Ohio Shale as well as the Berea Sandstone. In 2018, exploratory drilling in the counties of the WNF mostly targeted the Point Pleasant Formation/Utica Shale. Other recent oil and gas targets in Ohio included the Trenton-Black River, Rose Run, Trempealeau and Mt. Simon, not necessarily all occurring in all three WNF units.

According to available ODNR records, in 2006 a total of 765 oil and gas wells were completed in Ohio of which 45 were exploratory wells. Of the 45 exploratory wells, 17 were dry holes. In 2018 a total of 297 oil and gas wells were completed in Ohio of which 18 were exploratory wells. Of the 18 exploratory wells, 10 were dry holes. Four of the 2018 exploratory wells were drilled in Monroe County targeting the Point Pleasant Formation/Utica Shale. The 2018 exploratory well numbers reflect a general downward trend from a high of 163 exploratory wells drilled in 2012 due in part to overall lower oil and gas prices. Overall success of exploratory wells in counties associated with the WNF over the last thirteen years has ranged from 80% to 100% successful.

4.4 New Field and Reservoir Discoveries

The most recent new fields and reservoir discoveries in Ohio, including parts of the WNF, in the last 10 to 15 years include the Marcellus Shale and Point Pleasant Formation/Utica Shale. While these units have historically been known to contain appreciable volumes of natural gas and oil, advancements in unconventional drilling technologies have made these units productive targets. The Marcellus Shale extends through parts of extreme western Maryland, New York, Ohio, Pennsylvania, western Virginia, and West

Virginia. The Marcellus Shale is found in the eastern part of Ohio and is generally less than 50 feet thick. Depth to the Marcellus is approximately 2,000 feet in northern Ohio and deepens to approximately 7,000 feet in southern Ohio (Penn State, 2010). Marcellus Shale production ranges from a dry gas which is high in methane to a wet gas with higher percentages of ethane content.

The Point Pleasant/Utica Shale extends through parts of New York, Pennsylvania, West Virginia, and Ohio. The Utica Shale is found throughout the eastern half of Ohio and varies in thickness from approximately 85 feet to over 300 feet. Depth to the Utica Shale is approximately 3,500 feet in central Ohio and deepens to approximately 10,000 feet in easternmost Ohio (Wickstrom, et al., 2012).

5.0 PAST AND PRESENT OIL AND GAS DEVELOPMENT ACTIVITY

This section describes historic and current oil and gas development activity in Ohio based on information provided by both public and private sources. Information includes leasing activity, well spacing requirements, drilling and completion statistics by county, drilling practices, production statistics, oil and gas characteristics, oil and gas prices, operational costs (drilling, completion, gathering and transmission), conflicts with other mineral development, and gas storage fields.

Ohio's first well drilled to produce petroleum was completed in Trumbull County in 1859 (ODGS, 2004). Since then, the oil and gas industry in Ohio evolved along a typical "boom or bust" cycle (Ohio Oil and Gas Association, n.d.). Since 1860, more than 220,000 productive oil and gas wells have been drilled in Ohio and production from these wells is over 1 billion barrels (Bbbls) of oil and 9 trillion cubic feet (Tcf) of natural gas (ODGS, 2004). More than 60,000 wells are still active in Ohio and most of these are referred to as marginal or stripper wells because they produce less than 10 barrels (bbls) of oil or 60,000 cubic feet of natural gas per day.

5.1 Leasing Activity

A Federal oil and gas lease is a legal contract that grants exclusive rights to the lessee to develop federally owned oil and gas resources but does not authorize surface-disturbing activities or obligate the lessee to drill a well on the parcel in the future. Should a parcel be leased and a detailed plan for oil and gas development on the parcel be identified, the BLM and Forest Service would conduct additional site-specific environmental analysis and any required consultations, prior to any ground disturbing activities. The site-specific analysis would occur at the Application for Permit to Drill stage. The USFS would not be involved with further analysis if a proposed development plan involves privately held surface not administered by the USFS,

Under the Mineral Leasing Act, the BLM must conduct lease sales quarterly when eligible parcels are available for lease. The BLM generally issues two types of leases for oil and gas exploration and development of Federal minerals, competitive and noncompetitive. The Federal Onshore Oil and Gas Leasing Reform Act of 1987 requires that all public lands available for oil and gas leasing be offered first by competitive leasing. The BLM may issue a noncompetitive lease only after offering a parcel competitively at auction and not receiving a bid. The 1992 Energy Policy Act also allows the BLM to issue noncompetitive leases on mineral reversion parcels if certain production criteria apply.

Leasing parcels involving non-Federal minerals are negotiated between a mineral owner and a producer. Neither the BLM, USFS nor the ODNR get involved in contractual leasing between private landowners and producers. Accordingly, while it is recognized that oil and gas leases on private minerals exist within the WNF, it is not feasible for the BLM to attempt to quantify or characterize private leases within the WNF.

Given recent shale play activities, it would be reasonable to assume more private leases presently exist in the Marietta Unit than either the Athens Unit or the Ironton Unit. In the eastern portion of the Marietta Unit, where a number of unconventional wells exist and more are planned, it is reasonable to assume that many private mineral owners have entered into oil and/or gas leases.

Since 2006, the BLM has issued one lease (39.00 acres) in the Athens Unit, fourteen leases (9,432.66 acres) in the Ironton Unit, and 64 leases (4,953.00 acres) in the Marietta Unit. Six of the Marietta Unit leases were issued when previously acquired mineral rights reverted to the United States and had existing private leases. Five of these 79 leases, all located in the Marietta Unit, have been developed for oil and gas production. These 79 leases totaled approximately 14,425 acres of the 244,265 acres within the WNF, or about 5.9% of the total acres. None of the wells on the above mentioned five leases were installed on Federal surface and only include Federal mineral at depth and associated with unconventional wells.

5.2 Well Spacing Requirements

The State of Ohio has rules governing the location of wells, or " spacing" requirements. Ohio well spacing requirements for oil and gas wells drilled are subject to the rules and regulations of Ohio as stated in the Ohio Administrative Code, Division of Mineral Resources Management – Oil and Gas, Chapter 1501:9-1-04, Spacing and setback requirements of oil and gas wells. Minimum unit size is based on depth of the producing formation and the smallest unit size would be 1 acre for depths up to 1000 feet (OAC 1501:9-1-04(C)(1)(a)). The shortest lateral distance between well heads is 100 feet unless an exception is granted by the Division (ORC 1509.021[I]). The wellheads of all newly drilled wells, regardless of depth, cannot be closer than 50 feet to the traveled portion of a road which is the berm of the roadway and must have a 100-foot minimum setback requirement from homes. The spacing requirements are *minimum* distances and acreages. Factors such as terrain, surface/mineral ownership issues, economics, and operator preference can contribute to the actual well spacing being greater than State minimums. A summary of Ohio well spacing requirements is shown in Table 2.

Table 2: State of Ohio Spacing Requirements

Depth to oil & gas pool up to 1,000 Feet	
Minimum acres of tract or drilling unit hosting well	1
Minimum distance between other wells in the same pool	200 feet
Minimum distance from any boundary of subject tract or drilling unit	100 feet
Depth to oil & gas pool 1,000 up to 2,000 Feet	
Minimum acres of tract or drilling unit hosting well	10
Minimum distance between other wells in the same pool	460 feet
Minimum distance from any boundary of subject tract or drilling unit	230 feet
Depth to oil & gas pool 2,000 up to 4,000 Feet	
Minimum acres of tract or drilling unit hosting well	20
Minimum distance between other wells in the same pool	600 feet
Minimum distance from any boundary of subject tract or drilling unit	300 feet
Depth to oil & gas pool over 4,000 Feet	
Minimum acres of tract or drilling unit hosting well	40
Minimum distance between other wells in the same pool	1,000 feet
Minimum distance from any boundary of subject tract or drilling unit	500 feet

The State may grant exceptions to its spacing requirements, but such exceptions must be technically justified. Exceptions can be made pursuant to OAC 1501:9-1-04(E)(2) and ODNR has granted exceptions as close as 15 feet between well heads. However, the legal spacing between the producing portions of the wells must be maintained regardless of the wellhead distance.

Within the WNF there are multiple potentially productive zones at varying depths and the potential exists for a higher density of wells due to overlapping spacing units. Two wells could be located side by side and still satisfy spacing requirements because they are completed at different depths. However, operators will seek to produce multiple formations within a single wellbore whenever possible rather than incur the expense of drilling another well.

The majority of the foreseeable drilling targets within the WNF are the Point Pleasant/Utica formations, Marcellus Shale and Clinton sandstone in the Marietta Unit. Depths to the Marcellus may be as shallow as 1,800 feet and depths to the Point Pleasant/Utica formations may be between 3,000 and 9,000 feet. Accordingly, most new wells will be drilled on a minimum density of one well pad per 20 acres (target less than 4,000 feet) or 40 acres (targets greater than 4,000 feet). Drilling to the Clinton sandstone in the Marietta Unit, which lies over 4,000 feet deep also requires a minimum density of one well for every 40 acres. In the western two units, that is, Athens and Ironton, there may be some shallow well potential, but nothing anticipated less than 1,000 feet. Wells that produce between 1,001 feet and 2,000 feet require 10 acres. From 2,001 feet to 4,000 feet the requirement is 20 acres and anything over 4,000 feet needs at least 40 acres per drilling unit (Opritza, 2019).

5.3 Drilling Activity

Drilling activities typically include well pad and access construction, well installation and well stimulation prior to well production or a well being plugged and abandoned if dry. Rotary and cable tool drilling rigs are used to drill conventional or directional/unconventional wells. Conventional wells are vertically drilled wells. Unconventional wells are drilled vertically to a target formation depth and then drilled horizontally within that target formation. Currently in Ohio unconventional wells are being drilled primarily for natural gas in shale formations. Well pads typically contain multiple wells, especially when unconventional wells are drilled. Advancements in technology have resulted in more unconventional wells being drilled in the WNF, especially the eastern third of the Marietta Unit. Depending on the intended target, drilling can be classified as exploratory (wildcat), infilling, stratigraphic test, solution mining, gas storage or injection wells. Well stimulation predominately is hydraulic fracturing, although other stimulation techniques, such as acidification, may also be employed depending on the target being drilled.

The Ohio Department of Natural Resources, Division of Oil and Gas Resource Management (ODNR-OGRM) is responsible for non-federal gas and oil permitting and compliance in the state. In 2006, the state issued 1,239 new drilling permits, of which 952 wells (77%) were drilled (ODNR, 2007). In 2018, the state issued 388 new drilling permits and 30 reissued permits, of which 297 wells (71%) were drilled (ODNR, 2019c). Between 2006 and 2018, a low of 347 wells and a high of 1,428 wells were permitted with between 62% and 77% of the permitted wells drilled (ODNR, 2007 – 2016; 2019a-c). Wells drilled in the counties of the WNF are shown in Table 3.

For the three units of the WNF, from 2006 to 2012, most wells drilled were conventional wells. Since 2012 the number of unconventional wells being drilled has increased with all known new wells in the Marietta Unit being unconventional wells. The unconventional wells targeted the Point Pleasant Formation/Utica Shale and to lesser degree the Marcellus.

Table 3: Drilling and Well Completions from 2006 to 2018 in Counties of the WNF

DEVELOPMENT WELLS DRILLED IN COUNTIES OF THE WAYNE NATIONAL FOREST 2006-2018														
	2006		2007		2008		2009		2010		2011		2012	
P = Produced D = dry well	P	D	P	D	P	D	P	D	P	D	P	D	P	D
Athens	14		15		10		3		1		4		2	
Gallia							1							
Hocking			4		1								2	
Jackson			1											
Lawrence		1	1						4					
Monroe	55	1	76		64		22		16		15		23	
Morgan	6		20		22		6		5		2		1	
Noble	27		21		21		19		7				36	
Perry	24	2	21		13	1	3	1	1	2	2	1	2	
Scioto														
Vinton			1										**1**	
Washington	14		19		10		4		11				4	
Total Ohio Development Wells	720		818		748		391		319		285		374	
Total WNF Counties Development Wells	140	4	179	**0**	141	1	58	1	45	2	23	**1**	71	**0**
WNF Counties Development Well Success	97%		100%		99%		98%		96%		96%		100%	

DEVELOPMENT WELLS DRILLED IN COUNTIES OF THE WAYNE NATIONAL FOREST 2006-2018												
	2013		2014		2015		2016		2017		2018	
P = Produced D = dry well	P	D	P	D	P	D	P	D	P	D	P	D
Athens	1		1									
Gallia												
Hocking											1	
Jackson												
Lawrence												
Monroe	14		56		47		38		52		60	
Morgan	6		4	1								
Noble	37		54		20		21		16		5	
Perry	3		1							1		
Scioto												
Vinton												
Washington	3		14		1							
Total Ohio Development Wells	490		615		368		190		289		269	

Total WNF Counties Development Wells	64		130	1	68		59		68	1	66	
WNF Counties Development Well Success	100%		99%		100%		100%		98%		100%	
Note: ODNR lists total wells by county. Wells counted might not have been drilled within the Wayne National Forest Proclamation Boundary. ODNR has on occasion revised data after an Annual Report has been issued. ODNR well numbers in this table are based on data presented in ODNR's Annual Reports and do not include possible subsequent ODNR revisions.												

Table 4: Drilling and Well Completions from 2006 to 2019 in WNF

WELLS DRILLED IN THE WAYNE NATIONAL FOREST PROCLAMATION BOUNDARY 2006-2019										
	2006		2007		2008		2009		2010	
V = Vertical/Conventional H= Horizontal/Unconventional	V	H	V	H	V	H	V	H	V	H
Athens			4		3		1		3	
Gallia										
Hocking			1							
Jackson										
Lawrence									4	
Monroe	65		62		57		20		18	
Morgan										
Noble										
Perry	4		2		3		1		1	
Scioto										
Vinton										
Washington	15		8		6		1		3	
Total Wells Drilled in the WNF	84		77		69		23		29	
Total Wells Drilled on Federal Surface	1		4		3		0		3	
Total Wells Drilled on Non-Federal Surface	83		73		66		23		26	

WELLS DRILLED IN THE WAYNE NATIONAL FOREST PROCLAMATION BOUNDARY 2006-2019										
	2011		2012		2013		2014		2015	
V = Vertical/Conventional H= Horizontal/Unconventional	V	H	V	H	V	H	V	H	V	H
Athens	1				1					
Gallia										
Hocking	1		1							
Jackson										
Lawrence										
Monroe	11		19	3	4	12	3	8		17
Morgan										
Noble										

Perry			2		1					
Scioto										
Vinton										
Washington			1		2		2		2	
Total Wells Drilled in the WNF	13		26		20		13		19	
Total Wells Drilled on Federal Surface			2		2					
Total Wells Drilled on Non-Federal Surface	13		24		18		13		19	

WELLS DRILLED IN THE WAYNE NATIONAL FOREST PROCLAMATION BOUNDARY 2006-2019								
	2016		2017		2018		2019	
V = Vertical/Conventional H= Horizontal/Unconventional	V	H	V	H	V	H	V	H
Athens								2
Gallia								
Hocking								
Jackson								
Lawrence								
Monroe		17		14	1	15		8
Morgan								
Noble								
Perry								
Scioto								
Vinton								
Washington								
Total Wells Drilled in the WNF	17		14		16		10	
Total Wells Drilled on Federal Surface								2
Total Wells Drilled on Non-Federal Surface	17		14		16		8	

5.4 Drilling Practices

After applicable leases and permit are obtained, access roads and a drilling pad are constructed. Typical drilling practices include installing conductor casing, surface casing, intermediate casing, production casing, production tubing and, in some cases, liner. The largest diameter casing, the conductor casing may be installed to depths up to 100 feet and prevents unconsolidated soil and broken rock from collapsing the well. Surface casing, installed within the conductor, is installed to a depth below known ground water and provides support to a blowout preventor. Intermediate casing is installed within the surface casing and length varies depending on well conditions. Intermediate casing isolate potential trouble areas such as lost circulation zones, unstable rock strata and high-pressured strata. Production casing is installed within the intermediate casing and isolates a production stratum from non-production strata. Cement fills the annular space between each type of casing. Production tubing is installed within the production casing to transport oil and/or gas to the surface. Liners are casings that do not extend to the surface as with other casing types. After drilling, a well is stimulated by various techniques that may include hydraulic fracturing, to enable oil and natural gas in the production strata to be produced (OOGA, 2013).

Oil and gas drilling in southeastern Ohio is typically performed either by a cable tool drilling rig or a rotary tool drilling rig. Conventional drilling can be performed by cable tool or rotary drilling rigs. Cable tool drilling rigs use an impact tool or bit to crush rock at the bottom of the hole. Rock fragments are removed to advance the hole. In 2018, six wells in Ohio (none in the WNF) reportedly were drilled utilizing cable tool drilling rigs. Depths of these wells ranged from approximately 690 feet to 3,453 feet (ODNR, 2019c).

Unconventional drilling traditionally uses rotary drilling rigs but, may employ cable tool drilling rigs in the initial vertical portion of the well. Drilling operations for traditional oil and gas reservoirs utilize a variety of techniques including air drilling and circulating water-based or oil-based mud techniques. With the recent focus in southeastern Ohio on the Point Pleasant Formation/Utica Shale gas reservoir, unconventional drilling methods and advancements in hydraulic fracturing techniques have allowed increased access to productive reservoirs. The initial vertical segment in these wells is drilled with the traditional air or water-based drilling techniques and the unconventional lateral is drilled with an oil-based drilling mud system. In one Point Pleasant Formation unconventional well a total well length of approximately 30,676 feet (vertical depth of 10,314 feet) was drilled in Monroe County, Ohio (ODNR, 2019c). This nearly four-mile long lateral was considered when developing a four-mile buffer around the WNF Federals surfaces for analysis purposes.

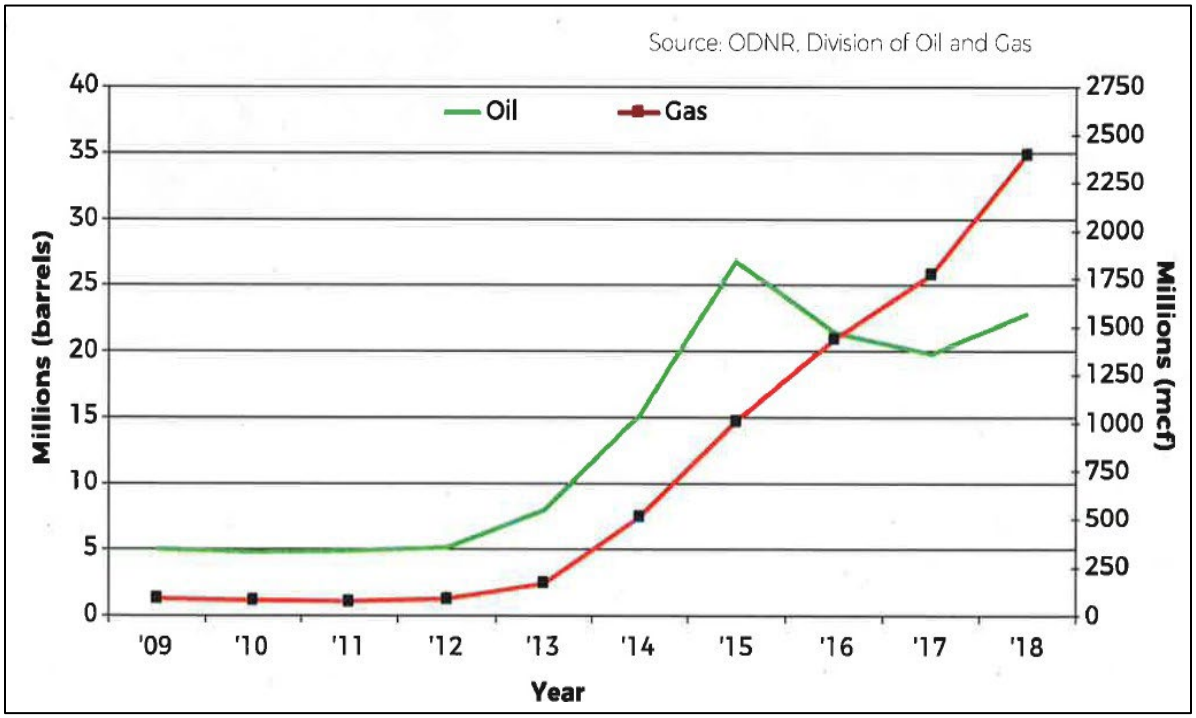
5.5 Drilling and Completion Costs

Drilling costs and well completion costs vary considerably by depth, reservoir, and completion practice for the specific reservoir to be produced and are determined relative to drilling, completion, and total well cost estimates. In 2018, average drilling cost per foot for an unconventional well was $1,127 and cost per foot for a conventional well was $125 (FTI, 2019). The cost for Marcellus Shale and Point Pleasant Formation/Utica Shale gas wells are higher than conventional vertical wells because of the increased costs associated with depth (1,800 feet to 3,000 feet and deeper) and the unconventional drilling techniques and multiple fracture stimulation treatments (hydraulic fracturing) performed on these wells. The installation cost of a typical unconventional Point Pleasant Formation/Utica Shale well is between 12-15 million dollars. The installation cost of a typical conventional Berea Sandstone well is between 0.5-1 million dollars.

5.6 Production Statistics

Oil and gas production statistics are currently available from the ODNR-OGRM through 2018 (latest available data). Considering the time since the 2006 Forest Plan, in 2006, the total volume of oil produced in Ohio was 5,422,194 barrels (one barrel is 42 U.S. gallons). The total volume of Ohio natural gas produced in 2006 was 86,315,100 million cubic feet (MMcf). In 2018, the total volume of oil produced in Ohio was 22,795,481 barrels. The total volume of natural gas produced in Ohio was 2,398,386,763 Mcf. Since 2009 oil and gas production has increased as shown in Figure 1 below. Although not shown in Graph 1, Oil and natural gas volumes produced between 2006 and 2008 are similar to 2009 production levels.

Graph 1: Total Oil and Gas Production for the State of Ohio (2009 - 2018)



Source: ODNR, 2018

ODNR oil and gas production statistics are well-based; however, the ODNR data may be separated by county and provide a general estimate of total county oil and gas production for each of the three WNF units. Based on combined 2006 data, wells located in the counties of the Athens Unit (Athens, Hocking, Morgan, Perry and Vinton) produced a total of 364,527 barrels oil and 86,098 Mcf of natural gas from approximately 4,612 wells. In 2018 these same counties produced a total of 10,159 barrels oil and 1,588,991 Mcf of natural gas from approximately 4,855 wells. Based on combined 2006 data, wells located in the counties of the Ironton Unit (Gallia, Jackson, Lawrence and Scioto) produced a total of 38,810 barrels oil and 760,826 Mcf of natural gas from approximately 738 wells. In 2018, these same counties produced a total of 31,282 barrels oil and 387,822 Mcf of natural gas from approximately 980 wells. Based on combined 2006 data, wells located in the counties of the Marietta Unit (Monroe, Noble and Washington) produced a total of 180,152 barrels oil and 6,213,725 Mcf of natural gas from approximately 7,343 wells. In 2018, these same counties produced a total of 1,526,365 barrels oil and 419,749,267 Mcf of natural gas from approximately 10,414 wells. These results are summarized below in Table 5.

Table 5: 2006 and 2018 Oil and Gas Production

	Athens Unit	Ironton Unit	Marietta Unit
2006			
Number of wells	4,612	738	7,343
Oil Production (bbls)	364,527	38,810	180,152
Gas Production (Mcf)	86,098	760,826	6,213,725
2018			
Number of wells	4,855	980	10,414
Oil Production (bbls)	10,159	31,282	1,526,365
Gas Production (Mcf)	1,588,991	387,822	419,749,267

Source: (ODNR, 2019)

Since 2006, oil production decreased in counties comprising the Athens and Ironton Units and increased in the counties comprising the Marietta Unit of the WNF. Gas production since 2006 increased in the Athens and Marietta Units and decreased in the Ironton unit. The total number of wells increased in counties included in all three units. The increase of unconventional wells drilled into the Point Pleasant and Utica Formations contributed greatly to the increase in natural gas production. The Marcellus Shale Play has produced a marked increase in leasing activities since 2003 when Range Resources Corporation drilled the first economically producing well in the shale unit using unconventional drilling and hydraulic fracturing techniques similar to those used in the development of wells in the Barnett Shale Formation of Texas. Prior to the initial Marcellus well activities and the increase in natural gas prices from 2003-05, the standard deal for lease agreements in unexplored areas of Ohio, Pennsylvania, and West Virginia had been about $25/acre for 5 years with a 12.5% royalty. In recent years, leases in some of the "hot spots" were in excess of $6,000/acre for 5 years with royalties as high as 20% (Wickstrom, et al. 2012).

5.7 Oil and Natural Gas Characteristics

5.7.1 Natural Gas

Natural gas is classified as conventional or unconventional natural gas based in part on the type of rock in which it occurs and on the method of production. Conventional natural gas is generally characterized as natural gas that migrates upward until impeded by a trap rock and accumulates in a permeable and/or porous rock reservoir. Conventional natural gas is often associated with oil and/or water. Conventional natural gas is often produced initially by reservoir pressure and later, as reservoir pressure decreases, by pumping.

Unconventional natural gas is associated with natural gas that occurs in shale and similar less permeable and/or porous rocks. Unconventional natural gas is often produced by drilling and hydraulic fracturing of the producing zone to induce porosity. Unconventional natural gas can be characterized as dry or wet. Dry natural gas is essentially methane with minor concentrations of condensable hydrocarbons. Wet natural gas is shale-derived gas that contains significant concentrations of condensable hydrocarbons such as butane and propane.

Natural gas recovered from fields in Ohio ranges from a "wet" gas, which contains some of the heavier fluid hydrocarbons in the northwest quarter of the state, to a "dry" gas with little or no condensate that is found toward the east, particularly the gas from the Marcellus Shale and Point Pleasant/Utica Shale. Most shale gas production is low in hydrogen sulfide (H_2S), and less than 1,120 British thermal units (Btu) per cubic foot. The Marcellus Shale gas production from the western and southern portions of the play ranges from 1,150 to 1,350 Btu per cubic foot at the wellhead and has an ethane content of up to 18% after processing.

5.7.2 Crude Oil

Crude oil is generally characterized by the oil's gravity, sulfur content and the presence or absence of any contaminants, including nitrogen, that may ultimately affect or limit the use of that crude oil in refinery operations. Crude oils are generally termed light or heavy crudes based on the American Petroleum Institute (API) gravity, and sweet or sour based on the sulfur content. A light crude oil is generally one with an API gravity over 40°, while very heavy crude oils will typically have an API gravity of 20° or less. The higher the API gravity is, the lower the density of the crude oil. In the area of the WNF the Berea Sandstone is seen to have API gravity of 38°, Ohio Shale (Upper Devonian Sandstone play) approximately 44°, Clinton-Medina Sandstone (Lower Silurian Sandstone play) approximately 43.5°, and the Marcellus Shale and Point Pleasant Formation/Utica Shale (Ordovician carbonate shelf play) has API gravity above 40° (condensate from wet gas). Sulfur content is expressed as weight percent of sulfur and typically ranges from 0.1 to 5.0 weight percent. The higher the weight percent of sulfur, the sourer the crude oil is considered.

Ohio grade crude oil typically contains wax and paraffin. Ohio grade crude oil can be broken down into the following five basic fractions: gasoline, kerosene and fuel oil, gas oil, wax distillate, and cylinder stock or bottoms. The percentages of gasoline and other fuels that can be produced or distilled are relatively small. The highest percentages of products from Ohio crude oil are high quality lubricating oils and waxes. Crude oil produced in Ohio has a wide variety of API gravity ratings which vary with depth, the producing reservoir, and the geographic location.

5.7.3 Coal Bed Methane

Coal bed methane gas is considered an unconventional natural gas associated with coal formations. In the Appalachian basin, coal bed methane occurs primarily in coal beds of Pennsylvanian (Carboniferous) age. According to the U.S. Energy Information Administration (EIA), between 2006 and 2008, Ohio had a proved reserve of 1 billion cubic feet of gas derived from coal beds. However, according to EIA, the proved reserve has been 0 for 2009 and 2010, the most recent data available (EIA, 2018). The reduction to zero in the most recent data has not been explained.

5.8 Oil and Gas Prices

The average annual crude oil wellhead prices for Ohio from 2006 through 2018 are shown in the table below. The price of Ohio crude oil rose from an annual average of $62.43 per barrel in 2006 to a peak annual average of $95.71 per barrel in 2013. Since 2013 the price of a barrel of Ohio crude oil has decreased. ODNR reported an annual average price of $60.14 per barrel in 2018. While ODNR has not released a 2019 Ohio crude oil average price, based on national averages the price is expected to be similar to 2018. A summary of oil and gas prices from 2006 to 2018 is shown in Table 6.

Table 6: Ohio Oil and Gas Prices 2006 and 2018

Oil and Natural Gas Prices 2006 - 2018							
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Oil ($/Barrel)	62.43	67.69	93.79	55.56	74.42	90.06	92.05
Gas ($/Mcf)	7.75	7.40	9.77	4.36	4.68	4.28	2.86
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Oil ($/Barrel)	95.71	79.92	36.78	39.36	47.25	60.14	-
Gas ($/Mcf)	3.51	3.78	1.96	2.36	2.80	2.92	-

(Source: ODNR, 2007-2019c)

The average annual natural gas wellhead prices for Ohio from 2006 through 2018 are shown in the table above. The price of Ohio natural gas rose from an annual average of $7.75 Mcf in 2006 to a peak annual average of $9.77 Mcf in 2008. Since 2008 the price of Ohio natural gas has generally decreased. ODNR reported an annual average price of $2.92 per Mcf in 2018. While ODNR has not released a 2019 Ohio natural gas wellhead average price, based on national averages the price is expected to be similar to 2018.

5.9 Gas Storage Fields

Extracted natural gas may be temporarily stored underground in gas storage fields. Gas storage fields are typically located near consumption or production areas and may utilize depleted oil and/or gas fields, aquifer storage fields or salt cavern storage. U. S. Energy Information Administration (EIA) data indicates 24 existing

natural gas storage fields in Ohio as of 2018 (FERC, 2019). None of the storage fields are located within the WNF Proclamation Boundary. The nearest gas storage field, the Laurel Field, is located near Hocking Hills State Park approximately 2 miles northwest of the western-most extent of the Athens Unit.

6.0 OIL AND GAS OCCURRENCE POTENTIAL

The oil and gas occurrence potential describes the likelihood of hydrocarbon-containing rocks within the WNF Proclamation Boundary.

6.1 Existing Oil and Gas Production

Ohio's first commercial petroleum well was completed in Trumbull County in 1859, shortly after the first well drilled in the United States that intentionally targeted oil was drilled near Titusville, Pennsylvania. The first major oil and gas discovery in Ohio was the Lima-Indiana oil and gas fields in 1884. Since 1860, more than 220,000 oil and gas wells have been drilled in the state. Oil and gas has been produced from all but 11 of 88 counties in Ohio (BLM, 2011). All 12 counties included in the WNF, but not necessarily within the WNF proclamation boundary, have had oil and gas production. Currently, oil and natural gas production are concentrated in the eastern half of Ohio (ODNR, 2019d). Recent Marcellus and Utica Shale discoveries and new drilling permit applications also follow this trend.

6.2 Oil and Gas Exploration and Production

Various oil and natural gas plays have been identified in Ohio since the noted Trumbull County well was drilled. From 2006 to 2018, the total number of oil and gas wells drilled annually in Ohio fluctuated from a maximum of 1,089 to a minimum of 248 wells. Only during 2007 and 2008 did wells drilled exceed 1,000 wells per year and all other years below 750 wells drilled. In 2018, a total of 297 oil and gas wells were drilled in the state. Wells drilled into the Utica/Point Pleasant formation accounted for 248 of the 297 wells. By 2018, there were over 65,000 active oil and gas wells in Ohio (ODNR, 2019c).

According to a January 2020 review of BLM's Automated Fluid Mineral Support System (AFMSS), there are 22 producing natural gas and 53 producing oil wells in the Athens Unit that include all or some Federal minerals, in addition to shut in or plugged wells. These are conventional wells producing from the Berea or Clinton Formations, which typically predate United States government acquisition of the minerals. AFMSS identifies five producing conventional gas wells in the Ironton Unit, all developed in the Clinton Formation. The Marietta Unit has 239 producing conventional gas wells and 152 conventional producing oil wells, in addition to shut in or plugged wells, in AFMSS. These AFMSS-listed wells are developed in several different formations, but the Berea, Ohio Shale and Clinton-Medina Formations comprise a majority (AFMSS, 2020).

Based upon recent exploration and production information, the greatest potential for oil and gas production is within the eastern Ohio counties including the WNF. As of 2019, all WNF units had producing oil or gas wells. The potential for the expansion of natural gas production in the Marcellus Shale exists in all three WNF units. The potential for the expansion of oil and natural gas production in the Utica/Point Pleasant formation exists in the Marietta and Athens units. Drilling of conventional oil and gas wells has fluctuated over the last decade based on the price of oil. Unconventional drilling for oil and natural gas in the Marcellus and Utica/Point Pleasant Formations increased between 2013 and 2018 and is expected to increase over the next fifteen years.

6.3 Natural Gas Production

Natural gas is found mainly in the eastern half of Ohio with additional fields in the northwest corner of the state (BLM, 2011). Natural gas production in 2006 was 86,315 million cubic feet and remained relatively unchanged through 2012. Gas production since 2013 has increased as a result of unconventional drilling in the Marcellus and Utica/Point Pleasant Formations. Natural gas production in the state of Ohio in 2018 was 2,398 billion cubic feet. Continued development of the Marcellus Shale (since 2006) and Point Pleasant Formation/Utica Shale (since 2010) Formations are expected to increase annual production rates for the foreseeable future in Ohio and the WNF.

6.4 Crude Oil Production

Crude oil is produced mainly in the eastern half of Ohio. Oil production in 2006 was 5,422,000 barrels of crude oil. Oil production was relatively unchanged from 2006 through 2012 and then increased from 2012 to 2015, where it peaked before a decline. The increase in oil production between 2012 and 2015 was influenced by an increase in unconventional wells producing from the Marcellus and the Utica/Point Pleasant Formations. Since 2017, crude oil production has slowly increased in Ohio with 22,795,481 barrels of oil produced in 2018 (ODNR, 2019c). Continued development of the Marcellus and Point Pleasant/Utica Formations should increase annual production rates for the foreseeable future in Ohio and the WNF.

6.5 Potential Oil and Gas Production Outlook

In 1993, the U.S. Geological Survey (USGS) completed an assessment of undiscovered oil and gas potential in the Appalachian Basin Province, which includes Ohio (USGS, 1993). The assessment estimated a mean of 70.2 trillion cubic feet of natural gas, a mean of 54 million barrels of oil, and a mean of 872 million barrels of total natural gas liquids. Approximately 94% of the undiscovered natural gas resource appears continuous and is found in the Utica-Lower Paleozoic play, the Devonian Shale-Middle to Upper Paleozoic play and the Carboniferous Coal-Bed Gas. The remaining 6% of undiscovered natural gas would be from conventional wells and gas accumulations. (USGS, 1993). Since this assessment, the USGS has completed additional assessments of undiscovered continuous oil and gas resources in the Marcellus and Point Pleasant/Utica Formations. The USGS estimated undiscovered, technically recoverable continuous resources of 96.5 trillion cubic feet of gas in the Marcellus Formation (USGS, 2019b). The USGS estimated undiscovered, technically recoverable continuous resources of 1.8 billion barrels of oil and 117.2 trillion cubic feet of gas in the Point Pleasant/Utica Formations (USGS, 2019b). While these quantities reflect the entire extent of these formations and not just within the WNF units, they show a potential for future development of oil and gas deposits within these shales in the WNF.

The potential for future development of oil and gas deposits within Ohio are closely tied to price trends. Crude oil production increased from 2006 through 2013 as prices generally rose from $62.43 per barrel to $95.71 per barrel. Crude oil production decreased from 2014 through 2016 as prices decreased from $79.92 per barrel to $39.36 per barrel. Crude oil prices increased in 2017 to $47.25 per barrel and in 2018 to $60.14 per barrel (ODNR 2019). Natural gas production increased from 2006 through 2018 (most current data from ODNR) although prices decreased from $7.75 per million cubic feet to $2.92 per million cubic feet. Increased production appears to have depressed the natural gas prices, but the greatly increased production made producing gas still profitable. (ODNR 2019a). It should be noted that some producing gas wells have been temporarily shut in or are producing at below maximum capacity levels while natural gas prices are low.

There is some potential for continued exploration and development in the Clinton Sandstone in Ohio and the WNF which has been the target of most new wells drilled in the state over the last decade. Historically,

development of this reservoir has depended upon drilling and recovery techniques and continued development of these techniques may sustain the Clinton Sandstone as an economic reservoir. The greatest potential for development is in the Marcellus and Point Pleasant/Utica Shale plays. Marcellus development began in Ohio in 2006 and continued to increase until the Point Pleasant/Utica Shale, a thicker unit, became a preferred target for unconventional wells. Marcellus development continues though not at the level of Point Pleasant/Utica Shale development. Utica Shale development began in the state in 2010 and already includes 16 wells drilled with another 35 well permits issued. The trend for exploration and production from the Marcellus Shale and Point Pleasant/Utica Shale is to utilize multi-well pads, new unconventional drilling techniques, and new multi-stage well stimulation techniques (hydraulic fracturing). Development in shallower formations, such as the Clinton-Medina and Berea, that traditionally were conventional wells, are expected to follow similar trends. Based upon these developments, the focus for development over the next fifteen years would be the Marcellus and Point Pleasant/Utica Shale with some unconventional development of shallower plays.

6.6 Conflicts with Other Mineral Development

Mineral development in Ohio includes a variety of economic rock and mineral resources in addition to oil and gas. These include coal, clay, limestone/dolomite, peat, sand, gravel, and crushed rock. Other than oil and gas, coal is the prevalent mineral development in the area of the three units of the WNF. Ohio coal deposits are only located in the eastern third of the state, that includes the parts of the WNF. In 2018, 9,613,912 tons of coal, 742,357 tons of clay, 65,458,961 tons of limestone/dolomite, and 31,700,708 tons sand and gravel were produced in Ohio (ODNR, 2019). Peat production was not reported. According to the Ohio Department of Natural Resources, six abandoned underground limestone mines (totaling approximately 486 underground acres of disturbance) are located within the WNF Proclamation Boundary. All six reported mines are in the Ironton Unit, three occur under private surface, one occurs under Forest Service surface and two occur under private and Forest Service surfaces.

The top leading coal producing counties in Ohio in decreasing order are Belmont, Harrison, Tuscarawas, Athens and Jefferson. (OHC, 2019). The WNF proclamation boundary only includes parts of Athens County. There are approximately 702 known abandoned coal, clay, or limestone (limestone mines noted above) mine sites located within the WNF, the majority of which are coal mines (ODNR, 2019). Approximately 22,000 acres of Federal lands of the WNF overlies inactive underground mines, with impacts concentrated in the Athens Unit where 20,174 acres of sub-surface (or 27.83% of the unit) have been mined. Mined acres is shown below in Table 7.

Table 7: Surface and Subsurface Mining in the WNF

	Unit Acres	Mined Acres (Federal lands only)	Percent Mined (Federal lands only)	Additional Acres from Mines (of unknown extent)	Total Percent Mined
Surface Mining					
Athens Unit	72,485	9,819	13.55	1,389	15.46
Ironton Unit	107,113	9,610	8.97	143	9.10
Marietta Unit	64,667	148	0.23	0	0.23
Totals	**244,265**	**19,577**	**8.01**	**1,532**	**8.64**
Subsurface Mining					
Athens Unit	72,485	20,174	27.83	-	-
Ironton Unit	107,113	1,704	1.59	-	-
Marietta Unit	64,667	3	0.005	-	-
Totals	**244,265**	**21,881**	**8.96**	**-**	**-**

Source: (USDA Forest Service, 2019)

When oil and gas exploration and development activities overlap mining areas, conflicts may arise over the place and size of access roads, transmission lines and drill pads. In the WNF, a total of 369 conventional oil and gas wells are within the unit acre boundary of 78 of the 141 surface mining operations in the Athens Unit. A total of 14 conventional oil and gas wells are within 9 of the 89 surface mining operations in the Ironton Unit. A total of 52 conventional oil and gas wells are within the unit acre boundary of 5 of the 7 surface mining operations in the Marietta Unit. Most of the oil and gas wells identified within a boundary of surface mining activities were either plugged and abandoned prior to issuance of a mining permit or plugged and abandoned a few years after a mining permit was issued. Plugging these wells may have avoided a potential conflict between oil and gas and mining activities.

7.0 OIL AND GAS DEVELOMENT POTENTIAL

The oil and gas development potential describes the likelihood of developing oil and natural gas within the WNF Proclamation Boundary for each of the three WNF units over a fifteen-year period. The forecast for Ohio oil and natural gas production was based upon the most recent statistics available from the EIA, the ODNR, the Department of the Interior's Office of Natural Resources Revenue (ONRR) and the 2018 Annual Energy Outlook Reference Case scenario (EIA, 2018).

7.1 Relative Oil and Gas Development Potential

Tables 1 and 3 identified exploration and production wells in WNF counties for the thirteen-year period from 2006 to 2018. Exploration wells were drilled in all twelve WNF counties, except for Scioto and Vinton counties. Monroe, Noble and Morgan counties had the most exploration wells drilled over this thirteen-year period. In the last 2 years, only Monroe and Perry Counties had exploration wells drilled. Producing wells were drilled in this same thirteen-year period in all WNF Counties, except Scioto County. Monroe, Noble and Morgan counties had the most producing wells drilled over this thirteen-year period. In the years 2017 and 2018, only Hocking, Monroe, Noble and Perry Counties had producing wells drilled.

Wellhead oil prices on the spot market averaged approximately $60.14 per barrel in 2018. Wellhead oil prices averaged $64 per barrel in 2019, despite continued economic sanctions on two OPEC members, supply cuts and continued unrest in the Middle East. In early May 2020, the EIA forecasted world crude oil prices would average $34 per barrel in 2020 and $48 per barrel in 2021 (EIA, 2020). Beginning in early 2020, a pandemic has reduced oil and gas consumption and negatively impacted oil and gas prices and activities. At this time, the long-term effects of the pandemic are not known but may last a number of years. If prices remain at, or near, the current levels, oil exploration and production in Ohio should remain similarly negatively impacted. It is forecasted that when higher consumption resumes and prices rise, oil exploration and production in Ohio would also increase. In 2018, 86% of total crude oil production came from unconventional/horizonal primarily natural gas wells on the Marcellus and Point Pleasant/Utica formations. Given the historical exploration and production data, coupled with the spatial extent of the thermal window (the zone where formation temperature does not raise above 130^{o} Celsius) for oil producing formations within the state, no significant discoveries or major increases in production of crude oil are expected and the majority of crude oil production would continue from unconventional primary natural gas wells in the Marcellus and Point Pleasant/Utica wells (ODNR, 2019). If crude oil prices were to decline below an economic price per barrel and remain there for an extended time period, then drilling and production rates would likely be reduced.

7.2 Oil and Gas Development Potential on Federal Land

Between 2006 and 2018, a low of 347 wells and a high of 1,428 wells were permitted annually, with between 62% and 77% of the permitted wells actually drilled (ODNR, 2011 – 2016; 2019a-c). In 2018, the state issued 418 drilling permits (388 new drilling permits and 30 reissued drilling permits) of which 297 wells (71%) were actually drilled (ODNR, 2019c). Four of the 297 wells (1.35%) were drilled in Monroe County, the only WNF county to have wells drilled during 2018. None of these wells were installed on Federal surface.

For the three units of the WNF, since 2009, leases totaled approximately 12,590 acres of the 244,265 acres within the WNF, or about 5.15% of the total Federal acres. In the WNF area the industry trend from 2006 through 2019 reflects a preference for drilling from non-Federal surface and avoiding the Federal owned surface land. However, it is not out of the realm of possibility that wells may be drilled on Federal owned surface lands. This trend may change if more economically feasible private surfaces are not available, Federal oil and gas regulations change, changes to USFS surface occupancy stipulations, or increased oil and natural gas prices make Federal surface lands attractive. Leased Federal minerals are typically encountered in spacing units for unconventional wells. This trend is likely to continue given the availability of suitable non-Federal lands for installation of well pads and ancillary surface features. Given the patchwork distribution of Federal and non-Federal surfaces in the WNF, Federal surfaces that are not economically feasible to avoid may be considered for subsurface distribution pipelines if drilling and production volumes increase.

Oil and gas development potential for the three units of the WNF may be classified low, medium or high potential for the next 15 years. This classification refers only to the three units of the WNF relative to each other and not any larger regional development potential. This classification is based primarily on geology and development activity (number of wells drilled per county but not necessarily within the WNF proclamation boundary) from 2006 through 2018 (last available data). Many of the same traditional conventional well oil and gas producing targets (such as Berea Sandstone, Ohio Shale and Clinton-Medina Sandstone) occur under all or parts of the three units of the WNF. Unconventional oil and gas targets, such as the Utica/Point Pleasant and Marcellus targets are located under the Athens and Marietta Units and may extend partially under the Ironton Unit. Two hundred and twenty-one producing wells were reported drilled in counties of the Athens Unit from 2006 through 2018, Nineteen producing wells were reported drilled in counties of the Ironton Unit and 1,064 producing wells were reported drilled in counties of the Marietta Unit during this same period. The Marietta Unit is classified as a high potential for development based on current high industry interest in the Utica/Point Pleasant target, the Athens Unit is a medium potential given the geologic potential but less industry interest and the Ironton Unit is low potential for development given low industry interest.

8.0 RFDS BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION

As mentioned in Section 2.0, a RFDS is a modeled scenario of anticipated oil and gas exploration, and/or development activity for a defined area and specified period, and documentation of technical information in the administrative record of any analysis for which it is used. This RFDS provides support information for an update to the 2006 Land and Resource Management Plan for the Wayne National Forest. This document was prepared during 2019 and early 2020 and the 15 years being analyzed for future potential development is 2020 to 2034.

The following summarizes the baseline scenario assumptions used by the BLM to prepare this RFDS:

- The change in Ohio's production over the forecast horizon (2020 to 2034) will mirror that of the Annual Energy Outlook Reference Case.
- New well pads, access roads and ancillary support features (pipelines, storage tanks, metering stations, etc.) may be constructed anywhere within the proclamation boundary of the three WNF units, whether surface ownership is Federal or non-Federal subject to any lease stipulations.
- Interest in obtaining leases within the WNF would continue at the same or slightly increased level of interest.
- Valid existing rights will remain in effect.
- Industry exploration and extraction of oil and gas would continue to follow a similar pattern of focus on known producing plays underlying the WNF.
- The Federal leasing process would continue relatively unchanged for the next fifteen years or until all available Federal minerals have been leased.
- Non-Federal leasing within the WNF proclamation boundary would continue relatively unchanged for the next fifteen years or until available non-Federal minerals are leased.
- Multiple unconventional wells drilled from a single well pad.
- Well pad size would comply with ODNR regulations.
- New well pads and access roads would preferentially be constructed on non-Federal surface. Construction of Federal surface well pad sites would increase only when private surface sites are no longer available.
- Existing roads and facilities would be used where possible and any additional offsite or central facilities for compressors, dehydrators/separators, and storage and metering would be constructed preferentially on private surface.
- Oil and gas exploration, development and production of potentially productive areas are open under the standard lease terms and conditions except those areas designated as closed to leasing by law, regulation, or executive order.
- Deep unconventional wells would continue being installed at a same or slightly greater rate than shallow conventional wells.
- No new regulations or restrictions to oil and gas development that have not already been implemented or are currently pending, would be implemented.
- Oil and gas prices similar to current prices would remain for a number of years and would thereafter increase to the end of the 15-year period ending in year 2034.
- Oil and gas drilling and production costs would remain stable over the next 15 years.
- Federal surface and mineral estates within the WNF would increase through USFS acquisitions and mineral reversions.

8.1 Discussion of Determining Oil and Gas Resource Potential

Publicly available descriptions of stratigraphy, structure, historic oil and gas activities, as well as relevant studies conducted in the area were used to determine oil and gas resource potential for the WNF.

8.2 Methodology for Predicting Future Oil and Gas Exploration and Development Activity

Predictions of future oil and gas exploration and development activities are determined by an area's geology, historic and present activities, economics, technological advances, access to oil and gas resources, transportation, and available processing facilities. Economics and technology may be hard to predict because

of their complex nature and potential rapid rate of change. Projections of oil and gas activities are based upon present knowledge. Future changes in global oil and gas markets, infrastructure and transportation, or technological advancements may affect future oil and gas exploration and development activities within the state.

8.3 Relating the Potential for Resource Occurrence to Potential for Activity

Projected oil and gas activity does not necessarily correlate with geologic potential for the presence of hydrocarbons. Although the geology of an area may suggest the possibility of oil and gas resources, actual exploration and development may be restricted by high exploration costs, low oil and gas prices, or difficulty accessing the area. Thus, a small area may have a high resource potential, yet have a low exploration and development potential due to accessibility. Conversely, technological advancements or an increase in oil and gas prices could result in oil and gas activities in areas regarded as having low potential for occurrence.

This RFDS assumes that all potentially productive areas are open under the standard lease terms and conditions except those areas designated as closed to leasing by law, regulation, or executive order. The projections are intended to provide the information necessary so that all potential cumulative impacts can be analyzed. The disturbance for each well is based on the typical depth of wells for an area; generally, shallow wells disturb fewer acres than deeper wells.

The study area for the WNF was defined as all WNF land including a 4-mile wide buffer zone around Federal surface lands within the WNF. Estimates for oil and gas development within the WNF Proclamation Boundary and within 4-miles from Federal surface lands are forecast.

9.0 SURFACE DISTURBANCE DUE TO OIL AND GAS ACTIVITY ON ALL LANDS

In 2018, the ODNR issued 837 permits (includes permits to convert, deepen, drill, plug back, plug and abandon, reissue and reopen) of which permits to drill oil and gas wells totaled 418 (388 new permits and 30 reissued permits). Unconventional wells accounted for 79% of all oil and gas permits. Based on all oil and gas permits issued, the recent trend for crude oil exploration and development in Ohio is the Clinton Sandstone (9% of permits), deeper formations such as the Beekmantown dolomite, Rose Run sandstone, Trempealeau dolomite (5% of permits) and the Trenton/Black River formations (3% of permits). Based on oil and gas permits issued, the recent trend for natural gas exploration and development in Ohio involves the Point Pleasant Formation/Utica shales (76% of permits) and Marcellus shale (3% of permits) (ODNR, 2019c). These relative percentages are like 2016 and 2017 oil and gas permits issued except for Berea sandstone permits instead of Trenton/Black River formations permits (ODNR, 2019b). An analysis of the data compiled in this report forecasts that, upon applying a "Reasonably and Foreseeable Development Scenario," the Point Pleasant Formation/Utica Shale and Marcellus Shale plays for natural gas and the Clinton Sandstone, Trenton formation, Berea Sandstone and various deeper formation plays for oil should continue to dominate exploration and development activities for natural gas and crude oil over the next 10-15 years. The surface disturbance forecast presented in this section is presented as primarily conventional single-well pads for oil well drilling, and as primarily unconventional multi-well pads for natural gas drilling. The possibility for multiple conventions wells or single unconventional wells being installed on a single well pad was also considered. Surface disturbance activities should be similar regardless of actual formation being targeted.

9.1 Surface Disturbances

Estimates of anticipated surface disturbances associated with the development of oil and gas within the State of Ohio over the time period 2020 to 2034 were determined from a variety of resources, including previous oil and gas environmental assessments, recent drilling permits applications, discussion with state oil and gas personnel, discussion with a prominent operator in the WNFs, and document reviews. As previously mentioned, assumptions used to evaluate potential surface disturbance include drilling of multiple wells from a single well pad (unconventional wells), single well from a single well pad (conventional wells), well pad sizes that comply with ODNR regulations, drilling of wells from existing locations, use of existing roads and facilities (pipelines, storage tanks, metering stations, etc.) where possible, preferential installation of well pads on private surface rather than Federal surface, and preferential construction of any additional offsite or central facilities for compressors, dehydrators/separators, and storage and metering facilities on private surface.

The level of disturbance (well pad, access road, soil stockpiles, erosion-control features, guard shacks, etc.) associated with oil and gas development varies depending on the depth of the well and type of well drilled (unconventional or conventional). Conventional well pads in the area of the WNF typically contain one well. Unconventional well pads in the area of the WNF may contain one to eighteen or more wells, with three wells per well pad being common. One example of a recently permitted unconventional well pad installed on non-Federal surface but intersecting Federal minerals at depth were reviewed for surface disturbance (BLM. 2019). The Jackson pad is proposed to contain 7 unconventional wells and new surface disturbance during construction is estimated in their permit application to be approximately 18 acres. The 18 acres of disturbance consist of an 8.7 acre well pad, 1.32-acre access road and 8.03 acres of pipeline. Typically, after construction is complete most disturbed ground is regraded and seeded leaving only an access road and well pad as longer-term disturbance (for the life of the well). Proposed longer term disturbance for the site is 3.7.

9.1.1 Well Spacing

The State of Ohio has rules governing the location of wells, or "spacing" requirements. Given the availability of directional drilling techniques, it is possible for a surface location to be offset from its intended bottom hole location. The State may grant exceptions to its spacing requirements, but such exceptions are rare and must be technically justified. In addition to the above bottom hole restrictions, the wellheads of all newly drilled wells, regardless of depth, cannot be closer than 50 feet to the traveled portion of a road which is considered to be the berm of the roadway and must have a 100-foot minimum setback requirement from homes.

It is important to keep in mind that the spacing requirements are *minimum* distances and acreages. Factors such as terrain, surface/mineral ownership issues, economics, and operator preference can contribute to the actual well spacing being greater than State minimums. For example, even though the State spacing requirements for Clinton wells in Lawrence County call for a minimum drilling unit size of 20 acres, one operator in the area reports using drilling units 60 to 70 acres in size.

Within the WNF there are multiple potentially productive zones at varying depths and the potential exists for higher density of wells due to overlapping spacing units. Two wells could be located side by side and still satisfy spacing requirements because they are completed at different depths. However, operators will seek to produce multiple formations within a single wellbore whenever possible rather than incur the expense of drilling another well.

The majority of the foreseeable drilling targets within the WNF are between 2,000 to 4,000 feet deep, which means most new wells will be drilled on a minimum density of one well pad per 20 acres. In addition, there appears to be growing interest in drilling to the Clinton-Medina Formation in the Marietta

Unit, which lies at a depth greater than 4,000 feet and thus requires a minimum density of one well for every 40 acres.

9.1.2 Well Pads

Well pads provide a stable work platform for well drilling. Well pad are typically constructed using standard construction equipment, such as bulldozers, graders and scrapers to provide a level pad. Given hilly topography in the region that includes the three units of the WNF, cut and fill methods are often used. The volume of material removed depends on slope steepness and size of pad. The steeper the slope under the proposed pad, the greater volume of material that needs to be removed, used as fill and/or stockpiled for later reclamation. Soil is typically removed and stockpiled during pad construction. Typically pads for deep targeted unconventional wells or multiple wells, are larger than shallow conventional wells.

9.1.3 Well Pad Access

Well pad access is location dependent but, is typically designed to be the shortest feasible route to reduce construction and haulage costs. Well pads access are often constructed to maximize existing access roads. Access roads are typically constructed using standard construction equipment, such as bulldozers, excavators, graders and scrapers according to best management practices and safety interests. Access roads typically consist of a 14 to 20 feet wide running surface with the volume of downcast material dependent on slope. Access roads are constructed to support heavy equipment and use drainage and erosion controls such as side ditches and culverts. Depending on expected well life and surface owner agreements, access roads may be temporary or permanent.

9.1.4 Surface Brine Disposal

Conventional and unconventional drilling and development activities may produce brine solutions. Brine typically refers to naturally occurring salty water in rocks but, may be used to describe any salty water produced during oil and gas activities. Brine concentrations may vary between formations and within the same formation and volumes produced depends on specifics of the formations being drilled and length of the borehole. Unconventional drilling typically are longer boreholes and have a potential to produce more brine. Most of the brine is produced during flowback after hydraulic fracturing. In Ohio brine produced during oil and gas operations may be disposed of in one of approximately 225 deep injection wells. Three of these wells are identified within the Athens Unit, one well is identified within the Ironton Unit and five wells are identified within the Marietta Unit. None of these deep injection wells are known to occur on Federal Surface or minerals (ODNR, 2020b). Brine solutions from conventional wells may also be applied to roadways for dust suppression and deicing. The surface impact from produced brine potentially would be on treated road surfaces and possibly any adjacent drainage ditches.

9.2 Typical Oil and Gas Operations

9.2.1 Drilling Operations

Initially, heavy earth moving equipment is used to build the access road and well pad. Topsoil is stockpiled for use in reclaiming areas not needed during the production phase. Currently most drilling operations use aboveground storage tanks to store fluids (potable water, flowback water, brine, etc.). However, if aboveground storage tanks are not used, a large "reserve" pit to temporarily store drilling fluids may be dug on the well pad. Material excavated from the pit during construction is stockpiled on-site to backfill the pit when drilling is finished.

Most wells will be drilled by a rotary rig. Less commonly, wells will be drilled by a cable tool rig. Both types of rigs are powered by diesel engines. In 2017, only three cable tool rigs operated in Ohio (ODNR, 2019c) During drilling, the mast of a rotary rig extends from 80 to 100 feet in height, while a cable tool rig mast height typically extends less than 30 feet. Since drilling is a continuous operation until the total depth of the well is reached, the lights and engine noise from the rig are evident throughout the day and night. It takes a rotary rig about three to five days to drill a typical well in the WNF.

9.2.1.1 Conventional Drilling

Conventional drilling is typically used on shallower target depths, use smaller drilling rigs and typically require a smaller surface disturbance footprint. Once drilling commences activities are continuous until the well is completed or plugged and abandoned. While many variables can impact drilling time, a typical conventional well takes about three days to drill. During this time surface impacts would include travel to and from the well pad, noise and air emissions.

9.2.1.2 Unconventional Drilling

Unconventional drilling is typically used on deeper target depths, use larger drilling rigs and typically require a larger surface disturbance footprint than conventional drilling. Once drilling commences activities are continuous until the well is completed or plugged and abandoned. While many variables can impact drilling time, a typical unconventional well takes about five days to drill. During this time surface impacts would include travel to and from the well pad, noise, light and air emissions. Multiple wells may be drilled in succession increasing the number of consecutive drilling days, quantity of noise, light and air emissions occurring on the pad. Unconventional drilling is more likely to utilize hydraulic fracturing technology to stimulate or increase production after drilling operations have concluded.

The Oil and Gas Potential Analysis contained in the 1992 Amendment #8 to the WNF Plan concluded that directional or unconventional drilling would not be economically feasible in the Forest. Since the 1992 Amendment #8 WNF Plan, unconventional drilling of the Marcellus Formation and later the Point Pleasant Formations/Utica Shale has become common due to advances in technology, especially in the Marietta Unit's Monroe County.

9.2.2 Production Operations

The typical producing oil well and its associated production facility consists of one or two 100-barrel steel oil/water storage tanks surrounded by an earthen dike, a pump jack and motor to bring the oil to the surface, an electric line to run the motor, a separator (a vessel that separates the raw well stream into oil, gas, and water), and if gas is being produced with the oil, a gas meter. If an electric source is not readily available, pump jack motors can be run by natural gas drawn off the well. A typical producing gas well and its facility typically consist of an assortment of valves on the wellhead, a 100-barrel tank for produced water, a separator, and a gas meter.

Hydrocarbons are transported from the wellbore to the production equipment by means of varying lengths of 2-inch diameter pipe. Where feasible, pipelines are buried at least 24 inches below the ground surface. There may be a permanent flare to dispose of small quantities of natural gas that are not economic to sell. When natural gas can be marketed, gathering pipelines transmit the gas from the production facility to secondary collector lines and on to main transmission lines. Given the long history of gas production in the WNF, there is already a well-developed pipeline infrastructure in place which should minimize the need for lengthy gathering lines to service new wells. However, as existing infrastructure ages and degrades it will need to be repaired, replaced or additional pipelines installed. If production volumes increase greater diameter pipelines may be needed to be installed.

Water produced along with the oil and gas is generally salty, sometimes sulfurous and may contain radionuclides as well as other dissolved elements. Federal and state regulations require proper disposal of this saltwater, or brine. In 2018 most producing wells in the 12 counties that include the WNF reported no brine production. While most wells reported no brine production, some wells, primarily in the Marietta and Athens Units, reported tens to thousands of barrels of brine produced. The maximum 2018 brine volume reported from one producing well was 82,115 barrels for a well located in Monroe County. The most common method (98% of the time) of disposal in Ohio is for the brine to be trucked to a state-licensed disposal well where it is injected into underground formations already containing brine. A less common disposal method allowed in certain townships is road spreading of brine for the purpose of dust and ice control. Producing wells in the WNF typically report producing none or only small amounts of brine.

Access to the site would typically be through a locked gate located at the start of a lease access road. A company employee, called a "pumper," regularly inspects and maintains the well and facility. Tanker trucks will pick up oil and/or brine from production tanks on a volume-determined schedule. Occasionally, producing oil and gas wells experience mechanical problems in the wellbore that require a process called a workover. A workover involves bringing a smaller service rig to the location to perform any needed service on the well. Workovers take place on the existing well pad and typically use aboveground storage tanks but may use a small pit to contain any fluids circulated from the wellbore. After the workover is complete, any fluids remaining in the pit are vacuumed out and disposed of in accordance with state requirements. The pit is then backfilled and revegetated as appropriate.

9.2.3 Abandonment and Final Reclamation

Ohio and Federal regulations require permanent abandonment of depleted producing wells to occur quickly after all oil and gas operations have ceased. If there will be an excessive interval of time between one phase of activity and another, Federal and state regulations require that the well be temporarily plugged.

If oil and gas are not found in commercial quantities, under state and Federal regulations the drilled wellbore is plugged with cement. The well pad, access roads and associated disturbed grounds are restored to original contour and all disturbed area reseeded. The operator is responsible for ensuring vegetation is satisfactorily established over the affected areas in order to stabilize the soil and prevent erosion.

Plugging and abandonment of wells installed to shallow depths and lacking encounters with geologic hazards, typically can be completed within three days on wells located in the WNF. Wells installed to deeper depths or that encounter geologic hazards typically take longer to plug and abandon. Activity at the site will entail use of a smaller truck-mounted service rig and several large trucks which will be used for the retrieval of well casing and the placement of cement plugs and hydrostatic mud in the bore hole. All horizons of hydrocarbon occurrence, unusual water flows, and freshwater zones will be sealed from the bore hole by the cement plugs. Remaining surface equipment is removed at this time. Surface restoration and reclamation should be initiated and completed within 1 year of well abandonment on Federal surface lands. Final approval of surface restoration and reclamation by the surface management agency may take up to five years.

9.3 Production History and Life Expectancy of Producing Fields

The average life expectancy of producing conventional wells within the WNF is fifteen to thirty years, and the average life expectancy of producing unconventional wells is twenty-five to forty years. Numerous examples can be given on both ends of the life expectancy spectrum, including wells that have been produced continuously since the early 1900s, on the one end, to economic wells which never produce due to legal hindrances, on the other.

Conventional wells typically produce at a relatively high rate for the first few years, and after experiencing a rapid decline in production they will continue to produce at a low rate for the remainder of a wells' lives. Production from unconventional wells typically produce at a relatively high rate for the first several months to a year and then have a long well life with a decline in production throughout its production history. Production will usually continue until operators determine that the wells will no longer produce enough hydrocarbons to pay for the day to day operating expenses.

ODNR information on well completions in the 12 counties where the WNF is located were examined for development trends that may impact Forest lands. Below, the 46-year period from 1973 to 2018 was broken up into five separate periods (the first four are a decade each) to look at timeframes that are equivalent to Forest planning periods. The results of this breakdown are as follows:

- **For the period 1973 to 1982** - A total of 1,861 wells were completed in the twelve subject counties. Of this total, 600 wells, or 32.24 percent, were completed within the WNF Proclamation Boundary. Of the wells drilled within the Forest proclamation boundary, 121 wells, or 20.17 percent, were completed on surface managed by the Forest Service.
- **For the period 1983 to 1992** - A total of 4,924 wells were completed in the twelve subject counties. Of this total, 1,073 wells, or 21.79 percent, were completed within the WNF Proclamation Boundary. Of the wells drilled within the WNF Proclamation Boundary, 213 wells, or 19.85 percent, were completed on surface managed by the Forest Service.
- **For the period 1993 to 2002** - A total of l,180 wells were completed in the twelve subject counties. Of this total, 330 wells, or 27.97 percent, were completed within the Forest proclamation boundary. Of the wells drilled within the WNF Proclamation Boundary, 22 wells, or 6.67 percent, were completed on surface managed by the Forest Service.
- **For the period 2003 to 2012** - A total of 1,193 wells were completed in the twelve subject counties. Of this total, 500 wells, or 41.91 percent, were completed within the Forest proclamation boundary. Of the wells drilled within the WNF Proclamation Boundary, 16 wells, or 3.2 percent, were completed on surface managed by the Forest Service.
- **For the period 2013 to 2018** - A total of 574 wells were completed in the twelve subject counties. Of this total, 99 wells, or 17.25 percent, were completed within the Forest proclamation boundary. Of the wells drilled within the WNF Proclamation Boundary, 2 wells, or 2.02 percent, were completed on surface managed by the Forest Service.

This information suggests that for the past approximately 50 years, oil and gas drilling on federally owned surface has not been a development preference within the WNF Proclamation Boundary. From this, one could conclude that, if suitable non-Federal surface is available, oil and gas operators would continue preferentially developing non-Federal owned surface over Federal owned surface. As additional nonconventional wells are drilled in the WNF it is highly likely most federal minerals would be accessed in the subsurface from wells installed on non-Federal surfaces.

9.3.1 Development Forecast for the Athens Unit

The principal exploration targets of the Athens Unit are the Berea and Clinton-Medina formations. These exploration targets have been drilled using conventional methods, however it is possible that they may be drilled unconventionally in the future. The Berea is approximately 1,000 feet deep equating to a minimum drilling unit size of 1 to 10 acres per well and Clinton-Medina is less than 4,000 feet deep in the Athens Unit equating to a minimum drilling unit size of 20 acres per well. There is potential for production from formations shallower than the Berea, but to date no significant production has been established from these zones in the area. There is also potential for production deeper than the Clinton-Medina but drilling below the Clinton has been rare for the area and is not expected in the foreseeable future. The Point Pleasant/Utica Formation is an unconventional target that exist beneath the Athens Unit. At this time there are no unconventional targets being developed; however, traditionally conventional targets may become unconventional targets in the future. It is possible that technology used to install deeper unconventional wells may be used on shallower formations to increase production. It is possible that existing conventional wells may be converted into unconventional wells if an operator believe it is economically feasible. The geology underlying this unit, relative to the other two units, suggest a medium potential for development. However, based on modeling no new wells are predicted to be installed in the Athens Unit in the next 15 years. This prediction takes into consideration current natural gas and oil prices and lack of industry interest in Federal leases on this unit at this time.

In Ohio, a total 2,804 wells were plugged from 2008 to 2018. Athens, Hocking, Morgan, Perry, Vinton and Washington Counties of the Athens Unit had a total 523 wells plugged (18.6% of state total) from 2008 to 2018. While Washington County extends into both the Athens and Marietta Units, wells plugged in Washington County are included only in the Marietta Unit wells plugged number. Wells being plugged are conventional wells, since unconventional wells are not known in Athens, Hocking, Morgan, Perry or Vinton Counties. Assuming a similar rate of plugging, this report projects that 785 depleted producers would be plugged in these counties over the next 15 years. Using 0.55 acres as the average amount of net surface disturbance associated with a producing conventional well (e.g., 0.38 acres of road and 0.17 acres of well pad), plugging 785 depleted producers will result in approximately 432 acres of restored surface over fifteen years.

9.3.2 Development Forecast for the Ironton Unit

Two principal exploration targets of the Ironton Unit are the Berea Sandstone and the Clinton-Medina formations. These exploration targets have been drilled using conventional methods, however it is possible that they may be drilled unconventionally in the future. The Berea is approximately 1,600 feet deep in this unit, equating to a minimum drilling unit size of 10 acres per well, and Clinton-Medina is less than 4,000 feet deep in the in this unit, equating to a minimum drilling unit size of 20 acres per well. There is potential for production from other formations in the Ironton Unit include Ohio Shale, Queenston Formation, Buell Run Sand, Maxton Sand, Keener Sand and the 1st Cow Run, the Beekmantown, the Rose Run, and the Mt. Simon formations. The Point Pleasant/Utica Formation may extend below a part of the eastern half of the Ironton Unit. The Marcellus Shale is not known to extend beneath the Ironton Unit. At this time there are no unconventional wells being developed; however, traditionally conventional target formations may become unconventional target formations in the future. It is possible that technology used to install deeper unconventional wells may be used on shallower formations to increase production. It is possible that existing conventional wells may be converted into unconventional wells if an operator believe it is economically feasible. The geology underlying this unit, relative to the other two units, suggest a low potential for development. Based on modeling no new wells are predicted to be installed in the Ironton Unit in the next 15 years. This prediction takes into

consideration current natural gas and oil prices, the industry focus on unconventional drilling of the Point Pleasant/Utica Formation and Marcellus Shale which do not occur under the Ironton Unit, and lack of industry interest in Federal leases on this unit at this time. No new surface disturbance is anticipated

Existing surface disturbances may decrease as non-productive wells are plugged and the surface disturbance reclaimed. Gallia, Jackson, Lawrence and Scioto Counties of the Ironton Unit had a total 51 wells plugged (1.8% of state total) from 2008 to 2018. Assuming a similar rate of plugging, approximately 75 depleted producers would be plugged in these counties in the next 15 years. Using 0.55 acres as the average amount of net surface disturbance associated with a producing conventional well (e.g., 0.38 acres of road and 0.17 acres of well pad), plugging 75 depleted producers will result in approximately 41.25 acres of restored surface over fifteen years.

9.3.3 Development Forecast for the Marietta Unit

Principal exploration targets of the Marietta Unit are the Ohio Shale, Berea Sandstone, Point Pleasant Formation/Utica Shale and the Marcellus. These exploration targets have been drilled using both conventional and unconventional methods. Additional conventional targets that are potentially productive and present include the Clinton-Medina, Gordon Sand, Big Injun, Cow Run, Buell Run Sand, Maxton Sand, Keener Sand and the Maxville formations. The Point Pleasant/Utica Formation and Marcellus Shale are unconventional targets that are potentially productive exist beneath the Marietta Unit. Presently, unconventional targets are being developed in the Point Pleasant/Utica Formation and Marcellus Shale and no conventional targets are being drilled anywhere in the unit. In the next 15 years, however, traditionally conventional targets may become unconventional targets. The current prediction is 81 new wells will be installed within the Marietta Unit over the next 15 years, not necessarily on Federal surface. This prediction takes into consideration current natural gas and oil prices and the industry focus on unconventional drilling of the Point Pleasant/Utica Formation and Marcellus Shale. Eighty of the wells are predicted to be installed in Monroe County and one well is predicted to be installed in Noble County.

Monroe, Noble and Washington Counties of the Marietta Unit had a total 489 wells plugged (17.44% of state total) from 2008 to 2018. Assuming a similar rate of plugging, approximately 734 depleted producers would be plugged in the next 15 years. Using 0.55 acres as the average amount of net surface disturbance associated with a producing conventional well (e.g., 0.38 acres of road and 0.17 acres of well pad), plugging 734 depleted producers will result in approximately 404 acres of restored surface over fifteen years.

As noted, eighty-one new unconventional wells (some potentially drilled from well pads containing multiple wells) are predicted to be installed in the Marietta Unit. Some of these wells will target the Marcellus Shale, but most are projected to target the deeper Point Pleasant Formation/Utica Shale. Unconventional well pads in southeastern Ohio have ranged in disturbance acreage from 6 to 35 acres, depending on topography, access, pipelines and the number of wells proposed per pad. After initial construction of a well pad, access roads and any pipelines, most of the associated disturbance is typically regraded and seeded as interim reclamation to prevent erosion. Well pads and access disturbances remaining after interim reclamation range from 3 to 10 acres and typically remain until final reclamation (when wells plugged). Using recently installed well pads and wells it is estimated that oil and gas activity in the Marietta Unit for the planning period will result in between 171 and 998 new acres of initial disturbance and 86 to 285 acres of longer term disturbance remaining after interim reclamation and until final reclamation of the pad and access. As noted in a previous section, the land reclaimed by plugging depleted producers would offset longer term surface disturbance associated with drilling new wells.

9.4 Gas Storage Potential

The BLM has received no expressed interest in gas storage within the WNF Proclamation Boundary over the last 30 years. However, in 2019, an inquiry regarding possibly establishing a gas storage field within the Ironton Ranger District was received by the USFS, and this inquiry is still at an early stage and no application has been submitted to date (Dahl, 2020). Accordingly, it is reasonable to expect that if a proposed Ironton Ranger Unit gas storage permit application is received and approved it most likely would be constructed or completed over the course of the fifteen-year RFDS period. Since no written request has reportedly been received, it would be difficult to describe possible surface disturbances associated with a gas storage field. However, given other gas storage fields it is possible additional gas injection wells may be installed as well as access roads, piping, etc. that may or may not occur within the WNF proclamation boundary.

10.0 WNF ECONOMIC PROJECTION FOR OIL AND NATURAL GAS DEVELOPMENT

The forecast of oil and gas development on WNF used in the RFD was generated from an internal BLM spreadsheet-based model of oil and gas production. Model inputs included production and price data and forecasts from US DOE Energy Information Administration's 2019 Annual Energy Outlook (EIA, 2019) and *The Distribution of U.S. Oil and Natural Gas Wells by Production Rate (2019)* (EIA, 2019b), production statistics from Ohio wells by well vintage from DRILLINGINFO.COM, well-level exploration, development and geo-spatial data, statistics and reports from the Ohio Department of Natural Resources website, and Federal revenue and production statistics from ONRR (ONRR, 2019). These results are a forecast only based on modeling and available information at this time. The overall forecast is for a 15-year period and, while the model projected annual results, should be used as a 15-year period of time and not necessarily year by year. It is possible individual annual development levels may vary within the forecasted 15 years.

It was assumed that changes in Ohio production over the forecast horizon will mirror that of the AEO Reference Case. In 2018, Ohio represented 8.2% of total US marketed natural gas production (2.4 Tcf). The 2018 AEO US Reference Case forecasts year-over-year changes in gas production in 2020-2034 ranging from 0.4% to 4.6% and averaging 1.8% per year. For Shale Gas these statistics ranged from 1.2% to 4.6% (average 3.5%).

Forecasted production from new wells is assumed to be the difference between the overall production estimate and the production from wells existing in 2018. The production decline from existing wells was estimated using annual well-level production reports from the Ohio DNR. For example, most of these wells (95%) are expected to decline by 1% per year, while production from the wells in the top 1% is modeled to decrease by 10%. As these wells grow older their year-over-year rate of decline diminishes.

New Ohio wells – especially the natural gas wells – exhibit a rapid decline in the quantity of gas produced per year for the first several years in operation. A model representing a typical new gas well was estimated using well-level production data that was developed and used to estimate the annual production from new wells (reference ODNR, USGS). This model estimates the annual decline in production per year and an estimate of the annual improvement in well-productivity based upon technological improvements.

Based upon recent trends in Ohio oil and gas production, it is assumed that most new wells will be horizontally drilled unconventional natural gas wells.

The forecasted production from this representative new well (i.e., the modeled "typical" well) is used to estimate the total number of new wells needed to produce the difference between the state-level production

forecast and the production from existing wells. Between 2020 and 2034 this process results in an estimate of 154 to 352 new wells needed statewide per year. Note that the additional gas produced by these new wells in subsequent forecast years becomes part of the total production from existing Ohio wells in these forecast years and therefore reduces the needed new gas production (and wells) in those years.

The number of new wells forecast for WNF was estimated as being proportional to the (recent) historic percentage of gas produced per county and the percentage of each county that belonged to WNF mineral estate. Using this approach, of the counties containing WNF surface or minerals, Monroe County is the location of almost all the forecast new wells into WNF, and 1.5% of Monroe County is located on WNF.

This forecast assumes three producing wells (three wells for predictive modelling although technology may result in additional wells from a single pad) will be located on each new drilling site and one of these wells would include Federal minerals. This is the average number of wells per well pad for recently drilled gas wells in the area based on review of ODNR and AFMSS data (see section 6.2). Each new well pad is assumed to have its three wells drilled and producing in the same year as the pad is constructed. The average cost per well was estimated to be $9.5 million in 2020 and total costs were forecast to reach $16.5 million by 2034. These costs include pad-level costs such that total well-pad spending could be estimated by multiplying the number of expected wells per pad.

The state-level forecast for Ohio oil production follows the same process as the gas forecast. The quantity of needed new oil production each year was estimated as the difference between the state-level production forecast and the quantity of oil produced from existing wells.

Unlike the gas forecast, it is assumed that new oil production within WNF will come from oil produced from new gas wells and there will be no new oil wells located on WNF. Oil production from existing oil wells show low levels of decline from year to year new drilling and even with high GORs (gas-oil ratios) new gas wells will produce enough new oil to make up for oil production declines. Proposed oil and gas activities are shown in Table 8.

Table 8: Forecast of proposed wells

FORECASTED OIL AND GAS ACTIVITY IN THE WAYNE NATIONAL FOREST 2020-2034										
	2020		2021		2022		2023		2024	
New Wells	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil
Athens Unit										
Athens	0	0	0	0	0	0	0	0	0	0
Hocking	0	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0	0
Vinton	0	0	0	0	0	0	0	0	0	0
[1]Washington	0	0	0	0	0	0	0	0	0	0
Ironton Unit										
Gallia	0	0	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0	0
Scioto	0	0	0	0	0	0	0	0	0	0
Marietta Unit										
Monroe	3	0	5	0	5	0	6	0	6	0
Noble	0	0	0	0	0	0	0	0	0	0
[1]Washington	0	0	0	0	0	0	0	0	0	0

Total New WNF Wells drilled	3	5	5	6	6
Total New Well Pads	1	2	2	2	2
Total Potential Initial Surface Disturbance (during construction)	6-35 acres	12-70 acres	12-70 acres	12-70 acres	12-70 acres
Total Potential Longer-Term Surface Disturbance (until wells plugged)	3-10 acres	6-20 acres	6-20 acres	6-20 acres	6-20 acres
Total Well Cost	$ 28,555,000	$ 49,417,813	$ 61,695,668	$ 64,186,631	$66,778,166

FORECASTED OIL AND GAS ACTIVITY IN THE WAYNE NATIONAL FOREST 2020-2034

	2025		2026		2027		2028		2029	
	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil
Athens Unit										
Athens	0	0	0	0	0	0	0	0	0	0
Hocking	0	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0	0
Vinton	0	0	0	0	0	0	0	0	0	0
[1]Washington	0	0	0	0	0	0	0	0	0	0
Ironton Unit										
Gallia	0	0	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0	0
Scioto	0	0	0	0	0	0	0	0	0	0
Marietta Unit										
Monroe	6	0	6	0	6	0	6	0	4	0
Noble	0	0	0	0	0	0	0	0	1	0
[1]Washington	0	0	0	0	0	0	0	0	0	0
Total New WNF Wells drilled	6		6		6		6		5	
Total New Well Pads	2		2		2		2		2	
Total Potential Initial Surface Disturbance (during construction)	12-70 acres		12-70 acres		12-70 acres		12-70 acres		18-105 acres	
Total Potential Longer-Term Surface Disturbance (until wells plugged)	6-20 acres		6-20 acres		6-20 acres		6-20 acres		18-30 acres	
Total Well Cost	$ 69,474,334		$ 72,279,361		$ 75,197,640		$ 78,233,744		$ 67,827,027	

FORECASTED OIL AND GAS ACTIVITY IN THE WAYNE NATIONAL FOREST 2020-2034										
	2030		2031		2032		2033		2034	
	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil
Athens Unit										
Athens	0	0	0	0	0	0	0	0	0	0
Hocking	0	0	0	0	0	0	0	0	0	0
Morgan	0	0	0	0	0	0	0	0	0	0
Perry	0	0	0	0	0	0	0	0	0	0
Vinton	0	0	0	0	0	0	0	0	0	0
[1]Washington	0	0	0	0	0	0	0	0	0	0
Ironton Unit										
Gallia	0	0	0	0	0	0	0	0	0	0
Jackson	0	0	0	0	0	0	0	0	0	0
Lawrence	0	0	0	0	0	0	0	0	0	0
Scioto	0	0	0	0	0	0	0	0	0	0
Marietta Unit										
Monroe	6	0	5	0	5	0	5	0	5	0
Noble	0	0	0	0	0	0	0	0	0	0
[1]Washington	0	0	0	0	0	0	0	0	0	0
Total New WNF Wells drilled	6		5		5		5		5	
Total New Well Pads	2		2		2		2		2	
Total Potential Initial Surface Disturbance (during construction)	12-70 acres		12-70 acres		12-70 acres		12-70 acres		12-70 acres	
Total Potential Longer-Term Surface Disturbance (until wells plugged)	6-20 acres		6-20 acres		6-20 acres		6-20 acres		6-20 acres	
Total Well Cost	$ 84,678,651		$ 88,097,552		$ 76,378,742		$ 79,462,534		$ 82,670,834	

[1] Washington County occurs in both Athens and Marietta Units. Values for Washington County are reported only in the Marietta Unit.

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APPENDIX A

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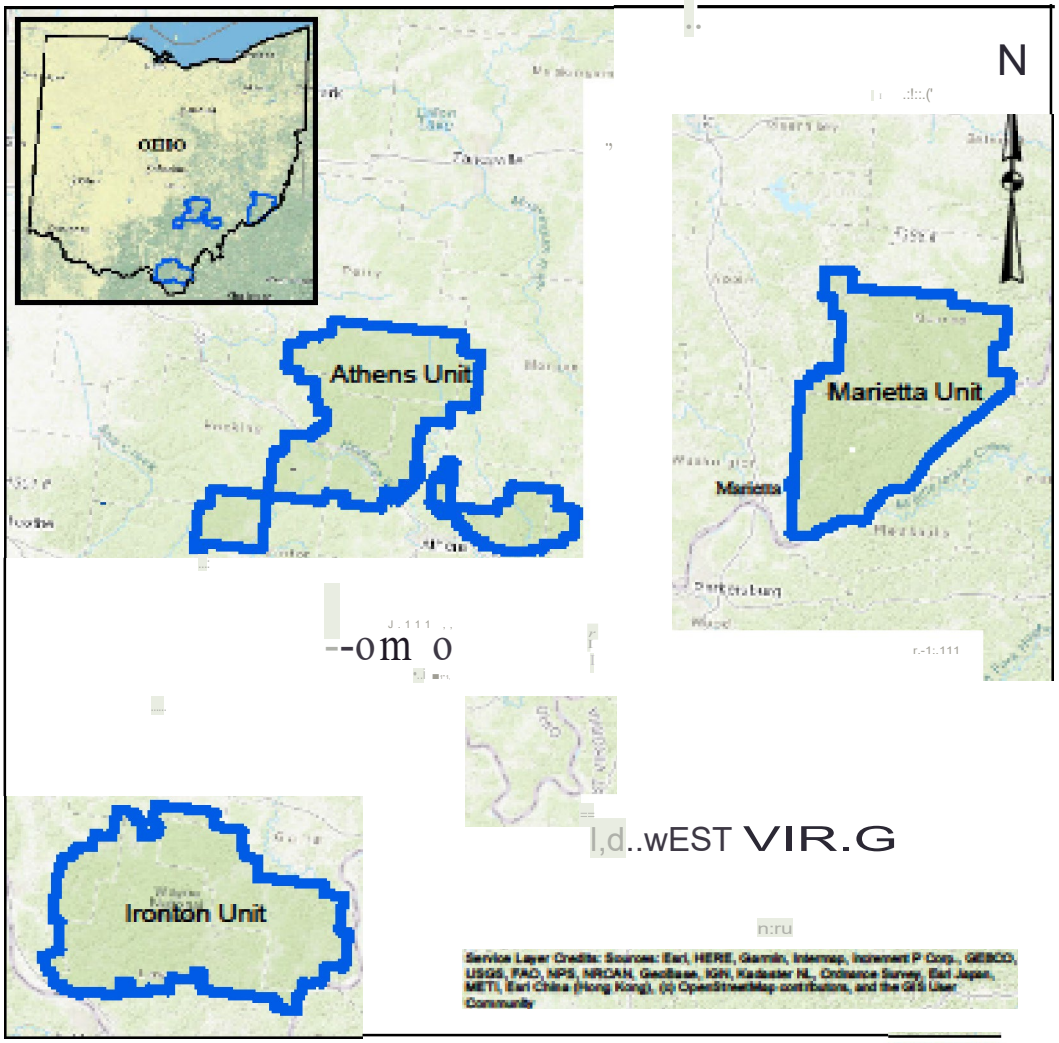

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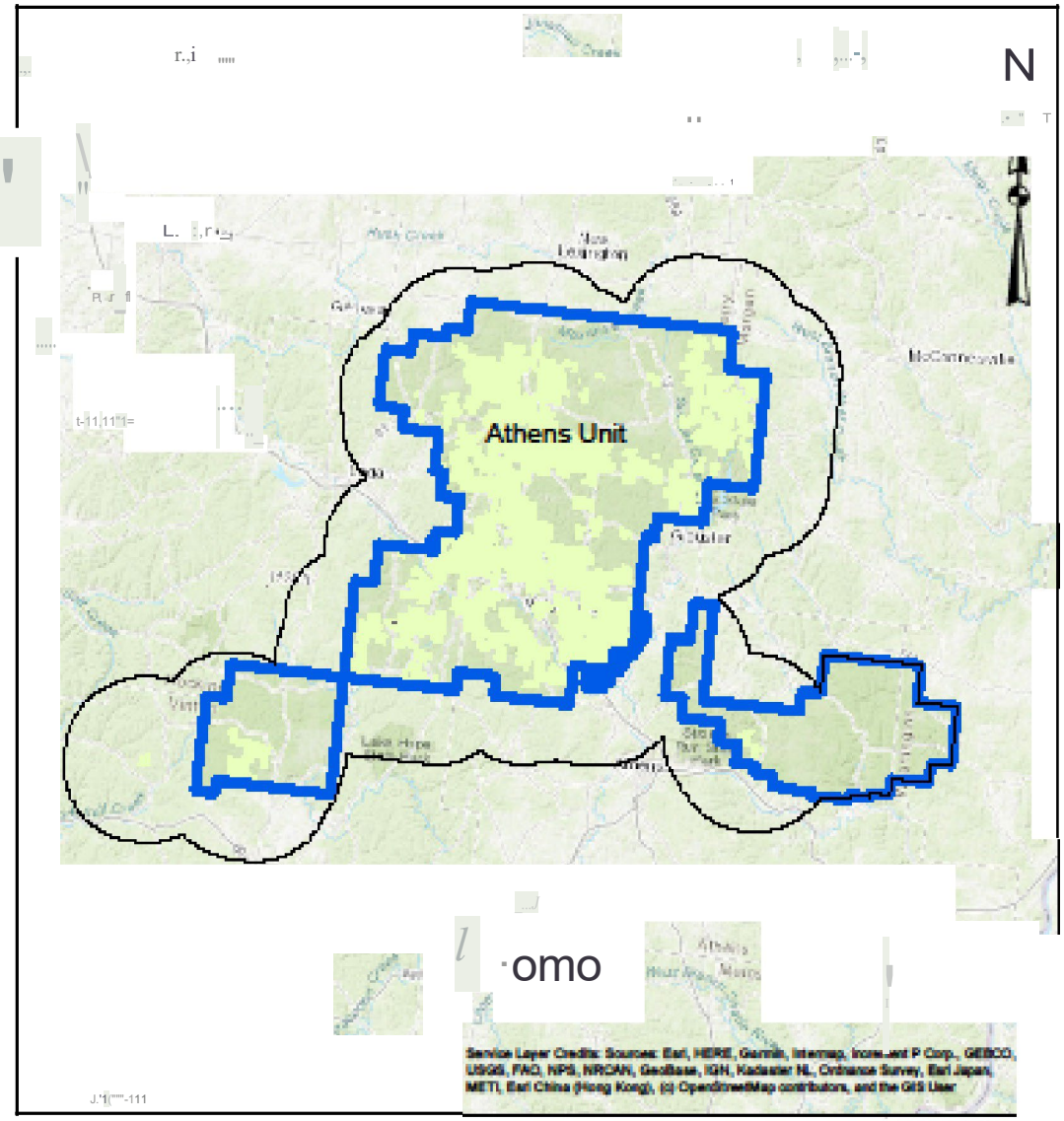

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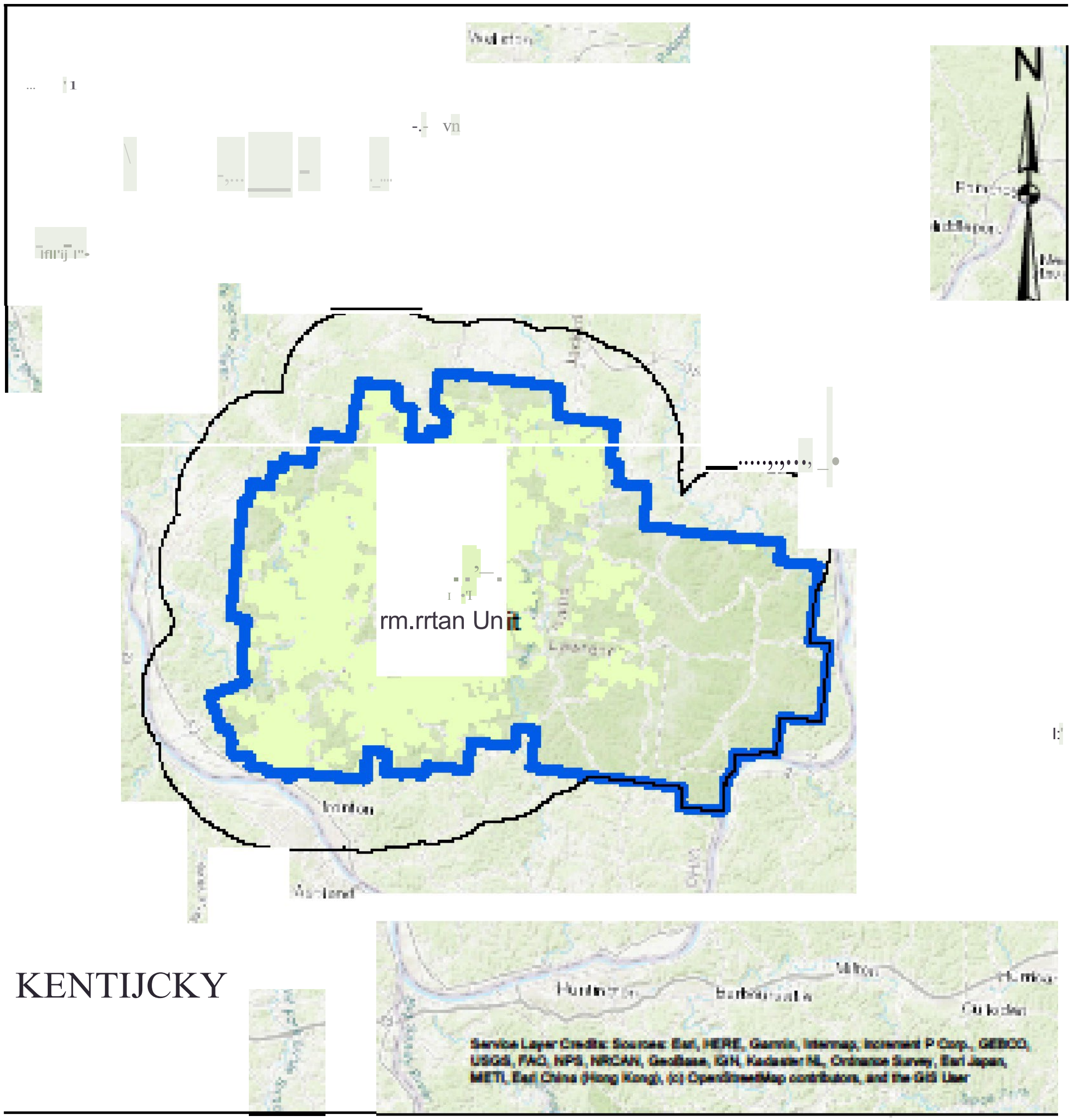
WAYNE NATIONAL FOREST



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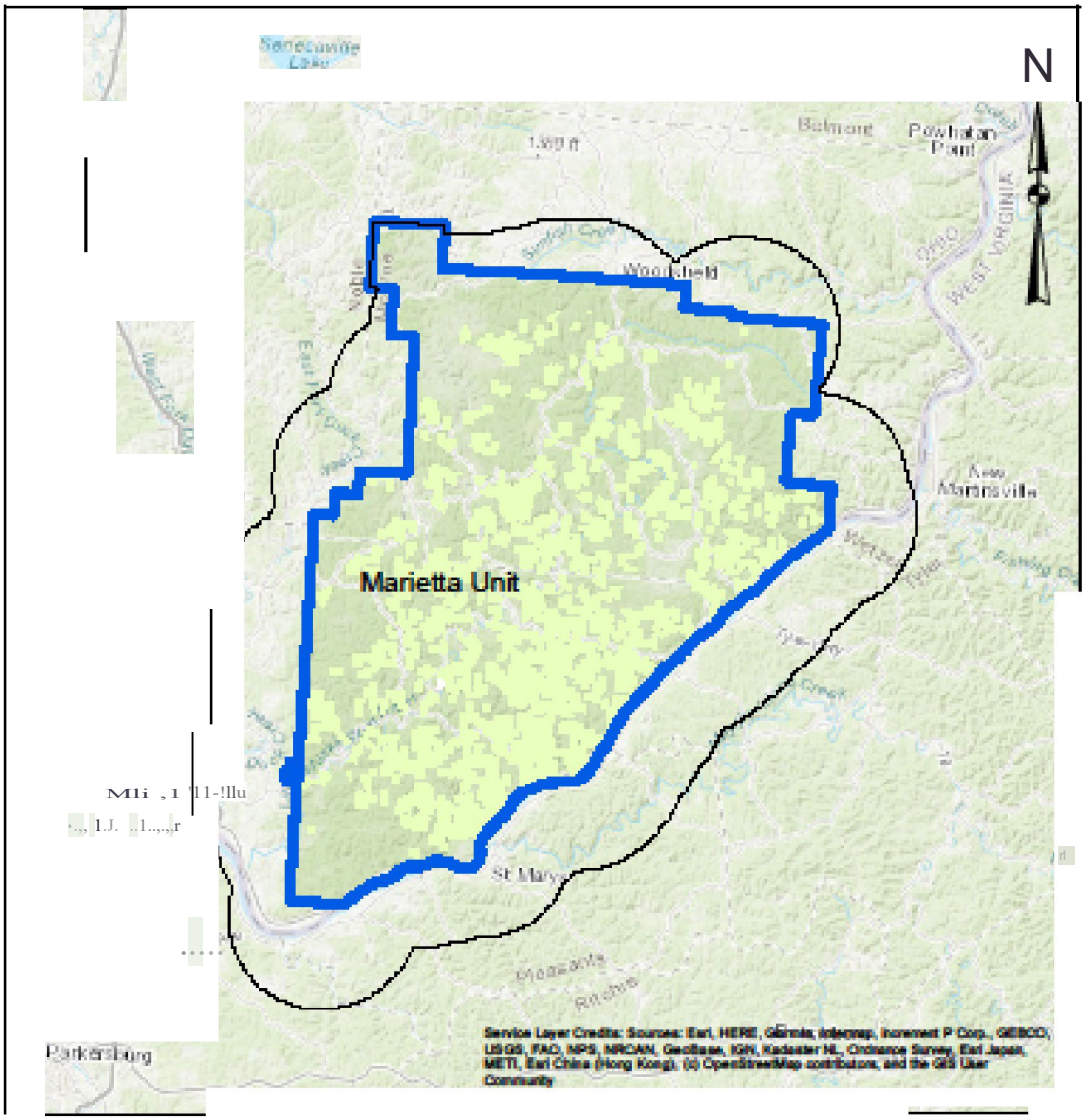

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Appendix E – Legal and Regulatory Authorities

APPENDIX E:

Legal and Regulatory Authorities

1.1. Legal and Regulatory Authorities

In addressing environmental considerations of the Proposed Action, the BLM is guided by relevant statutes (and their implementing regulations) and Executive Orders that establish standards and provide guidance on environmental and natural resources management and planning. These include, but are not limited to, the following.

- NEPA (1969) and the associated CEQ regulations at 43 CFR Parts 1500–1508
- FLPMA (1976), as amended, and the associated regulations at 43 CFR Part 1600
- Mineral Leasing Act (1920), as amended and supplemented (30 USC 181)
- NHPA (1966), as amended, and the associated regulations at 36 CFR Part 800
- American Indian Religious Freedom Act
- Native American Graves Protection and Repatriation Act (1990)
- Endangered Species Act (ESA) (1973), as amended
- Clean Water Act (CWA) (1972), as amended
- Clean Air Act (CAA) (1970), as amended
- General Conformity requirements established in the CAA (*see* 42 U.S.C. § 7506)
- Federal Onshore Oil and Gas Leasing Reform Act (1987)
- Migratory Bird Treaty Act (1918)
- Resource Conservation and Recovery Act (1976) as amended
- 43 CFR 3170, Onshore Oil and Gas Operations (2023)
- EO 11988, *Floodplain Management* (1977, 42 *Federal Register* [FR] 26951)
- EO 11990, *Protection of Wetlands* (1977; 42 FR 26961)
- EO 12898, *Environmental Justice in Minority Populations and Low-Income Populations* (1994)
- EO 13045, *Protection of Children from Environmental Health and Safety Risks* (1997)
- EO 13007, *Indian Sacred Sites* (1996, 61 FR 26771–26772)

In addition to the above statutes, regulations, and executive orders, the following BLM and USFS policies are applicable to oil and gas leasing.

- **Memorandum of Understanding**: Between the BLM and USFS, Concerning Oil and Gas Leasing and Operations (USFS Agreement No. 06-SU-11132428-052; BLM Memorandum of Understanding WO300-2006-07)
- **Oil and Gas Leasing**: Land Use Planning and Lease Parcel Reviews (BLM IM 2023-010)

The Proposed Action and No-Action Alternative are in conformance with the 2006 Forest Plan (USFS 2006a). Goal 10.1 in the 2006 Forest Plan states, “Provide a supply of mineral commodities for current and future generations, while protecting the long-term health and biological diversity of ecosystems. Facilitate the orderly exploration, development, and production of mineral and energy resources on land open to these activities” (USFS 2006a). The BLM was a cooperating agency in development of the 2006 Forest Plan (USFS 2006a) and its

related *Final Environmental Impact Statement for the Wayne National Forest 2006 Land and Resource Management Plan* (2006 Forest Plan Final EIS) (USFS 2006b). USFS signed its Record of Decision for the Forest Plan on December 14, 2005.

The Forest Service also reviewed the governing Forest Plan for the Wayne National Forest (USFS 2006a) and determined that the Proposed Action is in conformance with the Forest Plan.

1.1.1. Procedures and Environmental Protections Required for a Federal Minerals Lessee Applying to Drill on Non-Federal Lands

The BLM's regulatory jurisdiction applies to federal lands and minerals and is limited in circumstances where private surface lands are used to access federal minerals. Because of this limitation, BLM activities that affect non-federal (or in the case of the WNF, private) lands must be examined to ensure that BLM does not exceed its authority. To guide drilling activities targeting federal minerals from a non-federal surface, the BLM created Permanent Instruction Memorandum (PIM) 2018-014, *Directional Drilling into Federal Mineral Estate from Well Pads on Non-Federal Locations*. The policies and procedures from PIM 2018-014 are incorporated into this Supplemental EA and are further discussed below.

NEPA's procedural requirements do not expand or extend the BLM's authority beyond that provided in FLPMA and the Mineral Lease Act (BLM 2018). Nonetheless, the BLM's Section 6 lease term (BLM 2023) requires minimization of adverse environmental impacts. The authority of the Section 6 lease term is imposed on federal and non-federal surface development during the APD process by requiring completion of necessary inventories and technical studies as well as application of design features, COAs, and BMPs for approval of the application. Further, approval of an APD is a federal action or undertaking subject to the statutory requirements of NEPA, ESA, and NHPA. Thus, site-specific review, even on non-federal surface, will be performed by the BLM to ensure compliance with these federal regulations.

The BLM's process for approving APDs can be found at 43 CFR subparts 3162 and 3171. The BLM does not have the authority to enter non-federal lands without the landowner's consent. If the BLM deems surface access necessary to complete assessments and analyses required under NEPA, ESA, or NHPA, the BLM will ask the operator to provide access pursuant to its lease or other agreement with the landowner. Where operators hire consultants to complete preapproval surveys, the operator will be expected to facilitate access to the non-federal lands for the consultants. The inability to access the surface for resource surveys is not, in and of itself, sufficient reason to deny an APD, but the BLM may deny the APD if the inability to access the surface prevents the BLM from meeting its obligations under NEPA, ESA, or NHPA (BLM 2018).

BLM's inspection and enforcement authority on non-federal land includes compliance with any applicant/operator committed measures established by the operator and BLM in the approved APD and relied on by the BLM in completing its reviews under NEPA, ESA, and/or NHPA. If an operator fails to carry out the measures under the approved APD, the BLM may, in its discretion, take enforcement action against the operator for failure to comply with the terms of the APD (43 CFR 3163.1 and 3163.2).

Refer to PIM 2018-014 and Appendix C of the 2016 EA (BLM 2016) for additional information about federal and State regulatory requirements associated with permitting of oil and gas operations on non-federal land and Section 1.1.2, *State of Ohio Regulatory Setting* below, for additional information about Ohio's regulatory program.

In accordance with the Gold Book (BLM 2007), when development is proposed on private land to access federal minerals, operators must provide a reclamation plan to the BLM when filing the Application for Permit to Drill, to change an existing plan, or prior to abandonment if a plan is not on file with the BLM. Operators must complete reclamation on private surface to the satisfaction of the BLM in consultation with the surface owner.

If, as expected for the reasonably foreseeable development associated with the Proposed Action, development accessing federal minerals occurs on privately owned surface, then federal and State regulations exist to address potential concerns regarding contamination or spills. For example, the Onshore Oil and Gas Orders that were codified into the Code of federal Regulations (43 CFR 3170, Onshore Oil and Gas Production) provide requirements and standards for safe drilling and well abandonment, as well as the methods and approvals necessary to dispose of produced waters associated with oil and gas operations. The Onshore Orders may be found at 43 CFR subparts 3162 and 3171.

1.1.2. State of Ohio Regulatory Setting

For drilling federal minerals from private land, Chapter 1509 of the Ohio Revised Code (ORC) regulates the drilling, operation, maintenance, and abandonment of oil and gas wells in the State, including the use of hydraulic fracturing. In September 2011, the State of Ohio created the Division of Oil and Gas Resources Management (DOGRM) within the Ohio Department of Natural Resources (ODNR). In accordance with the ORC, DOGRM has sole and exclusive authority to regulate the permitting, location, and spacing of oil and gas wells and production operations within the state, excepting only those activities regulated under federal laws for which oversight has been delegated to the environmental protection agency and activities regulated under sections 6111.02 to 6111.028 of the Revised Code (ORC § 1509.02,). If there are other federal regulatory triggers, the U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), and U.S. Environmental Protection Agency (USEPA) may be required to approve or consult regarding oil and gas operations. Refer to Appendix C of the 2016 EA (BLM 2016) for additional information about regulatory requirements and permitting of oil and gas operations on non-federal surface. Oil and gas developers are subject to the ESA and required by law to follow protective measures or development alternatives should any endangered species be known to inhabit or be found inhabiting a potential development site (16 USC 1531-44).

Prior to drilling, reopening, converting, or plugging a well, permits must be obtained from the Chief of DOGRM (ORC § 1509.05).

ORC Chapter 1509 defines *well stimulation* as "the process of enhancing well productivity, including hydraulic fracturing operations." Requirements for well stimulation are outlined in ORC Section 1509.19, which states that:

> an owner who elects to stimulate a well shall stimulate the well in a manner that will not endanger underground sources of drinking water. Not later than twenty-four hours before commencing the stimulation of a well, the owner or the owner's authorized representative shall notify an oil and

> gas resources inspector. If during the stimulation of a well damage to the production casing or cement occurs and results in the circulation of fluids from the annulus of the surface production casing, the owner shall immediately terminate the stimulation of the well and notify the chief of the division of oil and gas resources management. If the chief determines that the casing and the cement may be remediated in a manner that isolates the oil and gas bearing zones of the well, the chief may authorize the completion of the stimulation of the well. If the chief determines that the stimulation of a well resulted in irreparable damage to the well, the chief shall order that the well be plugged and abandoned within thirty days of the issuance of the order. For purposes of determining the integrity of the remediation of the casing or cement of a well that was damaged during the stimulation of the well, the chief may require the owner of the well to submit cement evaluation logs, temperature surveys, pressure tests, or a combination of such logs, surveys, and tests.

ORC Section 1509.33 sets forth violations subject to civil penalties.

Appendix F – Existing Stipulations, Notifications, Guidelines, and Standards

APPENDIX F:

Existing Stipulations, Notifications, Guidelines, and Standards

Reference	Stipulation/Notification/Standard Text	Source
GFW-AIR-1	Coordinate management activities with air quality regulatory authorities and with research activities on the impact of air pollution on Forest resources.	SIR, p. 74
GFW-AIR-2	Coordinate with air quality regulatory authorities and with research activities on preventative practices to control any significant air pollution emissions resulting from National Forest management activities.	SIR, p. 74
GFW-AIR-3	Conduct management activities (including permitted activities) in a manner that does not contribute significantly to violations of National Ambient Air Quality Standards or violations of applicable provisions in the State Implementation Plan.	SIR, p. 74
GFW-AIR-4	The Forest Supervisor will advise the Regional Forester on the potential effects of proposals by the State of Ohio to modify air quality standards or attainment areas and the identification of present and potential impairment of Forest resources attributable to air pollution.	SIR, p. 74
Notification #1	The Forest Service is responsible for ensuring the area to be disturbed is examined for cultural resources prior to allowing surface disturbing activities on lands covered by this lease. Important cultural resource values may be present on portions of a lease. Surface-disturbing activities must avoid these areas unless the authorized officer agrees to the mitigation measures. The lessee/operators may, at their discretion and cost, conduct the examination on the lands to be disturbed. This examination must be done by or under the supervision of a qualified resource specialist approved by the Forest Service. An acceptable report must be provided to the Forest Service identifying the anticipated effects of the Proposed Action on cultural resource values. If items of substantial archaeological or paleontological values are discovered during operations, or a known deposit of such items is disturbed, the lessee (or operator) will cease work in the affected area. The lessee (or operator) will then notify the Forest Service and will not resume excavation until the Forest Supervisor gives written approval.	SIR, Appendix A, p. 2

Reference	Stipulation/Notification/Standard Text	Source
Stipulation #7	No surface occupancy (NSO) within archaeological or historical sites of known significance (see lease map). At the time of any new proposed lease developments, a Forest Service archeologist shall determine the need for any setbacks or restrictions for the protection of objects of historic or scientific interest.	SIR, Appendix A, p. 6
Notification #2	Any activities proposed in, or likely to affect a floodplain will be subject to: • Analysis and identification of alternate sites • Public notification and comment period • Provisions of any other Federal, state, or local laws and regulations as required under presidential Executive Order 11988, Protection of Floodplains	SIR, Appendix A, p. 2
Stipulation #16	Oil and gas activities may be allowed within that portion of a floodplain outside riparian areas. Mineral activities will be evaluated on a case-by case basis, and appropriate mitigation measures will be applied. The leaseholder and Forest Service inspector shall work together to identify locations for roads, pipelines, well pads and production facilities	SIR, Appendix A, p. 8
Notification #4	Operators are required to comply with all public laws and Federal regulations that apply to National Forest System lands and the WNF Land and Resource Management Plan.	SIR, Appendix A, p. 3
SFW-MIN-1	Prevent or eliminate occupancy that is not reasonably incident to, or required for, legitimate mineral operations.	SIR, p. 22
SFW-MIN-11	Within management areas where surface occupancy is generally permitted, apply the Controlled Surface Use stipulation for new Federal leases where the following conditions occur: • Riparian areas and wetlands • Managed wildlife openings • Developed recreation sites (located outside the Developed Recreation Management Area) • Areas of land with a Scenic Integrity Objective of *High* or *Moderate* • Known locations of federally listed species • Known locations of Regional Forester sensitive species • Portions of floodplains outside riparian areas • Slopes between 35 and 55 percent	SIR, p. 22

Reference	Stipulation/Notification/Standard Text	Source
SFW-MIN-12	Consider approval of plans of operation based on applicable regulations and analysis of: • Surface/subsurface resources • Any restrictions and mitigations determined by an environmental analysis • Road construction standards • Standard BLM lease stipulations • Appropriate lease-specific oil and gas notifications and stipulations	SIR, p. 22
SFW-MIN-9	Apply the NSO stipulation to new Federal leases in the following Management Areas: • Future Old Forest • Developed Recreation • Timbre Ridge Lake • Special Areas • Research Natural Areas • Candidate Areas	
Stipulation #2	No surface occupancy within designated areas of the lease (see lease map) for the protection of natural processes or research, historical, or educational values. On NFS lands in Research Natural Area Management Areas, the Forest Service will issue leases for Federal oil and gas only with a No Surface Occupancy (NSO) stipulation. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to the Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 4

Reference	Stipulation/Notification/Standard Text	Source
Stipulation #3	No surface occupancy within designated areas of the lease (see lease map) to protect natural processes or research, historical or educational values. On National Forest System lands in Special Interest Management Areas, the Forest Service will issue Federal oil and gas leases only with an NSO stipulation. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 4
Stipulation #4	No surface occupancy within designated areas of the lease (see lease map) for the protection of natural processes or research, historical or educational values. On National Forest System lands in Candidate Research Natural Management Areas, the USDA Forest Service will only issue Federal oil and gas leases that have an NSO stipulation. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 4-5
Stipulation #6	No surface occupancy within designated areas of the lease (see lease map) for the protection of the Timbre Ridge Lake Management Area. On NFS lands in the Timbre Ridge Lake Management Area, the Forest Service will issue Federal oil and gas leases only with an NSO stipulation. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 5

Reference	Stipulation/Notification/Standard Text	Source
SFW-MIN-2	Require that all proposed surface-disturbing mineral activities have an approved operation and reclamation plan before the activity begins.	SIR, p. 47
SFW-MIN-5	The operator, as directed by Ohio EPA, is responsible for remedial action for cleanup of soil and water resources and timely repair of damaged wells, pipelines, or tanks.	SIR, p. 49
SFW-MIN-8	Require owners and lessees to plug oil and gas wells when production ceases. Work with cooperating agencies to plug abandoned non-producing wells without identified owners.	SIR, p. 23
SFW-SAFE-17	Post warnings of dangerous conditions and threats of immediate concern for the safety of Forest employees and the public	SIR, p. 79
SFW-SAFE-18	Issue closure orders to protect the public when clear and present dangers cannot be mitigated in a timely manner.	SIR, p. 79
SFW-SAFE-19	Any wastewater that originates from oil and gas operations would be considered non-federal and so disposal would not be allowed on Wayne National Forest lands (including the roads under jurisdiction of the WNF). In addition, the Ohio Revised Code only allows for four different disposal methods of fluids associated with oil and gas operations: injection, surface application (on roads only, and only when permitted by the authority with jurisdiction over the road), enhanced recovery (reuse of the fluids in other wells) or other methods to test new technologies and methodologies (ORC 1509.22(C)(1)).	2016 EA, p. 65

Reference	Stipulation/Notification/Standard Text	Source
Stipulation #5	No surface occupancy within designated areas of the lease (see lease map) to protect special management units such as developed recreation areas, trails and associated trailheads, water supply facilities, administrative site, etc. On NFS lands within administrative sites, developed recreation areas, trails and associated trailheads, the Forest Service will issue leases for Federal oil and gas only with an NSO stipulation. The NSO designation will include a buffer zone, which will be determined in accordance with the Implementation Guide for Scenery Management. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to the Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 5
SFW-MIN-10	Within management areas where surface occupancy is generally permitted, apply the No Surface Occupancy stipulation for new Federal leases where the following conditions occur: • Slopes in excess of 55 percent and areas prone to mass soil movement • Areas within ¼ mile of Indiana bat hibernacula • Cultural resource sites of known significance.	SIR, p. 52
GFW-SM-54	Native soil should be removed and stockpiled before ground disturbance.	SIR, p. 83
GFW-WSH-10	Modify resource management practices according to soil characteristics and slope to protect soil productivity and minimize erosion and sedimentation. Refer to soil map unit descriptions and appropriate interpretive tables in the Wayne National Forest Soils Inventory (based on the USDA County Soil Surveys).	SIR, p. 82
GFW-WSH-11	Plan and implement erosion control measures for management activities that create bare mineral soil conditions. Stabilize disturbed areas based on direction in SFW-WSH-6, and GFW-WSH 7 and GFW-WSH-8.	SIR, p. 82

Reference	Stipulation/Notification/Standard Text	Source
GFW-WSH-8	When stabilizing disturbed areas, give priority to stabilizing areas that are discharging soil into watercourses, especially in municipal and recreational impoundment watersheds. Techniques may include: • Placing straw bales in ditch lines and small drainages • Leaving berms in road embankments during construction • Constructing diversion ditches • Hand placing slash and unmerchantable logs across slopes and trails • Installing check dams and ditch lines • Excavating sediment detention basins	SIR, p. 39
Notification #5	The area of this lease contains a considerable amount of land with steep slopes and/or unstable soils. Accordingly, the opportunity to locate access roads, drilling sites, pipelines, storage tanks and other improvements may be extremely limited.	SIR, Appendix A, p. 3
Stipulation #17	Oil and gas activities will be allowed on slopes from 35 to 55 percent on a case-by-case basis with appropriate mitigation. New road construction and maintenance shall be planned to disturb the least amount of ground. The leaseholder and Forest Service inspector shall work together to identify locations for roads, pipelines, well pads, and production facilities.	SIR, Appendix A, p. 8
Stipulation #8	No surface occupancy on slopes in excess of 55 percent (see lease map) to protect soil and water from erosion and mass failure hazards because of steep slopes.	SIR, Appendix A, p. 6
Stipulation #9	No surface occupancy is allowed for the exploration and development of energy minerals on areas with mass soil instability, as defined by the USDA County Soil Surveys (see lease map).	SIR, Appendix A, p. 6
GFW-TES-22	Limit ground compaction to the minimum area possible during major earth disturbing activities (including, but not limited to new road and trail construction, mineral resource exploration and development, or new facilities) that occur in suitable ABB habitat within 10 air miles of known occupied ABB habitat.	SIR, p. 54
GFW-TES-24	In occupied ABB habitat, design new roads with the minimum safe width necessary for planned use of the road.	SIR, p. 54

Reference	Stipulation/Notification/Standard Text	Source
GFW-TES-25	Within 10 air miles of known occupied ABB habitat, keep ground disturbance to a minimum during the reconstruction and maintenance of existing roads. Limit width of road, ditches, and surface materials to the minimum necessary for the planned use.	SIR, p. 55
GFW-TES-3	Establish a one quarter-mile forested buffer around all mine openings that are known Indiana bat fall swarming sites, but where actual Indiana bat hibernation has not been established. Reduce or eliminate human disturbances within the buffer. Implement vegetation management only to maintain or improve Indiana bat roosting, swarming, or foraging habitat.	SIR, p. 53
GFW-TES-31	Conduct surveys for running buffalo clover in suitable habitat prior to implementing ground or canopy disturbing activities.	Wayne NF Land and Resource Management Plan, p. 22
SFW-TES-10	During the non-hibernation season (April 15–September 15), do not cut, unless they are a safety hazard: • Trees of any species 6 inches dbh or more that are hollow, have major splits, or have broken tops that provide maternity habitat. • Snags 6 inches dbh or more that have Indiana bat roost tree characteristics. Consider any tree with less than 10 percent live canopy to be a snag. When removal of hazard trees is necessary in a recreation area during the non-hibernation season (e.g., developed recreation sites, access roads, trails), conduct emergence surveys at the identified hazard trees that possess the characteristics identified above, and at any hazard trees that possess large areas of loose bark providing maternity habitat.	SIR, p. 52

Reference	Stipulation/Notification/Standard Text	Source
SFW-TES-2	Establish a one-quarter mile buffer around all known hibernacula. Within this one quarter mile buffer: • Prohibit new trail and road construction. • Do not conduct prescribed burning during the fall swarming period (generally mid-August to mid-October) or during the hibernation period (September 15 through April 15). • Do not conduct prescribed burning during the fall swarming period (generally mid-August to mid-October) or during the hibernation period (September 15 through April 15). • Do not permit surface occupancy for exploration or development of federally owned minerals. • Implement vegetation management only to maintain or improve Indiana bat roosting, swarming, or foraging habitat.	SIR, p. 53
SFW-TES-32	Protect and improve occupied Regional Forester sensitive species habitat.	Wayne NF Land and Resource Management Plan, p. 22
SFW-TES-33	Do not conduct vegetation management within a 50-foot radius of rock shelters, or within 50 feet of the base and 50 feet of the top (measured horizontally) of naturally occurring, large rock faces or outcrops, unless designed to enhance the site characteristics for a federally listed species or a known population of Regional Forester sensitive species. Large rock faces or outcrops are defined as rock outcrop areas 15 feet or more in height and 100 feet or more in length. These rock outcrop habitats are not limited to solid "cliffs" and may include discontinuous rock faces, if the outcrop area is predominantly rock faces.	SIR, p. 65
SFW-TES-34	Avoid vegetation management within 50 feet of the base and 50 feet of the top of smaller rock faces (approximately 15 feet or more in height and less than 100 feet in length).	SIR, p. 65
SFW-FH-8	Forest contracts and permits shall include appropriate clauses for the prevention and/or treatment of nonnative invasive species.	Wayne NF Land and Resource Management Plan, p. 22

Reference	Stipulation/Notification/Standard Text	Source
SFW-FH-11	Ensure that seed mixes or cultivated plants used for restoring disturbed areas or landscaping on NFS land do not include any species on the Forest's NNIS list or NNIS species identified by the State of Ohio or its neighboring states (i.e., Kentucky, Pennsylvania, Michigan, Indiana, and West Virginia).	SIR, p. 66
GFW-FH-11	When restoring disturbed areas, prevent nonnative invasive species plant invasion or spread by using the following measures: • Use weed-free mulch and forage when available. • Use natural re-vegetation of native species for small-sized disturbances (e.g., utility rights-of-way, fire lines) where the threat of erosion and sedimentation is limited. When seeding is necessary to accomplish re-vegetation, prioritize the composition of the seed mix as follows: • Native species with local genotypes (locally adapted) • Native species with non-local genotypes (not locally adapted) • Desirable nonnative species that are non-aggressive and non-persistent (annuals) • Encourage use of locally grown/adapted native plant materials	SIR, p. 66
GFW-FH-12	Consider nonnative invasive species situations on adjacent lands when planning and conducting management activities.	SIR, p. 66
Stipulation #10	No surface occupancy within ¼ mile of all known Indiana bat hibernacula.	SIR, Appendix A, p. 6
Stipulation #12	No cutting of snags (trees with less than 10% live canopy), shagbark or shellbark hickories, or trees that are hollow and/or have major splits or broken tops, except during the bat hibernation season (September 15 to April 15). If such trees are a safety hazard, they may be cut anytime they pose an imminent threat to human safety, but if cut in the non-hibernation season the Forest Service biologist must be notified in advance. This stipulation applies only to trees over six inches in diameter. Protect all super canopy trees or other identified congregation roost trees for bald eagles along major river corridors and lakes. Protect known nests and roosts as described in the Bald Eagle Recovery Plan, or as directed by the US Fish and Wildlife Service. Prior to any surface disturbing activities a Forest Service biologist will conduct an assessment for potential American burying beetle habitat and occurrence. Occupancy restrictions will be determined at the time of the evaluation.	SIR, Appendix A, p. 7

Reference	Stipulation/Notification/Standard Text	Source
Stipulation #13	Controlled surface use may include setbacks or restrictions from portions of the lease to ensure protection of habitat for regional sensitive species. At the time of any new proposed lease developments, the responsible line officer shall determine the need for any setbacks or restrictions, or the need for timing-related stipulation in accordance with the aquatic and terrestrial wildlife and botanical resources standards and guidelines. The leaseholder and Forest Service inspector shall work together to identify locations for development and production facilities in order to protect the structural integrity of large old trees found on a portion of the tract.	SIR, Appendix A, p. 7
Notification #3	The Forest Service is responsible for assuring that the area to be disturbed is examined prior to allowing any surface disturbing activities on lands covered by this lease. The examination is to determine effects upon any plant or animal species listed, or proposed for listing, as Federal endangered or threatened, regional sensitive, and their habitats. If the findings of this examination determine that the operation(s) may have a detrimental effect on a species covered by the Federal endangered Species Act, the operator's plans may be denied or restrictions added. The presence of regional sensitive species may also require some restrictions of the operation(s). The Forest Service has the responsibility to conduct the required examination. In cases where the Forest Service time frames cannot meet the needs of the lessee/operator, the lessee/operator may, at his discretion and cost, conduct the examination on the lands to be disturbed. This examination must be done by or under the supervision of a qualified resource specialist approved by the Forest Service. An acceptable report must be provided to the Forest Service identifying the anticipated effects of the proposed action on Federal endangered or threatened species, regional sensitive species, or their habitats.	SIR, Appendix A, p. 2-3
GFW-ARR-12	Improve existing crossings to ensure passage of aquatic organisms when maintenance and reconstruction activities are scheduled.	SIR, p. 40
GFW-ARR-29	Prohibit vegetation management or ground disturbing activities within 100 feet of perennial springs, unless the activity is designed to protect water quality of the spring or integrity of the surrounding area.	SIR, p. 31

Reference	Stipulation/Notification/Standard Text	Source
GFW-ARR-5	Where earth-disturbing activities expose mineral soil, establish filter strips along waterbodies. • Filter strip width along perennial water bodies should be a minimum of 100 feet, measured horizontally from the edge of the aquatic ecosystem. • Filter strip width along intermittent water bodies should be a minimum of 75 feet, measured horizontally from the edge of the aquatic ecosystem. • Filter strip width along ephemeral water bodies should be a minimum of 50 feet, measured horizontally from the edge of the aquatic ecosystem.	SIR, p. 31
GFW-ARR-6	Earth-disturbing activities that expose mineral soil may occur within the filter strip only if effective sediment control measures that minimize and/or mitigate any detrimental effects are employed.	SIR, p. 31
GFW-ARR-8	Design stream crossings to be at right angles.	SIR, p. 39
GFW-ARR-9	Design and construct new permanent stream crossings (ephemeral, intermittent and perennial streams) to maintain upstream and downstream passage of aquatic and semiaquatic organisms.	SIR, p. 40
GFW-WSH-1	Water should not be diverted from streams, lakes, or springs when in-stream flow needs or water-level assessments indicate that diversion would adversely affect stream processes, aquatic and riparian habitats and communities, or recreation and aesthetic values.	SIR, p. 41
GWF-ARR-14	Avoid the use of heavy equipment in flowing streams. Alternatives may include concentric pipe (double pipe) and plowing.	SIR, p. 40
GWF-ARR-15	Encourage the location of pipelines at existing bridges.	SIR, p. 40
GWF-ARR-16	When a pipeline crosses a stream on NFS land, the following should apply: • Encourage the use of boring to locate pipeline crossings beneath Forest streams where topography, soil, and stream bottom conditions permit. • Stabilize disturbed soil and protect streamside banks as work progresses.	SIR, p. 40
SFW-ARR-10	Do not allow roads, trails, or log skidding within streambeds except at designated crossings.	SIR, p. 40
SFW-ARR-11	If stream crossings are removed, restore banks and channel to a natural dimension and shape.	SIR, p. 40

Reference	Stipulation/Notification/Standard Text	Source
SFW-ARR-13	Pipelines of 9-inch diameter or larger that cross streams on NFS land must be reviewed by the Ohio Public Utilities Commission and the Federal Energy Regulatory Commission.	SIR, p. 40
SFW-ARR-17	Require appropriate technology on all pipelines that cross streams so that supply and flow can be shut off upon detection of a leak.	SIR, p. 40
SFW-ARR-7	Design mitigation measures (e.g., sizing culverts to match the drainage area) into crossings of perennial, intermittent or ephemeral streams to meet site-specific needs.	SIR, p. 39
SFW-MIN-3	Require that operators conduct activities and maintain equipment to prevent the discharge of oil or brine onto the ground or into surface waters.	SIR, p. 48
SFW-MIN-4	Upon discovery or notification of an accidental spill of crude oil or brine that discharges, or threatens to discharge, into surface waters, notify the Ohio Environmental Protection Agency Emergency Response and Special Investigations unit in Columbus.	SIR, p. 49
GFW-TRANS-10	New road construction should follow the design guidance provided in Appendix A of the Forest-wide Roads Analysis document.	SIR, p. 77
GFW-TRANS-11	Use existing roads as an alternative to construction of new roads whenever possible.	SIR, p. 77
GFW-TRANS-5	Place load limits on roads that are susceptible to damage.	SIR, p. 77
GFW-TRANS-7	Avoid co-locating motorized trails with Maintenance Level 2 to 5 roads.	SIR, p. 77
GFW-TRANS-8	Avoid new road construction: • Within 50 feet of OHV or pedestrian trails (except at crossings) • Within riparian areas • Within the filter strips of streams and waterways, except for infrequent crossings • On mechanically unstable soils.	SIR, p. 77
GFW-TRANS-9	Require permit holders to install and maintain an appropriate physical barrier on special use roads to prevent unauthorized use. If special use roads remain in place without a barrier, the permit holder must reconstruct the road to Maintenance Level 3.	SIR, p. 77
SFW-TRANS-4	Allow motor vehicles licensed for travel on the State and Federal highways to use National Forest System roads at Maintenance Levels 2 to 5.	SIR, p. 77
SFW-TRANS-6	All roads are closed to the public unless the Forest road atlas specifically lists them as Maintenance Level 2 to 5 (open to the public).	SIR, p. 77

Reference	Stipulation/Notification/Standard Text	Source
G-DCF-VEG-2	Use even-aged timber management (thinning, shelterwood, clearcut or two-aged harvest) on approximately 25 percent of the area to perpetuate visual and vegetative diversity. Concentrate even-aged management on the periphery of the management area or on the periphery of large blocks of land targeted for uneven-aged management.	SIR, p. 59
GFW-TES-9	Retain all shagbark and shellbark hickory trees > 6 inches dbh, unless removal is necessary to protect human safety or to avoid adverse impacts to steep slopes, erodible soils, floodplains, or wetlands.	SIR, p. 52
GFW-WLF-11	In conjunction with opening development and maintenance, retain existing snags and create additional ones, unless they pose a safety hazard.	SIR, p. 62
GFW-WLF-6	When oil and gas well developments meet, or can be made to meet, the objectives of permanent forest openings, designate them accordingly so they may also contribute to herbaceous habitat objectives.	SIR, p. 62
GFW-WLF-7	Permanent forest openings should be larger than one acre in size, unless necessary to meet the needs of a site-specific species.	SIR, p. 62
Stipulation #1	No surface occupancy allowed on the entire lease or on designated areas of the lease (see lease map) for the protection of the Future Old Forest resources. On NFS lands in Future Old Forest Management Areas, the Forest Service will issue leases for Federal oil and gas only with an NSO stipulation. In the case of Federal leases issued pursuant to the Comprehensive National Energy Policy Act of 1992, the Forest Service will recommend to the Bureau of Land Management that operations be allowed to continue provided that all activities comply with Forest guidance. When the existing well (or wells) is depleted, all facilities must be removed and the site rehabilitated to Forest Service standards. No new wells will be allowed, nor will existing wells be allowed to be drilled to deeper formations. The NSO stipulation does not apply to reserved or outstanding mineral rights.	SIR, Appendix A, p. 3
Stipulation #14	At the time of any new proposed lease developments, the responsible line officer shall determine the extent of the surface use restrictions necessary to maintain habitat integrity for plant and animal species dependent on such habitats.	SIR, Appendix A, p. 7
GFW-SM-21	Avoid the need for lighted towers, particularly in locations visible from a lake or in the viewshed of a Concern Level 1 or 2 travel way or use area.	SIR, p. 73

Reference	Stipulation/Notification/Standard Text	Source
GFW-SM-23	Reduce visual impact of current and future obstruction lighting requirements as much as technology and FAA and FCC requirements will allow.	SIR, p. 73
GFW-SM-24	Reduce visual impact by using such techniques as, but not limited to, directional lighting, tilting, shields, etc.	SIR, p. 73
GFW-SM-25	Maximum intensity of lighting shall be the minimum required by FAA and/or FCC. Unless otherwise required by the FAA, only white (preferable) or red strobe lights should be used at night, and these should be the minimum number and intensity, with the minimum frequency of flashes (maximum duration between flashes), as required by the FAA.	SIR, p. 73
GFW-SM-64	Strive to schedule mechanized activities along Concern Level 1 and 2 travel ways, use areas, and water bodies to occur during low-use periods to alleviate noise and visual impacts.	SIR, p. 73
Stipulation #11	At the time of any new proposed lease developments, the responsible line officer shall determine the need for any visual quality mitigation. Some examples of mitigation may include special design and reclamation measures, transplanting trees and shrubs, fertilization, mulching, special erosion control structures, irrigation, site recontouring to match the original land contour, low profile equipment and painting to minimize contrast. Surface occupancy may also be limited or denied in sensitive areas, such as unique geologic features and rock formations, visually prominent areas such as designated trails and developed recreation sites.	SIR, Appendix A, p. 6
GFW-ARR-23	Avoid adverse impacts to ephemeral wetlands during ground-disturbing activities.	SIR, p. 31
GFW-ARR-4	Where possible, do not construct new facilities (such as roads, trails, campsites, and buildings) within riparian areas. Where such facilities must be located in riparian areas, construct and maintain them to minimize adverse impacts to ecological function.	SIR, p. 31
Stipulation #15	At the time of any new proposed lease developments, the responsible line Supplemental Information Report officer shall determine the appropriate surface use restrictions necessary to maintain the structural and ecological integrity of riparian areas, and aquatic and riparian-dependent species viability.	SIR, Appendix A, p. 7-8

Appendix G – USFWS Recommended Measures for Avoiding and Minimizing Adverse Impacts to Federally Listed Species

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Recommendations from the U.S. Fish and Wildlife Service for Avoiding Adverse Effects to Federally Listed Species from Bureau of Land Management Leasing and Subsequent Permitting of Federal Oil and Gas Rights on Marietta Unit of the Wayne National Forest in Ohio

The U.S. Fish and Wildlife Service (FWS) has prepared this document to provide guidance to avoid and minimize the anticipated impacts to Federally listed and proposed species or their habitat by the Proposed Action to lease Federal mineral estate within the proclamation boundary of the Wayne National Forest (WNF), Athens Ranger District, Marietta Unit and extending four miles beyond. The Marietta Unit is located within Monroe, Noble, and Washington Counties in Ohio. The parcels that could be leased as part of the Proposed Action consist of all Federal mineral estate underlying the National Forest and total approximately 40,000 acres. The proposed parcels would be leased for potential future oil and gas development. The next steps after leasing are discussed below.

The Bureau of Land Management's (BLM's) permanent instruction memorandum 2018-014 (PIM) considers the first three scenarios listed below and describes agency responsibility and jurisdiction between the time of leasing Federal minerals and receiving an Application for Permit to Drill (APD) said minerals. The fourth scenario is described specifically for this review of impacts to national forest system land:

1. **Scenario 1: Surface disturbance occurred on private land to access private minerals but no further surface disturbance will occur to access Federal minerals.**

   An example would be unrelated drilling on an existing well pad on private property and the only further action would be horizontal drilling from the existing well pad into Federal oil/gas. All the disturbance at the well pad would occur prior to BLM involvement and the only direct oversight that would have occurred for this previous action would be what is required under state law. The applicant may have contacted FWS for technical assistance under Section 9 of the Endangered Species Act (ESA) and FWS may have provided recommendations for avoiding take of Federally listed species.

   In this scenario, BLM would only assess the "down hole" impacts of the proposed actions to access Federal oil/gas. Any construction impacts (tree clearing, soil disturbance, road building) that do not have Federal involvement and that are reasonably certain to occur under this scenario would be considered as cumulative effects in any formal consultation if they occur within the area likely to be affected by a Federal action. These effects are also considered as cumulative effects under the National Environmental Policy Act (NEPA) analysis. These effects are outside of BLM or Forest Service (FS) control. However, these effects have been considered in both the Biological Assessment as well as the Environmental Assessment (EA). Impacts to mussels could occur if significant water withdrawal is required for boring of the well to reach Federal minerals.

Any such impacts would be connected to BLM's authorization and therefore subject to agency oversight.

2. **Scenario 2: Some disturbance on private surface may have occurred and additional disturbance will occur to access Federal minerals.**

   An example would be an existing well pad that is then expanded to accommodate more wells that would access Federal oil/gas. Previous disturbance would have already occurred prior to BLM involvement and the only direct oversight for this previous action would be what is required under state law. The applicant may have contacted FWS for technical assistance under Section 9 of the ESA and FWS may have provided recommendations for avoiding take of Federally listed species. Any construction impacts (tree clearing, soil disturbance, road building) that do not have Federal involvement and that are reasonably certain to occur under this scenario would be considered as cumulative effects in any formal consultation if they occur within the area likely to be affected by a Federal action. These effects are also considered as cumulative effects under the NEPA analysis. However, Section 7 (i.e., Federal) consultation is triggered when the APD is submitted. The additional/new disturbance would be considered effects resulting from the BLM's authorization to access Federal oil/gas and reviewed under the ESA Consultation Framework process described below.

3. **Scenario 3: No disturbance on private surface has occurred but new disturbance will be needed to access Federal minerals.**

   An example would be undeveloped private land (any landcover) proposed for well pad development to access Federal oil/gas. The new disturbance would be considered an effect of the Federal action and regulated under the ESA Consultation Framework described below . However, it is recognized under BLM regulations that the applicant could conduct surface disturbance, clear a well pad, and/or drill up to the border of Federal minerals prior to submitting the APD. In this case, if disturbance has already occurred prior to Federal involvement, it would again fall into Scenario 1. Because the non-federal party cleared the well pad and/or drilled without involving any Federal agency these activities would not prompt the need for section 7 consultation. Only the Section 9 prohibitions of the ESA would apply to the non-federal activities under scenarios 1 and 2. The FWS regularly provides Section 9 technical assistance as requested by entities conducting oil and gas activities on private land in Ohio.

4. **Scenario 3: Any and all surface disturbance will occur on Federal surface to access Federal minerals.**

   An example would be proposed development of a well pad on Wayne National Forest (or other Federal agency) surface to access permitted Federal oil/gas. The new disturbance would be an effect of the Federal action and regulated under the ESA Consultation Framework described below. No surface disturbance could occur until the lead Federal agency has completed Tier 2 section 7 consultation and the applicant has obtained the necessary permits/authorization from the Federal entity responsible for the surface.

Endangered Species Act Consultation Framework For Scenarios 2, 3, and 4

A Programmatic informal consultation for listed bats, mussels, and plants will include an overall limit to forested acres impacted over the next 10 years (over the term of the lease), as well as avoidance and

minimization measures, listed below, to limit and ensure that adverse effects to Federally-listed species are not likely.

Consultation Process: 10-Year Programmatic Informal Consultation for Bats, Mussels, and Plants Developed by Bureau of Land Management, Forest Service, and U.S. Fish and Wildlife Service

Process

The Tier 1 review is completed by FWS based on information from BLM and the FS in a programmatic approach prior to the availability of leases and considers the impacts of all the leasing as a whole.

1. Applicant uses the BLM Expression of Interest (EOI) process to demonstrate an interest in a lease.
2. BLM issues a lease to applicant.
3. Applicant submits APD to BLM. If the applicant has not completed Information for Planning and Consultation (IPaC) (the FWS's process for initiating project review), then BLM will enter the project into IPaC. BLM conducts an onsite inspection.

   BLM consults with FWS under this project's Tier 2 consultation according to the scenarios identified above. For scenario 3 if applicant follows all avoidance and minimization measures (AMM) then the project is not likely to adversely affect listed species and Tier 2 informal consultation will occur. Forest impacts would be tracked by FWS through the programmatic consultation process with BLM reporting and verifying in the field, if needed. BLM will identify all the AMMs that would be implemented. Once FWS has received all necessary information, informal consultation will be completed within 30 days.

   If applicant cannot follow all AMMs then a separate consultation between FWS and the BLM (outside this programmatic informal consultation) may be required as well as coordination with the FS, if the proposed project will impact the WNF. The BLM's Section 6 lease term (BLM 2023) requires minimization of adverse environmental impacts. Therefore, the APD cannot be issued until the wildlife impacts have been resolved. Formal consultation would follow standard regulatory timelines of 135 days once all required information has been provided to FWS (see 50 CFR 402.14).
4. The BLM determines if APD will be issued. The applicant must have all necessary state permits as well as any required permits from the FS.

Tier 1 overall impacts considered for construction of well pads, well drilling roads, pipelines, and other associated infrastructure include:

- Tree and vegetation clearing
- Disturbance: noise, activity
- Water quantity impacts (i.e., withdrawal)
- Water quality impacts
- Spread of invasive species (plants)

Avoidance and Minimization Measures

AMMs to address impacts to plants, bats, and mussels from Scenarios 2, 3, and 4 are listed below. If these AMMs cannot be implemented, then additional coordination with the FWS is required and formal consultation outside this Programmatic Informal Consultation may be required.

Bat AMMs

Require seasonal clearing/cutting (from Oct 1 to March 31) of all trees greater than 3 inches diameter at breast height (DBH).

- Bats utilize trees during the summer so tree clearing is limited to the winter when bats are hibernating (i.e., not present on the landscape) to avoid direct impacts.

Minimize clearing/cutting of mature trees (not including scrub/shrub/saplings less than 5 inches DBH) to 10 acres or less for each new Federal project including well pads, laydown yards, pipelines, access roads, etc. (i.e., choose non-wooded locations or already-disturbed areas for development). If greater than 10 acres of clearing is necessary, then additional conditions, in coordination with FWS, may apply.

- It is expected that clearing of 10 acres or less of bat habitat is less likely to remove a substantial portion of a maternity roost area or key foraging habitat. Indiana bats (*Myotis sodalis*), northern long-eared bats (*Myotis septentrionalis*), and tricolored bats (*Perimyotis subflavus*) exhibit strong site fidelity. When females return in the spring their energy demands are highest (due to being pregnant) and having to seek out a new roost or foraging area could result in impacts at a time when there are few insects on the landscape to support increased energy demands.

Require a closed system for the containment of produced water from drilling and all applicable local, state, and Federal regulations apply for the appropriate disposal of produced water.

- Indiana bats like to forage over water (streams, wetlands, as well as other water bodies). Bats will also drink water from surface sources, such as small impoundments. At well development sites, produced water from drilling in an open system could expose bats to contaminants. With their high energetic demands contaminants can accumulate and potentially harm individuals.

For areas near a potential hibernaculum, no clearing/cutting of trees within ¼ mile of a hibernaculum and for areas over ¼ mile but less than 5 miles away from a hibernaculum, limit clearing/cutting to Nov 15 to March 15.

- Clearing trees directly in front of a hibernaculum can potentially alter air flow patterns and internal microclimate conditions, disturb roosting bats and/or cause structural disturbance to the hibernaculum as well as may make it more accessible to vandalism.
- All three bat species will congregate near hibernacula in the spring and fall. Therefore, bats can be very concentrated in the area immediately around a hibernaculum until such time as they leave the area for summer habitat or enter the hibernaculum for the winter.

Limit the cumulative removal of forest habitat to no more than 105 acres of deciduous forest (trees greater than 5 inches DBH) annually and 998 acres total over the next 10 years (2020 Reasonably Foreseeable Development Scenario [RFDS] [BLM 2020]). There is an acknowledged discrepancy between sums due to the complex nature of the calculation conducted for the RFDS and uncertainty in market development of oil and gas in the future.

- An individual bat's home range can be relatively large. Impacts to a significant portion of this home range may result in a loss of roost trees, foraging habitat, and prey base. Acreage of tree removal is expected to be dispersed on the landscape. However, it does take a significant amount of time for trees to become a suitable size for roosting by bats. Therefore, a limited acreage of tree removal annually is needed to ensure that there is a significant amount of mature trees on the landscape at all times.

Based on a remote sensing analysis by BLM using 10-meter resolution satellite radar imagery, over 18,000 differences between 2015 imagery and 2023 imagery were detected in the Marietta Unit of the Wayne National Forest. These changes were then overlayed on well site locations, with each well site having a surrounding 250-foot buffer for analysis. When these two layers were intersected, only six of the over 18,000 changes matched well locations. Cumulatively the six well-related sites covered an area of less than one acre, equating to approximately 0.0004 percent of the total Marietta unit in the last 8 years. Expanding this calculation to include the four-mile assessment area surrounding the Marietta Unit results in approximately 1.67 acres of change across the total 447,102-acre area (BLM 2024). The computer analysis did not distinguish between changes to forest canopy and changes to structures or buildings. The six well locations reviewed manually indicated that the changes detected were not related to canopy coverage. This analysis does not account for vegetation health or tree characteristics that would determine suitability for bat habitat but indicate that impacts to potential roost trees and foraging habitat was minimal over nearly the last decade.

Historic and ongoing oil and gas development may have impacted canopy cover in the WNF and associated forested habitat for bats and other wildlife. As described in Appendix H (*Past, Present, and Reasonably Foreseeable Future Actions*) a remote sensing and Geographic Information System (GIS) analysis using data limited to WNF indicates that only six well-related sites covered an area of less than one acre, equating to approximately 0.0004 percent of the total Marietta unit has been impacted by oil and gas development between 2015 and 2023. This limited amount of habitat change suggests there has been negligible cumulative impacts to forested bat habitats within the WNF during the last 20 years.[1] In comparison to the total development expected on private lands in the Cumulative Impact Analysis Area (CIAA), there is a minimal amount of surface disturbance and well development under the Proposed Action, which would equate to a negligible incremental increase in habitat change and cumulative impacts to forested habitat, canopy cover, and associated bat and wildlife habitat.

Mussel AMMs

Prohibit in-water work in Group 2 and 4 mussel streams (currently identified in Appendix A of the *2023 Ohio Mussel Survey Protocol* and hereafter identified as "mussel streams") or conduct an USFWS-approved mussel survey following the most recent version of the Ohio Mussel Survey Protocol.

- In water work can result in direct mortality to mussels through crushing as well as impacts such as siltation and increased sedimentation and erosion which can suffocate mussels, impact their host fish and/or result in the dislodging of individual mussels. It can also destroy, alter, or degrade suitable in-stream habitat.

Prohibit well pads within 1,000 feet of a mussel stream.

[1] Note that data was not available to assess the entirety of the CIAA.

- Construction of a well pad can result in sedimentation due to ground disturbance, an increase in runoff due to impervious surfaces (such as the well pad and access roads), and increases in potential contamination from increased vehicular access (leaky engines, potential spills).

Establish 300-foot no-disturbance buffers along each side of mussel streams (no access roads within this buffer).

- This buffer will minimize contamination of mussel streams as well as reduce sedimentation. This will help to maintain the water quality in occupied mussel streams.

Prohibit water withdrawals from Little Muskingum River, Muskingum River, and any other Group 2 and 4 streams that may be identified in the future during drought conditions that exceed the severe drought category, according to the U.S. Drought monitor. Before any water withdrawals are initiated the applicant will check the U.S. Drought Monitor website at: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?OH to confirm that the source water does not exceed the D2 Severe Drought designation (i.e., no water withdrawal are allowed from areas experiencing "extreme drought" or "exceptional drought").

- Water withdrawals during low flow conditions could temporarily strand mussels resulting in mortality. Lower water levels can result in increases in water temperature as well as a decrease in oxygen levels which could also result in mortality to mussels. Lower water levels may reduce connectivity and prevent the movement of fish hosts, potentially impacting the movement and survival of glochidia. Lower water levels may also increase predation from some mammals as mussels are easier to access during low flow.

- Significant decreases in flow conditions can increase concentrations of contaminants leading to a potentially acute exposure as well as an accumulation of waste.

FWS encourages the use of recycled water to minimize the amount of water withdrawals from surface sources.

Plant AMMs

Avoid disturbance to suitable habitat for Virginia spiraea (*Spiraea virginiana*), northern monkshood (*Aconitum noveboracense*), small whorled pogonia (*Isotria medeoloides*). Suitable habitat for Virginia spiraea (VS) is limited to riparian habitats along rocky streambanks or sandbars. This species requires a habitat characteristic of flooding and subsequent deposition for successful colonization. Known populations of VS in Ohio occur on large, long-established gravel bars. Suitable habitat for the northern monkshood (NMH) is limited to cool, moist, talus slopes or shaded cliff faces in wooded ravines. Small whorled pogonia (SWP) occurs both in fairly young forests and in maturing stands of mixed-deciduous or mixed-deciduous/coniferous forests. The majority of SWP sites share several common characteristics: sparse to moderate ground cover in the microhabitat (except when among ferns); a relatively open sub-canopy (permitting diffuse light to reach the forest floor, while limiting direct light); and close proximity to trails, old logging roads, streams, or other features that create long-persisting breaks in the forest canopy. The soil in which the shallow-rooted SWP grows is usually covered with leaf litter and decaying material. The spectrum of habitats includes dry, rocky, wooded slopes to moist slopes or slope bases crisscrossed by vernal streams.

The applicant or BLM will conduct a desktop analysis to determine if potentially suitable habitat for the species (as described above) is present. Desktop analysis should include mapping of habitat types in the area, review of soils/geology in the area, and review of aerial maps to see if the area is within a

completely closed forest. If the project area is entirely mowed lawn or is entirely developed (such as parking lot, buildings) then the project would have no effect to listed plant species. FWS will review the desktop analysis to determine if it is acceptable and then provide guidance on whether a presence/absence plant survey is needed when BLM requests Tier 2 consultation.

- There are relatively few areas that provide suitable habitat for VS or NMH. While there is a greater potential for SWP to occur within the Action Area, a desktop analysis can determine if suitable habitat could be present. If suitable habitat is present a plant survey can be conducted for any of these species (during the appropriate season) to determine the presence/absence of this species at the project site. FWS will provide guidance on whether a desktop analysis or plant survey is recommended when BLM requests Tier 2 consultation.

Clean equipment before entering a site to prevent movement and spread of invasive species.

- This will prevent the movement of hitchhiker seeds and plant material of invasive plants that can quickly colonize an area and create a monoculture of vegetation, reducing habitat quality.

Revegetate disturbed areas with a mix of noninvasive annual ground cover and perennial native species.

- This will prevent erosion and lessen the germination of weed seed like Japanese stiltgrass.

Action Area

The Action Area includes the Marietta Unit of the WNF and the 4-mile distance around it in Ohio from which oil and gas can be extracted through horizontal drilling. Some impacts such as tree clearing and water withdrawals on the West Virginia side of the Ohio River are not expected to occur due to lack of currently defined process for Ohio oil and gas being pulled from the West Virginia side.

Tier 2 Consultation Process Occurs (Between FWS and BLM when BLM receives APD)

BLM consults with FWS. If applicant follows all AMMs and has obtained all state and any applicable FS permits then the project most likely will not adversely affect federally listed species. Forest impacts would be tracked. BLM submits form for informal consultation to FWS.

If applicant cannot follow all AMMs for the species expected to occur in that area (as indicated in the IPaC and Tier 2 consultation form) then the project may require separate consultation (outside the programmatic informal consultation).

References

Bureau of Land Management (BLM). 2018. Permanent Instruction Memorandum (PIM) 2018-014, Directional Drilling into Federal Mineral Estate from Well Pads on Non-Federal Locations.

Bureau of Land Management (BLM). 2020. *Reasonably Foreseeable Development Scenario (RFDS) For Oil and Gas Activities 2020–2034 Wayne National Forest*. DOI BLM Northeastern States District Office, Milwaukee, WI.

Bureau of Land Management (BLM). 2024. Unpublished Analysis for 2015–2023 Land Cover Changes Provided to the U.S. Fish and Wildlife Service.

Appendix H – Past, Present, and Reasonably Foreseeable Future Actions

APPENDIX H:

Past, Present, and Reasonably Foreseeable Future Actions

1.1. Introduction

This Supplemental Environmental Assessment (EA) considers past, present, and foreseeable future actions occurring on both federal and private lands within the Cumulative Impact Analysis Areas (CIAAs). Land within the Action Area is considered "checkerboard," with private and federal ownership intermingled. Privately owned lands (382,269 acres) currently account for 85.5 percent of the total Action Area (446,907 acres). Public lands (64,638 acres) account for approximately 14.5 percent of the Action Area, including public lands managed by the U.S. Forest Service (USFS) (64,637 acres) and the Wayne National Forest (WNF) and U.S. Army Corps of Engineers (USACE) (1 acre) as part of the Parkersburg Levee System (USGS 2023a).

1.2. Past, Present, and Reasonably Foreseeable Future Actions

The analysis of potential cumulative effects incorporates information from the 2016 EA (BLM 2016), 2020 RFDS (BLM 2020), 2006 Forest Plan (USFS 2006a), 2006 Forest Plan Final EIS (USFS 2006b), and 2012 SIR (USFS 2012), as well as new information that the BLM and USFS provided.

Historically, the largest contributors to existing vegetation and soil conditions in the WNF were grazing and other resource-extraction activities, including timber removal, which dominated current WNF lands throughout the twentieth century (BLM 2016). Land clearing resulted in regrowth of homogenized, single-aged stands across much of the WNF and many monoculture white pine stands were planted to combat soil erosion. Additionally, wildfire suppression, which decreases the ability of oak forests to regenerate properly, was practiced throughout the twentieth century (BLM 2016; USFS 2020a). It is estimated that 14 percent of Dry-Mesic Mixed Oak Hardwood Forest in the WNF would burn annually per historical fire regimes (USFS 2020a).

The largest historical contributors to existing conditions of wetlands, water resources, and water quality in the WNF were mining, timber extraction, farming and grazing, impoundment of water or water withdrawal, and pollution resulting from early settlements near and in the WNF that occurred throughout the twentieth century. Common historical practices included diverting and rerouting waterways, draining wetlands for farming, farming, and grazing right up to and in streams and rivers, and mining that produced acid wastes (BLM 2016). Many of these historical practices have ceased with the establishment of the WNF, and USFS focuses on sustainable management in the Marietta Unit.

At this time, a variety of specific, planned, and completed USFS projects on NFS lands within the Action Area have the potential to contribute to cumulative effects in combination with the Proposed Action, as listed below and shown on Figures H-1 and H-2. These projects were authorized under the 2006 Forest Plan (USFS 2006a) and 2006 Forest Plan Final EIS (USFS 2006b), or USFS or the BLM identified them as part of the NEPA review for the Supplemental EA process.

PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE USFS ACTIONS
Nonspecific Locations around the Marietta Unit
Spongy moth (*Lymantria dispar*) aerial treatments (i.e., mating disruption and insecticide applications) are permitted anywhere on the Marietta Unit except Rheas Run Research Natural Area and within buffered distance of open water
Nonnative and invasive species treatments
Trail and recreation site maintenance
System Trail Adaptation, Rehabilitations, and Relocation project (i.e., allowing for trail relocations and reconstruction/rehabilitation across NFS lands, as needed)
Orphan Wells and Abandoned Mines Project authorizes plugging and reclamation on 680 acres
Specific Locations
Trailhead development (Plainview Horse Trail)
Marietta Athens Pine Project – timber harvests
Ongoing use, occupancy, and maintenance of rights-of-way and other uses permitted through special use authorizations
Yellow fringed orchid (*Platanthera ciliaris*) prescribed fire implementation
Pleasant Bear Vegetation Management Project, included timber harvests and prescribed fire implementation
Periodic maintenance at operating oil and gas wells

In addition to the discrete projects listed above, the cumulative effects analysis considers past, ongoing, and reasonably foreseeable actions on private land dispersed throughout the Action Area. Private landowners conduct oil and gas activities, farming and grazing activities, and timber sales on their land.

The majority of past, present, and future activity in the Cumulative Impact Analysis Area is associated with oil and gas drilling. As of September 2023, there are approximately 17,125 oil and gas wells in the CIAA (Marietta Unit plus a 4-mile buffer), with 14,105 (i.e., 82 percent) of those wells occurring on private land (Table H-1). All but one of these 17,125 wells are on private lands or on federal leases issued prior to December 2016, when BLM conducted the first of several lease sales relying on the 2016 EA challenged in the CBD Court Case. The number of oil and gas wells on both private and NFS land within the CIAA are tallied in Table H-1 below. A total of 3,020 oil and gas wells are located on NFS lands within the CIAA. Of these wells, 1,941 are on NFS land in Washington County, 1,009 are on NFS land in Monroe County, and 70 are on NFS land in Noble County. Private land within the CIAA is in both Ohio (inside and outside the WNF) and West Virginia. Within Ohio, 7,582 wells are on private land in Monroe County, 1,082 in Noble County, and 4,491 in Washington County (ODNR 2023b). In the West Virginia portion of the CIAA, there are 735 wells on private land in Pleasants County, 111 in Tyler County, and 104 in Wood County (WVGES 2023).

Table H-1 Oil and Gas Wells within the Cumulative Impact Analysis Area

STATE	COUNTY	WELLS ON NFS LAND	WELLS ON PRIVATE LAND
Ohio	Monroe	1,009	7,582
Ohio	Noble	70	1,082
Ohio	Washington	1,941	4,491
West Virginia	Pleasants	–	735
West Virginia	Tyler	–	111
West Virginia	Wood	–	104
Total	**–**	**3,020**	**14,105**

Source: ODNR 2023b; WVGES 2023.

Leasing federal minerals within the Marietta Unit may lead to additional future mineral development on private land and private minerals within the area because the investment and cost for construction of well pads and infrastructure to access federal minerals could be leveraged in the future to develop private land and minerals. Although development of federal minerals requires compliance with a variety of federal environmental and resource regulatory requirements, numerous State laws and regulations in place also govern mineral development activities on private land (see Appendix C of the 2016 EA for a summary of the laws and regulations that govern mineral development activities on private land in Ohio).

Historic and ongoing oil and gas development may have impacted canopy cover in the WNF and associated forested habitat for bats and other wildlife. A remote sensing and GIS analysis using data limited to WNF indicates that only six well-related sites covered an area of less than one acre, equating to approximately 0.0004 percent of the total Marietta unit has been impacted by oil and gas development between 2015 and 2023. This limited amount of habitat change suggests there has been negligible cumulative impacts to forested bat habitats within the WNF during the last 20 years.[1] In comparison to the total development expected on private lands in the CIAA, there is a minimal amount of surface disturbance and well development under the Proposed Action, which would equate to a negligible incremental increase in habitat change and cumulative impacts to forested habitat, canopy cover, and associated bat and wildlife habitat.

In addition to individual past, present, and reasonably foreseeable projects, changes in environmental trends over the cumulative analysis timeframe could contribute to and/or exacerbate cumulative impacts. Changes in climate trends over time can contribute to effects on vegetation and forestry, wildlife, social and economic conditions, and water resources. For example, climate change may cause more severe or frequent floods in some places, including the Northeastern U.S. As warmer temperatures cause more water to evaporate from the land and oceans, changes in the intensity and frequency of heavy precipitation events may in turn affect the intensity and frequency of flooding (IPCC 2021).

The ability to accurately assess potential cumulative impacts from future development is limited because of the lack of site-specific information regarding whether, where, when, and to what scale potential future oil and gas development activities would occur. Therefore, at this stage, the

[1] Note that data was not available to assess the entirety of the CIAA.

2020 RFDS has been used to generalize the types of cumulative impacts that could occur associated with the proposed action. However, for the purpose of this analysis, the BLM has considered potential cumulative effects based on what is reasonably foreseeable at this time as described in the 2020 RFDS. On receipt of an APD, which would identify specific parcel(s) for development, a site-specific analysis would be conducted by the BLM, and by the USFS if development is proposed on NFS surface, along with additional cumulative effects analysis based on the specific development proposal.

Figure H-1. Marietta Unit Past, Present, and Reasonably Foreseeable Future Actions

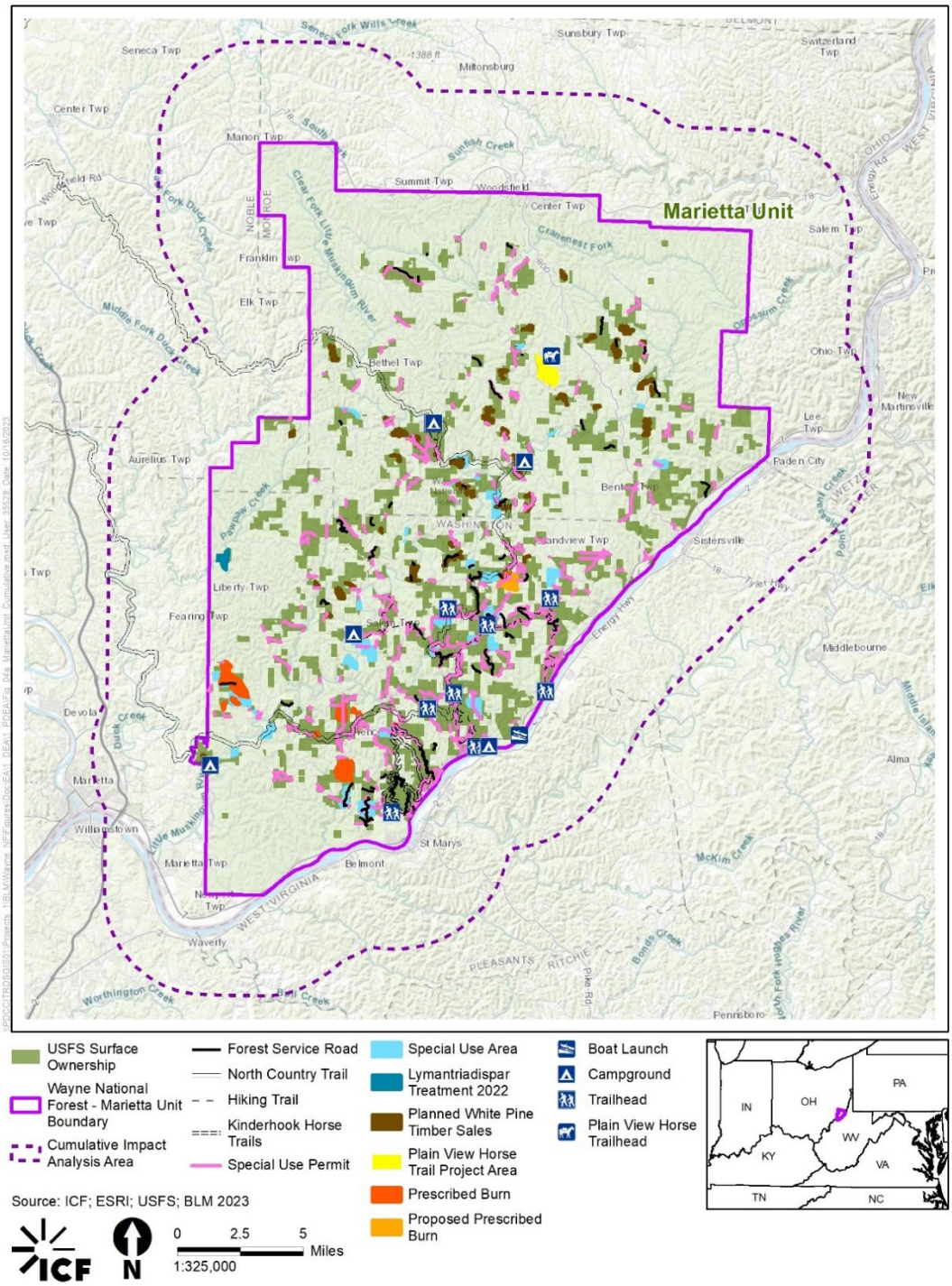
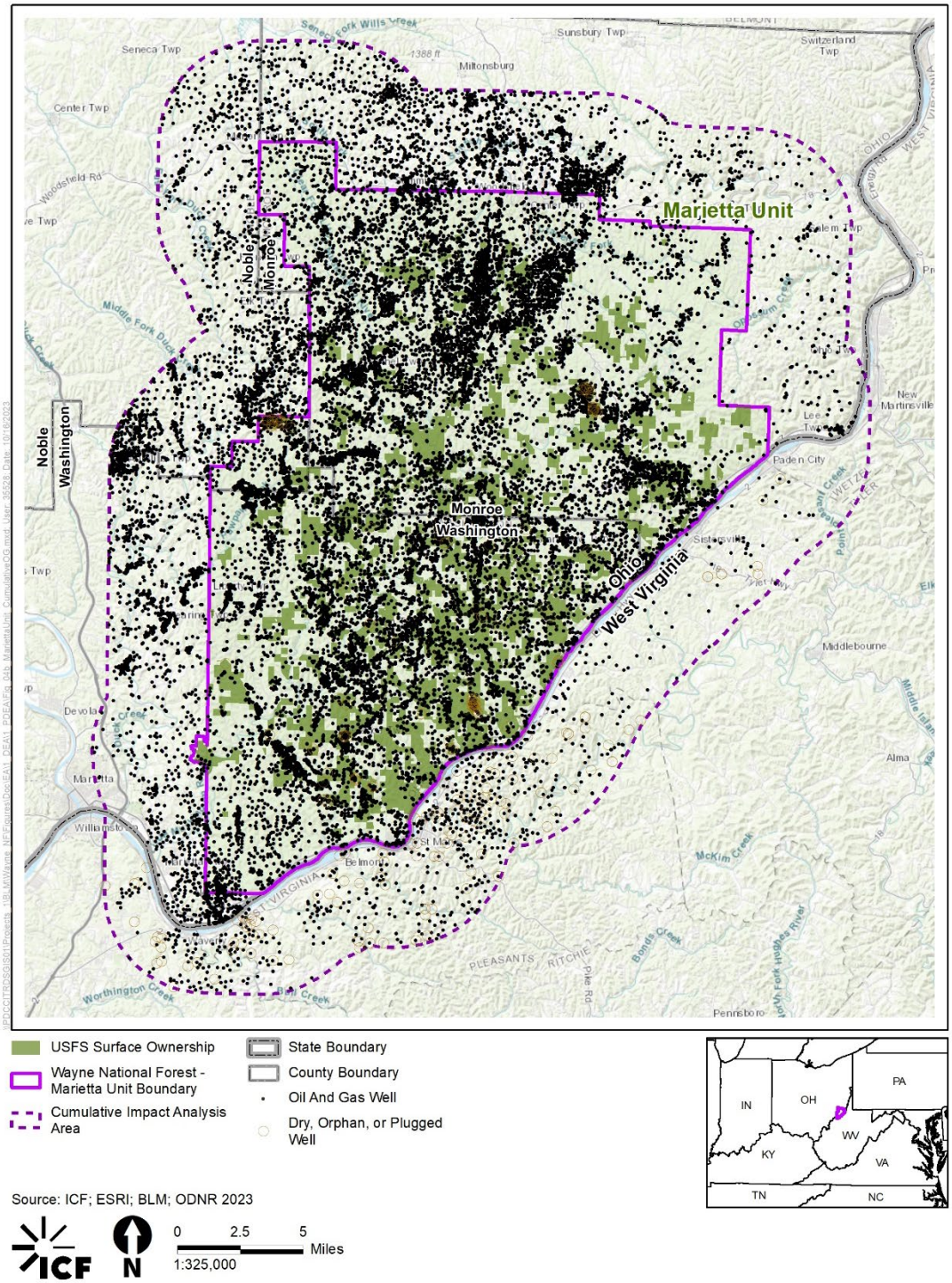


Figure H-2. Past, Present, and Reasonably Foreseeable Oil and Gas Development in the Cumulative Impact Analysis Area



Appendix I – Air Quality and Climate Impacts

APPENDIX I:

AIR QUALITY AND CLIMATE IMPACTS

CHAPTER 1. AIR RESOURCES

Air quality is a component of air resources which may be affected by Bureau of Land Management (BLM) applications, activities, and resource management. Therefore, the BLM must consider and analyze the potential effects of BLM-authorized activities on air resources as part of the planning and decision-making process. This appendix serves as a supplement to Sections 4.1 and 4.2 in the Environmental Assessment (EA) to provide additional information regarding the existing climate and air quality within the area potentially affected by the parcels under consideration for leasing under the Proposed Action.

1.1. Air Quality

Air quality is influenced by the interaction of meteorology, climate, and the magnitude and spatial distribution of local and regional air pollutant sources (including natural sources), and chemical properties of emitted air pollutants. The following sections detail the existing air quality conditions within the area potentially affected by the parcels under consideration for lease, and the effects of air pollution on health, visibility, and ecology.

1.1.1. Regulatory Guidance

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (USEPA) to establish and revise National Ambient Air Quality Standards (NAAQS). There are currently six criteria pollutants subject to a NAAQS: sulfur dioxide (SO_2), carbon monoxide (CO), coarse and fine particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb). The primary standards serve to protect public health, including the health of sensitive subpopulations, with an adequate margin of safety. Secondary standards serve to protect the public welfare from adverse effects on soil, water, crops, buildings, and other matters.

The states and the USEPA are jointly responsible for ensuring that all areas of the United States have the ability to attain and maintain the NAAQS. In this partnership, states are responsible for developing enforceable state implementation plans to reduce ambient levels of air pollution to meet and maintain the standard (USEPA 2015). Areas where air quality meets the standards are called attainment areas; areas where ambient air quality concentrations do not meet the NAAQS are designated as nonattainment areas (USEPA 2022). Nonattainment areas with air quality that improves to meet the NAAQS are redesignated as attainment-maintenance areas and are required to demonstrate that the air pollutant concentrations are maintained below the NAAQS for the next 20 years.

The Ohio Environmental Protection Agency (Ohio EPA) is the delegated authority for regulating air pollution within Ohio. The Ohio EPA uses ambient air monitors at multiple locations throughout the state to determine ambient air pollutant concentration for comparison to the NAAQS. The current NAAQS are provided in Table I-1; Ohio EPA has not established separate ambient air quality standards at the time of this report's publication (Ohio EPA 2023). Ambient air pollutant concentrations are expressed in concentration of pollutant present per volume of air

and reported in units of parts per million (ppm), parts per billion (ppb), and micrograms per cubic meter ($\mu g/m^3$).

Table I-1. National Ambient Air Quality Standards (as of February 28, 2024)

PRIMARY STANDARDS		SECONDARY STANDARDS	
LEVEL	AVERAGING TIME	LEVEL	AVERAGING TIME
Carbon Dioxide (CO)	–	–	–
9 ppm	8 hours	None	None
35 ppm	1 hour	None	None
Lead (Pb)	–	–	–
0.15 $\mu g/m^3$	Rolling 3-Month Average	Same as Primary	Same as Primary
Nitrogen Dioxide (NO_2)	–	–	–
53 ppb	Annual (Arithmetic Average)	Same as Primary	Same as Primary
100 ppb	1 hour	None	None
Coarse Particulate Matter (PM_{10})	–	–	–
150 $\mu g/m^3$	24 hours	Same as Primary	Same as Primary
Fine Particulate Matter ($PM_{2.5}$)	–	–	–
9.0 $\mu g/m^3$	Annual (Arithmetic Average)	15.0 $\mu g/m^3$	Annual (Arithmetic Average)
35 $\mu g/m^3$	24 hours	Same as Primary	Same as Primary
Ozone	–	–	–
0.070 ppm	8 hours	Same as Primary	Same as Primary
Sulfur Dioxide (SO_2)	–	–	–
75 ppb	1 hour	0.5 ppm	3 hours

ppb = parts per billion; ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter.

Any developments in nonattainment or maintenance areas are subject to the General Conformity process of the CAA. The General Conformity Rule, under the CAA, ensures federal actions conform to state air quality plans. It aims to prevent violations of NAAQS during federally supported activities. Furthermore, General Conformity requirements established in the CAA (*see* 42 United States Code [USC] § 7506) prohibit federal agencies from taking actions that do not conform to approved state or tribal implementation plans designed to attain and maintain national air quality standards in designated nonattainment and maintenance areas. As part of the environmental review of Applications for Permit to Drill (APDs) and other proposed development, federal agencies are responsible for demonstrating compliance with the General Conformity regulations in nonattainment or maintenance areas where federal actions are proposed to ensure that such actions conform to the applicable State or Tribal air quality implementation plan. The CAA General Conformity rule (40 Code of Federal Regulations [CFR] § 93) provides federal agencies a method for determining if proposed emissions in a nonattainment area will delay an area from attaining the NAAQS. This is done by showing that

emissions are either *de minimis* or conform to a State or federal Implementation Plan. The requirements ensure that states and tribes can improve air quality in areas that do not meet the NAAQS and ensure that maintenance areas do not revert to nonattainment.

BLM assesses applicability of the General Conformity Rule during the review of an APD. This evaluation ensures that drilling activities align with air quality goals, minimizing adverse effects on NAAQS. During its environmental analysis of an APD, BLM may apply further conditions of approval (COAs), including additional mitigation measures or emissions offsets that may be required to ensure compliance with the General Conformity Rule. If the APD is approved, the lease holder receives notification of air quality control measures necessary for NAAQS protection. Potential control measures are dependent on future regional modeling studies, other analyses, or changes in regulatory standards. The lease holder will be notified of the additional air quality control measures that are necessary to ensure protection and maintenance of the NAAQS as part of the APD approval (GPO 2016a, 2016b).

To preserve clean air in attainment areas, Ohio EPA is the authority delegated by USEPA to implement the Prevention of Significant Deterioration (PSD) program. The PSD program establishes an area classification scheme for attainment areas (USEPA 2015). Class I areas receive the highest degree of protection, with the smallest amount of additional air pollution allowed. Class II areas allow a moderate increase in certain air pollutants. No areas of the U.S. have been designated Class III, which would allow more air quality degradation (NPS 1991).

New major emitting facilities or significant modifications to major emitting facilities are required to undergo PSD pre-construction review. PSD review requires an air quality analysis to assess the project's potential contribution to the NAAQS and PSD increments (maximum allowable increases in air quality over baseline concentrations), a Best Available Control Technology Analysis, and an additional effects analysis (to assess potential effects to soils, vegetation, and visibility). A PSD review would be required if adjacent well pads were under common control and potential emissions exceeded PSD thresholds; a single well pad is not subject to PSD review. Applicability of a PSD review would be part of the environmental analysis conducted during review of an APD.

USEPA and Ohio EPA also regulate hazardous air pollutants (HAPs) also known as air toxics. HAPs are known or suspected to cause cancer or other serious health effects, or adverse environmental effects. Examples of listed HAPs emitted by the oil and gas industry include benzene, toluene, ethyl benzene, mixed xylenes, formaldehyde, n-hexane, acetaldehyde, and methanol. Ohio EPA addresses air toxic emissions via air permits issued to oil and natural gas well-site production operations.

1.1.2. Planning Area Overview

1.1.2.1. Ambient Air and NAAQS Designations

The Marietta Unit of the Wayne National Forest (planning area) is located within parts of Monroe, Noble and Washington counties. Monroe and Noble counties are designated as attainment areas for all NAAQS. Waterford Township in Washington County is designated as a nonattainment area for the primary SO_2 NAAQS, although the SO_2 nonattainment area does not include and is not adjacent to the Marietta Unit. All of Washington County, including part of the

Marietta Unit, is designated as an attainment-maintenance area for the O_3 and $PM_{2.5}$ NAAQS issued in 1997 (USEPA 2023a). The West Virginia counties of Wood, Tyler, and Pleasants border the Marietta Unit and are all currently in attainment for all criteria pollutant air quality standards. Wood County is the only WV county with an air quality monitor in place. Figure I-1 is a map of the Marietta Unit, affected counties, ambient air quality monitors, and NAAQS designations.

On June 15, 2007, Washington County was redesignated as an attainment-maintenance area for the 1997 8-hour O_3 NAAQS. On August 29, 2013, Washington County was redesignated as an attainment-maintenance area for the 1997 annual $PM_{2.5}$ NAAQS. Based on the current maintenance status of the county, any future developments in the nonattainment or maintenance areas would be subject to the general conformity process of the CAA.

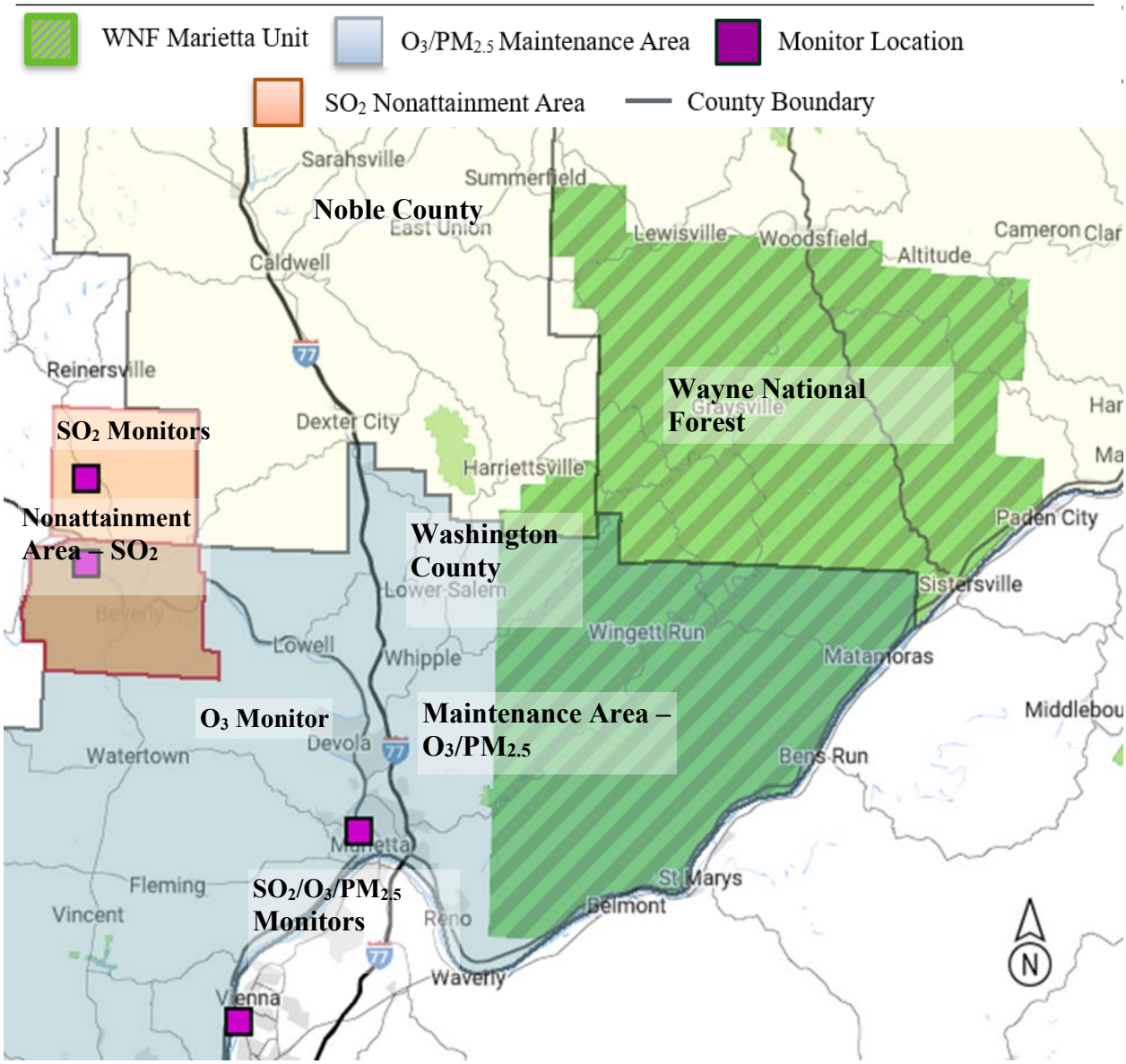


Figure I-1. Marietta Unit, Ambient Air Quality Monitors, and NAAQS Designations

Ambient air quality monitoring stations are located within and near the counties comprising the planning area, although there are no ambient air quality monitors within the Marietta Unit. Relevant information regarding ambient air quality monitoring stations is provided in Table I-2.

Table I-2. Ambient Air Quality Monitors Near the Planning Area for O_3, $PM_{2.5}$, and SO_2

COUNTY/ STATE	STATION ID	POLLUTANT	SAMPLING SCHEDULE	LATITUDE	LONGITUDE
Morgan/OH	39-115-0004: Hackney	SO_2	Hourly	39.63223ºN	81.67005ºW
Washington/OH	39-167-0011: Globe	SO_2	Hourly	39.58427ºN	81.67015ºW
Washington/OH	39-167-0004: WTP	O_3	Hourly	39.43212ºN	81.46044ºW
Wood/WV	54-107-1002: Neale	SO_2	5 Minute/ 24 Hour	39.32353ºN	81.55237ºW
Wood/WV	54-107-1002: Neale	O_3/$PM_{2.5}$	Hourly	39.32353ºN	81.55237ºW

Source: USEPA 2023b.
º = degrees; N = north; O_3 = ozone; OH = Ohio; $PM_{2.5}$ = fine particulate matter; SO_2 = sulfur dioxide; W = west; WV = West Virginia

Except for the SO_2 monitor 39-167-0011 located at Globe Metallurgical in Waterford, Washington County, OH, all monitors listed are designated State and Local Air Monitoring Stations (SLAMS) and operated by a state air agency (Ohio EPA or West Virginia Department of Environmental Protection [DEP]). Each of the SLAMS monitors has sufficient data to calculate the 3-year design value, which is used for attainment and nonattainment designations.

Part of the Marietta Unit is located within a maintenance area for O_3 and $PM_{2.5}$. O_3 and $PM_{2.5}$ are currently measured at two sites: one O_3 monitor within Washington County, Ohio and co-located O_3 and $PM_{2.5}$ monitors in adjacent Wood County, West Virginia. The O_3 and $PM_{2.5}$ design values for each of these sites are listed in Table I-3.

Table I-3. O_3 and $PM_{2.5}$ Design Values for Washington County, Ohio

STATION ID	POLLUTANT	DESIGN VALUE 2018–2020	DESIGN VALUE 2019–2021	DESIGN VALUE 2020–2022	NAAQS
39-167-0004: WTP	O_3	0.061 ppm	0.061 ppm	0.060 ppm	0.070 ppm
54-107-1002: Neale	O_3	0.060 ppm	0.059 ppm	0.059 ppm	0.070 ppm
54-107-1002: Neale	$PM_{2.5}$ 24-Hour	16 µg/m^3	17 µg/m^3	16 µg/m^3	35 µg/m^3
54-107-1002: Neale	$PM_{2.5}$ Annual	7.5 µg/m^3	7.6 µg/m^3	7.5 µg/m^3	9.0 µg/m^3

Source: USEPA 2023b.
O_3 = ozone; $PM_{2.5}$ = fine particulate matter; ppm = parts per million; µg/m^3 = micrograms per cubic meter.

1.1.2.2. Prevention of Significant Deterioration Designations

Class I areas receive the highest level of protection, allowing minimal additional air pollution. The Wayne National Forest is not a designated Class I area (USFS 2023); however, Otter Creek

and the Dolly Sods Wilderness Area are Class I areas within 300 km of the WNF. The Marietta Unit is within portions of Monroe, Noble, and Washington counties that are designated as Class II for PSD. This classification permits a moderate increase in certain air pollutants.

1.1.2.3. Hazardous Air Pollutants

The USEPA Air Toxics Screening Assessment and Mapping tool[1] can be used to evaluate impacts from existing HAP emissions in Ohio and West Virginia. The USEPA has calculated that total cancer risk in the state of Ohio is 20 in 1 million and in West Virginia. Cancer risk is defined as the probability of contracting cancer over the course of a lifetime assuming continuous exposure. County-specific cancer risk for the counties included in this analysis are 30 in 1 million in Washington County and 20 in 1 million in Noble and Monroe counties. Cancer risk in Wood County, Pleasants County and Tyler County, WV is 30 in 1 million. The oil and gas contribution to these cancers risks in each of the counties is 2.97, 0.20 and 0.30, respectively. The total cancer risk is within the acceptable range of risk published by the USEPA of 100 in 1 million as discussed in the National Contingency Plan, 40 CFR § 300.430.

The 2019 Air Toxics Screening National Respiratory Risk by Tract Source[2] presents noncancer hazard indexes for 14 target organ systems, or endpoints. The respiratory endpoint (the effect of air toxics on the lungs and the rest of the respiratory system) is often the driver of noncancer health effects and most applicable to oil and gas development. The noncancer respiratory hazard index for Washington, Noble and Monroe counties is 0.30, 0.30, and 0.20, respectively. The noncancer respiratory hazard index for the West Virgina counties of Wood, Pleasants, and Tyler are all 0.30. Hazard index values less than one mean it is unlikely that air toxics will cause adverse noncancer health effects over a lifetime of exposure. Oil and gas development and other foreseeable emission sources would contribute to HAP emissions and associated carcinogenic and noncancer risk.

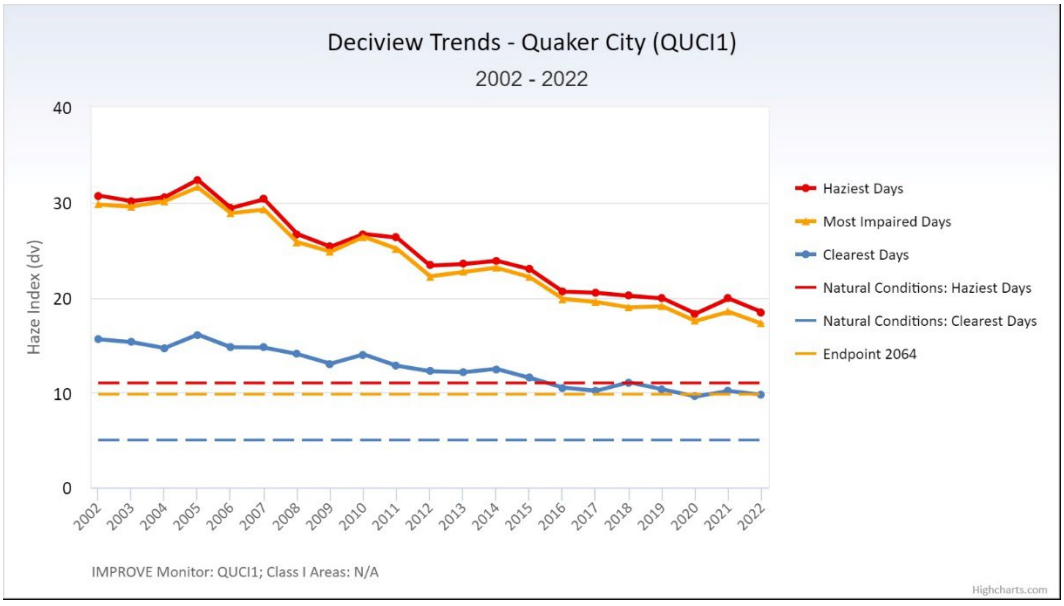
1.1.2.4. Air Quality Related Values

Air Quality Related Values (AQRVs) include wet and dry nitrogen and sulfur deposition, visibility, and acidification. Atmospheric deposition occurs when gaseous and particulate air pollutants are deposited on the ground, water bodies, or vegetation via rain, snow, or fog. Sulfur and nitrogen deposited into ecosystems can lead to acidification or enrichment of soils. Atmospheric nitrogen and sulfur deposition to water bodies may affect water chemistry and impact aquatic vegetation, invertebrate communities, amphibians, and fish. Deposition can also cause chemical changes in soils that alter soil microorganisms, plants, and trees. Excess nitrogen from atmospheric deposition can stress ecosystems by favoring some plant species and inhibiting the growth of others. Deposition impacts are generally described in terms of the critical load which is the threshold of concern for deposition at which harmful effects occur for a species, ecosystem, or other sensitive receptor. Detailed information on atmospheric deposition and critical loads in the Wayne National Forest can be found in the Forest Service Air Quality Assessment Supplemental Report incorporated by reference in the EA.

[1] https://www.epa.gov/AirToxScreen/airtoxscreen-mapping-tool
[2] https://www.epa.gov/AirToxScreen/2019-airtoxscreen-assessment-results

Pollution in the atmosphere can impair scenic views by degrading the contrast, colors, and distance an observer is able to see. Visibility can be assessed in terms of the distance that a person can distinguish a large dark object on the horizon and is measured as the standard visual range in miles. Visibility is monitored using methodologies established by the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. A deciview is a unit of measurement to quantify human perception of visibility. A one deciview change is roughly the smallest perceptible change in visibility. Visibility is characterized by two main groupings: the 20 percent clearest days and the 20 percent most impaired days. The 20 percent most impaired days account for the days with the most anthropogenic impairment. Additionally, the 20 percent haziest days can be viewed in IMPROVE data, but this grouping is no longer used in visibility assessments for the Regional Haze Rule. Visibility degradation is primarily due to sulfate, nitrate, and particulate matter in the atmosphere, with contributions from both anthropogenic and natural sources. Measuring progress in air pollution control can be challenging because natural sources largely beyond human control such as dust storms and wildfires can produce significant visibility impairment over large areas for days to weeks at a time. Quaker City, Ohio is the only IMPROVE monitor (i.e., QUCl1) located in Ohio. There are no IMPROVE monitors in West Virgina within 150 km of the Marietta Unit. Deciview trends for the period form 2002–2022 for the Quaker City monitor are presented in Figure I-2. The long-term trend indicates that visibility is improving at the site with the goal of reaching natural conditions by 2064. Additional information on visibility and the IMPROVE monitoring network can be found at http://vista.cira.colostate.edu/Improve/impairment/.

The reasonably foreseeable development of leases that could be issued under the Proposed Action could result in impacts to AQRVs. During site-specific permitting, additional analysis of impacts to AQRVs would be conducted based on the specific development proposals and associated emissions.



Source: IMPROVE 2024

Figure I-2. Quaker City, OH Visibility Trends 2002–2022

CHAPTER 2. CLIMATE

Climate is a component of air resources which may be affected by BLM applications, activities, and resource management. The focus of this section is on greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), which significantly contribute to the greenhouse effect, influencing global climate patterns. The report examines the scientific aspects of GHGs, their role in climate change, and the potential climate impacts from the proposed action.

2.1. Greenhouse Gases

GHGs are gases in the atmosphere that absorb infrared electromagnetic radiation contributing to the greenhouse effect. Increasing the concentration of GHGs in the atmosphere amplifies the greenhouse effect, which can create changes in temperature, precipitation, and other climate variables (BLM 2021).

GHGs including CO_2 and water vapor are emitted into the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The primary GHGs that enter the atmosphere due to anthropogenic activities include CO_2, CH_4, N_2O, and fluorinated gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), with CO_2 being the most abundant anthropogenic GHG emitted (BLM 2021).

Each of these gases can remain in the atmosphere for different lifetimes, ranging from about a decade to thousands of years. As a result, these gases become well mixed such that their measurement in the atmosphere is roughly the same all over the earth, regardless of the source or origin of the emissions. For this reason, global GHG emissions are the most useful basis for the cumulative analysis of emissions related to BLM actions. Unlike other common air pollutants, the ecological impacts that are attributable to the GHGs are not the result of localized or even regional emissions but are entirely dependent on the collective behavior and emissions of the world's societies.

2.1.1. Greenhouse Gases and Climate Change

The impacts from GHGs on global warming vary depending on how long the compounds last in the atmosphere and their ability to absorb infrared radiation. To measure and compare climate impacts between various GHGs, a factor was developed for each GHG to account for these effects; this factor is known as the Global Warming Potential (GWP). Emissions of GHGs are converted into an equivalent amount of CO_2 (CO_2e) by multiplying the GHG by its GWP. The larger the GWP, the more radiative adsorption of the GHG relative to an equal amount of CO_2 (BLM 2021). The GHGs and associated CO_2e factors used in this report are provided in Table I-4.

The choice of emission metric and time horizon depends on the type of application and policy context. The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change and its Kyoto Protocol. In addition, the USEPA uses the 100-year time horizon in its Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020 (USEPA 2020), GHG Reporting Rule requirements under 40 CFR Part 98 Subpart A, and in its science communications, consistent with the Intergovernmental Panel on Climate Change (IPCC)

Climate Change Synthesis Report (IPCC 2014). In this analysis, the BLM uses the 100-year GWP time horizon in its GHG emission calculations, as provided by the USEPA (GPO 2009).

Table I-4. Greenhouse Gases and Carbon Dioxide Equivalent Factors

GREENHOUSE GAS	CARBON DIOXIDE EQUIVALENT EMISSIONS
Carbon Dioxide (CO_2)	1.0
Methane (CH_4)	29.8
Nitrous Oxide (N_2O)	273.0

Source: BLM 2021.

The IPCC concluded that GHG emissions because of human activities have caused global warming, leading to a measurable increase of 1.1 degree Celsius (°C) in the global surface temperature from 1850–1900 to 2011–2020. Furthermore, the IPCC underscored the continual escalation of global GHG emissions, emphasizing the unequal historical and ongoing contributions originating from unsustainable practices in energy use, land utilization, lifestyle choices, and production patterns at various levels—ranging from regional and national to individual (IPCC 2023). The annual average surface temperatures for the contiguous United States have increased 1.0°C (1.8 degrees Fahrenheit [°F]) from 1900 to 2019. Annual average surface temperatures are expected to increase by about 1.4ºC (2.5ºF) regardless of future GHG emissions. Models of future GHG emissions demonstrate an increase in the global average surface temperature between 1.6ºC (3.0ºF) to 6.6ºC (12ºF), depending on a low or high worldwide GHG emissions scenario. The conterminous U.S. has experienced varying rates of climate change, as the length of frost-free seasons have increased since the early 1900s, the frequency of cold waves has decreased since the early 1900s, and the frequency of heat waves has increased since the mid-1960s (BLM 2021).

Because GHGs circulate freely throughout Earth's atmosphere, the region of influence for GHGs is the entire globe. The largest component of global anthropogenic GHG emissions is CO_2. Global net anthropogenic GHG emissions have been estimated at 59 gigatons (59,000,000,000 metric tons) for 2019, with CO_2 emissions from fossil-fuel combustion comprising 34 percent of that total, and the remainder resulting from industry, transport, and buildings (IPCC 2023).

2.1.2. Climate Change in the Planning Area

In the Köppen-Geiger climate classification system, Monroe, Noble, and the Washington County north of Marietta are classified as *Dfa: humid, continental*. This area is typified by hot, typically humid summers and cold snowy winters (Kottek 2017). This area experiences an average annual rainfall of 42.9 inches and snowfall of 18.0 inches, with precipitation regularly occurring each month of the year. The highest average precipitation typically occurs in March. The summer average temperature is 74.9ºF, and the maximum recorded temperature was 103ºF. The winter average temperature is 31.0ºF, and the minimum recorded temperature was -23ºF (NWS 2023). From 1972 to 2022, the average wind speed 6.0 miles per hour, with winds primarily from the southwest (ISU 2023).

Potential impacts to air resources due to climate change vary. Although potential GHG emissions at the project level can be quantified, current methodologies do not permit an assessment

between project-scale GHG emissions and specific effects on climate change, as effects on climate change are influenced by all global GHG emissions. For Ohio, the USEPA has identified the following continued changes due to an increasingly warmer climate (USEPA 2016).

- Increase in the frequency of heavy rainstorms and flooding, especially within the Ohio River and its tributaries;
- Increasing severity of summer droughts, which could impact commercial navigation;
- Decreasing the ice cover on the Great Lakes, with ice forming later and melting sooner;
- Increase the number of algal blooms in the Great Lakes, which harm fish and decrease water quality;
- Change to crop yields with increases in some crops but decreases in corn and soybean yield;
- Higher temperatures and more frequent and severe heat waves, which can threaten human health by causing heat stroke and dehydration; and
- Decreases in air quality due to the increase in formation of ground-level O_3, a pollutant that causes lung and heart problems and harms plants.

Further discussion of climate change science and predicted impacts, as well as the reasonably foreseeable and cumulative GHG emissions associated with the BLM's oil and natural gas leasing actions, were included in the *BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (BLM 2021; hereafter referred to as the Annual GHG Report). This report examines the estimated emissions of GHGs attributable to development and consumption of fossil fuels produced on lands and mineral estate the BLM manages. The 2021 Annual GHG Report is incorporated by reference as an integral part of this analysis and is available at https://www.blm.gov/content/ghg/2021.

The continued increase of GHG emissions over the past 60 years has contributed to global climate change impacts. A discussion of past, current, and projected future climate change impacts appears in Chapters 8 and 9 of the 2021 Annual GHG Report (BLM 2021).

2.2. Climate Change and GHG Analysis

2.2.1. Methodology

Emissions inventories at the leasing stage are imprecise due to uncertainties including the type of mineral development (i.e., oil, gas, or both), scale, and duration of potential development, types of equipment (e.g., drill-rig engine-tier rating, horsepower, fuel type), and the mitigation measures that a future operator may propose in their development plan. In order to estimate reasonably foreseeable on-lease emissions at the leasing stage, the BLM uses estimated well numbers based on state data for past lease development, combined with data on per-well drilling, development, and operating emissions from representative wells in the area. The amount of oil or gas that may be produced if the offered parcels were developed is unknown. For purposes of estimating production and end-use emissions, potential wells were assumed to produce oil and natural gas in similar amounts as existing nearby wells. Although the BLM has no authority to direct or regulate the downstream end-use of the products, for this analysis, the BLM assumes that all produced oil or gas would be combusted (e.g., for domestic heating or energy production).

The BLM acknowledges that there may be additional sources of GHG emissions during midstream operations associated with production from the lease parcels. These sources may include emissions of CH_4 (a more potent GHG than CO_2 in the short term) from pipeline and equipment leaks, storage, and maintenance activities. These sources of emissions are highly speculative at the leasing stage; therefore, the BLM has chosen to assume for this analysis that midstream emissions associated with lease parcels would be similar to the national-level emissions that the Department of Energy's National Energy Technology Laboratory (NETL) indentified (NETL 2019, 2009).

The emission estimates calculated for the GHG analysis were generated using the assumptions previously described above, using the BLM Lease Sale Emissions Tool and the 2020 RFDS (BLM 2020). Emissions are presented for each of the phases of post-lease development, including:

- **Well development emissions** occur over a short period and may include emissions from heavy equipment and vehicle exhaust, drill rig engines, completion equipment, pipe venting, and well treatments, such as hydraulic fracturing.
- **Well production operational, midstream,** and **downstream end-use emissions** occur over the entire production life of a well, which, for this analysis, is assumed to be 30 years, based on the productive life of a typical oil/gas field.
- For the purposes of this analysis, **downstream end-use emissions** are calculated by assuming that all produced oil and natural gas would be combusted for energy use. End-use emissions were estimated by multiplying the estimated ultimate recovery (EUR) of produced oil and natural gas with emissions factors for combustion that USEPA established (Tables C-1 and C-2 in 40 CFR § 98, Subpart C). Additional information about emission factors and EUR factors can be found in the Annual GHG Report (Chapter 4).
- **Production emissions** may result from storage-tank breathing and flashing, truck loading, pump engines, heaters and dehydrators, pneumatic instruments, or controls, flaring, fugitives, and vehicle exhaust.
- **Midstream emissions** occur from the transport, refining, processing, storage, transmission, and distribution of produced oil and natural gas. Midstream emissions are estimated by multiplying the EUR of produced oil and natural gas with emissions factors from the NETL life-cycle analysis of U.S. oil and natural gas. Additional information about emission factors can be found in the Annual GHG report (Chapter 4, Tables 4-7 and 4-9).

Several federal agencies work in concert to implement climate change strategies and meet U.S. emissions reduction goals all while supporting U.S. oil and gas development and operations. USEPA is the federal agency charged with regulation of air pollutants and establishing standards for protection of human health and the environment. The USEPA has issued regulations that will reduce GHG emissions from any development related to the proposed leasing action. These regulations include the New Source Performance Standard for Crude Oil and Natural Gas Facilities (49 CFR 60, subpart OOOOa) which imposes emission limits, equipment design standards, and monitoring requirements on oil and gas facilities. A detailed discussion of existing regulations and Executive Orders that apply to BLM management of federal lands as well as current federal and state regulations that apply to all oil and gas development and production can be found in Chapter 2 of the 2021 Annual GHG Report (BLM 2021).

2.2.2. Monetized Impacts from Greenhouse Gas Emissions

The social cost of C (SC-CO_2), social cost of N_2O (SC-N_2O), and social cost of CH_4 (SC-CH_4)—together, the social cost of GHGs (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

In accordance with existing guidance, the Supplemental EA and this appendix provide estimates of the monetary value of changes in GHG emissions that could result from the alternatives. Such analysis should not be construed to mean that a cost determination is necessary for addressing potential impacts of GHGs associated with specific alternatives. These numbers were monetized; however, they do not constitute a complete cost-benefit analysis, nor do the SC-GHG numbers present a direct comparison with other impacts analyzed in this document. For example, the BLM's overall economic analysis for this Proposed Action does not monetize most of the major costs or benefits and does not include all revenue streams from the Proposed Action but seeks to quantify certain impacts related to employment numbers and labor income. SC-GHG is provided only as a useful measure of the benefits of GHG emissions reductions to inform agency decision-making.

The SC-GHGs associated with estimated emissions from future potential development of leased parcels are reported in Table I-5 for the low-development scenario of 29 wells and Table I-6 for the high-development scenario of 81 wells. These estimates represent the present value (from the perspective of 2022) of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions from potential well development and operations and potential end-use, as described in Section 3.3.2 of this Supplemental EA. Estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and the BLM's estimates of emissions in each year, rounded to the nearest $1,000. The estimates assume that development would start in 2026, and end-use emissions would be complete in 2064, based on experience with previous lease sales.

Discount rates represent the future value of an investment in terms of its present value. A high discount rate means that future effects are considered much less significant than present effects, whereas a low discount rate means the present and future effects are closer to equally significant. The social cost of GHGs represents the total market and nonmarket costs to society associated with the predicted level of GHG emissions, rather than costs specific to the socioeconomic analysis area.

Table I-5. Social Cost of Greenhouse Gases Associated with Future Potential Development (Low Scenario – 29 Wells)

Phase	SC-GHGs (2023 $)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Development and Operations (CO_2e)	$6,323,974	$21,868,202	$32,264,847	$63,203,804

Phase	SC-GHGs (2023 $)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Midstream and End-Use (CO_2e)	$21,548,026	$79,260,448	$119,307,531	$238,105,624
Total (CO_2e)	**$27,872,000**	**$101,128,000**	**$151,573,000**	**$301,310,000**

Sources: IWG 2021; BLM 2021.
CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SC-GHG = social cost of greenhouse gases.

Table I-6. Social Cost of Greenhouse Gases Associated with Future Potential Development (High Scenario – 81 Wells)

Phase	SC-GHGs (2023 $)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Development and Operations (CO_2e)	$17,674,935	$61,097,682	$90,139,115	$176,581,342
Mid-Stream and End-Use (CO_2e)	$60,221,641	$221,447,958	$333,320,373	$665,211,540
Total (CO_2e)	**$77,897,000**	**$282,546,000**	**$423,459,000**	**$841,793,000**

Source: IWG 2021; BLM 2021.
CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; SC-GHG = social cost of greenhouse gases.

The BLM cannot meaningfully estimate the net effects across all energy markets to understand the mix of energy resources that would meet demand and therefore cannot provide an estimate of SC-GHG for the No-Action Alternative.

CHAPTER 3. REFERENCES

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