TOPIC	Context/Interest/Importance to People?	Affected by the Plan?	Change Since 2006?	Unit	Information: Available + Needs (Drivers, Conditions, Sustainability)	Resources
Solar Energy						
Solar Energy: All land types	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Technical potential: Solar potential of WNF area ranges from 397-412 watt-hours per sq.ft. per day. A 2005 report by the National Renewable Energy Laboratory shows only the Ironton unit as containing the minimum solar resources. A 2013 follow-up to this report set the minimum thresholds for PV at 5.8 kWh/m2/day and slope at <1% and no areas of the WNF made the cut. However, technological improvements in the past few years may may increase feasibility. For instance, Campbell's Soup in Napoleon OH now has a 9.8MW facility on 55 acres.	https://www.energy.gov/maps/solar-energy-potential. https://www.nrel.gov/docs/fy05osti/36759.pdf https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf https://www.prnewswire.com/news-releases/campbell-dedicates-98-megawatt-solar-power-system-159850375.html
Solar Energy: All land types	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Demand/ interest: Ohio has a burgeoning market for utility scale solar, which did not exist in 2006.	https://www.seia.org/sites/default/files/2018-09/Factsheet_State_Ohio_2018Q2.pdf
Solar Energy: All land types	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Permitting Issues: There is currently one example of a solar project moving forward on Forest Service land with a Special Use Permit, a 10MW project on mine-affected lands (Carlota Copper) in Tonto NF in Miami, AZ.	https://solarindustrymag.com/solar-project-on-repurposed-public-land-moves-forward-in-arizona#.Vz3mKds1AfI.twitter http://solarbrownfields.com/arizona-carlota-copper
Solar Energy: All land types	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Transmission/interconnection: All units have electrical transmission lines in or adjacent.	U.S. Energy Mapping System: https://www.eia.gov/state/maps.php
Solar Energy: Mined Lands	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Mapped areas Map of mined lands in Ohio is available.	https://gis.ohiodnr.gov/MapViewer/?config=OhioMines
Solar Energy: Brownfields	YES: Both from product and impacts perspective.	NO	Solar energy not mentioned in 2006 plan.	All	Mapped areas: Ohio brownfield inventory map does not show any sites within the Wayne NF area	http://wwwapp.epa.ohio.gov/gis/test/DERR_brownfields.html
Solar Energy: Other Open Areas	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Mapped areas: Need cover/veg maps	
Solar Energy: Currently Forested Areas	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Mapped areas: Need cover/veg maps	
Solar Energy: Mined Lands	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Ecological impacts: Potential for high conflict with desired conditions for herbaceous, shrub and early successional habitat, if surface-affected mined lands have been revegetated. Of particular concern for Henslow's sparrow, a 2006 Management Indicator Species for grasslands on reclaimed mine sites and an Ohio SWAP top avian SGCN. Needs site-specific analysis.	
Solar Energy: Mined Lands	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Potential for conflict with other users. Need GIS (mapped areas + other uses)	
Solar Energy: Other Open Areas	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Ecological impacts: Potential for high conflict with desired conditions for herbaceous, shrub and early successional habitat, if surface-affected mined lands have been revegetated. Of particular concern for Henslow's sparrow, a 2006 Management Indicator S	
Solar Energy: Other Open Areas	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Conflicts with other uses & access (eg, recreation): Potential for conflict with other users. Need GIS (mapped areas + other uses)	
Solar Energy: Currently Forested Areas					Ecological impacts: Potential for high conflict with forest habitat. Needs site-specific analysis.	
Solar Energy: Buildings and Parking Lots	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Potential sites, cost: are there other facilities that can host additional rooftop solar (as on the HQ), or parking lots suitable for carport installations?	https://www.fs.usda.gov/detail/wayne/news-events/?cid=STELPRDB5086741
Solar Energy: Currently Forested Areas	YES: Both from product and impacts perspective.	YES	Solar energy not mentioned in 2006 plan.	All	Conflicts with other uses & access (eg, recreation): Potential for conflict with other users. Need GIS (mapped areas + other uses)	
Biomass Energy						
Biomass Energy: Forested Lands	YES: Both from product and impacts perspective.	YES	Biomass energy not mentioned in 2006 plan (only mention is that timber production does not include fuelwood).	All	Potential: 2013 Analysis of Renewable Energy Potential on National Forest Lands lists the Wayne NF as having 127,877 low-suitability acres, 42,996 medium-suitability acres and 0 high suitability acres.	https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf (page 39)
Biomass Energy: Forested Lands	YES: Both from product and impacts perspective.	YES	Biomass energy not mentioned in 2006 plan (only mention is that timber production does not include fuelwood).	All	Ecological and biodiversity impacts: Potential for high conflict with forest habitat and climate protection. Biomass export (wood pellets) has emerged in recent years as a substantial threat to southeastern forests, particularly bottomland hardwood forests.	https://www.dogwoodalliance.org/wp-content/uploads/2014/08/DA_SFClimateInfographicFINAL1.jpg
Biomass Energy: Forested Lands	YES: Both from product and impacts perspective.	YES	Biomass energy not mentioned in 2006 plan (only mention is that timber production does not include fuelwood).	All	Demand: firewood, pelletized products, export; Economic drivers	https://www.fs.fed.us/research/biomass-bioenergy/ https://www.usda.gov/energy/maps/maps/Investment.htm
Biomass Energy: Forested Lands	YES: Both from product and impacts perspective.	YES	Biomass energy not mentioned in 2006 plan (only mention is that timber production does not include fuelwood).	All	Role in/need for wildfire hazard reduction: Probably low: see biodiversity group info.	
Biomass Energy: Forested Lands	YES: Both from product and impacts perspective.	YES	Biomass energy not mentioned in 2006 plan (only mention is that timber production does not include fuelwood).	All	Conflicts with other uses & access (eg, recreation): Need GIS and specific analysis.	
Wind Energy						
Wind Energy Potential	Possibly not if there is no/low potential resources	NO	2006 Plan doesn't mention wind; substantial change in economic and policy conditions since.	All	Is wind viable in WNF? Probably not: WNF area is probably not currently feasible or economically viable with current wind technology. Both the 2005 and 2013 versions of Analysis of Renewable Energy on National Forest Lands list zero acres of wind potential in the Wayne.	https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf https://windexchange.energy.gov/maps-data?utf8=%E2%9C%93&search=ohio&category=land-based https://www.energy.gov/eere/articles/unlocking-our-nation-s-wind-potential **FS Special Uses: Wind Energy** https://www.fs.fed.us/specialuses/special_energy.shtml **Land-based Wind Energy Guidelines** https://www.fws.gov/midwest/wind/resources/guidances.html
Wind Energy Permitting and Impacts	YES: Both from product and impacts perspective.	YES	2006 Plan doesn't mention wind; substantial change in economic and policy conditions since.	All	Contingent on potential	
Geothermal Energy						
Geothermal Energy Potential	Possibly not if there is no/low potential resources	NO	2006 Plan doesn't mention geothermal; substantial change in economic and policy conditions since.	All	Is Geothermal energy viable in WNF? Conventional geothermal seems to have very little potential, but enhanced may have high potential: However, the 2013 Analysis of Renewable Energy on National Forest Lands assessed Enhanced Geothermal Systems (EGS) defined as "for areas with suitable subsurface heat, but insufficient natural permeability or fluid saturation. An EGS is a man-made reservoir where fluid (typically water) is strategically injected underground to further open pre-existing fractures, and increase subsurface permeability. Once greater permeability has been established, the fluid circulates throughout the hot rock and transports heat to the surface just like naturally occurring geothermal systems. The DOE believes that EGS has the potential to serve as a significant energy source for the nation." EGS potential for the Wayne and found 109,221 medium-high suitability acres and 63,321 high suitability acres.	https://www.nrel.gov/gis/images/geothermal_resource2009-final.jpg https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf
Geothermal Energy Permitting and Impacts	YES: Both from product and impacts perspective.	YES	2006 Plan doesn't mention geothermal; substantial change in economic and policy conditions since.	All	Needs thorough review if there is potential. For instance, "Enhanced geothermal systems (hot dry rock) can also increase the risk of small earthquakes. In this process, water is pumped at high pressures to fracture underground hot rock reservoirs similar to technology used in natural gas hydraulic fracturing."	https://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-geothermal-energy.html#.W_3n2GhKiUk

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Oil and Gas Development						
Fugitive methane emissions from drilling operations and pipelines	Yes. Methane is a powerful greenhouse gas	yes	Yes. Understanding of climate change has advanced substantially.		Need full environmental impact assessment.	https://science2017.globalchange.gov/ https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks Belmont County Methane leak: https://www.sierraclub.org/nc/press-releases/2018/03/icymi-massive-methane-spill-revealed-exploded-oil-and-gas-site-ohio Comprehensive information on methane emissions from the oil and gas sector is available in a Series of white papers published by the EPA in 2014: https://web.archive.org/web/20150913130519/http://www.epa.gov/airquality/oilandgas/pdfs/20140415leaks.pdf https://web.archive.org/web/20150914171346/http://www.epa.gov/airquality/oilandgas/pdfs/20140415completions.pdf https://web.archive.org/web/20150914163225/http://www.epa.gov/airquality/oilandgas/pdfs/20140415pneumatic.pdf https://web.archive.org/web/20150404021159/http://www.epa.gov:80/airquality/oilandgas/pdfs/20140415liquids.pdf https://web.archive.org/web/20150920121146/http://www3.epa.gov/airquality/oilandgas/pdfs/20140415compressors.pdf
GHG production from burning of federal lands-produced fossil fuels.	Yes. Reduction of fossil fuel production and use is urgently needed to halt climate crisis.	yes	Yes. Understanding of climate change has advanced substantially.		Need full environmental impact assessment.	https://science2017.globalchange.gov/ https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks https://www.wilderness.org/sites/default/files/media/file/In%20the%20Dark%20Report_FINAL_Feb_2018.pdf https://pubs.usgs.gov/sir/2018/5131/sir20185131.pdf
Other air pollutants from drilling operations (particularly benzene and other volatile compounds)		yes			Need full environmental impact assessment.	**SEE WG ON Ecological Forest Management, Sustainable Economies and Climate Protection for additional details on these resources:** G.P. Macey et al., Air concentrations of volatile compounds near oil and gas production: a community-based exploratory study. Environmental Health 2014 13:82 https://doi.org/10.1186/1476-069X-13-82 McKenzie LM, Allshouse WB, Byers TE, Bedrick EJ, Serdar B, Adgate JL (2017) Childhood hematologic cancer and residential proximity to oil and gas development. PLoS ONE 12(2): e0170423. doi:10.1371/journal.pone.0170423 Ellen Webb, Jake Hays, L Dyrszka, B Rodriguez, C Cox, K Huffling and S Bushkin-Bedient, Potential hazards of air pollutant emissions from unconventional oil and natural gas operations on the respiratory health of children and infants, Rev Environ Health 2016; aop; DOI 10.1515/reveh-2014-0070. McKenzie LM et al., Ambient Nonmethane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks. Environ Sci Technol. 2018 Apr 17;52(8):4514-4525. doi: 10.1021/acs.est.7b05983.
Risk of fires and explosions from well pads and fires Truck emissions: particulates Truck emissions: GHGs	Yes. Major health and safety concern. Additionally, potential heightened fire risk in adjacent forested areas.	Yes. Risk increases as these activities are permitted on forest lands.	Several have occurred in Ohio since 2006, eg, Monroe, Belmont and Noble Counties.		Need risk assessment. Several explosions and fires have occurred in the region.	Belmont County Explosion & Fire: https://www.alleghenyfront.org/well-pad-explosion-in-eastern-ohio-causes-mandatory-evacuation-of-residents/ Monroe County well pad explosion & fire: https://www.fractracker.org/2014/09/statoil-fire-review/ Noble County pipeline explosion: http://www.mariettatimes.com/news/2018/02/pipeline-explosion-in-noble-county/
Mining and Minerals						
Current operations emissions					Coal strip mine in Poland was found to affect air quality in a nearby village: "Based on factor chemical profiles, the mine was found to contribute to PM1-10 and PM10 in the village by 6% and 20%, respectively."	Pokorná, Hovorka and Brejcha. 2016. Impact of mining actvivities on the air quality of a village nearby a coal strip mine. IOP Conf. Ser.: Earth Environ. Sci. 44 032021. http://iopscience.iop.org/article/10.1088/1755-1315/44/3/032021/pdf
Climate impacts					Needs full environmental assessment.	https://science2017.globalchange.gov/ https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks https://www.wilderness.org/sites/default/files/media/file/In%20the%20Dark%20Report_FINAL_Feb_2018.pdf https://pubs.usgs.gov/sir/2018/5131/sir20185131.pdf
Timber Operations						
Operations emissions: particulates & dust					"Emissions during the whole life cycle of the fuels and the base oils are included in the study. The highest CO_2 and NO_x emissions occurred when rapeseed methyl ester was used as fuel together with rapeseed as base oil for chainsaw and hydraulic oil. The highest HC and CO emissions occurred when environmental class 3 diesel fuel was used."	https://www.sciencedirect.com/science/article/pii/S0048969700004630
Operations emissions: GHGs					Energy input per unit of timber production (m^3ub) was 82 MJ, 11% of which was due to energy consumption during the production phase of the fuel.	Energy input per unit of timber production (m3ub) was 82 MJ, 11% of which was due to energy consumption during the production phase of the fuel. See also: https://www.arb.ca.gov/msei/offroad/pubs/logging_draft.pdf https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-heavy-equipment
GHG emissions: carbon sequestration/ soil carbon Truck emissions					Logging activities are a major threat to the ability of forests to store carbon. Carbon emissions attributable to harvest currently account for 85% of the annual forest carbon loss from U.S. forests (86% in Ohio), dwarfing that of losses from insects, fire, wind and drought combined (Harris et al., 2016). It has further been calculated that wood products, which are sometimes touted as a form of carbon sequestration, provide long-term storage for only about 1% of the carbon that was originally stored in the living forest (Ingerson, 2011).	Harris, N. L., Hagen, S. C., Saatchi, S. S., Pearson, T. R. H., Woodall, C. W., Domke, G. M., … Yu, Y. (2016). Attribution of net carbon change by disturbance type across forest lands of the conterminous United States. Carbon Balance and Management, 11(1), 24. https://doi.org/10.1186/s13021-016-0066-5 Ingerson, A. (2011). Carbon storage potential of harvested wood: summary and policy implications. Mitigation and Adaptation Strategies for Global Change, 16(3), 307–323. https://doi.org/10.1007/s11027-010-9267-5 See also: Biodiversity WG information on Climate Change and Carbon Sequestration.
Recreation						
Operations emissions, dust etc.: OHVs Operations emissions: Boats Operations emissions: Road travel Operations emissions: Road Dust						https://pubs.usgs.gov/of/2007/1353/report.pdf
Climate Change						
Change in fire potential		While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of global change.			Central Appalachians forest vulnerability assessment states that: "Climate conditions will increase wildfire risk by the end of the century (medium evidence, medium agreement). Some national and global studies suggest that wildfire risk will increase in the region, but few studies have specifically looked at wildfire potential in the assessment area."	Butler, Patricia R., Louis R. Iverson, Frank R. Thompson III, L. A. B., & Stephen D. Handler, Maria K. Janowiak, P. Danielle Shannon, Chris Swanston, et al. (2015). *Forest Service Central Appalachians Forest Ecosystem Vulnerability Assessment and Synthesis: A Report from the Central Appalachians Climate Change Response Framework Project*. Retrieved from http://www.nrs.fs.fed.us/
Change in community air hazard vulnerability (eg: asthma sensitivity)		While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of global change.			Climate warming will exacerbate ozone, particulate matter, wildfire smoke, quantity and types of pollen, and other air pollution.	Nolte, C.G., P.D. Dolwick, N. Fann, L.W. Horowitz, V. Naik, R.W. Pinder, T.L. Spero, D.A. Winner, and L.H. Ziska, 2018: Air Quality. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 512–538. doi: 10.7930/NCA4.2018.CH13
Effect of CO2 concentration		While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of global change.			Elevated carbon dioxide levels may result in increased primary productivity (CO_2 fertilization effect); however the effect is constrained by the availability of other nutrients (especially nitrogen and water). Further, species differ in their response to CO_2 fertilization, and invasive species may benefit disproportionatetely.	Norby R Warren J Iversen C Medlyn B McMurtrie R. CO2 enhancement of forest productivity constrained by limited nitrogen availability. Proceedings of the National Academy of Sciences of the United States of America 2010 vol: 107 (45) pp: 19368-73. Blumenthal D Resco V Morgan J Williams D LeCain D et. al.. Invasive forb benefits from water savings by native plants and carbon fertilization under elevated CO and warming. New Phytologist 2013 vol: 200 (4) pp: 1156-1165

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Oil and Gas Development						
Removal of water from streams for fracking	Yes. Potential for removal of large quantities of water from stream systems."Traditionally, Appalachian West Virginia and Ohio laterals require 970–1080 gallons per lateral foot (GPLF) with demand growing at a rate of 11–22% per year."	yes	yes, with increase in drilling			Robert C. Palmer, Damien Short, and Walter E. Ted Auch, The Human Right toWater and Unconventional Energy, Int. J. Environ. Res. Public Health 2018, 15, 1858; http://www.mdpi.com/1660-4601/15/9/1858/htm, published 8-28-18. From packet #13, 8-28-18. https://www.epa.gov/sites/production/files/2016-12/documents/hfdwa_executive_summary.pdf
Mining and Minerals						
Do these operations remove water?						
Timber Operations						
Timber or burn operations that remove vegetation and thus water holding capacity increases runoff and raises flood risk for downstream communities.	Yes. Flooding is a major concern for southeast Ohio communities, many of which are built substantially on riverine floodplains.	Yes.	Population growth and increase in extreme precipitation events since the 2006 plan.		Southeast Ohio is unique in that peak flows are decreasing over time despite population incerases, due to the absorptive capacity of the local forests, including the Wayne. Any increase in forest cover removal should fully assess impacts to waterholding capacity and downstream community (eg, Athens) flood risk.	USGS historical data shows that peak stream flow has decreased over the past 50 years as the forests have regenerated.
Recreation						
Presence of and access to water: water-based recreation						
Presence of and access to water: water-adjacent land-based recreation (eg, hiking)						
Climate Change						
Change in drought potential						
Change in flood potential						

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Oil and Gas Development						
Fate/movement of injected brine in drilling operations; risk of groundwater contamination	Many local residents utilize individual wells or groundwater-based municipal supply.	Yes. Risk increases as these activities are permitted on forest lands.	Yes. The major increase in horizontal drilling and hydraulic fracturing in the region since 2006 requires a closer look at the potential impacts to water resources.			SEE WG ON Ecological Forest Management, Sustainable Economies and Climate Protection for additional details on these resources: Yan and Stoten, Association of groundwater constituents with topography and distance to unconventional gas wells in NE Pennsylvania, Science of the Total Environment Vol. 577, 15 January 2017, pp 195-207 DiGiulio DC1, Jackson RB. Impact to Underground Sources of Drinking Water and Domestic Wells from Production Well Stimulation and Completion Practices in the Pavillion, Wyoming, Field, Environ Sci Technol. 2016 Apr 19;50(8):4524-36. doi: 10.1021/acs.est.5b04970 Theo Colborn et al., 2011, Natural Gas Operations from a Public Health Perspective, Human and Ecological Risk Assessment. 17 (5): 1039–1056. doi:10.1080/10807039.2011.605662. Ellen Webb et al., Developmental and reproductive effects of chemicals associated with unconventional oil and natural gas operations, Rev Environ Health 2014; 29(4): 307–318.
Fate/movement of wastewater/ effluent in injection wells (eg, Coolville injection well)		Yes. Risk increases as these activities are permitted on forest lands.	Yes. The major increase in horizontal drilling and hydraulic fracturing in the region since 2006 requires a closer look at the potential impacts to water			Akob, D.M, et al, *Wastewater Disposal from Unconventional Oil and Gas Development Degrades Stream Quality at a* ***West Virginia Injection Facility*** , Environ. Sci. Technol., pub 09 May 2016 DOI:10.1021/acs.est.6b00428 S.C. Nagel, Endocrine disrupting activities of surface water associated with a West Virginia oil and gas industry wastewater disposal site Science of the Total Environment ,557–558 (2016) 901–910.
Surface-level spills from drilling operations and pipelines	Potential to impact water sources and aquatic habitat. Belmont explosion potentially impacted Eastern Hellbender habitat and other aquatic life.	SFW-MIN-4 and SFW-MIN-5	Yes. The major increase in horizontal drilling and hydraulic fracturing in the region since 2006 requires a closer look at the potential impacts to water		Have these standards been adequate to prevent degradation of aquatic resources? Several spills and explosions have occurred in the region.	Rover Pipeline Spill: https://energynews.us/2017/05/12/midwest/ohio-pipeline-spill-raises-broader-questions-about-oversight/ Belmont explosion: https://www.alleghenyfront.org/well-pad-explosion-in-eastern-ohio-causes-mandatory-evacuation-of-residents/ Spills of Hydraulic Fracturing Chemicals on Agricultural Topsoil: Biodegradation, Sorption, and Co-contaminant Interactions, Environ. Sci. Technol., 2016, 50 (11), pp 6071–6078, DOI: 10.1021/acs.est.6b00240
Surface-level spills from brine trucking	High. At least one brine truck spill has affected a reservoir in OH (Barnesville), and multiple other accidents and spills have been reported. Potential to impact surface water and aquatic habitat.	Yes. Risk increases as these activities are permitted on forest lands.	Yes. The major increase in horizontal drilling and hydraulic fracturing in the region since 2006 requires a closer look at the potential impacts to water		Risk assessment and tracking system needed. Anecdotal evidence suggests that brine truck crashes/spills have increased in frequency with expansion of drilling.	http://www.cantonrep.com/article/20160506/news/305069985 Barnesville Reservoir incident: http://www.theintelligencer.net/news/top-headlines/2016/03/natural-gas-water-truck-in-accident-spills-brine-near-barnesville-reservoir/
Mining and Minerals						
Current operations acid drainage and other pollutants	Water quality is important to aquatic habitat, recreation, downstream water useres.Acid mine drainage is described om the 2006 plan as one of the problems that "spoil the scenic countryside."	Yes. Described in Objective 2.1b of 2006 plan.	Ohio's State Wildlife Action Plan (aquatic habitats chapter) states that for the Hocking River and its tributaries "Extraction of coal, oil, and gas has had			http://wildlife.ohiodnr.gov/Portals/wildlife/pdfs/proposed%20rule%20changes/OHIO%202015%20SWAP_Aquatic.pdf https://www.ohio.edu/engineering/orite/research/projects/acid-mine-drainage.cfm http://minerals.ohiodnr.gov/abandoned-mine-land-reclamation/acid-mine-drainage https://gis.ohiodnr.gov/MapViewer/?config=OhioMines OU Voinovich School's Ohio Waterhsed Data: http://www.watersheddata.com/default.aspx
Legacy operations and AMLs: acid drainage and other pollutants						
Timber Operations						
Operations erosion					"Soil erosion in an undisturbed forest is extremely low, generally under 1 mg ha−1 yr−1 (0.5 ton/acre/year). Disturbances, however, can dramatically increase soil erosion to levels exceeding 100 mg ha−1 yr−1 (50 tons/acre/year). These disturbances include natural events such as wildfires and mass movements and human-induced disturbances such as road construction and timber harvesting. Soil erosion, combined with other impacts from forest disturbance, such as soil compaction, can reduce forest sustainability and soil productivity."	https://forest.moscowfsl.wsu.edu/smp/docs/docs/Elliot_1-57444-100-0.html
Recreation						
Erosion potential: OHVs Erosion potential: Horses						https://pubs.usgs.gov/of/2007/1353/report.pdf https://www.fs.fed.us/t-d/pubs/pdf/ATV/TOContents.pdf https://www.parks.ca.gov/pages/1324/files/hoosier%20nf%20trail%20report,%20final.pdf https://www.imbacanada.com/sites/default/files/Marion_Wimpey_Review%20and%20Best%20Practices.pdf
Erosion potential: Mountain bikes						https://www.lib.washington.edu/msd/norestriction/b67566091.pdf https://www.ncbi.nlm.nih.gov/pubmed/19864052 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.625.325&rep=rep1&type=pdf
Comparative studies (hiking, horse, MB, OHV)						https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3799134.pdf
Recreational boating						https://eponline.com/Articles/2017/03/27/The-Environmental-Impacts-of-Boating.aspx https://ucanr.edu/sites/coast/files/59476.pdf http://www.trpa.org/wp-content/uploads/2010-WI-Dept-of-Natural-Resources_UW-Boats-effects-on-ecosystems.pdf
Habitat for aquatic species of recreation interest						http://wildlife.ohiodnr.gov/Portals/wildlife/pdfs/proposed%20rule%20changes/OHIO%20
Effects of introduced game species?					I didn't find readily available info for this region. Most Ohio info pertains to Lake Erie.	
Climate Change						
Increased potential for heavy precipitation		While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of global change (through riparian buffer requirements, restoration activities, upgraded culverts and crossings, etc.)	yes	all	"The frequency and intensity of heavy precipitation events are projected to continue to increase over the 21st century (high confidence). Mesoscale convective systems in the central United States are expected to continue to increase in number and intensity in the future (medium confidence)." "Midwest: Storm water management systems and other critical infrastructure in the Midwest are already experiencing impacts from changing precipitation patterns and elevated flood risks (Ch. 21: Midwest, KM 5). In addition, harmful algal blooms (HABs) in western Lake Erie have been steadily increasing over the past decade. Warmer temperatures and heavy precipitation associated with climate change contribute to the development of HABs."	Easterling, D. R., J. R. Arnold, T. Knutson, K. E. Kunkel, A. N. LeGrande, L. R. Leung, R. S. Vose, D. E. Waliser, and M. F. Wehner, 2017: Precipitation Change in the United States. *Climate Science Special Report: Fourth National Climate Assessment, Volume I*. Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds., U.S. Global ChangeResearch Program, Washington, DC, USA, 207–230. doi:10.7930/J0H993CC Lall, U., T. Johnson, P. Colohan, A. Aghakouchak, C. Brown, G. McCabe, R. Pulwarty, and A. Sankarasubramanian, 2018: Water. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 145–173. doi: 10.7930/NCA4.2018.CH

Increased potential for drought (concentrates pollutants)	While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of global change.	all	"Changes in climate and hydrology have direct and cascading effects on water quality. Anticipated effects include warming water temperatures in all U.S. region, which affect ecosystem health (Ch. 7: Ecosystems), and locally variable changes in precipitation and runoff, which affect pollutant transport into and within water bodies. These changes pose challenges related to the cost and implications of water treatment, and they present a risk to water supplies, public health, and aquatic ecosystems. Increases in high flow events can increase the delivery of sediment, nutrients, and microbial pathogens to streams, lakes, and estuaries; decreases in low flow volume (such as in the summer) and during periods of drought can impact aquatic life through exposure to high water temperatures and reduced dissolved oxygen."	Lall, U., T. Johnson, P. Colohan, A. Aghakouchak, C. Brown, G. McCabe, R. Pulwarty, and A. Sankarasubramanian, 2018: Water. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 145–173. doi: 10.7930/NCA4.2018.CH3 Wehner, M. F., J. R. Arnold, T. Knutson, K. E. Kunkel, and A. N. LeGrande, 2017: Droughts, Floods, and Wildfires. Climate Science Special Report: Fourth National Climate Assessment, Volume I. Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds., U.S. Global Change Research Program, Washington, DC, USA, 231–256. doi:10.7930/J0CJ8BNN.
Change in water temperature (affects dissolved oxygen, temperature-sensitive species, etc.)	While climate change is a global phenomenon, the forest must address it as a stressor/driver, and management decisions based on the plan can ameliorate or exacerbate local impacts of	all	See above on HAB risk and DO.	

Ecosystem Service+A1:F8	Socioeconomic Context	Drivers of Change	Ecological Conditions	Sustainability	Key References
Renewable Energy					
The Wayne National Forest **could provide space** for solar energy development on degraded lands such as former mining lands with no potential to be reforested.		Solar is not mentioned in the 2006 plan and drivers of solar demand (technology, price, societal interest) have changed substanitally since then.		Sutainability and suitability would need to be evaluated in detail, along with effects on other ecosystem services (especially habitat and access).	https://gis.ohiodnr.gov/MapViewer/?config=OhioMines
The Wayne National Forest **is unlikely to provide space** for solar energy development on degraded lands such as brownfields with no potential to be reforested.	Ohio brownfield inventory map does not show any sites within the Wayne NF area				http://wwwapp.epa.ohio.gov/gis/test/DERR_brownfields.html
The Wayne National Forest **could provide space** for solar energy development on lands that are currently forested or contain early successional habitat; ***however, potential for conflict with other uses, values and services is high***.			Lands currently in forest, shrub or grassland cover are potentially important habitat.	Utilizing areas that are currently providing other ecosystem services, like wildlife habitat, recreation, etc. for solar is likely not to be ecologically sustainable.	
The Wayne National Forest **is unlikely to be a major supplier** of fuelwood for biomass energy.	2013 Analysis of Renewable Energy Potential on National Forest Lands lists the Wayne NF as having 127,877 low-suitability acres, 42,996 medium-suitability acres and 0 high suitability acres.				https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf https://windexchange.energy.gov/maps-data?utf8=%E2%9C%93&search=ohio&category=land-based https://www.energy.gov/eere/articles/unlocking-our-nation-s-wind-potential
The Wayne National Forest **is unlikely to** provide space for wind energy generation because of low wind potential in this region.		Though the wind industry has undergone substantial technological change since 2006, land-based turbines are not yet of sufficient size to capitalize on the wind resource in our area.	In the event that technological change makes wind generation feasible in the future, impacts to wildlife, particularly bats (including listed species) and birds would need to be carefully considered.	Commercial development of wind energy is not likely to be economically sustainable due to low wind energy potential.	FS Special Uses: Wind Energy: https://www.fs.fed.us/specialuses/special_energy.shtml Land-based Wind Energy Guidelines https://www.fws.gov/midwest/wind/resources/guidances.html
The Wayne National Forest **is unlikely to** provide space for traditional geothermal energy generation due to low geothermal potential in this region, but **could provide energy using "Enhanced Geothermal Systems (EGS)**."	EGS systems are a new		In the event that EGS systems become feasible, a full assessment of impacts would be necessary prior to the advancement of any proposal.		https://www.nrel.gov/gis/images/geothermal_resource2009-final.jpg https://digital.library.unt.edu/ark:/67531/metadc871583/m2/1/high_res_d/1115595.pdf