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Summary of Scoping Process for Bakken Environmental Status and Trends (BEST) Report

By Max Post van der Burg

Administrative Report

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

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Contents

Figures

Tables

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Background

Energy development within the Williston Basin, especially development focused on the Bakken formation, has led to unprecedented natural, social, and cultural change across the Northern Great Plains (fig. 1). This development is expected to continue for at least the next 50 years as energy companies and scientists continue to discover new mineral-producing horizons and innovative technologies for extraction. Because of the recent rapid rate of energy development, resource managers and communities throughout the region need to understand how these activities are affecting important resources and develop strategies to better manage development to sustain the quality of natural and social environments. Resources of notable concern to managers include water, soil, wildlife populations, air quality, cultural resources, Native American values, and agricultural lands.

In March 2012, President Obama identified energy development associated with the Bakken Formation as a priority (Executive Order 13604) requiring collaboration toward improved timeliness of permitting combined with reasonable measures to maintain environmental quality. Since April 2012, executives from more than a dozen Federal agencies have been working together to address common challenges associated with Bakken-related development. This Bakken Federal Executive Group (BFEG) is focused on developing an understanding of the cumulative environmental changes attributed to oil

and gas development across the landscape to (1) inform and facilitate more orderly development, (2) support NEPA and ESA compliance, (3) pursue proactive long-term mitigation, enhance restoration and conservation across the landscape, and (4) forge collaborations among states, Tribes, Federal agencies, industry, and NGOs for sustainable management.

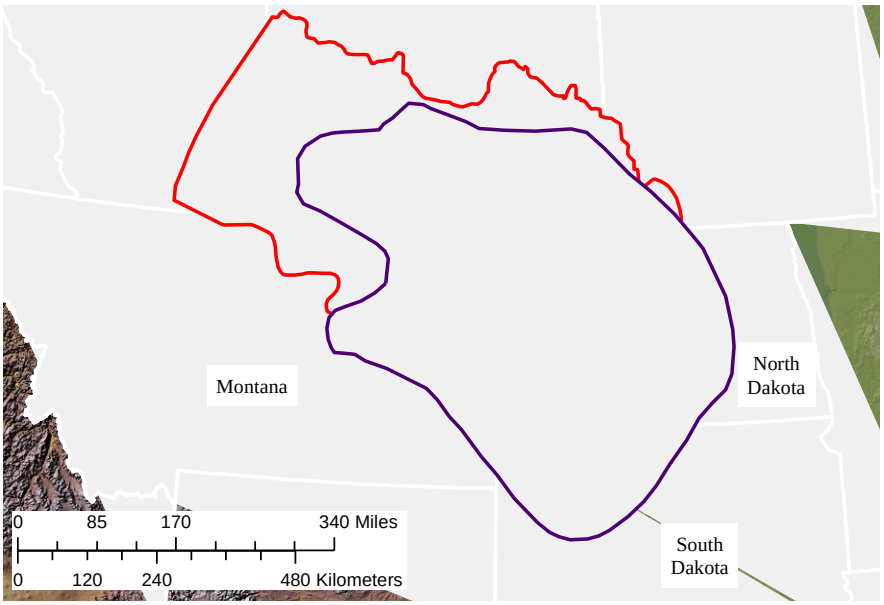

Figure 1. Map showing boundaries of the Williston Basin and Bakken Formation and the geographic scope of the Bakken Environmental Status and Trends (BEST) Report.

To this end, the BFEG would like to develop a foundational report that synthesizes current information about the status of natural resources within the boundaries of the Williston Basin and Bakken Formation (fig. 1). The BFEG has titled this report the Bakken Environmental Status and Trends (BEST) Report. In general, the goals of the BEST Report are to synthesize existing information on science topics that are of wide interest across the BFEG partnership and that support regulatory decisions related to development. Additionally, the BEST Report should identify where information is currently lacking about the status of resources and what issues could arise with resource management as energy development continues.

Report Development Process

The BFEG has partnered with the U.S. Geological Survey (USGS) to develop the BEST Report. Because the report needs to be responsive to BFEG needs and focused on decision, the USGS has developed a two-phased approach to develop the report. The first phase consists of scoping a range of information needs from among partners of the BFEG and the second phase focuses on information synthesis and final development of the BEST. This Administrative Report summarizes the results of the first phase and will serve as the template for outlining and, ultimately, drafting the BEST Report.

Scoping process

One of the first steps in developing the BEST Report is understanding what information BFEG partners need to improve decisions made with regard to oil and gas development; however, there exists the potential for a prohibitively long list of needs and some of those needs may be specific to one or a few partners. In order to efficiently address only the most pressing needs across the partnership, I used an approach known as structured decision making (a.k.a. decision analysis; Gregory and others, 2009) to elicit and prioritize key information needs. Decision-analytic approaches generally consist of a structured process of developing objectives (that is, outcomes of interest), developing alternative options to meet those objectives, qualitatively or quantitatively assessing the alternatives in terms of the objectives, and then making a decision based on the assessment. Before beginning such a process, however, one typically begins with some initial scoping to begin understanding what decision makers are expecting or hope to gain from the process.

Initial scoping

I conducted a series of informal phone interviews with representatives from some of the organizations in the BFEG, including the U.S. Army Corps of Engineers, Bureau of Indian Affairs,

Bureau of Land Management, Bureau of Reclamation, and the National Park Service. These interviews focused on determining what kinds of decisions the partners make that might be related to, or affected by, energy development, and identifying the information needed to make or improve those decisions. These interviews allowed me to develop a preliminary understanding of which agencies are primary decision makers with regard to energy development and which ones were more focused on managing the effects of energy development. Likewise, the interviews allowed me to develop an initial understanding of how to begin structuring the prioritization process and develop contacts with potential workshop participants.

Scoping workshop

Once the interviews were completed and a preliminary report on the process was presented to the BFEG, I scheduled a scoping workshop, which was held with some members of the BFEG Resources Subcommittee. The workshop took place on July 15 and 16, 2014 in Bismarck, North Dakota (table 1). The primary goal of the workshop was to develop a process that could be used to identify and prioritize science topics for the BEST Report.

Table 1. List of participants attending the Bismarck, North Dakota, workshop (alphabetical order by organization/agency).

Organization/agency	Name
U.S. Army Corps of Engineers	Eric Laux
U.S. Army Corps of Engineers	Johnathan Shelman
Bureau of Indian Affairs	Mark Herman
Bureau of Land Management	Michael Philbin
Bureau of Land Management	Jessica Montag
Bureau of Land Management	Tim Zachmeier
U.S. Environmental Protection Agency	Cindy Beeler
National Park Service	Kara Painter

Typically, information needs from a decision-analytic perspective are most accurately assessed using value-of-information analyses (for example, Felli and Hazen, 1998), which quantitatively measure

how much decisions may change as information about the consequences of decisions improve. Such analyses often indicate that some information thought to be important actually does little to improve or change the decision being made. One limitation of value-of-information analyses is that they are fairly labor intensive, often requiring the development of detailed models. Because the BEST Report must include the needs of multiple partners, a more detailed process would be extremely time intensive and thus not practical given the timeline for this project.

I used a simpler approach that relied on the principles of multiple criteria decision analysis (Keeney and Raiffa, 1976; Clemen and Reilly, 2001) to develop a list of potential science topics for the report and then developing group criteria (that is, objectives) against which to rank those science topics. As a group, we approached this process by first developing a list of science topics that were thought to support key decisions being made about energy development, and then developing a set of criteria by which to score the importance of each topic in supporting those decisions.

Identifying potential science topics

The workshop participants defined science topics as the information needed to inform decisions with regard to oil and gas development (table 2).

Table 2. Examples of decision types considered in the discussion of science topics. These types were also used in the development of the assessment criteria.

Decision type	Example decisions
Engagement	Whether to engage industry or not; which agencies/organizations should engage
Leasing	Whether to lease; stipulations of lease
Compliance	Whether to consult; what to include to prove environmental compliance (National Environmental Protection Act, Endangered Species Act, Section 106, etc.)
Permitting	Whether to issue permit; conditions of permit

More specifically, these types of decisions include choices about how to engage with development companies when Federal resources or interests would be potentially affected and choices about what conditions ought to be included in permits, among many others. Most of this information was also expected to help inform the process of documenting environmental compliance (for example, NEPA). As a starting point, the group used the topical areas typically used in the NEPA process to begin a discussion about what information is needed within those topical areas. The discussion then broadened to include other types of information. The group also pointed out that some of these topical areas may have well developed analyses and information, and that those needs should be screened from the prioritization step. Finally, the group agreed that topics addressed in the exercise were not specific enough and further work would be necessary to refine the needs. More refinements were made by individual group members following the workshop as part of the assessment process outlined in the next section (Appendix: table 5).

Science topic prioritization

The focal decision that needed to be made by this group was how to best prioritize the science topics elicited in the previous step. The group had a discussion about possible objectives for a report designed to support decision making. These objectives could then be used to compare each science need and prioritize the entire list. I will continue to refer to these objectives as criteria for the remainder of this report, because the group felt more comfortable with that term. In the end, the group agreed that the BEST Report should improve and support better decision making between and within the Federal agencies tasked with making decisions about oil and gas development or about resources affected by development. Based on this agreement, the group identified the following criteria:

- Information should improve particular types of decisions:
    1. Improve compliance decisions

2. Improve permitting decisions
3. Improve leasing decisions
4. Improve engagement decisions

- Information should support a wide breadth or range of decisions
    1. Increase number of partners supported
    2. Increase geographic scope of decisions supported
- Information should be urgent; in other words, information on a topic should largely be lacking.

These criteria were arranged into a hierarchy to better show how the group valued information and also to show how the criteria were related (fig. 2).

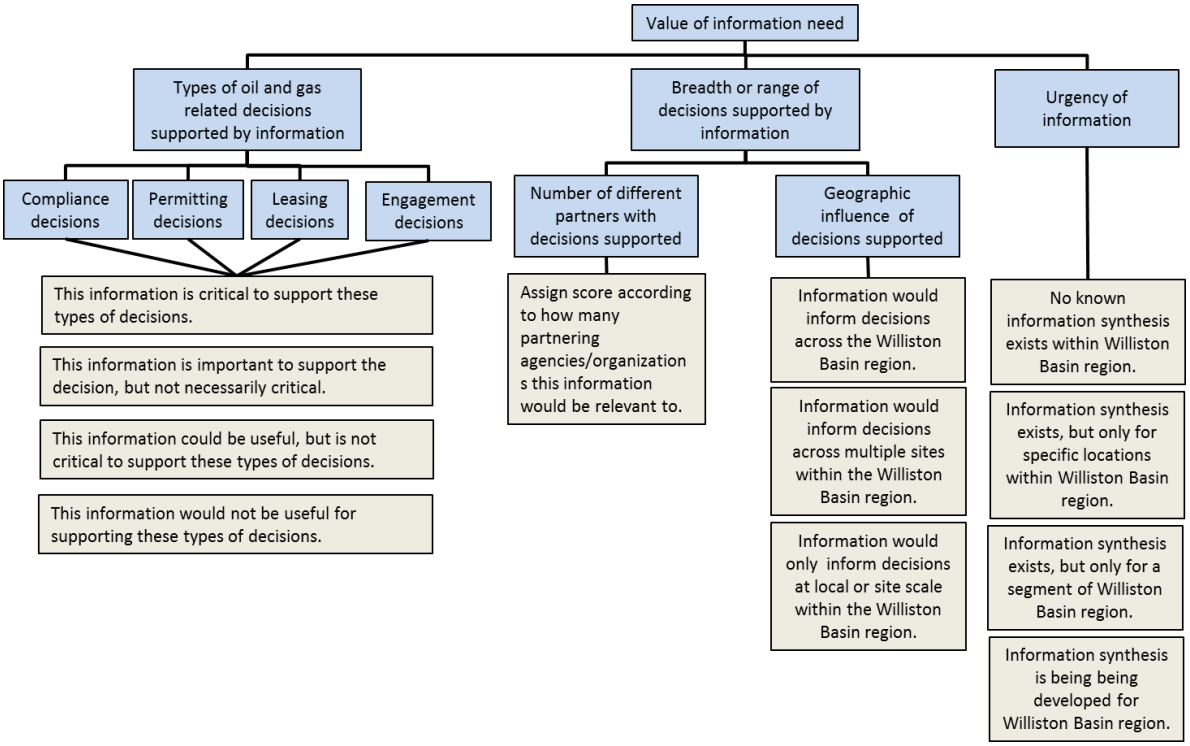

Figure 2. Criteria hierarchy displaying the relationships between criteria (blue) used in the assessment and how those criteria would be used to establish metrics for assessing science topics. Verbal descriptions of those metrics are found in the grey boxes.

The group worked to establish preliminary metrics by verbally describing a scale for assessing each science topic and then assigning a quantitative score to each verbal description (table 3).

Table 3. Criteria and metrics used to score and assess each science topic.

Criterion	Metric
Compliance decisions	10 – Critical
	5 – Important but not critical
	3 – Somewhat important
	0 – Not important
Permitting decisions	10 – Critical
	5 – Important but not critical
	3 – Somewhat important
	0 – Not important
Leasing decisions	10 – Critical
	5 – Important but not critical
	3 – Somewhat important
	0 – Not important
Engagement decisions	10 – Critical
	5 – Important but not critical
	3 – Somewhat important
	0 – Not important
Number of partners	Assign score according to how many partnering agencies/organizations this information would be relevant to.
Geographic scope	10 – Regional
	5 – Multi-site
	3 – Local
Urgency	10 – No synthesis
	5 – Partial synthesis
	3 – Local synthesis
	0 – Synthesis for WB

Initial Scoring and Weighting Exercise

The group then worked through a demonstration of the scoring process, which entailed assigning a score on each criterion for each science topic. The group then conducted a preliminary weighting exercise to assign relative importance to each of the criteria. I used a swing weighting technique for this group, which entails establishing hypothetical alternative options where performance can only improve on one objective or criterion at a time (von Winterfeltd and Edwards, 1986). Each participant was asked to rank their preference for the improvement, which indirectly weights each criterion. I then showed the

group how to combine the weights and the scores to rank each science need, which entailed computing the weighted sum of the scores and weights for each science topic across the seven criteria. This created a composite score for each science topic, which became the basis for ranking the topics.

Final Scoring and Weighting

Following the workshop, each participant was asked to score each science topic and then assign weights to each of the criteria. Five participating agencies in the BFEG returned their completed assessments. Using those completed assessments, I computed the average score for each science topic, as well as the standard deviation (Appendix I: table 5). By then plotting the average scores by their standard deviations, one can then begin to develop a sense for how important each topic was and how much agreement there was on the importance (fig. 3).

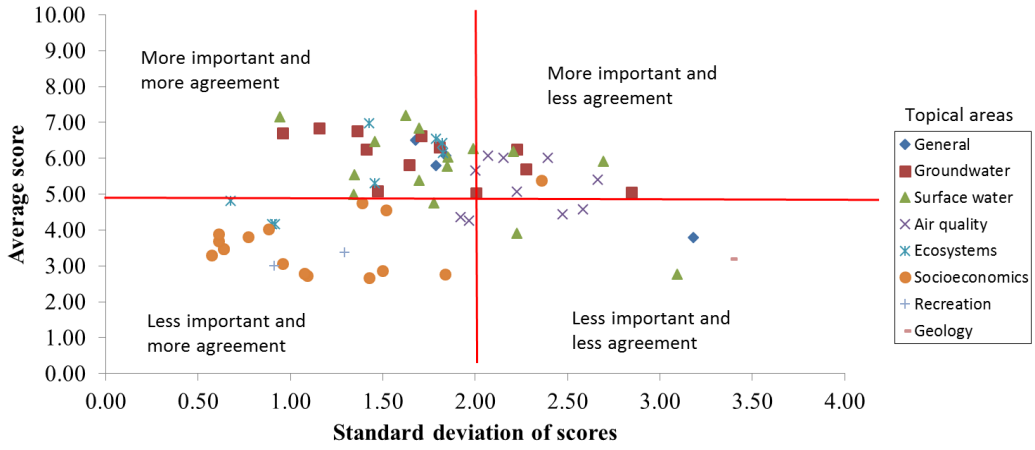

Figure 3. Relationship between average score and the standard deviation of scores. The red lines represent cutoff values for importance (average=5.0) and agreement on score (standard deviation=2.0).

In this case, the group interpreted higher average scores with low standard deviations, as evidence that there was agreement on the importance of that topic. On the other hand, scores that were relatively high, with higher standard deviations, suggested that there was less agreement on the importance of that topic. I was then able to sort the topics in terms of their scores and standard

deviations (fig. 3). In an effort to shorten the list of topics, I selected cutoff values (fig. 3) to show how the group could develop explicit decision rules about which topics to include in the BEST Report. In figure 3, I demonstrated an example by setting the importance cutoff at a value of 5.0 and an agreement cutoff of 2.0. The group agreed that these cutoffs were useful and agreed to use these values as a reference point for determining which priorities would go into the report. Using these cutoff values, I was then able to identify "priority" science topics, which were presented in table 4. Note that although air quality topics were not initially chosen due to the arbitrary cutoffs, the group expressed interest in exploring some air quality topics in the BEST Report, and were thus added to table 4 as well.

Next Steps

Using table 4, the USGS will now develop the BEST Report to specifically address these priority topics. Immediate next steps in the development of the BEST Report include the formation of writing teams to develop a workplan and outline for the report. Following the development of the outline, these writing teams will begin to assemble available information about the priority topics and will then synthesize this information. In the end, the goals for the BEST Report are to compile and describe current information and identify data gaps about these topics, provide scientific guidance on information that could be relevant for evaluating effects of energy development, and provide guidance on effective assessment techniques to describe effects of energy development on particular resources.

Acknowledgements

This work would not have been possible without the workshop participants and their willingness to work through this process. Likewise, Northern Prairie Wildlife Research Center financially supported my participation in the workshop and the creation of this report. Finally, I would like to thank Aaron Pearse and Conor McGowan for thoughtful reviews of this report.

Table 4. Priority science topics identified from the example presented in figure 3.

General
Geospatial maps that depict boundaries of surface and subsurface jurisdictions. This would include Tribal trust land (BIA), fee, allotted land, Ft. Berthold Indian Reservation, geospatial files on boundaries of Federal lands (BLM, NPS, USFWS, and so forth.)
Oil, gas, water production data. Historical and present oil, gas, water production data; spud date; gas flared; gas lease use; API Well No.; Operator; well location; well construction info; test info; production zones; non-producing gas zones; digital oil and gas well log info that can be used to develop 2D and 3D representations of well construction, production zones location, and aquifer locations.
Spills, citizen complaints. Reports made to other (non-EPA) agencies, especially on releases/disposal of produced/flowback water into creeks, rivers, or lakes.
Groundwater
Hydrogeological information and data. Geology, lithology (faults and fractures), aquifer characteristics such as transmissivity, permeability, porosity, thickness, areal location, and recharge areas. Induced seismicity criteria/characterization, formational subsidence
Aquifers. Locations (maps), quality, quantity, location and amount of drinking water supply, interactions with recharge areas and between aquifers.
Locations of source water protection zones. Maps depicting the location of sensitive groundwater resources such as municipal watersheds, sensitive aquifers, and recharge areas.
Surface water
Existing conditions of wetlands and riparian areas (inventory and mapping).
Existing surface water characterization. Tables to ID the designated uses of water bodies and the specific pollutants of concern (where applicable).
Maps of municipal watersheds and designated SWPZs.
Maps of topography and soils near surface water bodies. Steep slopes, erodible soils.
Produced water collected and injected into UIC wells (monthly).
Reference watersheds; reference streams.
Segments of water bodies designated as impaired (CWA 303D).
Surface water drinking water sources. Locations and boundaries.
Surface water monitoring. Surface water monitoring locations, sample analytics historic and present.
Ecosystems
Federal TandE Species (abundance, distribution, habitat). Physical site assessments for ESA Federal agency obligations, need for EPA permitters.
Golden and bald eagles (abundance, distribution).
Migratory birds (abundance, distribution).
State Species of concern (abundance and distribution).
Exotic plants/invasive plants (abundance and distribution).
Air Quality
Ambient monitoring data. Location of monitors and historical and present air quality data.
Emissions (HAPS, Criteria, GHG) estimates tied to development. Emission inventories, MNSR registrations and permitted facilities for actuals.

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Appendix. Science topic assessment

Table 5. Results from scoping workshop discussions showing each science topic categorized by topical area. In addition, workshop participants began the initial process of assessing whether they thought information currently exists (Y=Yes, N=No, P=Partially, U=Unknown) and where the information could potentially be acquired. For each topic, the average and standard deviation for scores across the workshop participants is also presented.

Topical area	Science topic	Existing information	Source	Comments	Average	Standard deviation
			General			
	Geospatial map that depict boundaries of surface and subsurface jurisdictions. This would include Tribal trust land (BIA), fee, allotted land … Ft. Berthold Indian Reservation; Geospatial files on boundaries; Federal lands (BLM, NPS, USFWS) …	Y	BLM, BIA, John Wieber (EPA R8 Data Steward)	John Wieber received maps from BIA for all Reservations in EPA R8 in July 2014 - OandG, coal and other mineral ownership + surface ownership … how does this relate to environmental law jurisdiction? Include Federal land surface and subsurface ownership.	6.50	1.68
	Land cover. Historical, current. and potential uses/conversions	U	USACE	USACE has completed level 1 and 2 resource inventories on our project lands	3.78	3.18

Oil, gas, water production data. Historical and present oil, gas, water production data; spud date; gas flared; gas lease use; API Well No.; Operator; well location; well construction info; test info; production zones; non-producing gas zones; digital oil and gas well log info that can be used to develop 2D and 3D representations of well construction, production zones location and aquifer location, etc.	Y	NDIC, USGS Northern Prairie Wildlife Research Center and Northern Rocky Mountain Science Center, John Wieber (EPA R8 Data Steward)	--	5.79	1.79
Spills, citizen complaints. Reports made to other (non-EPA) Agencies, especially on releases/disposal of produced/flowback water into creeks, rivers, or lakes.	Y	NDIC; EPA NRC; other agencies	Part of Premium NDIC Subscription	6.07	1.84
Ground water					
	U	--	--	6.84	1.15
Aquifer locations (maps)					
	--	--	--	6.25	2.23
Groundwater characterization - quantity and quality					
Groundwater use - location on landscape. Public water supply wells, domestic wells, springs, agricultural and stock wells.	--	--	--	5.69	2.27

Hydrogeological information and data. Geology, lithology (faults and fractures), aquifer characteristics such as transmissivity, permeability, porosity, thickness, areal location, recharge areas. Induced seismicity criteria/characterization, formational subsidence.	U	Ft. Berthold Reservation; State designations	BIA: On FBIR, the Programmatic EA identifies all SWPZs and Intakes (6) for public water supply	6.25	1.41
Interactions between aquifers	--	--	--	5.09	1.47
Interactions between aquifers and target zones	P/U	USGS Water census, State Water Commission, ND Dept. of Health	Outdated info on FBIR and maybe elsewhere.	5.03	2.00
Locations and amount of current drinking water supply	U	USGS, State Water Commission	Yes, but outdated info on FB Res and maybe elsewhere.	6.70	0.96
Locations and interactions between aquifers and recharge areas	--	--	--	6.32	1.81
Locations for potential drinking water supply	--	--	--	5.06	2.85
Locations of source water protection zones	--	--	--	6.76	1.36
Water Quality (aquifers)	--	--	--	6.63	1.71

	Y	NDSWC	--	5.82	1.64
Water Quantity (aquifers)					
Surface water					
Existing conditions of wetlands and riparian areas (inventory and mapping)	P	USFWS, Delineation reports	USACE has applicants complete wetland delineations on Project lands and along ROW of pipelines, within seismic survey boundaries, etc.	7.20	1.62
Existing surface water characterization. Tables to ID the designated uses of water bodies and the specific pollutants of concern (where applicable).	P	USACE	USACE collects data on a regular basis in Lake Sakakawea; not collecting every parameter	6.27	1.99
Flood control infrastructure	Y	USACE, FEMA	--	2.77	3.09
Flood plain locations (in underdeveloped areas)	P	FEMA	USACE does not map these, but FEMA may	6.18	2.21
Influence of hydrofracking risk of frac-out	P	USACE	USACE has had applicants complete a frac-out (includes risk analysis) plan for HDD pipeline projects. No hydrofracturing risk analysis.	5.92	2.69
Maps of municipal watersheds and designated SWPZs	Y	EPA and NDOH may have these	--	6.47	1.46

Maps of topography and soils near surface water bodies. Steep slopes, erodible soils, etc.	Y	USGS, NRCS Web Soil Survey, USACE	--	5.78	1.85
Produced water collected and injected into UIC wells (monthly). Currently cannot link produced water to disposal, reuse or recycle, trucked vs. piped.	P	NDIC OandG Data	--	6.03	1.85
Projections of in-stream flow	P	USGS, USACE, BOR	Climate change study, 2014 WRDA developing monitoring of in-stream flow.	3.91	2.22
Reference watersheds; reference streams	U	USACE ERDC	HGMs may have these	5.55	1.35
Segments of water bodies designated as impaired (CWA 303D)	Y	EPA and NDOH may have these	--	5.38	1.70
Segments of water bodies designated as not impaired (CWA 305B)	Y	EPA and NDOH may have these	--	4.99	1.34
Segments of water bodies not known (CWA 305B)	Y	EPA and NDOH may have these	--	4.76	1.77
Surface water drinking water sources. Locations and boundaries.	Y	NDSWC and local municipalities	--	6.83	1.70

Surface water monitoring. Surface water monitoring locations, sample analytics historic and present.	U	USGS	--	7.15	0.94
Air Quality					
Air quality modeling results. e.g. Regional Haze planning/modeling (NPS currently funding CSU study on ammonia measurements).	P/Y	EPA, ND Dept Health	--	5.06	2.22
Ambient monitoring data. Location of monitors and historical and present air quality data.	P/Y	States, EPA, ND Dept Health	--	6.01	2.15
Emissions (HAPS, Criteria, GHG) estimates tied to development. Emission inventories, MNSR registrations and permitted facilities for actuals.	P	EPA, ND Dept Health	--	6.06	2.07
Indirect emissions (e.g. truck traffic)	U	EPA, NDOH	--	5.40	2.66
Meteorological data	Y	NOAA	--	4.57	2.58
Night skies/light pollution	P	BLM, NPS	--	4.27	1.97

Nitrogen and mercury deposition	U	EPA, NDOH	--	4.45	2.47
Soundscapes/noise disturbance	P	BLM, NPS	--	4.37	1.92
U.S. Class I airshed and regional haze	Y	EPA	--	5.66	2.00
Validation of Equipment emissions	P	EPA, NDOH	--	6.01	2.39
Wildlife					
Federal TandE Species (abundance, distribution, habitat)	Y	USFWS has data available, PBA for Fort Berthold (Reservation only)	Recovery plans exist. Species list, distribution maps and habitat description on website	6.98	1.42
Fish (game and non-game)	Y	NDGF, USFWS, PBA for Fort Berthold (Reservation only)		4.16	0.90
Game species (birds, mammals)	Y	NDGF, USFWS, PBA for Fort Berthold (Reservation only)	--	4.17	0.92

Golden and bald eagles	Y	NDGF, USFWS, PBA for Fort Berthold (Reservation only)	--	6.43	1.82
Migratory birds	Y	NDGF, USFWS PBA for Fort Berthold (Reservation only)	--	6.15	1.83
Other species of concern (abundance and distribution)	Y	NDGF, BLM, FS, USFWS, PBA for Fort Berthold (Reservation only)	--	4.81	0.68
State Species of concern (abundance and distribution)	Y	NDGF, USFWS, PBA for Fort Berthold (Reservation only)	--	6.55	1.79
Vegetation					
Exotic plants/invasive plants	P	Forest Service for Federal lands, NRCS, ND Dept. of Ag., Weed Boards	Likely not all communities have been mapped	5.30	1.46
Socioeconomics					
Attitudes, values, beliefs	U	ND Dept of Social Services	--	3.81	0.77

Cost of living	Y	ND Dept. of Commerce	--	3.48	0.64
Education (e.g. capacity, quality)	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	2.73	1.09
Emergency services	Y	ND Dept. of Commerce, Local municipalities	--	4.56	1.52
Employment, income, unemployment	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	3.07	0.96
Environmental justice. Identify minority, low-income, Tribal communities within geographic scope of Bakken and a description of the sources of the data and the methodology/criteria utilized in the identification.	P	Dept. of Social Services, ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	4.75	1.39
Health and safety	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	5.38	2.36
Housing	Y	ND Dept. of Commerce	--	3.48	0.64
Impacts on ranching	P	USDA - NRCS, ND Dept. of Ag, Weed associations	--	3.68	0.61

Local infrastructural costs	Y	Local governments, ND Dept of Commerce	--	3.31	0.57
Non-market values	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	2.86	1.50
Quality of life	Y	ND Dept. of Commerce	--	3.89	0.61
Social costs of carbon	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	4.03	0.88
Social services (abuse, aging population, etc.)	Y	Dept. of Human Services	--	2.68	1.43
Tax Revenues (State and local)	Y	ND Dept of Commerce, IRS, County Assessors	--	2.79	1.08
Transient workforce	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	2.79	1.08
Transportation	P	ND Dept. of Commerce, USACE, likely others (anyone doing NEPA)	USACE has EA for projects on USACE land that include these types of analysis	2.76	1.84

Recreation					
Transaction value of non-resident hunters	P	NDGF, ND Dept of Commerce	Minor compared to OandG potential revenues	3.00	0.91
Recreational revenue	P	NDGF, ND Dept of Commerce	Minor compared to OandG potential revenues	3.38	1.29
Geology					
Induced seismicity	P	USGS, state groups	Outside scope	3.19	3.38