Advancing Science in the BLM: An Implementation Strategy

BLM

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Introduction

The Federal Land Policy and Management Act of 1976 (FLPMA) directs the Bureau of Land Management (BLM) to manage the public lands for multiple use and sustained yield so as to ensure the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. Carrying out this mission is increasingly complex and visible in a world of rapid and dynamic change, presenting the BLM with difficult choices that will affect how the land will look for generations to come. The intricacy of natural and cultural systems, combined with public expectations and legal dictates, make it essential for the BLM to continue to be "science-informed," supporting its current culture in which mission-oriented science enables managers and staff to apply science in decisionmaking and adaptive management, at every level and in every program.

Science is the knowledge and study of the world based on facts learned through experiments and systematic observations. A wide range of biophysical and socioeconomic sciences are applicable to the BLM's decisionmaking. Throughout all the work processes the BLM employs to achieve various resource management outcomes, science and science-based tools should play a continual role in addition to many other inputs, such as legal and policy requirements, public opinion, and professional expertise (see Figure 1). When properly balanced with all of the other inputs of resource decisions, science informs decisions such as site-specific grazing permits, permits to drill and mine, landscape-scale planning, regional mitigation strategies, and adaptive management.

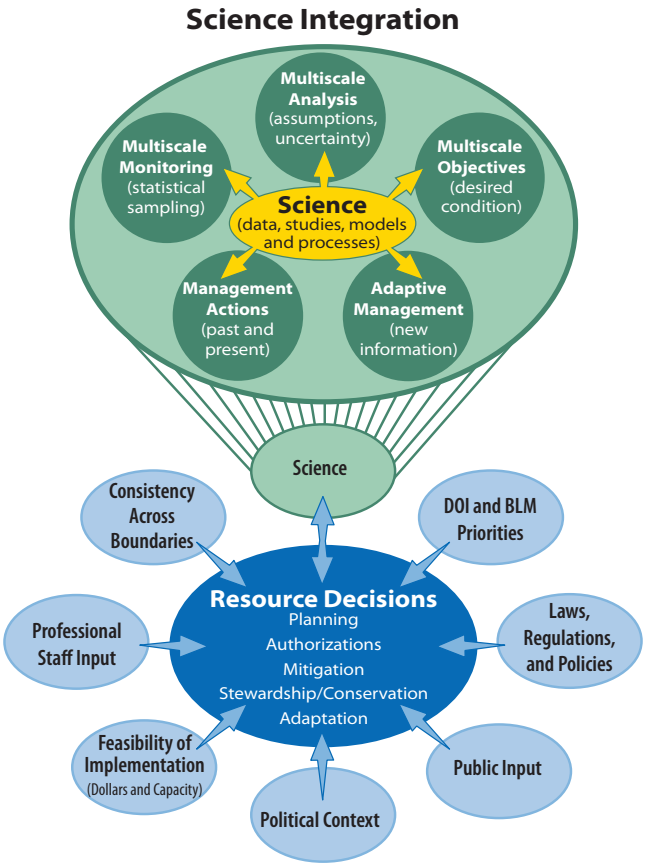


Figure 1. Contributors to the BLM decisionmaking process, with science as one of the many inputs

To help integrate science into multiple-use land management decisions in a consistent manner, the BLM invests in several science-based strategies and activities that provide multiscale insight to both the agency and the public. Products of these strategies and activities, including the Assessment,

Inventory, and Monitoring (AIM) Strategy; rapid ecoregional assessments (REAs); and the Geospatial Services Strategic Plan, build on existing successes and expand a decisionmaker's access to important information essential for landscape management.

As the BLM continues to develop a landscape-scale approach to management, consistent scientific data and tools will enhance the BLM's ability to work across traditional administrative boundaries to respond to broad-based issues. For example, consistent scientific data and tools are a key aspect of the BLM's efforts to manage Greater Sage-Grouse habitat, identify healthy lands focal areas, and develop regional mitigation strategies. As the BLM's planning process evolves with Planning 2.0, strong, sound scientific data will need to underpin the BLM's planning efforts even more than in the past.

Recognizing the increasing importance of science-informed decisions, the BLM performed an assessment of science activities and opportunities in 2012 and 2013. In 2014, BLM Director Neil Kornze asked a team (Advancing Science Integration Strategy Team—ASIST) to develop an implementation strategy to support the BLM's leadership and resource specialists as they apply science in their everyday work. The ASIST members consulted with the BLM Executive Leadership Team (ELT), Field Committee, Deputy State Directors for resources and minerals programs, and Washington Office (WO) Division Chiefs throughout the development of this strategy.

Findings

The ASIST members validated that effective and consistent integration of the best available science in decisionmaking is becoming more and more essential for public land management in an era of changing climate, landscape-scale planning, large dataset development, advanced technology, increased public expectations, and diverse legal challenges.

Generally, the BLM entrusts its resource specialists to keep abreast of how scientific understanding is evolving in their respective disciplines and to incorporate science into their work. The ASIST members found numerous examples (see Appendix1) in which the BLM is effectively embracing science-land management integration. These examples serve as a foundation to advance science into all aspects of land management and become models for effective integration of science as a consistent practice throughout the BLM. Additionally, the BLM should expand and fully embrace scientific partnerships, as the BLM does not have the capacity, nor would it be wise, to go it alone.

To be most effective in achieving its mission, the BLM should continue efforts to advance a culture that makes it a priority for employees to remain current on the most up-to-date science and the latest research of their peers and deliberately obtain and apply relevant science to all programs and projects. Managers and staff should have the tools and data necessary to apply the best available science in decisionmaking and adaptive management, and the public should gain a much better understanding of the related science if the BLM is routinely transparent about assumptions, objectives, and uncertainties in the analyses.

To advance a more effective and consistent use of science, the ASIST members recognized the need for the BLM to integrate science into the core of its actions and to provide the resources, training, and partnerships to ensure that scientific information is accessible. In other words, the BLM should ensure effective and consistent science integration into the BLM's core work processes (Implementation Strategy, Goal 1) and ensure that relevant, timely scientific information is accessible to BLM staff and managers (Implementation Strategy, Goal 2). These two implementation strategy goals are described in detail in the next section of this document.

The ASIST members also acknowledged that advancing science in the BLM does not stand alone. This implementation strategy reinforces several components of the BLM's publication "Winning the Challenges of the Future: A Road Map for Success in 2016" by placing an emphasis on data, monitoring, and adaptive management; investing in geospatial data and tools; and empowering the scientific capacity of BLM employees and partnerships. Furthermore, this strategy is closely connected with several other BLM priorities, including Planning 2.0, regional mitigation strategies, and the Greater Sage-Grouse planning effort. And lastly, this implementation strategy complements and will be coordinated with other ongoing science strategies, such as those adopted by the National Landscape Conservation System (NLCS) and the Joint Fire Science Program.

Implementation Strategy Goals

GOAL 1: Ensure effective and consistent science integration into the BLM's core work processes.

The ASIST members recognize the need to make the practice of integrating science into core work processes a more consistent part of BLM culture. Through the development of the Activity Based Costing system, the BLM identified nine basic work processes; six of these work processes have an essential nexus to the BLM's science-land management integration, including:

- Assess condition and status.
- Perform planning.
- Authorize use.
- Implement BLM actions.
- Manage compliance.
- Perform monitoring.

Through ASIST's review of scientific literature and many successful examples of science integration in land management, five principles and practices emerged that, if adopted, can help guide the BLM to more systematic and effective integration of science into these core work processes. They require a close working relationship between managers and technical specialists to access and interpret relevant scientific information.

Principles and Practices

1. *Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer-reviewed literature when it exists.*

   Use of the "best available science" has been the standard for the BLM. As data and scientific literature become more accessible via websites for resource specialists in the field, it becomes easier for the BLM to strive for a more careful and deliberate approach when determining the applicability of available data and science for the management question at hand. To the extent possible, the BLM relies on scientific knowledge and scientific data that have been rigorously peer reviewed by independent and qualified reviewers.

2. *Recognize the dynamic and interrelated nature of socioecological systems within which the BLM operates.*

   The BLM is responsible for managing pieces and blocks of large, dynamic, and interrelated socioecological systems at multiple scales. A change in any aspect of one or more components of these systems can have cascading impacts on the rest of the web of relationships. BLM resource specialists very often factor in the interconnectedness of the people and the landscapes when designing projects or writing the analysis in National Environmental Policy Act (NEPA) and planning documents. Ample tools exist to help understand, simplify, visualize, and communicate these interconnected systems, and the BLM will strive to consistently use these tools in its decisionmaking processes.

3. *Acknowledge, describe, and document assumptions and uncertainties.*

   Perfect scientific understanding, perfect datasets, and perfect models do not exist for most of the management questions facing resource managers. However, when scientific tools are applied, such as predictive models, statistically determined confidence intervals, and risk analysis, the BLM is able to more accurately depict anticipated effects and describe assumptions and uncertainties. Clear documentation of the assumptions and unknowns are important in the BLM's internal and external communications, in addition to when evaluating the effectiveness of actions over time. Moreover, the more resource managers acknowledge, describe, and document assumptions and uncertainties, the easier it will be to focus new scientific

investigations and implement adaptive management.

4. *Use quantitative data when it exists, in combination with internal and external professional scientific expertise.*

   Quantitative data are collected systematically and in statistically valid manners and used for many purposes. These data are useful at local levels and can also be rolled up to understand conditions regionally and nationally. Data are collected in concert with other agencies and external partners. These high-quality data serve as one core tenet of the decisionmaking process. Data are made publically available to the greatest extent possible, in order to allow for transparency and to provide an opportunity for the BLM's science partners to use the data for additional purposes and to improve the quality of the data over time. As BLM scientists and resource specialists and external partners are talented, educated, and have a sophisticated understanding of the landscape, their collective professional expertise are important complements to these datasets. For example, internal and external professional expertise is vital for identifying relevant datasets and reconciling conflicting data or scientific conclusions.

5. *Use transparent and collaborative methods that consider diverse perspectives.*

   BLM resource specialists and various partners bring strong scientific knowledge to the table during decisionmaking processes. When the BLM capitalizes on this type of knowledge, the BLM's understanding of the landscape is strengthened. Partnerships among agencies, academia, and the public increase opportunities to develop a vast array of information and technological tools that help improve the understanding of the environment for all parties involved. Some of these tools include interactive geospatial platforms, conceptual models, and diverse datasets. The BLM embraces these partnerships as foundational to internal and external collaborative processes.

Goal 2: Ensure that relevant, timely scientific information is accessible to BLM staff and managers.

It is widely recognized that there is a continuously growing reservoir of land management-related science, but it can be difficult to access in a timely manner and is often challenging to translate into management applications. ASIST members found that when the best available science is visible, accessible, and understandable, BLM professionals put it to use. The BLM and its science partners can do a better job of sharing information about relevant scientific findings, demonstrating the application and integration of science into BLM work, and focusing scientific undertakings on the most compelling management questions.

Some key elements of applying science to BLM core work processes include educating BLM employees on the most current science, staying abreast of emerging science, and teaching how to apply this knowledge. To accomplish this, the BLM should reinvest in employees and showcase their successes, internally and externally, in science-land management integration. As the public challenges the BLM to use the best available science, developing protocols and maintaining employee expertise will enable the BLM to evaluate and determine the best available science for the management decision being made or problem being solved.

Because the BLM sometimes relies on outside entities to develop and deliver science, cultivating and sustaining science partnerships is vital. The BLM can build on the many fine examples of such partnerships that help frame scientific investigations, that are responsive to management questions, and that use current technologies such as geospatial analyses and web-based information sharing to deliver science results. Interactive and ongoing partnerships that foster dialogue and real-time information sharing between managers and scientists have proven to be most effective. The BLM should continue to engage in partnerships that align science activities with BLM management needs and produce results that can be readily accessed, interpreted, and applied by BLM managers and staff.

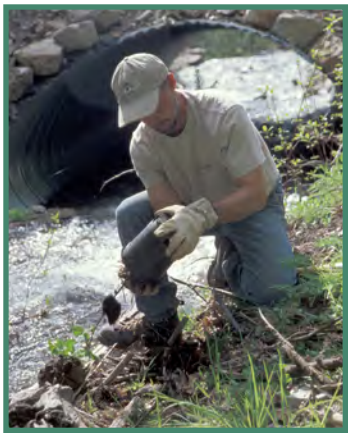
To leverage the BLM's limited resources along with those of its science partners and to wisely invest in employee development, it will continue to be important for the BLM to identify and communicate priority science needs. This has been an elusive undertaking for the BLM and will take committed leadership to reach measurable improvement. Science leadership within the BLM will be established through designation of a National Science Committee tied to the ELT (see Appendix 2). This committee will have a role in developing geographic or project-oriented science plans and strategies, such as those pioneered on National Conservation Lands, and strengthening communities of practice through existing science partnerships and additional forums for science information sharing.

Data and the use of modern technologies for managing data to be dynamic, accessible, and usable underpin the ability to integrate science into management decisions. By continuing to invest in and improve the BLM's outcomes in data management and technology, the goals of advancing science will be better realized.

Conclusion

The BLM can make significant strides in advancing science by committing to two focused goals and a series of associated implementation strategies and actions that will build science principles and practices into daily work at all levels of the organization. With a focused commitment toward implementation of the plan, the best available science can become more visible, accessible, and useful for BLM managers. The BLM can build upon many successes and lessons learned from creative and capable employees who have pioneered and demonstrated effective integration of science into daily work at all scales (see Appendix 1).

As the BLM achieves its goals and more consistently applies the principles and practices of science-informed land management, decisionmakers will routinely, and with greater ease, consult and contemplate the best available scientific understanding when undergoing a decisionmaking process. With increased transparency in the application of science to inform management decisions, "lack of science" will less likely be a focal point for litigation, and science will be more clearly documented in NEPA analyses. BLM leadership and employees will strive to stay current with up-to-date science and collaborate with existing science partners to deliberately pursue, communicate, and use science as a part of daily work. The BLM can become a more visible leader in advancing science as science-informed land management becomes more transparent across the entire agency.



Science Action Plan

The following action plan is a timely and realistic approach for the BLM to strengthen the building blocks for science integration and internalize best practices across the agency. Leadership commitment to these actions will advance science-informed land management and make significant progress toward meeting the two goals described in this implementation strategy.

Goal 1: Ensure effective and consistent science integration into the BLM's core work processes.

Strategy 1.1. Adopt, publish, and communicate the five principles and practices for more consistent science integration into land management core work processes.

Actions:

1. Implement a rollout plan to familiarize all employees with the principles and practices of successful science integration. The plan could include products such as videos/webinars, BLM Daily feature articles, a fact sheet, an instruction memorandum, and an endorsement message from the BLM Director and ELT.

   Lead: ASIST and the Communications Directorate (WO-600)

   Timeframe: 2nd quarter FY 2015

2. Conduct a pilot NEPA analysis that showcases the application of the five principles and practices of successful science integration and undergoes appropriate peer review, in partnership with a key BLM science provider. This pilot could serve as a model for future NEPA analyses as well as demonstrate how to establish a strong scientific basis for the monitoring, adaptive management, and mitigation that result from NEPA analyses.

   Lead: Division of Decision Support, Planning, and NEPA (WO-210), National Operations Center, and a BLM state (to be determined)

   Timeframe: FY 2015

3. Incorporate the principles and practices of successful science integration into BLM program-specific policies and processes including: planning, regional mitigation, monitoring, NEPA, Healthy Lands Initiative, Joint Fire Science Program, range, fuels, fire, NLCS, wildlife, minerals, realty, etc. The National Science Committee (see Appendix 2) will oversee coordination across initiatives and programs and track progress of the implementation schedule.

   Lead: Renewable Resources and Planning Directorate (WO-200); Energy, Minerals, and Realty Management Directorate (WO-300); and NLCS and Community Partnerships Directorate (WO-400) Deputy Assistant Directors and Division Chiefs will develop and implement a schedule.

   Timeframe: FY 2015 through FY 2017

4. Produce a technical guide and associated online training modules with explanations on how the five principles and practices of science are applied in land management. This guide will showcase effective examples of science-land management integration involving partnerships at various scales.

   Lead: National Operations Center Division of Resource Services, in conjunction with the National Training Center. Oversight provided by the National Science Committee.

   Funding Consideration: Consider short-term funding for additional capacity to support this effort.

   Timeframe: FY 2015 through FY 2017

5. Develop a comprehensive science manual to provide the BLM with the policy necessary to effectively coordinate and implement science-informed land management in the BLM.

   Lead: Renewable Resources and Planning Directorate (WO-200) and NLCS and Community

Partnerships Directorate (WO-400) science coordinators, with support and oversight from the National Science Committee.

Timeframe: Complete by 4th quarter FY 2016.

Strategy 1.2. Promote continuity of the science-land management integration culture throughout the agency and over time.

Actions:

1. Establish a National Science Committee (see Appendix 2) tied to the ELT to advance the science-land management integration culture, actively coordinate across the BLM's science activities (e.g., Joint Fire Science Program, National Conservation Lands science strategies, etc.), interface with external science partners (e.g., Cooperative Ecosystem Studies Units, Landscape Conservation Cooperatives, and other science agencies), and bring operational leadership to all components of this strategy.

   Lead: ELT

   Timeframe: 2nd quarter FY 2015

2. Promote the establishment of scientifically trained science coordinators/advisors in each state and in the WO-300 Directorate (either full time or collateral duty) to develop and communicate new policies and procedures, communicate science-land management integration successes, and help identify and communicate science needs priorities.

   Lead: ELT and Field Committee members at their discretion

   Funding Consideration: Consider allocating funding to support this function through WO directives in FY 2017, and leverage BLM money with Landscape Conservation Cooperative money.

   Timeframe: Ongoing. Designate individuals by the end of FY 2016.

Goal 2: Ensure that relevant, timely scientific information is accessible to BLM staff and managers.

Strategy 2.1. Communicate and translate new science results and science-land management integration successes.

Actions:

1. Establish the BLM "Science One-Stop" website to more broadly and consistently communicate relevant science results, examples of science-land management integration, and science partnerships on a routine basis (e.g., access to relevant scientific journals, monthly science Wednesdays on the BLM Daily, webinars, online monthly/quarterly BLM science publications, technical notes, science-land management integration resources/links). Systematically implement these online through a 3-year work plan to communicate science results and highlights. This would be accomplished by working closely with science providers (e.g., Joint Fire Science Program, Landscape Conservation Cooperatives, Climate Science Centers, U.S. Geological Survey, Cooperative Ecosystem Studies Units, etc.). Scientific journal access is also available through the BLM Library (www.blm.gov/library/) and the DOI Library (www.doi.gov/library/electronic/index.cfm).

   Lead: National Operations Center (with the National Science Committee)

   Timeframe: Continue to evolve from the BLM Library website. Complete 3-year plan by 4th quarter FY 2015.

2. Develop standard language that can be incorporated into partner agreements and contracts that require data management plans and science results. The standard language should clearly establish that products address management questions, should be understandable to managers, and should be applicable to land management.

   Lead: Renewable Resources and Planning Directorate (WO-200) and NLCS and Community Partnerships Directorate (WO- 400) science coordinators, in collaboration with contract

specialists. Develop and distribute language and guidance via an information bulletin.

Timeframe: FY 2015

Strategy 2.2. Strengthen communities of practice, employee skills, and partnerships.

Actions:

1. Promote BLM state and regional science roundtables/forums through Landscape Conservation Cooperatives and existing scientific meetings to share new science results, share successes of science integration, showcase effective partnerships, establish internal advocacy and enthusiasm for science, and continue to build partnerships. This could be further advanced by allocating funding through a competitive funding process overseen by the National Science Committee and funded out of the WO.

   Lead: State Directors/Deputy State Directors

   Funding Consideration: Consider funding three competitive proposals each year (FY 2017 through FY 2020).

   Timeframe: Ongoing and as opportunities arise

2. Recommit to employee technical training and staff attendance at scientific meetings and conferences to maintain currency and knowledge of best available science and build connections with their professional communities of practice. This could be facilitated through incentives, awards, direction in the annual work plan directives, and messaging through the BLM Director and ELT.

   Lead: National Science Committee, WO program leaders, and all supervisors

   Timeframe: Initiate in FY 2016 program directives.

3. At the national level, reinstitute routine coordination with the U.S. Geological Survey (DOI's science agency) to communicate the BLM's priority science needs, develop joint budget proposals, and leverage limited resources toward BLM priorities. Initiate via a 2-day workshop with the BLM and USGS leadership to reestablish relationships and draft a framework (possibly a memorandum of understanding) for coordination.

   Lead: Renewable Resources and Planning Directorate (WO-200) and NLCS and Community Partnerships Directorate (WO-400) science coordinators, in conjunction with the National Science Committee

   Timeframe: Initiate 2nd quarter FY 2015; complete framework by 4th quarter FY 2015.

4. Strengthen BLM engagement with science partners at all levels of the agency by explicitly designating science liaisons with partners (such as Cooperative Ecosystem Studies Units, Landscape Conservation Cooperatives, universities, etc.).

   Lead: Members of the Deputy State Director's group (WO Division Chiefs and Deputy State Directors for Resources and Minerals)

   Timeframe: Ongoing

5. Strengthen BLM scientific engagement with the public by piloting a citizen science program with the NLCS, with the aim of instilling citizen science as standard practice across the BLM.

   Lead: NLCS and Community Partnerships Directorate (WO-400) science coordinator

   Timeframe: Ongoing

Strategy 2.3. Identify and prioritize the changing needs of scientific information.

Actions:

1. Identify and prioritize science needs annually, and make recommendations to the ELT and WO on funding priorities.

   Lead: National Science Committee, in conjunction with Deputy State Directors/WO Division Chiefs

   Funding Considerations: Continue to allow for discretionary investments in science at the regional, state, and field office levels. Once the

National Science Committee has developed an effective prioritization process, consider allocating funding from across subactivities in support of science priorities recommended to the ELT.

Timeframe: Initiate with FY 2016 annual work plan and budget.

2. Establish clear priorities for the National Operations Center Division of Resource Services, and recommend funding allocations as the division coordinates and provides capacity to work across administrative boundaries at landscape scales (e.g., Sage-Grouse Cumulative Effects Analysis and Baseline Environmental Report, REAs, AIM Strategy, regional mitigation strategies).

   Lead: National Science Committee, in conjunction with Deputy State Directors/WO Division Chiefs

   Timeframe: Initiate with FY 2016 annual work plan and budget.

Strategy 2.4. Strengthen technology and data support.

Actions:

1. Support the BLM's GIS Transformation Project, the outcome of which is to serve geospatial data in a web-based environment founded on a common architecture and made readily available to the public and BLM partners and employees. To the greatest extent possible, the BLM will use and leverage already existing datasets and web-based analytical tools developed by the scientific community.

   Lead: Geospatial Steering Committee

   Timeframe: Continue ongoing efforts.

2. Advance tools and knowledge for growing remote sensing technologies to increase access to multiscale data and information (e.g., unmanned aerial systems, satellite imagery, and 3D close range photogrammetry).

   Lead: Renewable Resources and Planning Directorate (WO-200), National Operations Center, and states

   Timeframe: Continue ongoing efforts.

3. Continue the development of national data standards and datasets, and identify gaps needed for science-based conceptual models and analyses.

   Lead: Data Advisory Committee

   Timeframe: Continue ongoing efforts.

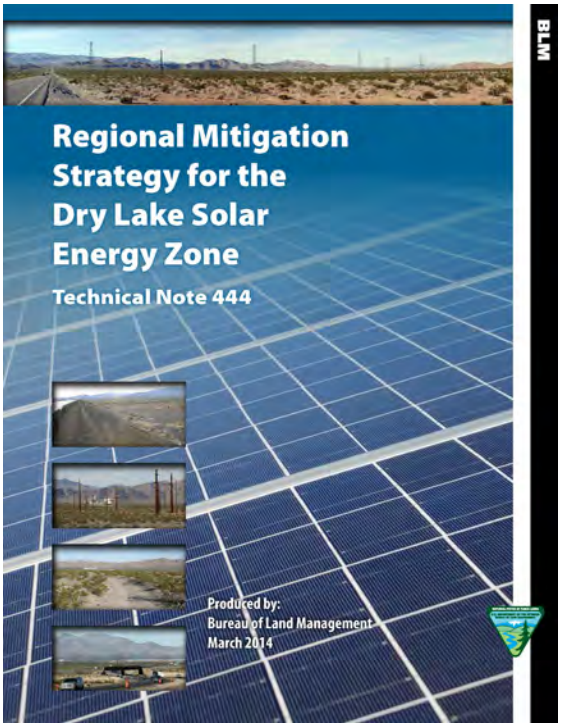
Appendix 1:
Case Studies that Exemplify the Principles and Practices of Effective Scientific Integration in the BLM

The brief descriptions of projects and activities in this appendix provide a snapshot of a few of the many examples of science integration across the Bureau of Land Management (BLM). The purpose of showcasing these case studies is not to provide a recipe for how science could or should be applied; rather, the intent is to give the reader a flavor for how science serves an important role in the successful management of diverse programs across many geographical areas. Links to additional articles and publications related to the case studies can be found in Appendix 3: Bibliography and Suggested Reading.

CASE STUDY #1

PROJECT NAME

Regional Mitigation Strategy for the Dry Lake Solar Energy Zone



BACKGROUND

In 2012, the BLM finalized a solar energy program plan ("Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States") for utility-scale (20 megawatt or greater) solar energy development on BLM lands in six southwestern states: Arizona, California, Colorado, Nevada, New Mexico, and Utah.

Under the program, the BLM categorized lands excluded from development (about 79 million acres) and identified locations well suited for utility-scale production of solar energy (solar energy zones, or SEZs) where the BLM proposes to prioritize development (about 285,000 acres). The program encourages development within the SEZs, although development may occur outside of the SEZs under special circumstances.

Regardless of where development takes place, the BLM requires developers to design projects to avoid, minimize, and compensate for adverse impacts on resources of concern.

PROJECT SUMMARY

In support of the solar energy program plan, the BLM developed a regional mitigation strategy for the Dry Lake Solar Energy Zone in southern Nevada to guide the application of avoidance, minimization, and compensatory mitigation for impacts from solar energy development in Dry Lake. This prototype mitigation strategy is being used to guide similar regional mitigation strategies for the additional SEZs in the six western states.

The process used in developing the mitigation strategy and the strategy itself exemplify the principles and practices identified in "Advancing Science in the BLM: An Implementation Strategy."

Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer-reviewed literature when it exists.

The peer-reviewed scientific information contained in the BLM's rapid ecoregional assessment (REA) substantially informed the development of the regional mitigation strategy. The REA data was the most thorough and applicable of the available scientific data and provided an important regional perspective. REA data layers on land cover and landscape intactness formed the baseline condition in the SEZ. REA data layers also helped identify problematic regional trends for specific resources and subsequently informed determinations about which resources warranted compensatory mitigation.

Recognize the dynamic and interrelated nature of the socioecological systems within which the BLM operates.

The BLM developed systems-based conceptual models of ecosystem interactions. These models helped build an understanding of the role that resources, individually and together, play in the function of the relevant ecological, social, and cultural systems. These models helped BLM staff and stakeholder partners understand how resource impacts of solar energy development will impact the ecological, social, and cultural systems of the Dry Lake area. The models also helped identify the mitigation actions necessary to offset those resource impacts and the monitoring necessary to ensure the effectiveness of the mitigation actions. The BLM used an iterative process with its stakeholders in developing the models.

Acknowledge, describe, and document assumptions and uncertainties.

The models used to support the regional mitigation strategy documented the BLM's assumptions about the relevant ecosystem interactions in a very open and public manner. As the models were built through an iterative process, there was an explicit acknowledgment of uncertainty in the BLM's understanding. That is, understanding how hydrology affects soil, which in turn affects vegetation. This takes an immense amount of ecological understanding, some of which has yet to be researched. Therefore, the BLM openly discussed these unknown aspects and relied on hypotheses (i.e., educated guesses) of these relationships to inform the understanding. As more information is gathered, the models can be refined and improved.

Use quantitative data when it exists, in combination with internal and external professional scientific expertise.

By using the BLM's REAs as the primary data source, the regional mitigation strategy relies explicitly on quantitative data. Expert opinion helped inform the conceptual model and important resource conditions and trends as a supplement to the quantitative understanding. For example, expert opinion was essential for defining the ecological relationships where there were gaps in scientific understanding.

Use transparent and collaborative methods that consider diverse perspectives.

The process to develop the regional mitigation strategy involved extensive outreach and engagement with all interested stakeholders and included four workshops, several web-based meetings, and opportunities to comment on preliminary and draft versions of methodologies and strategies. Workshops included field visits and discussions of regional conditions and trends, the use of mapping tools and data, and monitoring. All presentations (and additional information) from the workshops and webinars were posted on a public website. The BLM's data (e.g., the REAs) were available to all stakeholders, and the BLM welcomed submissions of data from the stakeholders.

CASE STUDY #2

GREATER SAGE-GROUSE CONSERVATION PLANNING EFFORT

The Greater Sage-Grouse conservation planning effort and subsequent implementation is a collaborative process that applies the principles and practices of "Advancing Science in the BLM: An Implementation Strategy." The overall objective of the planning effort was for the BLM and the U.S. Forest Service to respond to explicit management questions about managing lands and land uses to conserve Greater Sage-Grouse and its habitat. Scientific information and spatial data were synthesized at various scales and integrated into a large-scale planning project to address the threats to the species and its habitat. The table on the next page outlines the primary management questions, demonstrates how the best available science was incorporated throughout the core work processes, and identifies the scale from which scientific information was used and applied in analyses. Documents and reports referenced in the table can be accessed through links provided in Appendix 3.

In addition to incorporating scientific information from several reports to inform management alternatives and decisions, the BLM took a systems approach by focusing on biologically significant units rather than traditional administrative boundaries. Objectives were analyzed and determined in the context of priority habitats, sage-grouse management zones, and populations as defined by interagency teams. A wide range of conservation measures contained in the various alternatives in the NEPA documents were analyzed in a geospatial data-rich process to determine the effects of the actions and cumulative effects to sage-grouse. The assumptions and uncertainties were clearly acknowledged and because there are known gaps in the science and understanding, the BLM, U.S. Forest Service, and U.S. Fish and Wildlife Service collaborated to establish science-based monitoring methods that are cross-program, standardized, scalable, and defensible. These were incorporated into a Greater Sage-Grouse Monitoring Framework which will facilitate the collection of quantitative data and improve the understanding of the habitat condition and trends. As plans are implemented, the collaborative and transparent methods will better position the BLM and its land management partners to apply effective mitigation regionally and adapt management as necessary.

Table. Outline displaying how primary management questions and science were applied to the Greater Sage-Grouse conservation planning effort

Management Questions	Applied Science	Work Process	Scale
What are the threats to sage-grouse?	1. U.S. Fish and Wildlife Service (USFWS) listing decision identifies threats based on literature.	ASSESS	Rangewide
	2. BLM and state agencies delineate priority habitat based on lek data.	ASSESS	Rangewide
	3. The BLM and U.S. Geological Survey provide an environmental baseline report, displaying location and magnitude of threats and the EIS-affected environment.	ASSESS	Broad/Mid, Rangewide
How can the BLM ameliorate threats?	4. The National Technical Team (BLM and USFWS) provide alternatives to ameliorate threats.	PLANNING	Rangewide
	5. For the EIS effects analysis, evaluate alternatives to conservation objectives.	PLANNING	Populations
	6. Provide the EIS cumulative effects analysis with biological context.	PLANNING	WAWFA
	7. The EIS record of decision provides the BLM's decisions regarding allocations, opportunities, and constraints.	PLANNING	Local, Regional
Are BLM decisions meeting objectives?	8. The BLM, USFWS, and U.S. Forest Service provide monitoring framework methods for sagebrush and disturbance monitoring at multiple scales.	IMPLEMENTATION	Multiscale
	9. The BLM, USFWS, and states provide a regional mitigation strategy, which balances threats and tradeoffs across a landscape.	IMPLEMENTATION	Multiscale
	10. BLM, states: Adaptive Management and EIS. Science-based conceptual models, triggers, and thresholds.	IMPLEMENTATION	Multiscale

CASE STUDY #3

PROJECT NAME

Adaptive Grazing Management in Las Cienegas National Conservation Area

PROJECT SUMMARY

The BLM's resource management plan for Las Cienegas National Conservation Area includes an adaptive biological planning process that relies on monitoring data to inform grazing management. This adaptive process exemplifies the principles and practices identified in "Advancing Science in the BLM: An Implementation Strategy."

Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer-reviewed literature when it exists.

The biological planning process for grazing management at Las Cienegas is based upon monitoring data collected in the conservation area—data on precipitation, ecological site condition, riparian and aquatic condition, and vegetation trends. The BLM has refined collection protocols over time to meet best scientific principles and to become better connected to the understanding gained from the conceptual model.

Recognize the dynamic and interrelated nature of the socioecological systems within which the BLM operates.

A systems-based conceptual model is used to guide the understanding of the semidesert grasslands that comprise Las Cienegas in order to inform the BLM and stakeholders about the connection on the landscape and to make sense of monitoring data.

Acknowledge, describe, and document assumptions and uncertainties.

As the biological planning process is cyclical in nature and based on adaptive management principles, acknowledging assumptions and uncertainties is a necessary part of the process. Furthermore, the use of a conceptual model is a very effective form of documenting the BLM's assumptions about the ecological processes working on the landscape.

Use quantitative data when it exists, in combination with internal and external professional scientific expertise.

Quantitative monitoring data are at the core of the process, but these data are interpreted and understood based on the collective professional expertise of the BLM and stakeholders.

Use transparent and collaborative methods that consider diverse perspectives.

While the responsibility for management actions remains with the BLM, the Las Cienegas biological planning process is built around stakeholder engagement, with stakeholders helping to set and refine goals and objectives and collect and interpret data. More specifically, under the auspices of the Arizona Resource Advisory Council, a diverse team of stakeholders helps the BLM review data and provide recommendations on proposed management actions.

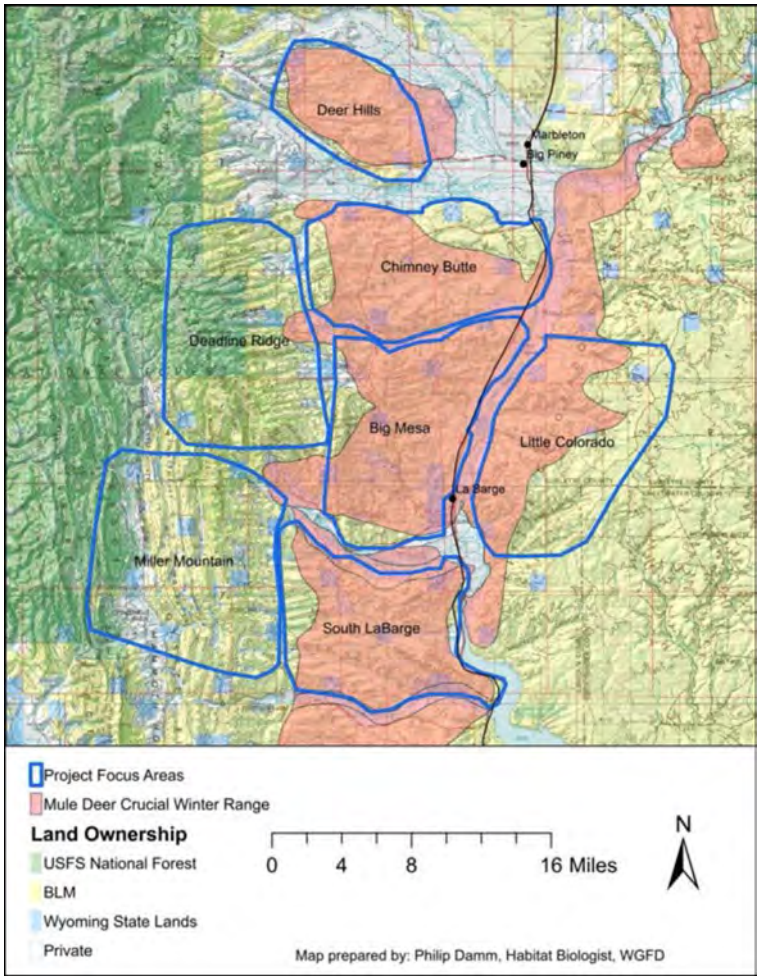
CASE STUDY #4

PROJECT NAME

Wyoming Landscape Conservation Initiative: LaBarge Mule Deer Habitat Case Study

BACKGROUND

Southwestern Wyoming has seen the pace of energy and urban development increase significantly in the 21st century with a potential of diminishing wildlife habitat, recreational opportunities, and quality of life. The need to address these and other landscape-level changes prompted federal, state, and local agencies to create the Wyoming Landscape Conservation Initiative (WLCI) in 2007. The initiative is a long-term science-based program designed to enhance wildlife habitat, maintain open spaces, and facilitate responsible energy development and other land uses.



Focus areas for Wyoming Range mule deer crucial winter range habitat projects near Big Piney and LaBarge in western Wyoming.

The initiative spans the entire southwestern corner of Wyoming and is primarily driven by a number of local project development teams. These teams use the best available science and professional expertise to cooperatively implement projects to address identified needs for wildlife habitat and other resources on a landscape scale. Although planned and implemented locally, projects are designed using a systems approach so that they fit within an overall science framework and are compatible with work being undertaken by other local working groups under the larger umbrella of the WLCI.

Projects are also designed to benefit a diversity of species, including sage-grouse. Through continual learning, adaptive management, and cooperation, project participants can modify the work as needed to ensure their efforts meet local project goals, as well as contribute to the overall objectives of the initiative.

Local project development teams may include scientists, biologists, range managers, district conservation staff, landowners, county commissioners, and other interested parties. The idea is to move away from smaller, isolated conservation projects and to, instead, design local cooperative projects that contribute to shared objectives and broad-scale ecological benefits.

PROJECT SUMMARY

The LaBarge habitat improvement project developed by the Sublette Project Development Team is a prime example of a project that applied the principles and practices described in "Advancing Science in the BLM: An Implementation Strategy." The purpose of the project is to seek to understand and reverse declines in the

LaBarge mule deer population by addressing habitat needs throughout its range. The population's range spans about 200 square miles, from upper elevation summer habitat, through transitional ranges, to lower elevation winter habitat near the town of LaBarge. Portions of this migratory route have been affected by energy development and other land uses. During the past decade, the mule deer population and mule deer habitat have been declining, but the reasons are not understood.

One key component of the LaBarge habitat improvement project is assessing the condition of mountain shrub patches (i.e., mountain mahogany, serviceberry, chokecherry, and sagebrush) and the influence of targeted vegetation treatments on the LaBarge mule deer population. Shrub patches are heavily browsed and not regenerating in some areas. The role of oil and gas operations, as well as other land uses, in mule deer behavior or population declines remains unknown.

Project collaborators assembled the best available science, taking advantage of a wealth of data and intensive monitoring from the Wyoming Game and Fish Department, the Wyoming Range Mule Deer Habitat Project, and numerous assessments. These assessments include a 20-year mountain shrub monitoring project by the Wyoming Game and Fish Department, a comprehensive landscape habitat assessment conducted by the Teton Science Schools, and the mapping and modeling of mountain shrub patches by the U.S. Geological Survey.

Data from these studies will help partners revise and prescribe vegetation treatments targeted to optimize access to the nutrients mule deer need during seasonal and life stages. The analysis also will help identify possible future mitigation actions for energy companies or other land users operating within or near important habitat areas.

The BLM and Wyoming Game and Fish Department are already assessing and monitoring the vegetation treatments, which include prescribed burns and mechanical techniques to diversify sagebrush stand structure and increase understory herbaceous plants, remove cheatgrass at lower elevations, and regenerate aspen at higher elevations. Two levels of effectiveness monitoring are used: (1) at a project level, after treatment has been implemented, to see how vegetation responded and if mule deer and other animals are using the forage; and (2) at a landscape level, looking for indicators of habitat condition and regeneration of shrubs on treated and untreated mountain shrub patches. Future monitoring will include mapping oil and gas development clusters to help determine what, if any, influence they may have on migration patterns.

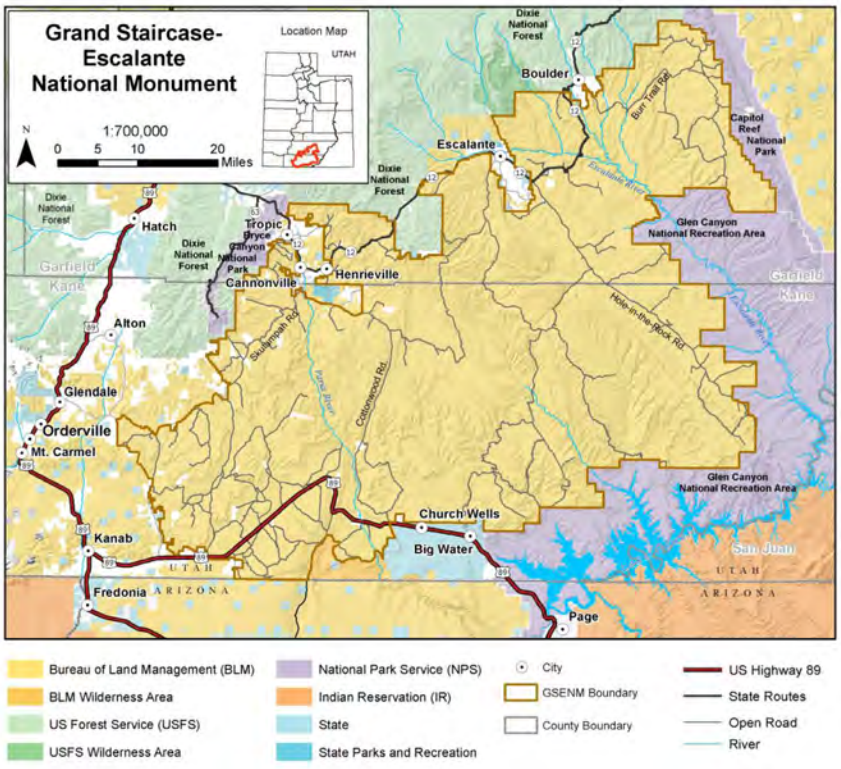
Team members of the LaBarge habitat improvement plan acknowledge that assumptions and uncertainties will continue to exist but will be reduced over time as effectiveness monitoring continues and new data are collected. Local team members and BLM resource specialists continue to integrate science activities with conservation planning and decisionmaking, working with the U.S. Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, and others. Appendix 3 provides links to documents with more specific detail.

CASE STUDY #5

PROJECT NAME

Biological Soil Crust Forum, Grand Staircase-Escalante National Monument

PROJECT SUMMARY



Public scoping for a monument management plan amendment to address livestock grazing at Grand Staircase-Escalante National Monument identified gaps in basic knowledge about biological soil crusts or cryptogamic soils, one of the monument's key resources. The monument developed a unique approach—a Biological Soil Crust Forum—that combined elements of joint fact finding, collaborative issue identification, and public involvement to create an environment of enhanced trust and shared understanding that has enabled the planning process to move ahead. The Biological Soil Crust Forum, a 1-day, three-session audience-participation event in which a panel of five experts fielded questions from stakeholders and from a public audience, focused on biological soil crust distribution, condition, and potential for restoration. The "science forum" process could be adapted for use in other situations in which scientific understanding of key resources is not broadly shared, is scant, or is rapidly evolving. This project exemplifies the principles and practices identified in "Advancing Science in the BLM: An Implementation Strategy."

Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer-reviewed literature when it exists.

The science forum approach gave the monument the opportunity to share information on biological soil crusts with a broad audience composed of ranchers and permittees; land managers; county and state agency representatives, including planners and resource specialists; BLM resource specialists; environmental groups and conservationists; and the numerous individuals and organizations that had provided extensive comments regarding the critical nature of biological soil crusts during public scoping. Many scoping comments drew the BLM's attention to peer-reviewed literature; others relied on information about biological soil crusts drawn from personal experience and observation, unpublished research, and ongoing field studies. The peer-reviewed literature available on biological soil crusts did not always address the management questions the BLM faces in managing the monument; the science forum approach allowed the BLM and the public to ask the literature authors questions directly.

Acknowledge, describe, and document assumptions and uncertainties.

The science forum concept acknowledges, describes, and documents assumptions and uncertainties explicitly through the collaborative development of management questions and the act of addressing critical management questions in a public forum. The forum approach gives the BLM the opportunity to be very upfront about the value, limits, and underpinnings of the scientific knowledge currently available on narrowly focused topics.

Use quantitative data when it exists, in combination with internal and external professional scientific expertise.

The science forum approach is one method for building professional expertise among BLM staff; the forum "leverages" scientific understanding and staff by tapping into a pool of expertise that is acknowledged to include the "best available" scientists when there is insufficient "best available science" to resolve public concerns over data.

Use transparent and collaborative methods that consider diverse perspectives.

The process the monument used to develop the biological soil crust forum relied on collaboration and public participation in four arenas: identifying the issue, identifying relevant management questions, identifying appropriate expertise, and sharing expertise in a public forum.

1. *Use a collaborative approach to issue identification*. The issue revolved around whether or not livestock grazing could be managed to meet the goals of preserving the monument's important ecological values in general and protecting the fragile cryptobiotic crusts in particular. The public scoping process brought this issue to the forefront.

2. *Use a collaborative approach to identify critical management questions necessary for the development of a robust suite of management alternatives*. The monument worked with stakeholders, cooperating agencies, soil scientists, land managers, and livestock grazing permittees to craft questions addressing what the BLM now knows about the distribution and condition of biological soil crusts in the planning area, what the BLM knows about how crusts respond to disturbance and to restoration, and what the BLM would like to know about biological soil crusts for the management of livestock grazing in the years ahead. These questions were shared with scientific experts, including those who eventually were selected to serve as panel experts during the forum itself.

3. *Use a collaborative approach to identify scientific experts*. The panel of five scientific experts on biological soil crust was developed by and agreed upon among the stakeholders, a team identified by the cooperating agencies, key ranchers and grazing permit holders, and the monument staff. The panel included university-based scientists and scientists based in other agencies, including the U.S. Geological Survey and the U.S. Forest Service; all had conducted field studies on the monument or in very similar settings, published research in peer-reviewed journals, or made presentations at national conferences, and all held PhDs in soil science, lichenology, or a closely related field.

4. *Ensure public involvement in the forum*. The forum was held in a public meeting space at a local library and was broadcast live using the BLM National Training Center live-streaming expertise. The public attending the forum, both in person and via webcast/livestream, was invited to submit written questions during each of the three sessions; the panel of five scientists fielded these questions live during the forum. The public attending the forum in person was also invited to address any lingering questions to the panel on camera immediately following the final session of the day. Altogether, the panel fielded more than 50 questions during the forum, including questions that were shared with the panel in advance and questions that came in during the sessions. The entire forum was recorded and captured digitally and is available for reference by the BLM and the public.

Appendix 2: Bureau of Land Management National Science Committee

In June 2014, the Bureau of Land Management's (BLM's) Executive Leadership Team (ELT) approved the establishment of a National Science Committee (NSC) as the focal group to execute the ideas put forth in the document titled "Advancing Science in the BLM: An Implementation Strategy" (Implementation Strategy).

Vision

The BLM is a resource management agency that uses science as one of the critical inputs in its decisionmaking processes at every level. BLM managers and specialists deliberately obtain and apply mission-oriented science in every office, in every program, and in every project.

Mission Statement

The mission of the NSC is to lead the BLM's ongoing efforts to advance science and integrate science into daily work as a sound and defensible foundation for informing the BLM's decisionmaking. In accordance with the Implementation Strategy, the NSC embraces the two following goals:

1. Ensure effective and consistent science integration into the BLM's core work processes.
2. Ensure that relevant, timely scientific information is accessible to BLM staff and managers.

Purpose and Jurisdiction:

The NSC will:

1. Oversee progress of the Science Action Plan as outlined in the Implementation Strategy. Biannually report progress to the ELT.
2. Make recommendations to the ELT regarding funding allocations to advance science in the BLM.
3. Advise and make recommendations to BLM management and staff on how scientific knowledge can be integrated into work processes, policies, and priorities.
4. Facilitate development of policy, technical references, information sharing tools, and training to support the advancement of science within the BLM.
   - Advise BLM management and staff on scientific integrity issues.
   - Pursue opportunities to develop and access relevant science for management decisions.
5. Promote science-management partnerships.

Direction and Accountability (reports to and receives direction from)

The NSC reports to the ELT via the NSC Chairperson and the Deputy Director for Operations. An Associate State Director serves as the Committee Chairperson (Chair). The National Science Coordinator (WO-200) serves as the Co-Chairperson (Co-Chair).

Committee Membership (13 voting members, 2 external advisors)

Members:

- Associate State Director (Chair)
- BLM National Science Coordinator (WO-200) (Co-Chair)
- 2 Deputy Assistant Directors (DADs) from: Renewable Resources and Planning (WO-200); Energy, Minerals, and Realty Management (WO-300); National Landscape Conservation System and Community Partnerships (WO-400)
- Chief of the Division of Resource Services, National Operations Center
- 1 Deputy State Director (DSD) for Resources and Minerals - selected by the DSDs group
- Joint Fire Science Program representative - selected by the National Interagency Fire Center
- Director of the National Training Center
- District Manager – selected by the Field Committee
- Field Manager – selected by the Field Committee
- 3 BLM field-based scientists (representing renewable and nonrenewable resources)

Advisors:

- 2 external agency scientists (e.g., U.S. Geological Survey, Landscape Conservation Cooperatives/U.S. Fish and Wildlife Service, Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Forest Service, Agricultural Research Service, Natural Resources Conservation Service, Department of Defense)
- Science advisors from WO-400, National Operations Center, and WO-300 (if established)
- Communications advisor from WO-600 to advise and support internal and external communications

Members serve 3-year terms in order to maintain continuity. Due to normal turnover within the organization, it is anticipated that there will be change in membership at least annually. When a position is vacated, the NSC Chair will recruit a replacement for the position vacated within 3 months, with concurrence from the Deputy Director. Members must have approval from their supervisor.

Duties of the Chair:

- Make final determinations on NSC agendas.
- Lead the committee in discussions and decisionmaking.
- Serve as liaison to the ELT and Field Committee, keeping them informed and making recommendations.
- Provide biannual reports to the ELT.
- Represent the NSC in external venues and meetings as opportunities arise.

Duties of the Co-Chair:

- Provide input on NSC meetings and agendas.
- Alert and advise the NSC of science-related issues and events.
- Serve as liaison to and Chair of the Core Science Team, surfacing issues and recommendations from the Core Science Team to the NSC and vice versa.
- Receive and execute timely completion of assignments from the NSC in an agreed-upon manner.
- Represent the positions of the NSC both internally and externally.
- Serve as Chair in the Chair's absence.

Staff Support

Primary staff support (facilitator) for the NSC is provided by the Field Committee Resource Advisor. This support includes coordinating agendas, preparing NSC notes, documenting and tracking actions/assignments, coordinating with the Core Science Team, and other logistics as needed.

Core Science Team

The Core Science Team provides scientific and technical support to the NSC and assists with carrying out the NSC's delegated work. The National Science Coordinator proposes members for the Core Science Team, and the NSC approves the membership. The BLM National Science Coordinator serves as both a member of and the Chairperson for the Core Science Team.

Subcommittees

The NSC may establish appropriate subcommittees to address issues and tasks as necessary.

Coordinating Committees

The NSC, or as delegated to the Core Science Team, will coordinate with the following BLM science-related teams:

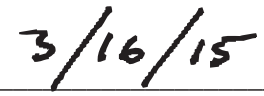
- National Operations Center Science Coordinator
- State Science Coordinators
- NLCS Science Advisory Team
- BLM Socioeconomic Team
- Joint Fire Science Program Science Coordinator
- Other relevant science-related teams

Charter Review

The charter will be reviewed by the ELT every 3 years. Minor changes will be approved at the Field Committee level; major changes will be recommended to the BLM Director for final approval.

Approved

Director, Bureau of Land Management



Date

By-Laws (Committee Operations)

Guidelines and Work Plans

The Implementation Strategy (2015) will serve as the initial action plan for the first 2 years of NSC operations. In subsequent years, a 2-year Science Action Plan will guide the work of the NSC. The NSC will review and update the plan annually.

Decisionmaking

The NSC makes decisions by consensus; if this is not feasible, decisions will be based upon a majority vote of the NSC members present, comprised of a minimum total of seven members. Decisions will be in the form of recommendations to the ELT, submitted via the Chair. They will be documented in meeting notes and prepared in the format of a recommendation with a rationale. Recommendations will be presented to the ELT for further action.

Meeting Schedule

The NSC convenes on a quarterly basis via conference call/video teleconference. They may choose to meet face-to-face to focus on substantial work assignments. At a minimum, the NSC will meet early in the calendar year to provide input regarding the preparation of the agency's out-year budget proposals and again near the end of the fiscal year to prepare accomplishment reports for the ELT and determine priorities for the coming year. Subcommittees may meet at any time to work on specific NSC tasks.

Agenda Development

Agendas will be developed under the leadership of the Chair, Co-chair, and Facilitator. A draft agenda will be developed by this core group and vetted 2 weeks prior to the meeting and vetted with the NSC members to add new items and adjust as needed. Background materials will be made available prior to the meeting in order to facilitate effective discussions and decisions.

Review and Revision of Operating Practices

These operating practices may be reviewed and revised by the NSC as needed at any time. No approvals for these revisions will be required.

Appendix 3:
Bibliography and Suggested Reading

Publications Referenced in the Body of This Strategy

Bureau of Land Management. 2011. Winning the Challenges of the Future: A Road Map for Success in 2016. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/socialmedia.Par.99057.File.dat/2016_report_lowres.pdf.

Bureau of Land Management. 2012. Activity Based Costing System, BLM Cost Management website. http://abc.blm.gov/prodABC/#.

Bureau of Land Management. 2012. BLM Performance: From the Field to the DOI Strategic Plan [PowerPoint slides]. U.S. Department of the Interior, Bureau of Land Management, National Training Center, Phoenix, AZ. http://www.ntc.blm.gov/krc/uploads/611/ Audio_Forum_on_Performanc%20_KRC.pdf.

Manier, D.J., D.J.A. Wood, Z.H. Bowen, R.M. Donovan, M.J. Holloran, L.M. Juliusson, K.S. Mayne, S.J. Oyler-McCance, F.R. Quamen, D.J. Saher, and A.J. Titolo. 2013. Summary of Science, Activities, Programs, and Policies That Influence the Rangewide Conservation of Greater Sage-Grouse (*Centrocercus urophasianus*). Open-File Report 2013–1098. U.S. Geological Survey in cooperation with the Bureau of Land Management. http://pubs.usgs.gov/of/2013/1098/OF13-1098.pdf.

Suggested Reading and Publications Related to Case Studies

Regional Mitigation Strategy for the Dry Lake Solar Energy Zone

Bureau of Land Management. 2014. Regional Mitigation Strategy for the Dry Lake Solar Energy Zone. Tech Note 444. U.S. Department of the Interior, Bureau of Land Management, Southern Nevada District Office, Las Vegas, NV. http://www.blm.gov/pgdata/etc/medialib/blm/wo/blm_library/tech_notes.Par.29872.File.dat/TN_444.pdf.

Bureau of Land Management and U.S. Department of Energy. 2012. Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://solareis.anl.gov/documents/fpeis/index.cfm.

Greater Sage-Grouse Conservation Planning Effort

Bureau of Land Management. 2011. Washington Office Instruction Memorandum No. 2012-044. BLM National Greater Sage-Grouse Land Use Planning Strategy. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2012/IM_2012-044.html.

Bureau of Land Management. 2014. BLM Library: Greater Sage-grouse Subject Guide. Online resource: http://www.blm.gov/wo/st/en/info/blm-library/research/subject-guides/greater_sage-grouse_subj_guide.html.

Manier, D.J., D.J.A. Wood, Z.H. Bowen, R.M. Donovan, M.J. Holloran, L.M. Juliusson, K.S. Mayne, S.J. Oyler-McCance, F.R. Quamen, D.J. Saher, and A.J. Titolo. 2013. Summary of Science, Activities, Programs, and Policies That Influence the Rangewide Conservation of Greater Sage-Grouse (*Centrocercus urophasianus*). Open-File Report 2013–1098. U.S. Geological Survey in cooperation with the Bureau of Land Management. http://pubs.usgs.gov/of/2013/1098/OF13-1098.pdf.

Sage-grouse National Technical Team. 2011. A Report on National Greater Sage-Grouse Conservation Measures. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. https://www.blm.gov/epl-front-office/projects/lup/9153/39961/41912/WySG_Tech-Team-Report-Conservation- Measure_2011.pdf.

U.S. Fish and Wildlife Service. 2013. Greater Sage-grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Denver, CO. http://www.iwjv.org/sites/default/files/cot-report-with-dear-interested-reader-letter.pdf.

Adaptive Grazing Management in Las Cienegas National Conservation Area

Bureau of Land Management. 2003. Approved Las Cienegas Resource Management Plan and Record of Decision. U.S. Department of the Interior, Bureau of Land Management, Tucson Field Office, Tucson, AZ. http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/nepa/library/resource_management.Par.73866.File.dat/LCROD-WEB.pdf.

Bureau of Land Management. 2010. Science and Adaptive Management at Las Cienegas National Conservation Area website. http://www.blm.gov/wo/st/en/prog/blm_special_areas/NLCS/wednesday_las_cienegas.print.html.

Sonoita Valley Planning Partnership. http://www.doi.gov/initiatives/AdaptiveManagement/documents/sonoitavalleypartnership.pdf.

Wyoming Landscape Conservation Initiative

Damm, P., and J. Randall. 2012. Wyoming Range Mule Deer Habitat Management Plan: Big Piney – LaBarge Area. Wyoming Game and Fish Department, Pinedale, WY. http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/WRMD_HABITATPLAN_20110001869.pdf.

U.S. Geological Survey. 2013. Wyoming Landscape Conservation Initiative website. www.usgs.gov/climate_landuse/lcs/projects/wlci.asp.

Wyoming Cooperative Fish and Wildlife Research Unit and Wyoming Game and Fish Department. 2014. Wyoming Range Mule Deer Project: 2014 Spring Update. University of Wyoming, Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, WY. Available upon request from the BLM Library.

Suggested Reading on Related Topics (Strategies and Initiatives)

Adaptive Management

U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service. 2014. Missouri River Recovery Program: Effects Analysis website. http://moriverrecovery.usace.army.mil/mrrp/f?p=136:80:0::NO.

U.S. Department of the Interior. 2008. Adaptive Management Implementation Policy. Departmental Manual, Part 522, Chapter 1. http://www.doi.gov/initiatives/AdaptiveManagement/documents/3786dm.pdf.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. U.S. Department of the Interior, Adaptive Management Working Group, Washington, DC. http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf.

Assessment, Inventory, and Monitoring Strategy

Bureau of Land Management. 2012. Washington Office Information Bulletin No. 2012-080. Assessment, Inventory, and Monitoring (AIM) Strategy Update. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_information/2012/IB_2012-080.html.

Bureau of Land Management. 2014. Assessment, Inventory, and Monitoring (AIM) Documents website. http://www.blm.gov/wo/st/en/prog/more/Landscape_ Approach/aim_documents.html.

MacKinnon, W.C., J.W. Karl, G.R. Toevs, J.J. Taylor, M. Karl, C.S. Spurrier, and J.E. Herrick. 2011. BLM Core Terrestrial Indicators and Methods. Tech Note 440. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. http://www.blm.gov/pgdata/etc/medialib/blm/wo/blm_library/tech_notes.Par.83785.File.dat/TN_440.pdf.

Taylor, J.J., E.J. Kachergis, G.R. Toevs, J.W. Karl, M.R. Bobo, M. Karl, S. Miller, and C.S. Spurrier. 2014. AIM-Monitoring: A Component of the BLM Assessment, Inventory, and Monitoring Strategy. Tech Note 445. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. http://www.blm.gov/pgdata/etc/medialib/blm/wo/blm_library/tech_notes.Par.24137.File.dat/TN_445.pdf.

Toevs, G.R., J.J. Taylor, C.S. Spurrier, W.C. MacKinnon, and M.R. Bobo. 2011. Bureau of Land Management Assessment, Inventory, and Monitoring Strategy: For Integrated Renewable Resources Management. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2012.Par.53766.File.dat/IB2012-080_att1.pdf.

Geospatial Services Strategic Plan

Bureau of Land Management. 2008. Geospatial Services Strategic Plan. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/gis.Par.33723.File.dat/Geospatial_Services_Strategic_ Plan.pdf.

Healthy Lands Initiative

43 CFR 4180.1, Fundamentals of rangeland health. http://www.gpo.gov/fdsys/pkg/CFR-2004-title43-vol2/pdf/CFR-2004-title43-vol2-sec4180-1.pdf.

43 CFR 4180.2, Standards and guidelines for grazing administration: http://www.gpo.gov/fdsys/pkg/CFR-1998-title43-vol2/pdf/CFR-1998-title43-vol2-sec4180-2.pdf.

Bureau of Land Management. 1998. Washington Office Instruction Memorandum No. 98-91. Healthy Rangeland Initiative: Implementation of Standards and Guidelines. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://web.blm.gov/internal/wo-500/directives/public/fy98/im98-91.html. [Internal; accessible to BLM employees.]

Bureau of Land Management. 2012. Washington Office Instruction Memorandum No. 2012-124. Implementation of Land Health Reporting Data Standard: A New Standardized System for Reporting and Mapping Achievements in Land Health. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2012/IM_2012-124.html.

Bureau of Land Management. 2014. Washington Office Instruction Memorandum No. 2014-124. Identification of Multi-year Funding Priorities and Consideration for Healthy Lands Focal Areas. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2014/IM_2014-124.html.

Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, and W.G. Whitford. 2009. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume 1: Quick Start. Tech Ref 1734-8. USDA-ARS Jornada Experimental Range, Las Cruces, NM. http://www.blm.gov/pgdata/etc/medialib/blm/wo/blm_library/tech_refs. Par.2949.File.dat/TR_1734-08_Vol1.pdf.

Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, and W.G. Whitford. 2009. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume 2: Design, supplementary methods, and interpretation. Tech Ref 1734-8. USDA-ARS Jornada Experimental Range, Las Cruces, NM. http://www.blm.gov/pgdata/etc/medialib/ blm/wo/blm_library/tech_refs.Par.41495.File.dat/TR_1734-08_Vol2.pdf.

Pellant, M., P. Shaver, D.A. Pyke, and J.E. Herrick. 2005. Interpreting Indicators of Rangeland Health, version 4. Tech Ref 1734-6. U.S. Department of the Interior, Bureau of Land Management, Denver, CO. http://www.blm.gov/pgdata/etc/medialib/blm/wo/blm_library/tech_refs.Par.10940.File.dat/TR_1734-06rev05.pdf.

Landscape Approach

Bureau of Land Management. 2011. The National Landscape Conservation System 15-Year Strategy 2010-2025: The Geography of Hope. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Law_Enforcement/nlcs/strategies.Par.25079.File.dat/NLCS_Strategy.pdf.

Bureau of Land Management. 2012. Washington Office Information Bulletin No. 2012-058. The Bureau of Land Management's Landscape Approach for Managing the Public Lands. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_information/2012/IB_2012-058.html.

Bureau of Land Management. 2014. National 15-Year NLCS Strategy and State Step-Down Strategies website: http://www.blm.gov/wo/st/en/prog/blm_ special_areas/NLCS/nlcs_resources_/state_strategies.html.

Joint Fire Science Program Governing Board. 2014. Joint Fire Science Program Investment Strategy 2014. U.S. Departments of Agriculture and the Interior, Joint Fire Science Program, Boise, ID. http://www.firescience.gov/documents/JFSP_Investment_ Strategy_2014.pdf.

Planning

Bureau of Land Management. 2005. BLM Handbook H-1601-1, Land Use Planning Handbook. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.38665.File.dat/h1601-1.pdf.

Bureau of Land Management. 2008. BLM Handbook H-1790-1, National Environmental Policy Act Handbook. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/pgdata/etc/medialib/ blm/wo/Information_Resources_Management/policy/blm_handbook.Par.24487.File.dat/h1790-1-2008-1.pdf.

Bureau of Land Management. 2014. Planning 2.0: Improving the Way We Plan Together website: http://www.blm.gov/wo/st/en/prog/planning/planning_ overview/planning_2_0.html.

Rapid Ecoregional Assessments

Bureau of Land Management. 2013. Washington Office Instruction Memorandum 2013-082. Use of Regional Assessments. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-082.html.

Bureau of Land Management. 2014. Rapid Ecoregional Assessments Documents website: http://www.blm.gov/wo/st/en/prog/more/Landscape_ Approach/reas/docs.html.

Bureau of Land Management. 2014. Rapid Ecoregional Assessments website: http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html.

Bureau of Land Management. 2014. Washington Office Instruction Memorandum No. 2014-125. Incorporating Landscape Assessments into the Land Use Planning and Project-level Decision-making Processes. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://web.blm.gov/internal/wo-500/directives/dir-14/im2014-125.html. [Internal; accessible to BLM employees.]

Regional Mitigation

Bureau of Land Management. 2013. Washington Office Instruction Memorandum 2013-142. Interim Policy, Draft – Regional Mitigation Manual Section - 1794. U.S. Department of the Interior, Bureau of Land Management, Washington, DC. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2013/IM_2013-142.html.

Clement, J.P., A.d'A. Belin, M.J. Bean, T.A. Boling, and J.R. Lyons. 2014. A Strategy for Improving The Mitigation Policies and Practices of the Department of the Interior: A Report to The Secretary of the Interior from The Energy and Climate Change Task Force. U.S. Department of the Interior, Washington, DC. http://www.doi.gov/news/upload/Mitigation-Report-to-the-Secretary_FINAL_04_08_14.pdf.

U.S. Department of the Interior. 2013. Order No. 3330 of the Secretary of the Interior. Subject: Improving Mitigation Policies and Practices of the Department of the Interior. U.S. Department of the Interior, Washington, DC. http://www.doi.gov/news/loader.cfm?csModule=security/getfile&pageid=380602.

Scientific Integrity

Committee on Science, Engineering, and Public Policy. 2009. On Being a Scientist: A Guide to Responsible Conduct in Research, third ed. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies. Washington, DC: The National Academies Press. Available upon request from the BLM Library.

The White House. 2009. Memorandum for the Heads of Executive Departments and Agencies. Subject: Scientific Integrity. Office of the Press Secretary. http://www.whitehouse.gov/the-press-office/memorandum-heads-executive-departments-and-agencies-3-9-09.

The White House. 2010. Memorandum for the Heads of Executive Departments and Agencies. Subject: Scientific Integrity. Office of Science and Technology. http://www.whitehouse.gov/sites/default/files/microsites/ostp/scientific-integrity-memo-12172010.pdf.

U.S. Department of the Interior. 2011. Integrity of Scientific and Scholarly Activities. Departmental Manual, Part 305, Chapter 3. http://elips.doi.gov/elips/0/doc/3045/Page1.aspx.