Appendix H. Required Design Features and Best Management Practices

Adverse environmental impacts associated with development can be avoided, reduced, or mitigated through the project's design and implementation. In order to provide regulatory certainty that the measures will be incorporated, they must be required of every project. The National Technical Team (NTT) report identified management actions and practices that would reduce adverse impacts to greater sage-grouse if mandated to development throughout either Core Area (priority habitat) or occupied greater sage-grouse habitat or general habitat areas. Some of these practices are incorporated in Alternative D as being universally appropriate. The ones that could be analyzed on a planning area-wide basis have been made a part of the management actions and in this appendix as Required Design Features.

Other environmental protection measures could not be analyzed in a resource area-wide Environmental Impact Statement (EIS) because their appropriateness depends upon site-specific issues such as proximity to the boundary of Core Area or non-crucial habitat or engineering or physical limitations such as an oil and gas producing zone being too close to the surface to be recoverable through directional drilling. These best management practices (BMPs) are required to be considered in a site-specific project's design to reduce, prevent, or avoid adverse environmental or social impacts. These practices are analyzed to help ensure that development is conducted in an environmentally responsible manner. Some BMPs are as simple as choosing a paint color that helps oil and natural gas equipment blend with the natural surroundings, turning development less visible. Other BMPs may reduce the amount of vegetation lost to development, improve the speed of re-growth of desirable vegetation, or may reduce the amount of wildlife disturbance in important habitats. Public land users are encouraged to review these practices, incorporate them where appropriate, or develop better methods for achieving the same goal. However, the Bureau of Land Management (BLM) may also require their incorporation into the design features of the project as a Condition of Approval (COA). Only when the design feature is part of the BLM authorization as a COA, should the National Environmental Policy Act (NEPA) analysis of the project analyze the beneficial impacts of the design feature. If the practice is only voluntary or suggested, the BLM lacks the authority to require its implementation, so the project should be analyzed as if the practice will not occur. The BLM authorization will make clear whether the BMP is mandatory (attached as a COA) or merely encouraged.

NEPA analysis that concludes that BMPs should not be attached as mandatory COAs needs to clearly explain why with relation to site-specific factors. The purpose of this section is not to select certain practices or designs and require that only those be used. It is not possible to evaluate all the known practices and make determinations as to which are best, particularly without a specific project in a specific location. BMPs should be matched and adapted to meet the site-specific requirements of the management action, project and local environment. No one management practice is best suited to every site or situation, or will remain the most optimal practice over time. BMPs must be adaptive and monitored regularly to evaluate effectiveness.

As discussed more fully in the *Special Status Species-Wildlife* section, protections for the greater sage-grouse are an important focal point in the preparation of the Resource Management Plan (RMP), in part because of the importance of the Lander habitat for the survival and recovery of the species. Accordingly, a special section of BMPs identifies management that should be considered in both greater sage-grouse Core Area and general greater sage-grouse habitat. It

is expected that these BMPs will change over time as monitoring and further study develop improved greater sage-grouse protections.

Required Design Features

The following design approaches are required for all projects unless the proponent establishes that due to site limitations or engineering considerations, the design approaches are infeasible. Economic considerations such as increased costs do not render a design infeasible.

Greater Sage-Grouse Protection Required Design Features for All Projects:

The following measures, and others as they are identified, will be required for all BLM-authorized development. As appropriate, they may be required as part of the design of the project or as a mandatory COA. Other greater sage-grouse protections are identified below as BMPs which will be evaluated on a site-specific basis for inclusion as a mandatory COA.

General:

- In applying protections for greater sage-grouse protections, all projects must evaluate (1) whether the conservation measure is reasonable (see 43 Code of Federal Regulations [CFR] 3101.1-2 for the definition of "reasonable" for fluid mineral leases) and consistent with valid existing rights, and (2) whether the action is in conformance with the RMP. Each conservation measure will be evaluated on a site-specific basis for likely effectiveness on a cost-benefit basis.
- In Core Area, where development would result in the long-term loss of greater sage-grouse habitat, identify effective mitigation that will be applied for a sufficient term as to constitute replacement habitat. Example: Purchase private land and mineral rights in the priority area and deed to the United States, or obtain a conservation easement in perpetuity. Consider compensatory mitigation and monitoring of significant direct, indirect, and cumulative impacts on, and loss of habitat for greater sage-grouse.
- When additional mitigation is necessary, conduct it in Core Area in the same greater sage-grouse population area. If Core Area does not provide appropriate mitigation, conduct offsite mitigation in general greater sage-grouse habitat with the ability to increase greater sage-grouse populations.
- Designate a qualified biologist who will be responsible for overseeing compliance with all design features related to the protection of ecological resources throughout all project phases, particularly in areas requiring avoidance or containing concentrated greater sage-grouse populations. This person shall be approved by the BLM.

Facilities and Surface Disturbance:

- Give overall consideration to minimizing the adverse impact to greater sage-grouse through a project design that avoids, minimizes, reduces, rectifies, and/or adequately compensates for direct and indirect impacts to greater sage-grouse habitat or use. Apply a phased development approach with concurrent interim reclamation. Locate and design individual project facilities to minimize disruption of animal movement patterns and connectivity of habitats.
- Subject to topographic and other environmental constraints, require development for a project wholly or partially in Core Area to be placed in the area least harmful to greater sage-grouse based on vegetation, topography, or other habitat features.
- Co-locate new development (facilities, pipelines, etc.) in existing disturbances or in areas where reclamation success has not been fully achieved unless the proponent establishes that this is technically unfeasible. Cluster disturbances, operations (hydraulic fracture stimulation,

liquids gathering, etc.), and facilities. Co-locate powerlines, flowlines, and small pipelines under or immediately adjacent to existing roads. Design or site permanent structures to minimize impacts to greater sage-grouse, with emphasis on locating and operating facilities that create movement (e.g., pump jacks) or attract frequent human use and vehicular traffic (e.g., fluid storage tanks) in a manner to minimize disturbance of greater sage-grouse or interference with habitat use.

- Locate new compressor stations outside priority habitats and require a design that reduces noise directed toward priority habitat unless the proponent can establish that this requirement would preclude development of the lease.
- Properly contain and promptly remove refuse to avoid attracting predators.
- Use mats for drilling activities where topography permits to reduce vegetation disturbance, and as temporary roads between closely spaced wells to reduce soil compaction and maintain soil structure to increase likelihood of vegetation reestablishment.
- Restrict the construction of tall facilities, distribution powerlines, fences, and other infrastructure to the minimum number and amount needed. Place facilities such as tanks, which could serve as greater sage-grouse predator perches, outside of Core Area unless the proponent establishes that this technically is unfeasible. Equip tanks and other aboveground facilities with structures or devices that discourage nesting of ravens and raptors.
- Site and/or minimize linear features to reduce disturbance and fragmentation of greater sage-grouse habitats.
- Install greater sage-grouse safe fences around sumps, pits, and other trenching.
- Evaluate whether the benefits to greater sage-grouse from burying powerlines would outweigh the potential loss of habitat from the disturbance associated with burying the line, considering the potential threat from invasive nonnative species (INNS), low reclamation potential, and other factors. If the benefits outweigh potential adverse impacts, require that the powerlines be buried unless the applicant establishes that burying the lines is not technically feasible.
- Use remote monitoring techniques for production facilities, where applicable, and develop a plan to reduce vehicular traffic and human presence.
- Properly contain and promptly remove refuse to avoid attracting predators.
- Cover all fluid-containing pits and open tanks with netting (maximum 1.5-inch mesh size).
- Locate all residential development for employees and contractors ("man camps") outside of Core Area.

Reclamation:

- Where native shrubs located on lands proposed to be disturbed are unique and desirable for interim and final reclamation purposes, and the seed supply for these desirable brush species is not commercially available, seeds will be collected from the area and stored using the procedures of the Seeds of Success program. Seedlings or plugs of common dominant species will be propagated, preferably locally, in preparation for use in portions of area to be reclaimed to expedite vegetation recovery.
- Maximize the area of interim reclamation on long-term access roads and well pads, including reshaping, topsoiling, and revegetating cut-and-fill slopes.
- Identify areas of sustainable plant communities and populations appropriate for the project as sources for native plant material and manage for use in reclamation and restoration work. Prioritize native seed allocation for use in priority greater sage-grouse habitat in years when preferred native seed is in short supply.
- Utilize enhanced reclamation if needed to support more rapid interim and final reclamation including irrigation, mulching, soil amendments, and erosion blankets.

- When reseeding, use appropriate seed mixes and consider the use of appropriate subspecies of sagebrush seed. Continue to evaluate seed mixtures over time, considering potential changes in climate (Miller et al. 2011) when proposing seedings using native plants. Consider seed collections from the warmer component within a species' current range for selection of native seed (Kramer and Havens 2009).
- Include reclamation or post-fire restoration objectives requiring that greater sage-grouse habitat needs are adequately addressed, and monitoring protocol to verify that the objectives are accomplished. Include greater sage-grouse habitat parameters as defined by Connelly et al. (2000), Hagen et al. (2007), or if available, state greater sage-grouse conservation plans and appropriate local information in habitat restoration objectives. Make maintaining these objectives in priority greater sage-grouse habitat areas a high restoration priority.
- Identify and work with partners to increase native seed availability and work with plant material centers to develop new plant materials, especially the forbs needed to restore greater sage-grouse habitat.
- Choose native plant seeds for vegetation treatments based on availability, adaptation (site potential), probability for success, and the vegetation management objectives for the area covered by the treatment. Prioritize native seed allocation for use in Core Area in years when preferred native seed is in short supply.
- Make reestablishment of sagebrush and desirable understory plant cover (relative to ecological site potential) a high priority for restoration efforts. Write specific vegetation objectives to reestablish sagebrush cover and desirable understory cover.
- Implement interim reclamation as soon as feasible for all disturbed soils to the side of roadways and other long-term disturbances, reducing the disturbance to the smallest area possible.
- Restore disturbed areas at final reclamation to the pre-disturbance landforms and desired plant community.
- Maximize the area of interim reclamation on long-term access roads and well pads, including reshaping, topsoiling, and revegetating cut-and-fill slopes.

Impoundment Pond Design:

- Identify permanent ponds so as to reduce the number of newly flooded sites, which have high productivity for mosquitoes. Avoid flooding flat terrain or low-lying areas.
- Design impoundment ponds to reduce attraction to breeding mosquitoes while considering attraction to other vectors of diseases such as blue tongue disease. Design parameters should include steepness of sides, avoidance of shallows less than 2 feet (60 centimeters), and reduction of rooted vegetation (both aquatic and uplands).
- Separate inflow and outflow areas to produce open water; avoid creating wetlands.
- Avoid down slope seepage or overflow (including from natural drainage). Line constructed ponds as necessary to avoid seepage. Prevent shallow surface inflow and accumulation of sediment that promotes aquatic vegetation through piping discharge into open water and lining channels.
- Line the overflow spillway with crushed rock, and construct the spillway with steep sides to preclude the accumulation of shallow water and vegetation.
- Fence pond sites to restrict access by livestock and other wild ungulates that trample and disturb shorelines, enrich sediments with manure, and create hoof print pockets of water that are attractive to breeding mosquitoes.

Roads:

- Locate roads to avoid important habitats for greater sage-grouse and other wildlife. Construct, improve, and maintain access roads to minimize potential wildlife/vehicle collisions and facilitate wildlife movement through the project area.
- Apply dust abatement on roads, well pads, and other surface disturbances. Use of dust abatement with limited adverse impacts to vegetation, cultural resources, water quality, and other resources.
- When responding to a request for a road, develop a transportation plan on a landscape scale so as to consider all parties who will be authorized to use the road.
- Limit route construction to realignments of existing designated routes if that realignment has a minimal impact on greater sage-grouse habitat, eliminates the need to construct a new road, or is necessary for motorist safety.
- Identify measures to reduce the use of motorized vehicles to reduce adverse impacts to wildlife.
- Design roads to minimize total disturbance to the smallest amount possible and to the lowest standard while meeting road objectives or purpose including safety. Establish speed limits that will reduce vehicle speed to reduce greater sage-grouse mortality.
- If road crossings of linear water features (such as ephemeral, intermittent, and perennial streams) cannot be avoided, construct crossings to minimize impacts to the riparian-wetlands habitat. Usually this will mean crossing the feature at right angles. Temporary, portable bridges should be considered.
- Limit the use of new roads associated with development including not making it part of the public road network or implementing seasonal closures. Restrict motorized vehicle use to authorized users using signage, gates, and other devices.
- Establish slow speed limits on BLM-administered roads or design roads for slower vehicle speeds to reduce greater sage-grouse mortality and other wildlife conflicts.
- During travel management implementation, close and rehabilitate duplicate roads and rights-of-way (ROWs) no longer being utilized. When restoring original landform and establishing desirable vegetation, use appropriate seed mixtures or transplants as provided above and in Appendix D (p. 1477). Identify roads where the risk of vehicle or human-caused wildfires and the spread of invasive species into greater sage-grouse habitats could be minimized by planting perennial vegetation (e.g., green-strips) paralleling road ROWs (this BMP could be applied to BLM linear ROW authorizations).

Fire:

- Locate wildfire suppression facilities (i.e., base camps, spike camps, drop points, staging areas, and heli-bases) in areas where physical disturbance to greater sage-grouse habitat can be minimized. These include disturbed areas, grasslands, near roads/trails, or in other areas where there is existing disturbance or minimal sagebrush cover.
- Develop state-specific greater sage-grouse reference information and resource materials containing maps, a list of resource advisors, contact information, local guidance, and other relevant information. Provide localized maps to dispatch offices and extended attack incident commanders for use in prioritizing wildfire suppression resources and designing suppression tactics.
- Where applicable, utilize retardant and mechanized equipment to minimize burned acreage in Core Area during an extended attack.
- As safety allows, conduct mop-up where the black adjoins unburned islands, dog legs, or other habitat features to minimize sagebrush loss.
- Minimize unnecessary cross-country vehicle travel during fire operations in greater sage-grouse habitat.

- Prior to the fire season, provide greater sage-grouse training to resource advisors.
- Vegetation treatment: Power-wash all vehicles and equipment involved in vegetation treatment activities prior to entering the area to minimize the introduction of undesirable and/or invasive plant species.

Vegetation Treatment and Fuels Management:

- Design vegetation treatments in areas of high wildfire frequency to facilitate firefighter and public safety; reduce the risk of extreme fire behavior; and reduce the risk and rate of fire spread to greater sage-grouse habitats while facilitating the restoration of key habitats.
- Design fuels treatment objectives to protect existing sagebrush ecosystems, modify fire behavior, restore native plants, and create landscape patterns that most benefit greater sage-grouse habitat.
- Provide training to fuels treatment personnel on greater sage-grouse biology, habitat requirements, and identification of areas utilized locally.
- Use fire prescriptions that minimize undesirable effects on vegetation or soils (e.g., minimize mortality of desirable perennial plant species and reduce risk of hydrophobicity).
- Incorporate roads and natural fuel breaks into fuel-break design.
- Power wash all vehicles and equipment involved in fuels management activities prior to entering the area to minimize the introduction of undesirable and/or invasive plant species.
- Outside of priority habitat, give priority for implementing sagebrush restoration projects that are adjacent to priority habitat.
- As funding and logistics permit, restore habitat to a species composition characterized by perennial grasses, forbs, and shrubs.
- Do not reduce sagebrush canopy cover to less than 15 percent within a treatment polygon unless a vegetation management objective requires additional reduction in sagebrush cover to meet strategic protection of priority greater sage-grouse habitat and conserve habitat quality for the species.
- Ensure proposed sagebrush treatments are planned with interdisciplinary input from BLM and state wildlife agency biologists, and that treatment acreage is conservative in the context of surrounding greater sage-grouse seasonal habitats and landscape.
- In suitable greater sage-grouse habitat, the priority for vegetation treatments are those that conserve, enhance, or restore greater sage-grouse habitat, reduce fuels at strategic locations to minimize the size of wildfires and to limit loss of greater sage-grouse habitat. Remove conifers where they have encroached upon greater sage-grouse habitat. Reduce the density of conifers that have encroached into, but do not yet dominate, sagebrush plant communities.
- Minimize undesirable effects on vegetation or soils (e.g., minimize mortality of desirable plant species and reduce risk of hydrophobicity). Incorporate vegetation treatment standard operating procedures, such as those outlined in the 17 Western States Vegetation Programmatic EIS (PEIS), into treatments (BLM 2007c).
- Ensure that treatments are configured in a manner (e.g., strips) that promotes use by greater sage-grouse.
- Reestablish appropriate sagebrush species/subspecies and important understory plants relative to site potential. Identify priority plant species and collect seed of understory plants and sagebrush subspecies important to greater sage-grouse. Establish seed harvest areas that are managed for seed production and are a priority for protection from outside disturbances.
- Design vegetation treatments in greater sage-grouse habitats to strategically reduce wildfire threats in the greatest area. This could involve spatially arranging new vegetation treatments with past treatments, vegetation with fire-resistant serial stages, natural barriers, and roads to

constrain fire spread and growth. This could require vegetation treatments to be implemented in a more linear versus block design.
- Remove standing and encroaching trees within at least 100 meters of occupied greater sage-grouse leks and other habitats (e.g., nesting, wintering, and brood-rearing) to reduce the availability of perch sites for avian predators.
- Protect wildland areas from wildfire originating on private lands, infrastructure corridors, and recreation areas.
- Strategically place and maintain pretreated strips/areas (e.g., mowing, prescribed fire, herbicide application, and strictly managed grazed strips) to aid in controlling wildfire should wildfire occur near key habitats or important restoration areas (such as where investments in restoration have already been made).

Mineral Development:

- Give overall consideration to impacts to greater sage-grouse in applying technically feasible COAs. Selection and application of these measures shall be based on current science and research on the effects to important breeding, nesting, brood-rearing, and wintering areas. The Plan of Development or Plan of Operations, as applicable, shall address, at a minimum, the anticipated noise, density and amount of disturbance, mechanical movement (e.g., pump jacks), permanent and temporary facilities, traffic, phases of development over time, offsite mitigation, and expected periods of use associated with the proposed project. The NEPA analysis and authorization should identify seasonal habitats or typical project features related to potential greater sage-grouse impacts, such as drill mats that are not made a part of the COA, based on site-specific or project-specific considerations and the explanation of why these protections were not included.
- Where feasible, co-locate new development (facilities, pipelines, etc.) in existing disturbances. Cluster disturbances, operations (hydraulic fracture stimulation, liquids gathering, etc.), and facilities. Use drilling techniques to reduce surface disturbance in relation to the number of wells, where feasible. Place liquid-gathering facilities and compressor stations outside Core Area, unless the proponent can establish that this requirement would preclude development of the lease. Identify measures to reduce traffic in Core Area.
- To ensure comprehensive planning relative to greater sage-grouse conflicts, complete Master Development Plans or Plans of Development during planning and review of projects involving multiple proposed disturbances in Core Area.
- In Core Area, require closed-loop systems for drilling operations, with no reserve pits unless technically unfeasible.
- Require noise shields or other noise abatement devices when drilling during the lek, nesting, brood-rearing, and wintering seasons. Locate new compressor stations outside of Core Area if feasible, and require a design directed toward priority habitat that reduces noise.

Miscellaneous:

- Identify areas where acquisitions (including subsurface mineral rights) or conservation easements, would benefit greater sage-grouse habitat. Apply acquisition and disposal criteria from Appendix R (p. 1623).

Best Management Practices

The following sources contain information regarding the development and implementation of BMPs. These references are not to be considered as exclusive sources of information; rather, they should be used as a starting point when evaluating specific BMPs during project design and implementation.

Bureau of Land Management Best Management Practices Resources

BLM BMPs: This website provides an introduction to BLM BMPs with links to BLM contacts, specific resources, and other BMP links, and other resources related to BLM BMPs.
http://www.blm.gov/bmp/
See also http://www.oilandgasbmps.org/

General Information for Oil and Gas BMPs: This resource provides general information regarding BLM BMPs for oil and gas development. A sample of BMPs are provided with a brief description of types of BMPs and terminology.
http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/best_management_practices/general_information.html

BMP Frequently Asked Questions: The link below provides responses to frequently asked questions regarding BLM BMPs.
http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/best_management_practices/frequently_asked_questions.html

BMP Technical Information: The slide shows at the link below provide a detailed look at a menu of possible oil and natural gas development BMPs. These slide shows are only a starting point and are not intended to serve as a comprehensive list of BMPs.
http://www.blm.gov/nhp/efoia/wo/fy05/im2005-069.htm

Oil and Gas Exploration – The Gold Book: The publication *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (commonly referred to as The Gold Book) was developed to assist operators by providing information on the requirements for obtaining permit approval and conducting environmentally responsible oil and gas operations on federal lands and on private surface over federal minerals (split-estate). Split-estate surface owners will also find the Gold Book to be a useful reference guide. In 2007, the Gold Book was updated to incorporate changes resulting from the new Onshore Oil and Gas Order No. 1 regulations.
http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/best_management_practices/gold_book.html

Visual Resources: There are numerous design techniques that can be used to reduce the visual impacts from surface-disturbing projects. The techniques described here should be used in conjunction with BLM's visual resource contrast rating process wherein both the existing landscape and the proposed development or activity are analyzed for their basic elements of form, line, color, and texture.
http://www.blm.gov/wo/st/en/prog/Recreation/recreation_national/RMS/3.html

Renewable Energy Development BMPs: The following resources provide information on BMPs related to renewable energy development.

- *Wind Energy Development PEIS:* The scope of the Wind Energy PEIS analysis includes an assessment of the beneficial and adverse environmental, social, and economic impacts; discussion of relevant mitigation measures to address these impacts; and identification of appropriate, programmatic policies and BMPs to be included in the proposed Wind Energy Development Program.
http://windeis.anl.gov/documents/fpeis/index.cfm

- *BLM Instruction Memorandum [IM] 2009-043, Rights-of-Way, Wind Energy:* This IM further clarifies the BLM Wind Energy Development policies and BMPs provided in the Wind Energy Development PEIS. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2009/IM_2009-043.html

- *Record of Decision for the Geothermal Resource Leasing PEIS:* This Record of Decision provides a list of sample BMPs that have been collected from various BLM and United States Forest Service documents addressing geothermal and fluid mineral leasing and development, including RMPs, forest plans, and environmental reports for geothermal leasing and development. The document provides guidance on incorporating BMPs, as appropriate, into the geothermal permit application or as Conditions of Approval. http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/energy/geothermal_eis/final_programmatic.Par.90935.File.dat/ROD_Geothermal_12-17-08.pdf

- *Solar Energy Development PEIS:* This PEIS was issued July 24, 2012. Its policies and mitigation measures adopted as part of the proposed solar energy deployment program. The Solar Energy Development PEIS identifies for those that work in the solar industry, and stakeholders the best practices for deploying solar energy and ensuring minimal impact to natural and cultural resources on BLM-administered lands or other federal, state, tribal, or private lands. http://www.solareis.anl.gov/

U.S. Environmental Protection Agency (EPA) BMP Resources

Healthy Watersheds: This resource provides conservation approaches and tools designed to ensure healthy watersheds remain intact. The website provides example approaches that are generally site-specific, and watershed managers are encouraged to use the examples as guidance in developing local conservation strategies. The website also supplies outreach strategies to encourage stakeholder engagement in conservation and protection of healthy watersheds. http://www.epa.gov/owow/nps/

Storm Water BMPs: This online menu provides BMPs designed to meet the minimum requirements for six control measures specified by the EPA's Phase II Stormwater Program. The control measures include public education, public involvement, illicit discharge detection and elimination, construction, post-construction, and pollution prevention/good housekeeping. The menu also provides case studies assessing the performance of various storm water BMPs. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/menu.cfm

Pasture, Rangeland, and Grazing Operations BMPs: The link below provides BMPs compiled by the EPA to prevent or reduce pollution associated with livestock grazing. Topics include practices to reduce methane production, managing nonpoint source pollution, controlled grazing, reducing animal feeding operation pollution, and manure management. http://www.epa.gov/oecaagct/anprgbmp.html

U.S. Department of Agriculture – Natural Resources Conservation Service (NRCS) BMP Resources

National Conservation Practice Standards: This website provides links for national conservation practices developed by the NRCS on topics such as herbaceous wind barriers, feed management,

forest stand improvement, and irrigation management. The conservation practice standard contains information on why and where the practice is applied, and sets forth the minimum quality criteria that must be met during the application of that practice in order for it to achieve its intended purpose. http://www.nrcs.usda.gov/Technical/Standards/nhcp.html

National Range and Pasture Handbook: Developed by NRCS grazing land specialists, this handbook provides a source of expertise to guide cooperators in solving resource problems and in sustaining or improving their grazing lands resources and operations. http://www.glti.nrcs.usda.gov/technical/publications/nrph.html

Wyoming Game and Fish Department BMP Resources

Aquatic Invasive Species: This resource provides information about how to recognize aquatic invasive species and how to avoid introducing them or spreading them through Wyoming's waters. The website contains links to external resources including a link to waterbodies in the United States currently known to be impacted by zebra and quagga mussels. The website also contains information about how to decontaminate equipment and watercraft suspected of harboring aquatic invasive species. http://gf.state.wy.us/fish/AIS/index.asp

Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats: This document provides recommendations for mitigation and management options that development companies and resource agencies can implement to minimize impacts to wildlife from oil and gas development. http://gf.state.wy.us/web2011/Departments/Wildlife/pdfs/HABITAT_OILGASRECOMMENDATIONS0000333.pdf

Wildlife Protection Recommendations for Wind Energy Development in Wyoming: This document provides recommendations for BMPs, avoidance, monitoring, research, and mitigation opportunities for developers and resource agencies to minimize impacts to wildlife from wind-energy development. http://gf.state.wy.us/web2011/Departments/Wildlife/pdfs/WINDENERGY_WILDLIFEPROTECTION0000703.pdf

Forestry Best Management Practices

Wyoming Forestry Best Management Practices: This document provides recommendations for protecting water quality and forest soils. Some of the BMPs outlined in this document are listed below. http://slf-web.state.wy.us/oldsite/forestry/bmp2.aspx

Road Construction and Maintenance: The need for higher-standard roads can be alleviated through temporary road blockage, locked gate management, and seasonal weather restrictions.

Number of Roads, Existing Roads: Minimize the number of roads constructed in a watershed through comprehensive road planning, recognizing intermingled ownership and foreseeable future uses to avoid the creation of sediment, change of water temperature, or addition of unwanted nutrients. Use existing roads where practical, unless use of such roads would cause or aggravate an erosion problem. When using existing roads, reconstruct only to the extent necessary to provide adequate drainage and safety; avoid disturbing stable road surfaces.

Road Design and Implementation: Fit the road to the topography by locating roads on natural benches and following natural contours. Locate roads on stable geology, including well-drained

soils and rock formations that tend to dip into the slope. Avoid slumps and slide-prone areas characterized by steep slopes, toe slopes, natural drainage channels, highly weathered bedrock, clay beds, concave slopes, and hummocky topography, and rock layers that dip parallel to the slope. Avoid wet areas, including moisture-laden or unstable toe slopes, seeps, wetlands, wet meadows and natural drainage channels. Minimize earth-moving activities when soils appear excessively wet.

Drainage: Design roads to minimize disruption of natural drainage patterns. Provide adequate drainage, as part of the construction process, from the surface of all permanent and temporary roads. Design, install, and route road surface drainage features at adequate spacing to control erosion; steeper gradients require more frequent drainage features. Install road-drainage features above stream crossings to route discharge into filtration zones before it enters a stream or surface water. Use outsloped, insloped, or crowned roads and space road-drainage features so peak drainage flow on the road surface or in ditches will not exceed capacity. Provide energy dissipaters (rock piles, slash, log chunks, etc.) where necessary to reduce erosion at the outlet of drainage features. Cross drains, culverts, water bars, dips, and other drainage structures should not discharge onto erodible soils or fill slopes without outfall protection. Properly constructed drain drips can be an economical method of road surface drainage. Construct drain dips deep enough into the subgrade so that traffic will not obliterate them. Route road drainage through adequate filtration zones or other sediment settling structures to ensure sediment does not reach surface water.

Runoff/Erosion Control: Stabilize erodible, exposed soils by seeding, compacting, rip-rapping, benching, mulching, or other suitable means prior to seasonal runoff. Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes. Keep slope stabilization, erosion, and sediment control work current with road construction. Complete or stabilize road selections within the same operating season. Maintain erosion-control features through periodic inspection and maintenance, including cleaning dips and cross drains, repairing ditches, marking culvert inlets to aid in location, and clearing debris from culverts.

Debris and Excess Material Handling: Haul all excess material removed by maintenance operations to safe disposal sites and stabilize these sites to prevent erosion. Avoid sidecasting and place debris, overburden, and other waste materials associated with construction and maintenance activities in a location to avoid entry into streams. Include these waste areas in soil stabilization planning for the road. Minimize sediment production from borrow pits and gravel sources through proper location, development, and reclamation.

Cut and Fill Slopes: This includes: construct cut and fill slopes at stable angles to prevent sloughing and other subsequent erosion. Design roads to balance cuts and fills or use full bench construction (no fill slope) where stable fill construction is not possible. Avoid incorporating potentially unstable woody debris in the fill portion of the road prism. Where possible, leave existing rooted trees or shrubs at the toe of the fill slope to stabilize the fill. At the toe of potentially erodible fill slopes, particularly near stream channels, pile slash in a row parallel to the road to trap sediment. When done concurrently with road construction, this is one method that can effectively control sediment movement, and it can provide an economical way of disposing of roadway slash. Limit the height, width, and length of "slash filter wind-rows" so wildlife movement is not impeded. Sediment fabric fences or other methods may be used if effective.

Out/In Slopes: Outsloped roads provide a means of dispersing water in a low-energy flow from the road surface. Outsloped roads are appropriate when fill slopes are stable, drainage will not flow directly into stream channels, and transportation safety can be met. For insloped roads, plan ditch gradients steep enough, generally greater than 2 percent but less than 8 percent, to prevent sediment deposition and ditch erosion. The steeper gradients may be suitable for more stable soils; use the lower gradients for less stable soils. Do not disturb roadside vegetation more than necessary to maintain slope stability and serve traffic needs.

Weather Maintenance: Grade road surfaces only as often as necessary to maintain a stable running surface and adequate surface drainage. Avoid cutting the toe of cut slopes when grading roads, pulling ditches, or plowing snow. When plowing snow, provide breaks in the snow berm to allow road drainage. Consider gates, barricades, or signs to limit use of roads during spring breakup to other wet periods. Avoid using roads during wet periods if such use would likely damage the road drainage features. When access requires crossing moist areas with a poor road base, cross only when the ground is frozen or dry to alleviate a rutted, poorly drained road. Upon completion of seasonal operations, ensure that drainage features are fully functional. The road surface should be crowned, outsloped, insloped, or waterbarred. Remove berms from the outside edge.

Ditch Culverts: For ditch relief culverts, construct catch basins with stable side slopes. Protect the inflow end of cross drain culverts from plugging and armor if in erodible soil. Where possible, install culverts at the gradient of the original ground slope; otherwise armor outlets with rock or anchor downspouts to carry water safely across the fill slope. Skew ditch relief culverts 20 to 30 degrees toward the inflow from the ditch to help maintain proper function.

Stream Culverts: When using culverts to cross small streams, install those culverts to conform to the natural stream bed and slope on all intermittent streams that support fish or that provide seasonal fish passage. Ensure fish movement is not impeded by using culverts with a suitable diameter for permanent stream crossings and during peak flows. Maintain a 1-foot minimum cover for culverts 15 to 36 inches in diameter, and a cover of one-third diameter for larger culverts to prevent crushing by traffic. Place culverts slightly below normal stream grade to avoid culvert outfall barriers. Do not alter stream channels upstream from culverts, unless necessary to protect fill or to prevent culvert blockage. Install culverts to prevent erosion of fill. Compact the fill material to prevent seepage and failure. Armor the inlet and/or outlet with rock or other suitable material where feasible. Consider dewatering stream-crossing sites during culvert installation. This can be done with a temporary diversion channel or a sandbag dam with a pump diversion.

Stream Crossings: Minimize the number of road stream crossings and choose stable stream-crossing sites. Minimize stream-channel disturbances and related sediment problems during necessary construction of road and installation of stream-crossing structures. Whenever possible, retain existing vegetation and organic material around stream crossings. Locate temporary construction bypass roads where the stream course will have minimal disturbance. Design stream crossings for adequate passage of fish (if present) and time construction activities to have minimum impact on water quality and fisheries. Consider oversized pipe when debris loading may pose problems. Ensure sizing provides adequate length to allow for depth of road fill. Do not place erodible material into stream channels and remove stockpiled material from high-water zones. Abutments and wingwalls should prevent material from spilling into the stream. Avoid unimproved stream crossings. When a culvert or bridge is not feasible, locate drive-through (ford) on a stable, rocky portion of the stream channel, such as a bedrock stream.

Equipment Use: Avoid operation of wheeled or tracked equipment within isolated wetlands, except when the ground is frozen. Tractor skid where compaction, displacement, and erosion will be minimized. Avoid tractor or wheeled skidding on unstable wet or easily compacted soils.

Hazardous Substances/Weed and Pest Control: Know and comply with regulations governing the storage, handling, application (including licensing of applicators), and disposal of hazardous substances. Follow all label instructions. Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of the state Department of Environmental Quality (DEQ). A Spill Prevention and Countermeasures Plan is required by federal law for storage of more than 1,320 gallons, and state law requires the reporting of spills over 25 gallons.

Integrated Approach: Use an integrated approach to weed and pest control, including manual, biological, mechanical, preventative, and chemical means. To enhance effectiveness and prevent transport into streams, apply chemicals during appropriate weather conditions (generally calm and dry) and during the optimum time for control of the target pest or weed.

Prescribed Burning and Wildfire Suppression: Protect soil and water from prescribed burning effects by maintaining soil productivity, minimizing erosion, and preventing ash, sediments, nutrients and debris from entering surface water. After an intense wildfire or prescribed burn, emergency rehabilitation may be necessary to minimize the loss of soil, prevent the deterioration of water quality, and to mitigate threats to life and property. Stabilize all areas that have significantly increased erosion potential or drainage patterns altered by suppression activities by installing water bars and other drainage diversions in fire roads, fire lines, and other cleared areas, seeding, planting, and fertilizing to provide vegetative cover, spreading slash or mulch to protect bare soil, repairing road damage, and clearing stream channels of debris deposited by suppression activities and scarification as necessary to encourage percolation on excessively burned soils.

BMPs for Water Resources

BMPs would be appropriate for consideration when proposed activities are within groundwater zones 1-3, surface water zones 1-3, and sensitive aquifer systems identified through the use of the Wyoming Groundwater Vulnerability Assessment Handbook, or similar document updated over time. BMPs to mitigate impacts to water resources include, but are not limited to, the following:

- Use closed-loop drilling systems where technologically feasible.
- Reuse produced water for well completion activities and enhanced oil recovery operations using water.
- Do not use evaporation ponds or reserve pits in proximity to shallow aquifers. Reduce reliance on evaporation ponds in other locations and other forms of surface disposal.
- Line surface impoundment ponds (evaporation ponds or drilling pits) with synthetic liners and subsequently decommission them by removing all contaminants and liners, and reclaiming the area.
- Identify private water supply wells and implement appropriate protection measures for the affected aquifer(s), as necessary to prevent the introduction of contaminants into the well (e.g., site oil and gas wells at a distance necessary to prevent the introduction of contaminants into the drinking water supply well, collect baseline water quality data from the water supply well, etc.).
- Require a monitoring plan that includes collection of baseline and periodic water quality data from potentially affected drinking water supply wells, identification of parameters to monitor, reporting results to the BLM and well owners, and reporting to Wyoming DEQ any

contaminant in groundwater exceeding Wyoming DEQ (or EPA) Class I drinking water standards.

- Review the geology of shallow aquifers to determine well construction requirements, which may include cementing to surface and drilling with a fresh water mud system.
- Require surface casing and cement to a specific formation or depth to protect aquifers at depth that need protection.
- Set surface casing below the lower-most drinking water and set into a confining (e.g., shale) layer.
- Set an intermediate string of casing and cement in the event of deep aquifers.
- Require submittal of a well logging plan and document submittal plan to ensure proper well construction to protect groundwater.
- Review the geology of shallow aquifers in proximity to groundwater development activities to determine potential impacts to flow patterns supporting water elements such as fen, wetlands, springs, seeps, and ponds.
- Because of the age of the well or depth or other factor, require re-completions to comply with state and federal standards for new well construction; analyze cement bond logs associated with any existing well location within ¼-mile of completing a new well or re-completing an existing one; and identify how re-completed wells will be tested and monitored.

BMPs for Greater Sage-Grouse Protections

Knowledge of BMPs for greater sage-grouse protections is an evolving field. As research is done on impacts of various kinds of activities, or the absence thereof, on greater sage-grouse, additional protections will be identified. While some of these will be generic enough to be applied planning area-wide, others will require site-specific analysis to determine if they are appropriate for inclusion as a mandatory COA. This BMP section of this appendix will be supplemented as technology and understanding of greater sage-grouse advance.