

Wyoming Statewide Forest Resource Assessment

Describing Conditions, Trends, Threats, and Priorities
September 2009



Wyoming State Forestry Division
Office of State Lands & Investments

Wyoming Statewide Assessment of Forest Resources

Collaboration with Wyoming State Forestry Division external and internal partners was important to the development of the Statewide Forest Resource Assessment. Many people contributed to the planning, analysis, writing, and editing of this document. WSFD would like to thank the following groups, organizations, agencies, and individuals for their valuable assistance in completing this assessment:

- Wyoming Joint Agriculture Committee
- WSFD Forestry Advisory Committee
- WSFD Community Forestry Council
- Wyoming Game and Fish Department
- United States Forest Service
- Bureau of Land Management
- Bureau of Indian Affairs
- Gary Collins - Tribal Liaison, Northern Arapaho Tribe
- Wyoming Department of Agriculture
- Cheyenne Urban Forestry Division
- Dr. Stephen E. Williams - University of Wyoming
- U.S.F.S. - Rocky Mountain Research Station
- Wyoming Association of Conservation Districts
- Wyoming Fire Action Team
- Natural Resources Conservation Service
- State Technical Committee
- Office of State Lands & Investments
- Council of Western State Foresters
- The Nature Conservancy
- The Conservation Fund
- Black Hills Forest Resource Association
- National Park Service
- WSFD Stewardship Coordinating Committee
- Wyoming State Parks and Cultural Resources
- Wyoming Department of Environmental Quality – Water Quality Division
- Governor’s Planning Office
- WSFD Staff

Wyoming Statewide Assessment of Forest Resources

Table of Contents

Background	1
State and Private Forestry Redesign	1
National Assessment.....	3
Statewide Assessment of Forest Resources	3
Statewide Forest Resource Strategy	5
Assessment Process.....	6
Wyoming Forest Resources.....	7
General Description	7
Forest Types	9
Forest Ownership.....	11
General Management.....	12
Non-forested Lands	16
Related Documents	17
Wyoming Wildlife Action Plan	17
Other Documents.....	17
GIS Analysis & Assessment	18
Data Layers	18
Analysis	33
Forest Conditions	36
Priority Forest Landscapes	57
Threats to Priority Landscapes	59
Multi-State Priority Areas	62
Appendices.....	63
GIS Analysis Methodology.....	63
GIS Model Diagrams.....	69

Wyoming Statewide Assessment of Forest Resources

Background

State and Private Forestry Redesign

The Wyoming State Forestry Division (WSFD) delivers a number of services to Wyoming's citizens through its Assistance Forestry program. Assistance Forestry includes community forestry, forest landowner assistance, forest health, cooperative fire, and fire mitigation, among other services. Although Assistance Forestry is a state program, WSFD has often utilized federal funding to help deliver these services. Most of the federal funding has been distributed to WSFD through the U.S. Forest Service – State & Private Forestry (S&PF).

In response to increasing demands placed on forestlands and the need for increased accountability in how federal funds are expended, the U.S. Forest Service has begun to *redesign* how the state and private forestry program works. The following text is from a one page summary of the redesign effort (<http://www.fs.fed.us/spf/redesign/redesign-article.pdf>):

In 2008, the U.S. Forest Service will begin implementing a “Redesigned” State and Private Forestry (S&PF) program. The S&PF Redesign effort was conceived in response to the combined impacts of increasing pressures on our nation's forests and decreasing S&PF resources and funds. Significant threats to forests, such as insect and disease infestations, catastrophic fire, and the loss of critical forested landscapes to development, coupled with the pressure placed on local economies by the increasingly global nature of the forest products industry, point to the need for more progressive strategies for conserving our nation's forest resources.

Over the past two years, the U.S. Forest Service has been working closely with the National Association of State Foresters (NASF) to:

1. Examine the current conditions and trends affecting forest lands,
2. Review existing S&PF programs to determine how to best address threats to our forests, and
3. Develop a strategy, including guiding principles and components of change, for delivering a relevant and meaningful set of S&PF programs, skills and opportunities.

The new Redesign approach will focus on three consensus-based S&PF National Themes:

- Conserve working forest landscapes,
- Protect forests from harm, and
- Enhance public benefits from trees and forests.

National and state resource assessments will be used to develop competitive proposals for S&PF funds; those projects that receive S&PF dollars will respond directly to the National Themes as well as annual national direction developed by the U.S. Forest Service. The amount of S&PF funds competitively awarded will gradually increase over the next several years, beginning with 15% in 2008.

Wyoming Statewide Assessment of Forest Resources

The Redesigned S&PF will also include an emphasis on transitioning to a more flexible and adaptive organization and will examine opportunities to integrate and maximize current programs with other, similar federal forestry programs.

The national S&PF office will report annually to Congress and partners on the progress of the Redesigned S&PF. New emphasis will be placed on improving our collective ability to demonstrate and communicate accomplishments.

The Forestry Title of the 2008 Farm Bill addressed the S&PF redesign issue in the following way (<http://www.nationalaglawcenter.org/assets/crs/RL33917.pdf>):

National Priorities. The 2008 farm bill (§ 8001) establishes a new set of national priorities for federal assistance for private forest conservation. It adds a new subsection to § 2 of the CFAA:

(c) PRIORITIES. — In allocating funds appropriated or otherwise made available under this Act, the Secretary shall focus on the following national private forest conservation priorities, notwithstanding other priorities specified elsewhere in this Act:

(1) Conserving and managing working forest landscapes for multiple values and uses.

(2) Protecting forests from threats, including catastrophic wildfires, hurricanes, tornados, windstorms, snow or ice storms, flooding, drought, invasive species, insect or disease outbreak, or development, and restoring appropriate forest types in response to such threats.

(3) Enhancing public benefits from private forests, including air and water quality, soil conservation, biological diversity, carbon storage, forest products, forestry-related jobs, production of renewable energy, wildlife, wildlife corridors and wildlife habitat, and recreation.

Thus, the 2008 farm bill requires that forestry assistance aim to conserve working forests, protect and restore forests, and enhance public benefits from private forests.

Statewide Assessments and Strategies. The 2008 farm bill (§ 8002) requires each state to conduct a statewide assessment of forest resource conditions, trends, threats, and priorities to receive federal forestry assistance funds. Each state also must prepare a strategy for addressing the identified threats, and describe the resources needed to address those threats. The states are to prepare the initial assessment and strategy, with updates as needed, and to coordinate with specified agencies and groups. The Secretary may use up to \$10 million annually for FY2008-FY2012 of appropriated forestry assistance planning funds to assist states with their assessments and strategies.

Therefore, in order for WSFD to continue to utilize federal funds for a portion of the Assistance Forestry program delivery, the agency must complete a statewide forest resource assessment.

Wyoming Statewide Assessment of Forest Resources

However, WSFD views this effort as more than a federal requirement. This type of analysis has value to the agency for evaluating where to invest state resources and for making the case to state leadership regarding the importance of the Assistance Forestry Program.

National Assessment

As the states proceed with state assessments, there is also a national assessment in progress. The following is a brief description of that process (<http://www.fs.fed.us/spf/redesign/redesign-assessment.pdf>):

The Redesign approach to State and Private Forestry (S&PF) will be guided by a national assessment of conditions, trends and opportunities on forest lands of all ownerships. The national assessment will be produced through a web-based geospatial decision support system that allows the user to view the inter-relationships between various data sets and to consider a variety of options and outcomes.

The national assessment will be used, along with the national themes, to establish broad scale priorities for investment of S&PF funding and resources. The national assessment will also be used, along with other accountability tools, to demonstrate how work accomplished in the states and regions addresses national needs. Ultimately, the decision support system that produces the assessment will be developed into an interactive resource that can be used at the regional and state levels, as well as at the national level.

Statewide Assessment of Forest Resources

Direction for the state assessment comes from the Redesign Implementation Council (RIC) and the 2008 Farm Bill. The latest direction for state forest resource assessments follows (http://www.fs.fed.us/spf/redesign/state_assess_strategies.pdf):

State assessments and resource strategies are integral to the State and Private Forestry (S&PF) Redesign and required as an amendment to the Cooperative Forestry Assistance Act (CFAA), as enacted in the 2008 Farm Bill. This document provides national guidance to States to develop their state assessments and resource strategies.

There are three components to the assessment and planning required by the State and Private Forestry (S&PF) Redesign approach to identify priority forest landscape areas and highlight work needed to address national, regional, and state forest management priorities:

- **State-wide Assessment of Forest Resources**—provides an analysis of forest conditions and trends in the state and delineates priority rural and urban forest landscape areas.
- **State-wide Forest Resource Strategy**—provides long-term strategies for investing state, federal, and other resources to manage priority landscapes

Wyoming Statewide Assessment of Forest Resources

identified in the assessment, focusing where federal investment can most effectively stimulate or leverage desired action and engage multiple partners.

- **Annual Report on Use of Funds**—describes how S&PF funds were used to address the assessment and strategy, including the leveraging of funding and resources through partnerships, for any given fiscal year. Each State is required to complete a State Assessment and Resource Strategy within two years after enactment of the 2008 Farm Bill (June 18, 2008) to receive funds under CFAA.

Statewide Assessment of Forest Resources

To ensure that federal and state resources are being focused on important landscape areas with the greatest opportunity to address shared management priorities and achieve measurable outcomes, each state and territory will work collaboratively with key partners and stakeholders to develop a statewide forest resource assessment. The state forest resource assessment should provide a comprehensive analysis of the forest-related conditions, trends, threats, and opportunities within the state.

At a minimum, state assessments will:

- Provide an analysis of present and future forest conditions, trends, and threats on all ownerships in the state using publicly available information.
- Identify forest related threats, benefits, and services consistent with the S&PF Redesign national themes.
- Delineate priority rural and urban forest landscape areas to be addressed by the state resource strategy. States can also identify linkages between terrestrial and aquatic habitat, as appropriate.
- Work with neighboring States and governments to identify any multi-state areas that are a regional priority.
- Incorporate existing statewide plans including Wildlife Action Plans, Community Wildfire Protection Plans, and address existing S&PF program planning requirements. States can also utilize relevant national and regional assessments as appropriate.

A combination of qualitative, quantitative, and geospatial data can be used in the statewide assessment to provide information relevant to key state issues and national themes. In addition, non-geospatial information can be used in combination with geospatial data to identify priorities. States may identify separate priority areas for different programs and issues.

Wyoming Statewide Assessment of Forest Resources

The national direction also specifies that the assessment should build on and utilize existing analyses whenever possible. Finally, the national direction identifies potential data layers to include in the analysis and potential sources for the data while allowing states some flexibility to use other data layers and data sources as appropriate for state needs.

Statewide Forest Resource Strategy

Following completion of the statewide assessment, states are to complete a statewide forest resource strategy to detail how priority forest landscapes will be addressed and how S&PF funds can contribute to that effort. There is national direction from the RIC regarding the state resource strategies (http://www.fs.fed.us/spf/redesign/state_assess_strategies.pdf):

Statewide Forest Resource Strategy

A state's forest resource strategy will provide a long-term, comprehensive, coordinated strategy for investing state, federal, and leveraged partner resources to address the management and landscape priorities identified in its assessment.

The resource strategy should incorporate existing statewide forest and resource management plans and provide the basis for future program, agency, and partner coordination.

At a minimum, state resource strategies should:

- Outline long-term strategies for addressing priority landscapes identified in the state forest resource assessment and the following national themes and associated management objectives (the intent and policy implications of each of these national objectives are described in Appendix A *of the source document*):
 - **Conserve Working Forest Lands:** conserving and managing working forest landscapes for multiple values and uses.
 - Identify and conserve high priority forest ecosystems and landscapes.
 - Actively and sustainably manage forests.
 - **Protect Forests From Harm:** protect forests from threats, including catastrophic storms, flooding, insect or disease outbreak, and invasive species.
 - Restore fire-adapted lands and reduce risk of wildfire impacts.
 - Identify, manage and reduce threats to forest and ecosystem health.
 - **Enhance Public Benefits from Trees and Forests:** including air and water quality, soil conservation, biological diversity, carbon storage, and forest products, forestry-related jobs, production of renewable energy, and wildlife.
 - Protect and enhance water quality and quantity.

Wyoming Statewide Assessment of Forest Resources

- Improve air quality and conserve energy.
 - Assist communities in planning for and reducing wildfire risks.
 - Maintain and enhance the economic benefits and values of trees and forests.
 - Protect, conserve, and enhance wildlife and fish habitat.
 - Connect people to trees and forests, and engage them in environmental stewardship activities.
 - Manage and restore trees and forests to mitigate and adapt to global climate change.
-
- Describe how the state proposes to invest federal funding, along with other resources, to address state, regional, and national forest management priorities.
 - Include a long-term timeline for project and program implementation.
 - Identify partner and stakeholder involvement.
 - Identify strategies for monitoring outcomes within priority forest landscape areas and how action will be revised when needed.
 - Describe how the state's proposed activities will accomplish national State and Private Forestry program objectives and respond to specified performance measures and indicators.
 - Describe how State and Private Forestry programs will be used to address priority landscape and management objectives.
 - Incorporate existing statewide plans including Wildlife Action Plans, community wildfire protection plans, and address existing S&PF program planning requirements.

Assessment Process

The national direction provided the categories to be addressed and examples of data layers to use. WSFD chose layers that matched national direction or appropriate substitute layers and assigned weights to the layers.

WSFD completed an initial GIS analysis using the chosen layers and then presented that information to various groups for input, including: Joint Agriculture Committee, Wyoming Legislature; Forestry Advisory Committee; Community Forestry Council; Wyoming Game and Fish Department; U.S.F.S. Regional Foresters, Forest Supervisors, and staff; BLM; BIA; Wyoming Department of Agriculture; U.S.F.S. Rocky Mountain Research Station; Wyoming Association of Conservation Districts; Wyoming Fire Action Team; Natural Resources Conservation Service; National Park Service; Council of Western State Foresters; The Nature

Wyoming Statewide Assessment of Forest Resources

Conservancy; The Conservation Fund; Black Hills Forest Resource Association; Stewardship Steering Committee; and WSFD staff. All of the listed entities had the opportunity to submit written or verbal comments, to suggest changes to data layers or layer weighting, and to suggest changes to the general direction of the assessment.

The draft assessment was completed in January, 2009. At that point activity on the assessment was paused while the draft document was distributed to the above list and input was gathered. In July, 2009, work resumed on edits to the draft document. Many changes based on input from the cooperators have been made. The most significant change was to the layer weights – all layers were changed to have the same weight in the assessment. This addressed a significant criticism – that the layer weights were arbitrarily determined by WSFD – and resulted in minor changes to the output of the GIS analysis.

Input from the cooperators was generally positive regarding the GIS analysis and the accompanying document, which together form the statewide assessment of forest resources.

Wyoming Forest Resources

General Description – Adapted from Wyoming’s *Forest Legacy Assessment of Need* written by The Conservation Fund in cooperation with WSFD (<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>)

Wyoming has a land area of over 62.6 million acres (97,812 square miles). Elevations range from a low of 3,099 ft on the Belle Fourche River in Crook County in the northeastern corner of the State to 13,804 ft on Gannett Peak in Fremont County. The forested areas of Wyoming located in the western and central portions of the State are part of two ecoregion provinces referred to as the Southern Rocky Mountain Steppe and Middle Rocky Mountain Steppe (Bailey 1978). The Rocky Mountains are rugged glaciated mountains as high as 14,000 feet with local relief between 3,000 feet and 7,000 feet. An isolated area of forest land exists in the northeast area of the State where ponderosa pine forests have found an ecological niche in the Black Hills. This province is referred to as the Black Hills Coniferous Forest Province (Bailey 1978). Wyoming’s forest land often consists of “island forests” surrounded by the non-forested lands of the high plains and basins. Examples are the forests of the Bighorn Mountains, Black Hills, Laramie Mountains, the Sierra Madre, and the Medicine Bow Mountains. The forests in the northwest portion of the state are more contiguous. A network of riparian forests occurs along the major river systems and tributaries providing a valuable habitat component and interconnection between other forested areas.

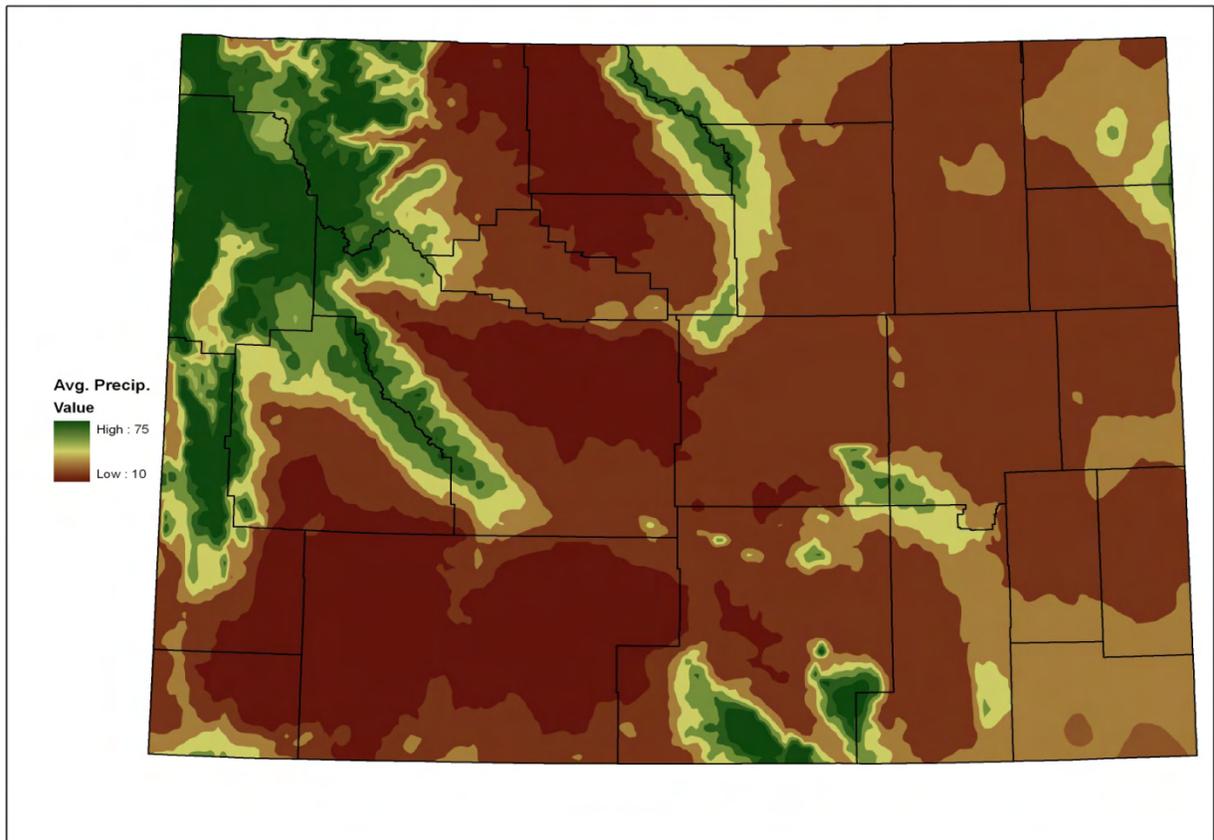
Approximately 17 percent of the land area, or about 11 million acres, is classified as timberland and 2 percent is classified as woodlands, together composing the total forest lands in Wyoming. Timberlands are composed of tree species traditionally used in the forest products industry. Woodlands are composed of woody species that have not traditionally been used by industry, but are important for other reasons. Timberlands tend to be at higher elevations where moisture regimes are higher, which is also generally correlated with federal ownership.

Wyoming Statewide Assessment of Forest Resources

Wyoming's mountains and hills have helped to shape the state's climate, vegetation, natural resources, industries, and people. Major physiographic regions include the Great Plains primarily in the northeastern quarter of the state, the Semi Desert region located in Central and South-Central Wyoming, the Southern Rockies consisting of the northwest portion of the state, the north-central portion, as well as parts of the Southeastern portion of the state, and finally the Black Hills found in the Northeastern corner of the Wyoming (WSFD and USDAFS, 2001). Every known type of geological feature can be found within the boundaries of the State of Wyoming. Forested areas are generally associated with elevation and moisture conditions closely associated with mountain ranges and the Black Hills.

The Rocky Mountains and the Continental Divide influence Wyoming's climate, as areas west of the mountains receive up to 75 inches of precipitation annually with the majority coming as snow in the higher elevations of Yellowstone and Grand Teton National Parks. The areas east of the various mountain ranges tend to be basins influenced by the continental divide, which are in the rain shadows of the mountain ranges, and therefore receive less than 10 inches of annual precipitation. The map on page 8 shows average precipitation for the state. Precipitation limits the distribution of forests in Wyoming and is a key factor limiting tree growth.

Wyoming Average Precipitation (inches)



Wyoming Statewide Assessment of Forest Resources

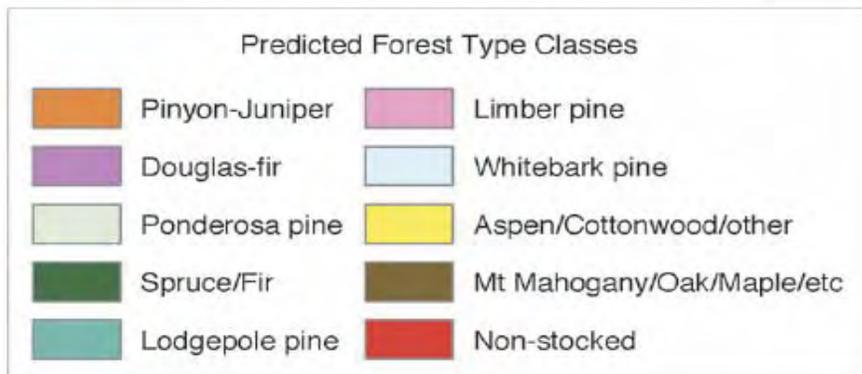
Forest Types – Adapted from Wyoming’s *Forest Legacy Assessment of Need* written by The Conservation Fund in cooperation with WSFD
(<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>)

Forest type (Largely adapted from WSFD, USDA, 2001, Wyoming Forest Health Report and USDA-RMRS, 2005) is one indicator of forest diversity, and refers to the predominant tree species in a stand based on tree stocking. The lodgepole pine type is the most abundant forest type in Wyoming, covering over 2.6 million acres (23 percent) of forest land. Second in abundance, the spruce-fir type covers 1.8 million acres (16 percent) of the state’s forest land. Third, ponderosa pine totals 1.1 million acres (9 percent) of forest area. Douglas-fir and Engelmann spruce each make up 8 percent of the area; juniper, 8 percent; aspen, 6 percent; whitebark pine 5 percent; and limber pine 4 percent. Non-stocked forest land accounts for 10 percent of total forest land in Wyoming. Non-stocked forest land includes sparsely stocked woodland, recently cut and burned areas, and other areas that fall below a 10-percent stocking threshold of live trees.

The map on page 10 displays the major forest types in Wyoming. This illustrates the evident and predictable nature of vegetation zones in relation to mountainous topographic features.

Wyoming Statewide Assessment of Forest Resources

Wyoming Forest Types (USDA RMRS)

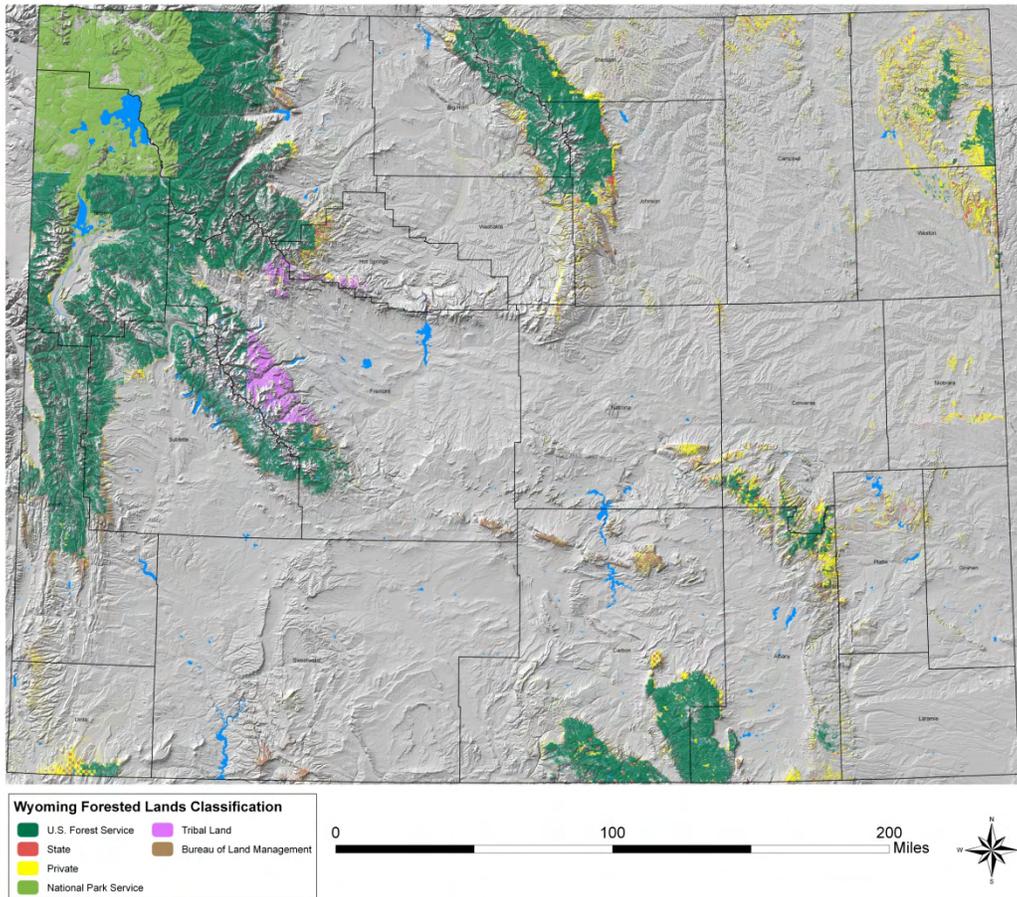


Wyoming Statewide Assessment of Forest Resources

Forest Ownership – Adapted from Wyoming’s *Forest Legacy Assessment of Need* written by The Conservation Fund in cooperation with WSFD
(<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>)

Fifty-three percent of the forest land is administered by the USDA Forest Service, and 17 percent is privately-owned, including Indian Trust land. Fifteen percent is administered by the National Park Service, 11 percent is administered by the USDI Bureau of Land Management (BLM), and the remaining 4 percent is owned by State, county, and miscellaneous Federal agencies. The map below illustrates the location of the major owner groups on forest land in Wyoming.

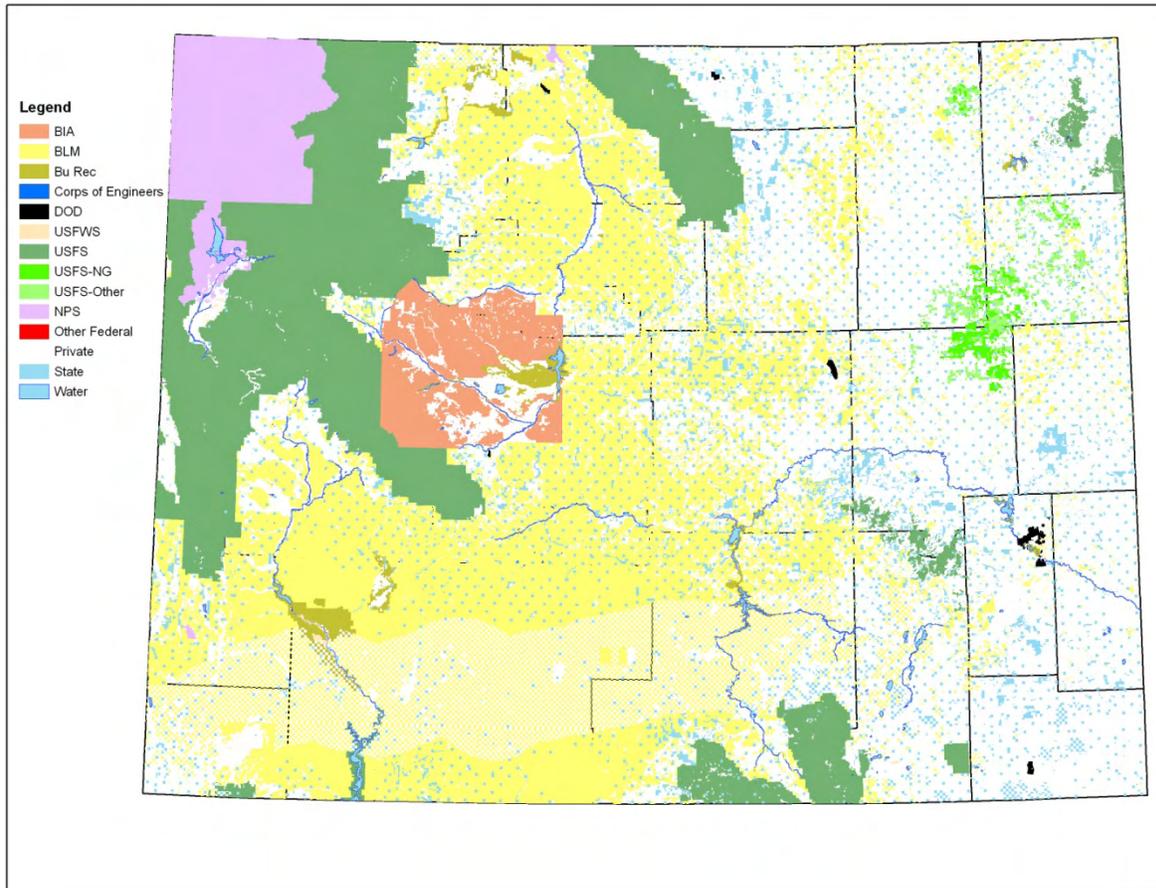
Wyoming Forest Ownership



Land ownership in Wyoming is often a checkerboard pattern with considerable intermixing of federal, state, and private lands. The pattern can complicate management and create problems in accessing land for management activities. For example, before managing state trust lands, WSFD must locate the boundaries of the parcel and secure access to the parcel. Given that the largest block of forested state trust land is about 4500 acres out of 263,000 forested acres, that process happens many times each year. Other land management agencies can face similar issues. Many private land parcels face development/subdivision pressure. The map on page 11 shows the land ownership/management pattern in the state.

Wyoming Statewide Assessment of Forest Resources

Wyoming Surface Management Status



General Management – Adapted from Wyoming’s *Forest Legacy Assessment of Need* written by The Conservation Fund in cooperation with WSFD (<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>)

About one-third of the total forest area is designated as in a “reserved” status based upon industrial availability, and thus timber derived economic values, without extensive environmental analysis. These lands are segregated in current IW-FIA analysis by the following parameters: forest land in designated “roadless” areas, greater than one mile from a maintained road, on a greater than 40 percent slope and/or less than 10 percent canopy cover. The result of these designated non-timber values within the federal land management systems is that the importance of private forest land has been elevated further. *Note: For the GIS analysis, roadless areas were not considered reserved land. See Appendix A, page 59, for more information.*

Non-reserved timber lands represent 57 percent of the forest lands in Wyoming. Twenty-three percent (1.9 million acres) are estimated to be non-industrial, private lands. The average net volume per acre in the non-reserved timber lands is 1,780 cubic feet per acre (cf/ac.). Private lands produce 1,044 cf/ac., yielding 3,220 board feet of sawtimber per acre.

Wyoming Statewide Assessment of Forest Resources

Private timberland stocking represents approximately half of the growing stock volume per acre measurements derived on Forest Service land in Wyoming. However, the administrative complexities of Forest Service removals offset this difference in the market place, as private lands can be managed with more flexibility and are therefore more important to timber harvest in the Intermountain West. Most importantly, the volumes available on private lands contribute substantially to the current regional and national timber markets, as well as to the employment of people in Wyoming and neighboring states.

In the year 2005, not including trees removed for land clearing or land use conversions, tree removals in Wyoming equaled 13.7 million cubic feet (mcf) of which 66 percent were derived from private timber forest lands. The source of trees for the timber industry has made a dramatic shift. Privately owned forest land has become critical to the survival of this industry. In 1976, 78 percent of forest products were derived from public lands with only 22 percent derived from private lands. By the year 2000, the volume of materials harvested in Wyoming had declined by 78 percent, but most significantly 73 percent of those materials came from private forests. There has also been a significant shift in which forest types are most important to the timber industry. Seventy-three percent of the sawtimber harvest was composed of ponderosa pine in 2005 with lodgepole pine contributing only 11 percent. (Wyoming's Forest Products Industry and Timber Harvest, 2005; http://www.fs.fed.us/rm/pubs/rmrs_rb009.pdf)

Wyoming's timber industry is now dependent on private forest lands as the primary source of raw materials for production. Wyoming's private timber supplies are often associated with multi-function ranches and affected by the price of timber relative to other ranch products and services. This underscores the importance of maintaining these private forests and facilitating forest management planning and practices.

In summary, there has been a shift in importance from publicly owned lands and lodgepole pine to private forest lands and ponderosa pine for the necessary raw materials to supply industry. The number of Wyoming mills has declined, but the industry has improved in overall efficiency and utilization. There has been an expansion of new forest product sectors such as cellulosic ethanol, house logs, manufactured log homes, and log furniture. Future harvest from forests on Federal lands may continue to be limited because of an increased public policy emphasis on non-timber harvest forest uses such as recreation and preservation. Wyoming's forest product industry is a significant component of Wyoming's economic and employment picture and is inextricably linked to the forest industries of neighboring states. Only 34 percent of Wyoming's forested acres are likely to be available for timber harvest in the near future, although in 2007 forest growth exceeded mortality and removals combined by nearly 123 percent. Net annual growth of softwood timber in 2007 was 117,650 thousand cubic feet from all ownerships, removals were 15,024 thousand cubic feet, and mortality was 80,968 thousand cubic feet (Forest Resources of the United States, 2007 <http://www.nrs.fs.fed.us/pubs/7334>). Note that in 2007 mortality exceeded removals by more than 500%.

Riparian forests are a highly valuable component of Wyoming's landscape. Riparian forests exist where there is adequate moisture, typically along creeks, rivers, and with human influence, along irrigation ditches. These forests can be as narrow as the shore along a river to several miles wide most often depending upon hydrology. In higher elevation settings, they are flanked by

Wyoming Statewide Assessment of Forest Resources

coniferous and aspen forests, while in lower elevations they typically border sagebrush steppe and grassland habitat types.

Compositionally, riparian forests vary greatly throughout the state with elevation and hydrology primary factors determining species occurrence and distribution. At higher altitudes spruce, fir, alder, willow and birch are common components, transitioning to Douglas fir, maple, chokecherry, hawthorn, mountain ash, plum and serviceberry in lower elevation mountain forests. Aspen is the most common deciduous component of upland riparian sites. Cottonwood, boxelder and willow predominate in the plains. Some eastern hardwoods such as American elm, bur oak, hackberry and hophornbeam at the western edge of their ranges are significant components of riparian forests in the lower elevations of eastern Wyoming. Non-native species such as Russian olive and saltcedar have extensively invaded some riparian areas, outcompeting native species, significantly reducing the quality of wildlife habitat and contributing to diminishing stream flows.

Less than one percent of the intermountain west is classified as riparian, yet an estimated 80 percent of wildlife depends on this limited area for food, water, shelter, and migration routes during some part of their life cycle. Consequently, riparian habitats are biologically rich, providing the greatest species diversity within the state. Just as importantly, wildlife uses Wyoming's riparian forests and associated riparian lands as migration corridors as these forests connect tracts of forested lands, and the structure of these forests provides cover and shelter for virtually every species of wildlife in the State of Wyoming.

Riparian forests and associated riparian habitats are particularly important for bird species. Over 60 percent of the neotropical migratory bird species in the western United States use riparian areas at some point during the year. Breeding diversity of birds is higher in riparian habitat than all other western habitats combined.

Riparian zones at the bottom of V-shaped valleys incised in bedrock are generally stable. However, riparian zones on the alluvial soils of broad floodplains common across Wyoming can change rapidly. A complex and shifting mosaic develops based on spring floods that overflow banks and relocate channels. Periodic spring floods create new channels and soft alluvial soils are eroded as the river seeks shorter passage downstream. Banks are cut on the outside of turns, and point bars of sand and gravel are formed on the insides of turns, creating new habitat for succession of riparian forest species. Oxbows are created in former river channels, creating wetlands and over time, fertile ground for the establishment of cottonwood and other tree seedlings. Riparian forests also play a key role in filtering sediments and nutrients and storing water in the spring in alluvial zones to sustain stream flow during drier months.

Wildfire also influences riparian forest ecology, despite higher moisture conditions than other forest types. Improved moisture conditions typically result in increased herbaceous and woody biomass. Seasonal curing of fine fuels makes wildfires common occurrences from late summer through early spring in many riparian forest habitats. These fires are often characterized as less intense with a corresponding reduction in destructive capacity. Drought and the buildup of dead woody fuels can lead to more intense fire behavior with stand replacement capabilities. Both types of fire activity should be considered typical for riparian forests though frequency rates

Wyoming Statewide Assessment of Forest Resources

differ. Some species such as aspen are highly dependent on fire disturbance to maintain population vigor.

Cottonwood forests provide much-needed shelter, stock water, and shade for human settlement and livestock operations across Wyoming's high plains landscape. Human settlement has altered some aspects of forest ecology, however. Flood control through the construction of dams and dikes has had a significant impact on riparian forest health in many parts of the state.

Cottonwood trees need flushing flows and the creation of point bars for the establishment of cottonwood seedlings. With regeneration significantly diminished, cottonwood woodlands appear to be declining in many areas of the state. Beaver also play a significant role in influencing riverine and riparian hydrology and in creating important habitat for fish, wildlife, and livestock, although their prevalence is still significantly diminished from past levels.

The productivity of riparian sites has resulted in the extensive conversion of riparian forest to other uses such as agriculture. Much of the state's most productive agricultural lands are within or adjacent to riparian areas. Proximity to water has made riparian areas valuable for urban, industrial, and recreational development.

At lower elevations, aging tree populations combined with a general lack of successful regeneration due to altered water flows, drought, agricultural and industrial uses, and urban development has resulted in the rapid decline of riparian forests in recent years.

Aspen, the most common deciduous component of Wyoming forests, has been a growing focus of concern within the Rocky Mountain Region. Approximately two-thirds of aspen forests are disturbance dependent and the combination of fire suppression plus a reduction in forest management - including less harvest of more shade tolerant conifers - has contributed significantly to the decline of aspen populations. However, the apparent decline of aspen could be a decline from higher amounts of aspen that resulted from large disturbances about 100 years ago with natural forest succession replacing aspen pending the next disturbance by harvest or fire. Nonetheless, stands are showing significant decline due to fire exclusion/suppression, reduced regeneration, succession to conifers, and browsing pressure from ungulate populations and domestic livestock. Additionally, many areas in the Rocky Mountains, including Wyoming, are currently experiencing a mortality event with widespread dieback and fast developing decline known as sudden aspen decline (SAD). The worst episodes of SAD appear to be developing on lower elevations and drier sites. If climate conditions warm, aspen forests may experience a significant reduction in area occupied due to SAD.

Wyoming's community forests are an important resource for residents and tourists alike. Wyoming has the highest percentage of Tree City USA communities in the nation with 40 percent of the communities meeting the Tree City USA standards.

The community forest is all of the trees and other associated vegetation in and around cities, towns and developments. Community forests serve many of the same functions as other forests. They affect natural systems, like the water cycle and nutrient cycle. Community forests are also important in controlling storm water run-off and regulating temperatures. Trees contribute to a sense of community. They reduce urban noise and provide places to rest, meet and socialize.

Wyoming Statewide Assessment of Forest Resources

Community trees increase property values and play an important role in the economic vitality of Wyoming's cities and towns. The community forest canopy is a distinctive feature of the landscape that provides residents protection from the elements and forms a living connection to earlier generations that planted and tended these trees.

Recent research on the costs and benefits of Wyoming's community forests concluded that for every \$1 spent on public trees the residents receive \$2.09 in benefits. Additional research conducted in Casper, WY revealed that Wyoming's community forests store 436,484 tons (\$8,138,006 value) of carbon and annually sequester 14,162 tons of carbon valued at \$259,951 per year.

Funding for tree management at the local level continues to increase. As local governments gain a better understanding of the benefits of community trees they allocate more staff and funding to care for their community forests. The community forestry grant program requires a local cash match which in turn has been a catalyst for cities to create budget line items for community forestry management.

Defining the boundaries of the community forest is difficult because the change between urban and rural land use is gradual in many parts of the state. Wyoming cities and towns have about 194,000 acres of land within their incorporated boundaries. It is estimated that over 2 million trees exist within these boundaries. Small acreage tracts surrounding towns such as Casper, Cheyenne, Jackson, and others contain hundreds of thousands of additional trees that are essentially part of the community forest ecosystem.

Comprehensive tree inventories on publicly owned land have been completed in over 40 cities and towns. These inventories have revealed a lack of species diversity in most communities with green ash, cottonwood, spruce and Siberian elm making up a large percentage of the species. Private trees - those located in yards - have much greater species diversity than public trees. The elevation of Wyoming towns varies from just over 3,800 feet to over 9,000 feet with lower elevation communities having greater potential for species diversity and faster growth rates for planted trees.

Non-forested Lands

This analysis is called a statewide assessment of forest resources, implying that only forested areas are addressed. However, WSFD (and S&PF) – through Assistance Forestry – also addresses non-forested lands. WSFD has direct and cooperative fire management responsibility on millions of acres of non-forested land. Through technical assistance and cost-share funding WSFD has contributed to thousands of acres of tree planting on non-forested residential and agricultural lands, for snow control along highways, and in communities that are not part of a traditional forest. Therefore, any state forest resource assessment for Wyoming must address non-forested lands.

Wyoming Statewide Assessment of Forest Resources

Related Documents

Wyoming Wildlife Action Plan

(<http://gf.state.wy.us/wildlife/CompConvStrategy/index.asp>)

The Wyoming State Comprehensive Wildlife Conservation Strategy (CWCS) was produced to provide a long-range conservation plan to conserve Wyoming's Species of Greatest Conservation Need (SGCN) and meet the requirements of the Congressionally-authorized State Wildlife Grants (SWG) Program. The Wyoming Game and Fish Department (WGFD) served as the lead agency in the development of this strategy, but many other partners and major stakeholders were invited to participate. The CWCS identifies 279 SGCN in Wyoming, along with key habitats for these species. Of these species, 44 have been included because of specific known conservation needs. The remaining 235 have been included primarily due to a lack of key data necessary to assess their conservation status. Key habitats for these species have been identified. Threats or challenges are identified, and the proposed actions to conserve the SGCN and their associated habitats are addressed. Monitoring measures are also identified. This strategy will guide conservation decisions in Wyoming for the next five years. It will be updated in 2010.

National guidance for statewide assessments of forest resources and the 2008 Farm Bill require that commonalities between state assessments and state wildlife action plans be addressed. Early in the development of this state assessment WSFD consulted the Wyoming Game and Fish Department (WGFD) for input regarding what data to use for the "fish and wildlife habitat" layer in the GIS analysis (see Appendix A). WGFD also reviewed the draft Assessment regarding wildlife issues.

The recommendation from WGFD was to utilize their data for priority habitat for aquatic and terrestrial species plus priority habitat for non-game species. Sage grouse core habitat areas were also included by WSFD decision. WSFD believes that the inclusion of the priority habitat layers and the review by WGFD effectively incorporates the state wildlife action plan into the state assessment.

Other Documents

Multi-resource management plans are developed for national forest system (NFS) lands according to National Forest Management Act direction. WSFD has been an active partner in the plan revision process and therefore has a good working knowledge of the latest land and resource management plans. Those plans provide direction for management of NFS lands. Threats and priorities identified by the Assessment, and direction provided by the resource strategy, can be addressed/implemented only to the extent allowed by the management plans.

The Bureau of Land Management (BLM) also develops multi-resource management plans for the lands it administers. WSFD and the Office of State Lands & Investments also have working knowledge of BLM resource management plans. Those plans provide direction for management of BLM lands. Threats and priorities identified by the Assessment, and direction provided by the

Wyoming Statewide Assessment of Forest Resources

resource strategy, can be addressed/implemented only to the extent allowed by the management plans.

Of the approximately 1.9 million acres of private forest lands in Wyoming, 410,295 acres (about 22 percent) have management plans developed through the Assistance Forestry program. Those management plans have been developed as a guide for landowners to help achieve their stated objectives. The information gathered through this effort has contributed to the development of the state forest resource assessment.

Community Wildfire Protection Plans (CWPP) have been developed at the county level for 20 of 23 counties in Wyoming. The CWPP's identify priority areas for wildfire mitigation/fuel reduction projects and make recommendations for how projects should be implemented. The CWPP's also define the boundaries of at risk communities including all land ownerships. The CWPP's have been an important information source for land managers. WSFD believes that the two fire risk layers included in the GIS analysis for the state forest resource assessment (see Appendix A) adequately represent the priority areas identified by the CWPP's.

The Forest Legacy Assessment of Need was developed to provide direction and priority areas for the Forest Legacy program. The Assessment of Need contributed significantly to this document and can be downloaded in its entirety here:

<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>

State trust land management plans are typically written at the project level. Development of a statewide management plan for forested lands, including an updated inventory, is in progress with data collection underway. WSFD of course has excellent knowledge of the priorities identified and management recommendations made by trust land management plans.

GIS ANALYSIS & ASSESSMENT

Data Layers

National direction suggests that state forest resource assessments should build on previous analysis efforts and utilize existing data whenever possible. The state forest resource assessment follows the Spatial Analysis Project (SAP) methodology to some degree. WSFD selected fourteen data layers for inclusion in the analysis. Brief descriptions and maps of the data layers follow. Please see Appendix A, page 59, for more detailed information on the included layers and the weights assigned to them. Please visit the SAP home page for more information on SAP and the included data layers www.fs.fed.us/na/sap/.

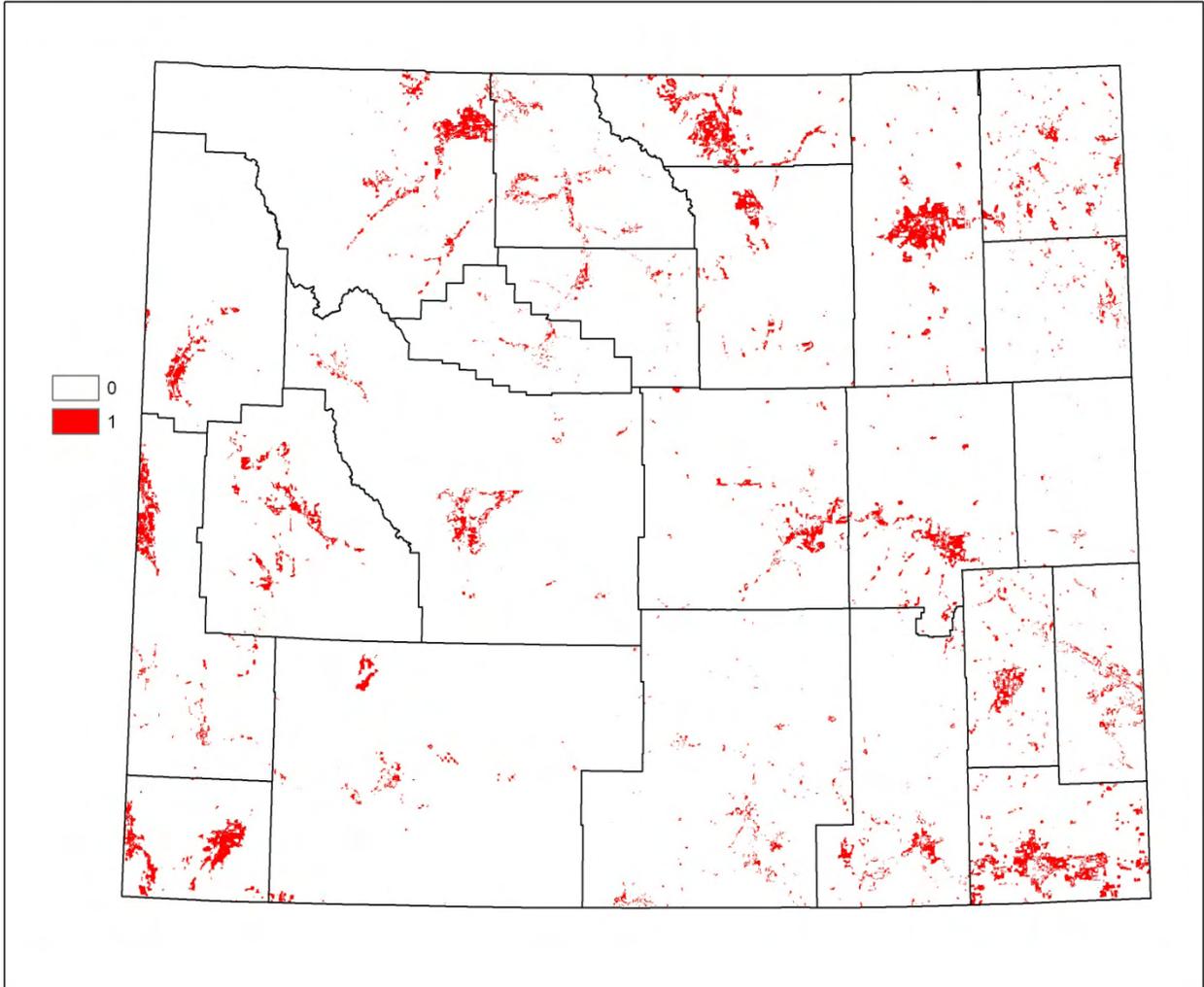
The reader is asked to remember that data layers and products from this statewide analysis are not intended to be used for detailed analysis at large map scales or for project level analysis. Please use caution if attempting to use or interpret data or analysis products from this Assessment at large map scales.

In some cases the data had to be adapted for use in this assessment. WSFD made every attempt to use the data correctly and without bias. The reader should use caution and common sense when interpreting or reaching conclusions based on the content of any data layer. While the

Wyoming Statewide Assessment of Forest Resources

data layers generally depict conditions in the state accurately, in some instances, if taken out of context, the data could be or appear misleading.

Development Risk



The data source for this layer is risk of housing development in the next 30 years produced by research at Colorado State University. This layer was taken directly from the SAP analysis. Please see Appendix A, page 59, for more detailed information on the development risk layer.

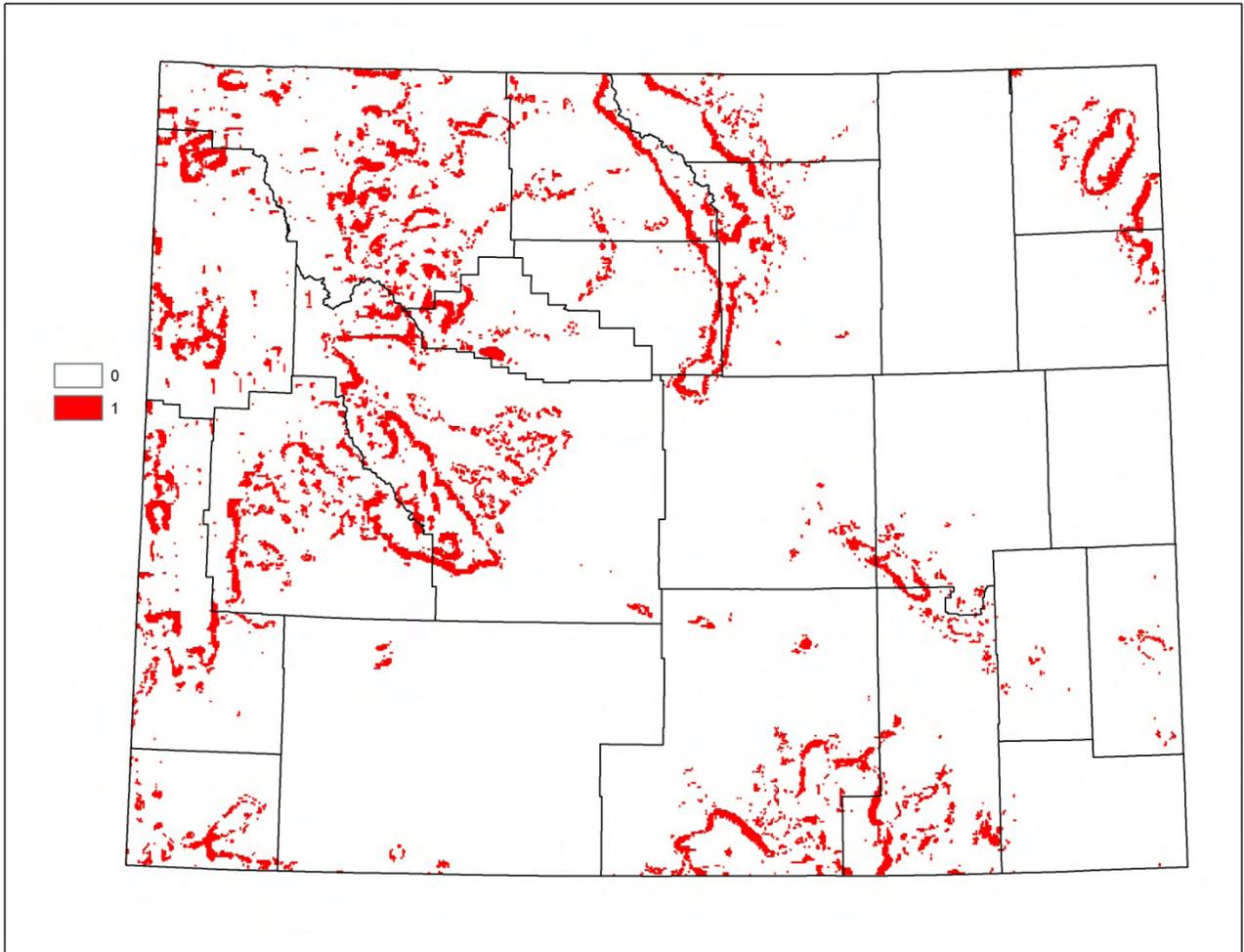
National Theme: Conserve working forest lands.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes.

National Direction: Assessments and strategies should attempt to identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.

Wyoming Statewide Assessment of Forest Resources

Forest Fragmentation



This is a national data layer from NationalAtlas.gov and is included to represent those forest lands on the edge of forested areas that are most susceptible to development and introduction of damaging agents. Please see Appendix A, page 59, for more detailed information on the forest fragmentation layer.

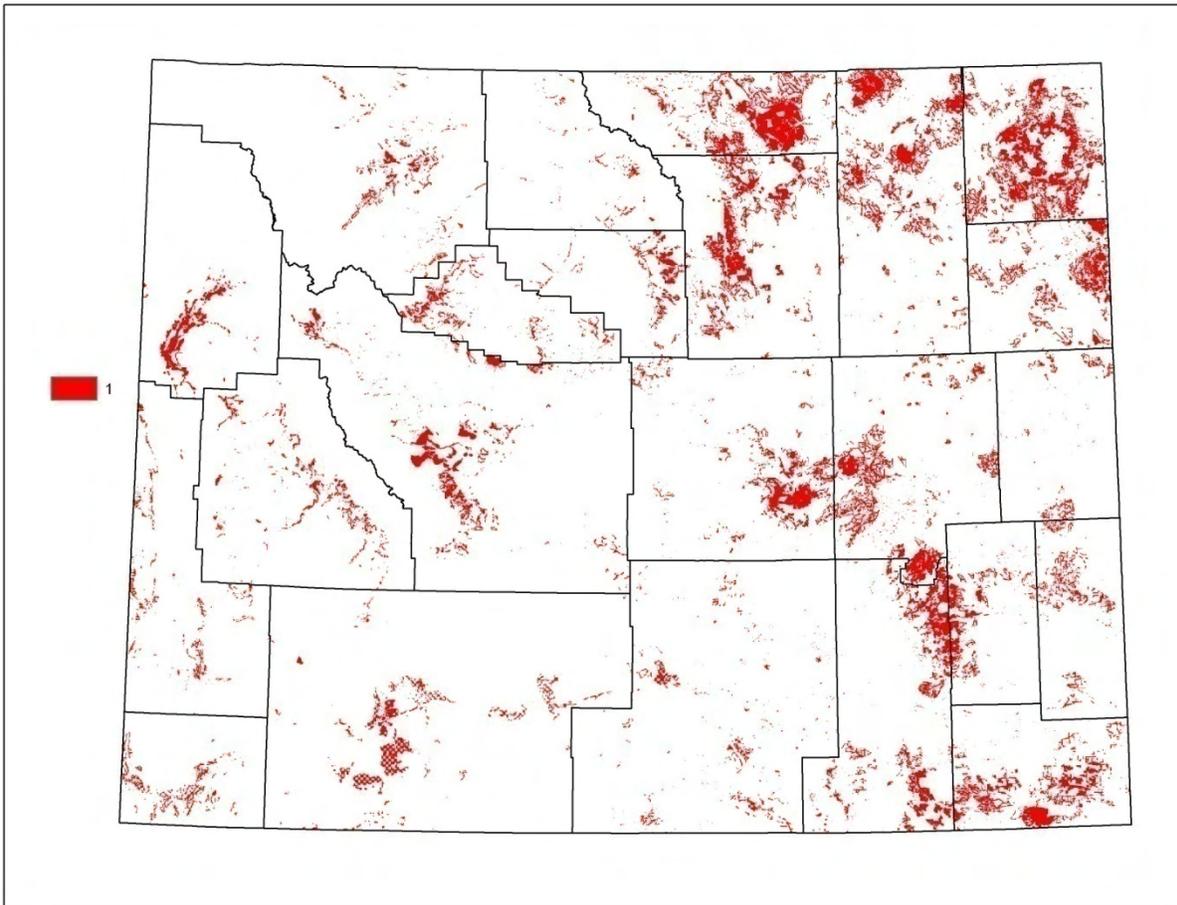
National Theme: Conserve working forest lands.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes.

National Direction: Assessments and strategies should attempt to identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.

Wyoming Statewide Assessment of Forest Resources

Wildfire Risk – Red Zone



Wyoming's Wildfire Hazard Assessment red zone data (2002) was used to address wildfire risk in and around the wildland-urban interface. Please see Appendix A, page 59, for more detailed information on the wildfire risk layer.

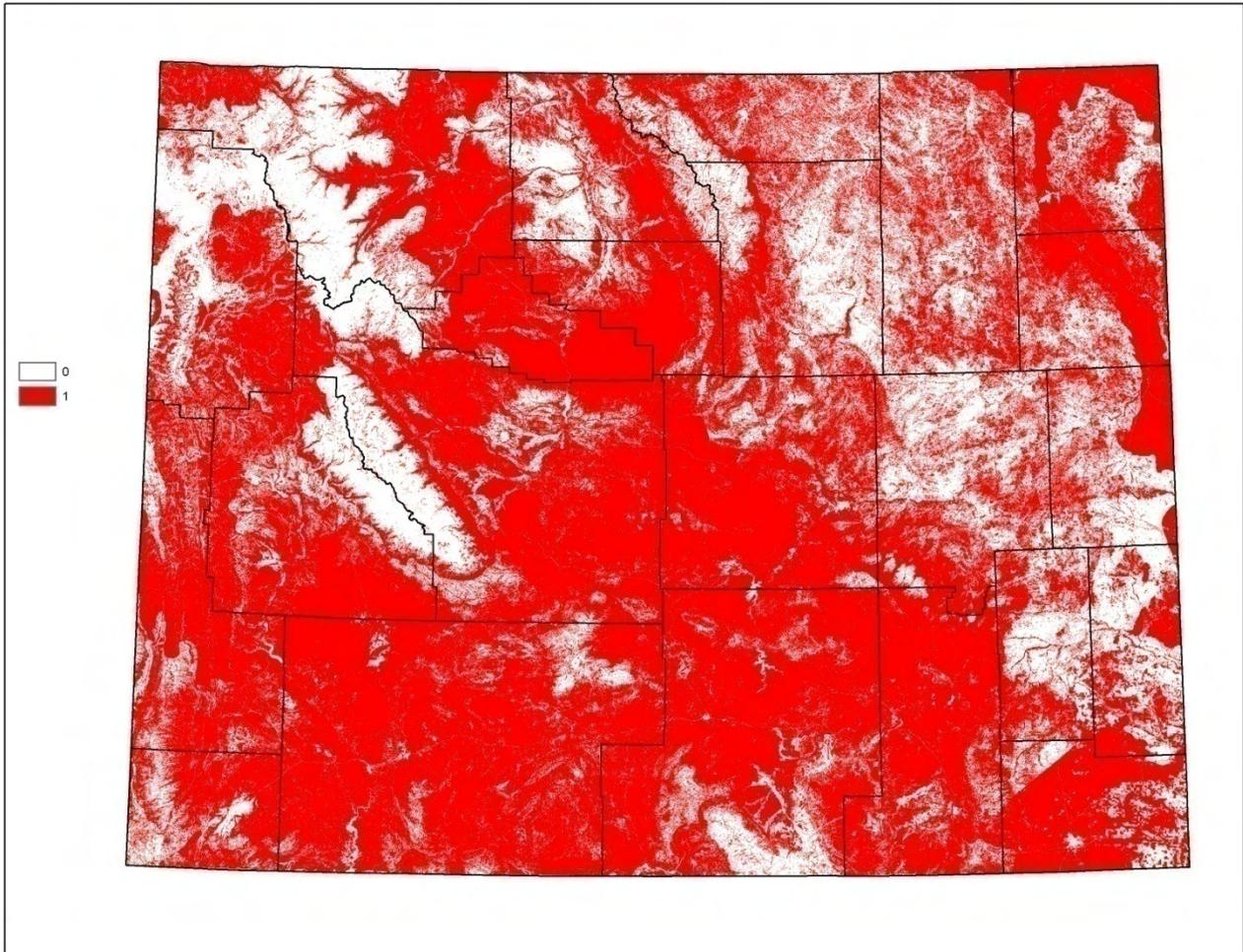
National Theme: Protect forests from harm.
Enhance public benefits from trees and forests.

Strategic Objective: Restore fire-adapted lands and reduce risk of wildfire impacts.
Assist communities in planning for and reducing wildfire risks.

National Direction: Assessments should identify areas where management can significantly reduce the risk of catastrophic wildfire while enhancing multiple associated forest values and risks. Assessments should identify areas where the effects of fire exclusion can feasibly be mitigated or countered through sound management, particularly where there are opportunities for federal, state, and community partnerships. Assessments should incorporate existing CWPP's and identify communities in especially vulnerable areas that need a CWPP.

Wyoming Statewide Assessment of Forest Resources

Wildfire Risk – Fire Regime Condition Class



Fire Regime Condition Class data was used to address wildfire risk by placing emphasis on areas outside of the wildland-urban interface. Please see Appendix A, page 59, for more detailed information on the wildfire risk layer.

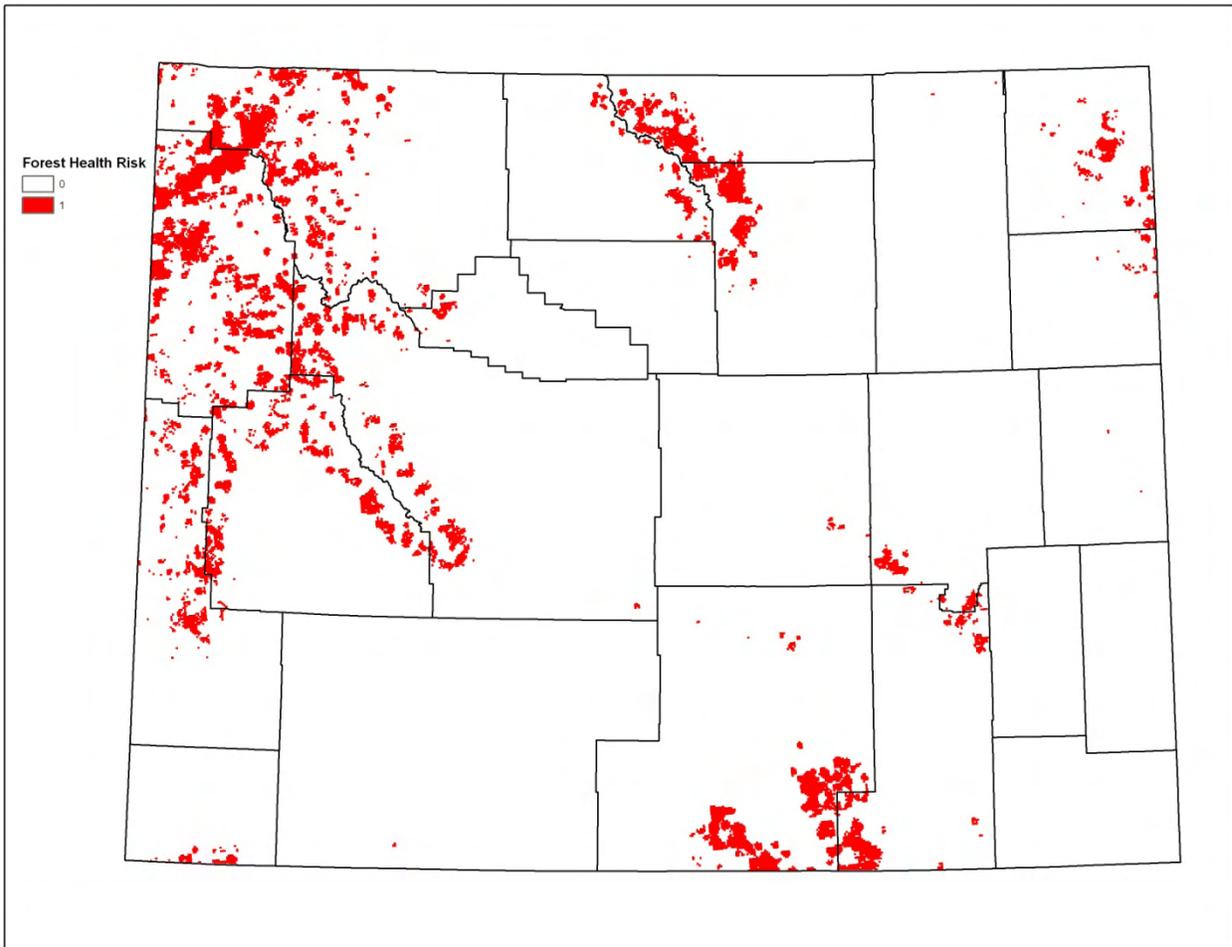
National Theme: Protect forests from harm.
Enhance public benefits from trees and forests.

Strategic Objective: Restore fire-adapted lands and reduce risk of wildfire impacts.
Assist communities in planning for and reducing wildfire risks.

National Direction: Assessments should identify areas where management can significantly reduce the risk of catastrophic wildfire while enhancing multiple associated forest values and risks. Assessments should identify areas where the effects of fire exclusion can feasibly be mitigated or countered through sound management, particularly where there are opportunities for federal, state, and community partnerships. Assessments should incorporate existing CWPP's and identify communities in especially vulnerable areas that need a CWPP.

Wyoming Statewide Assessment of Forest Resources

Forest Health Risk



The data source for this layer is the National Insect and Disease Risk Map (FHTET) and is included to represent areas at risk of basal area loss to insects and disease and where silviculture may help mitigate that risk if management plans and regulations allow. Please see Appendix A, page 59, for more detailed information on the forest health risk layer.

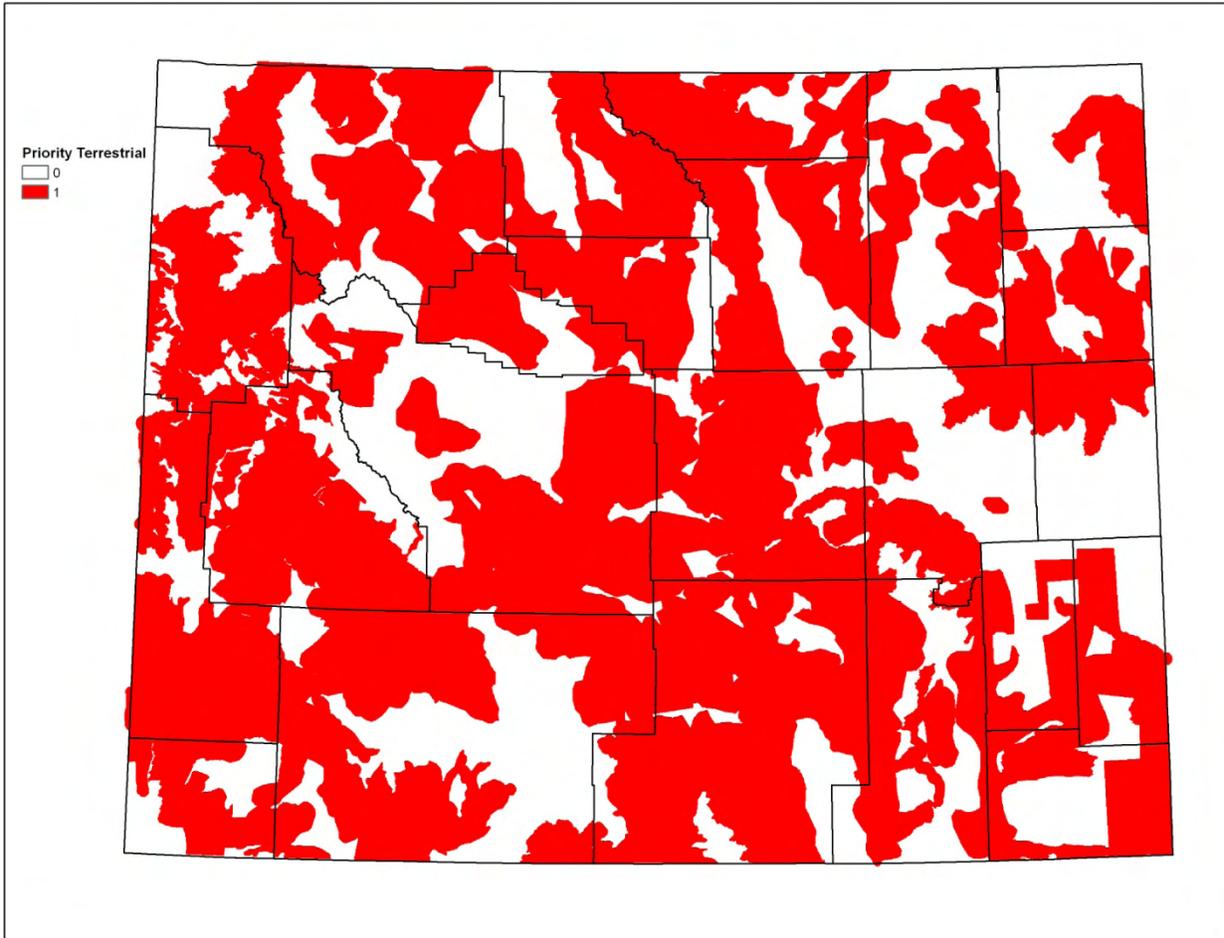
National Theme: Protect forests from harm.

Strategic Objective: Identify, manage, and reduce threats to forest and ecosystem health.

National Direction: Assessments should identify high value forest landscape areas that are especially vulnerable to existing or potential forest health risk factors where management practices are most likely to prevent and mitigate impacts. Assessments should also identify areas where management could successfully restore impacted forests.

Wyoming Statewide Assessment of Forest Resources

Fish and Wildlife Habitat – Terrestrial Habitat



This data layer includes priority terrestrial habitat data from the Wyoming Game and Fish Department plus sage grouse core habitat areas was used to emphasize important terrestrial wildlife habitat. Please see Appendix A, page 59, for more detailed information on the fish and wildlife habitat layer.

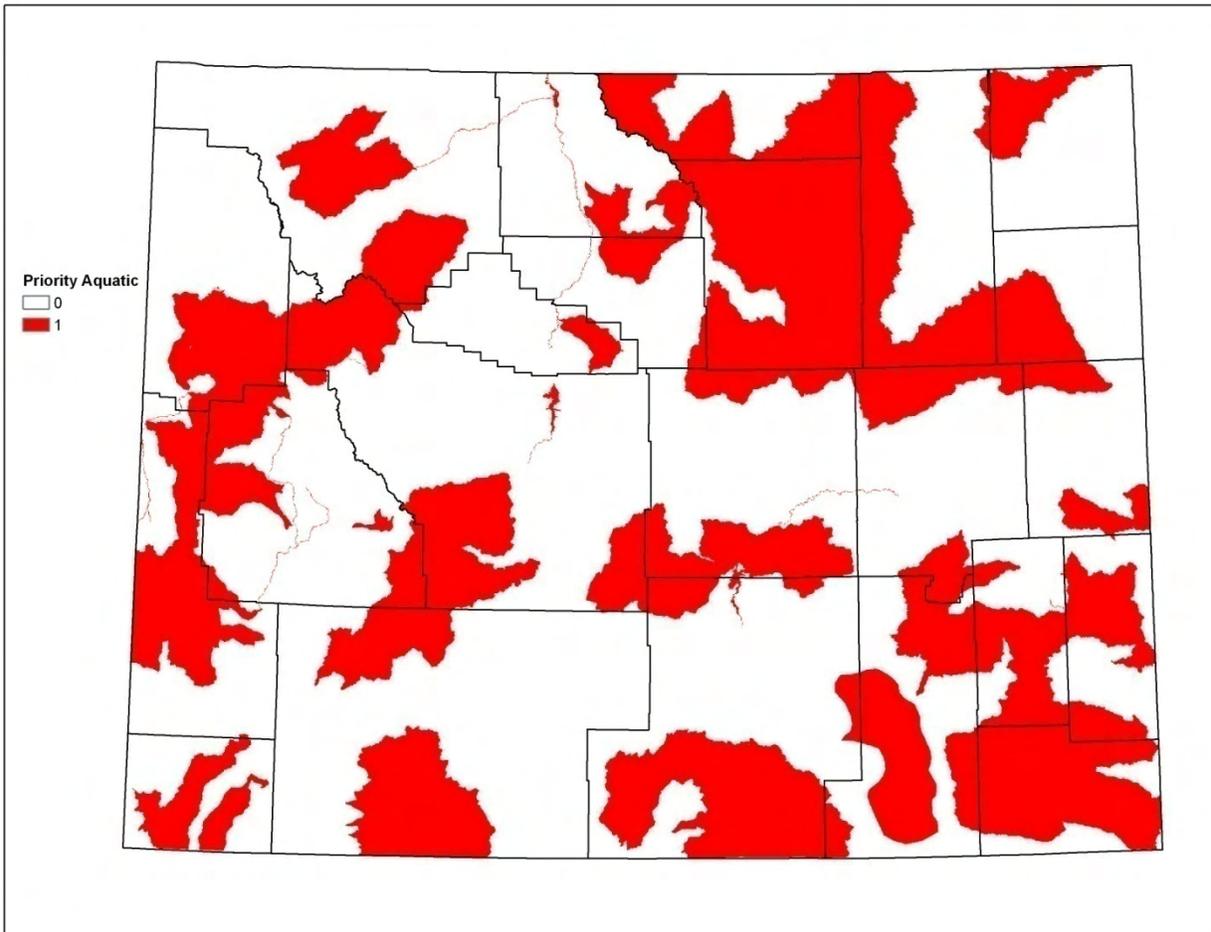
National Theme: Enhance public benefits from trees and forests.

Strategic Objective: Protect, conserve, and enhance wildlife and fish habitat.

National Direction: Assessments should identify forest landscapes that represent or contribute to viable wildlife habitats, contain high species richness, and/or represent core habitat for focal conservation species. Assessments should incorporate state wildlife action plans.

Wyoming Statewide Assessment of Forest Resources

Fish and Wildlife Habitat – Aquatic



This layer represents priority aquatic habitat data from the Wyoming Game and Fish Department and was used to emphasize important aquatic wildlife habitat. Please see Appendix A, page 59, for more detailed information on the fish and wildlife habitat layer.

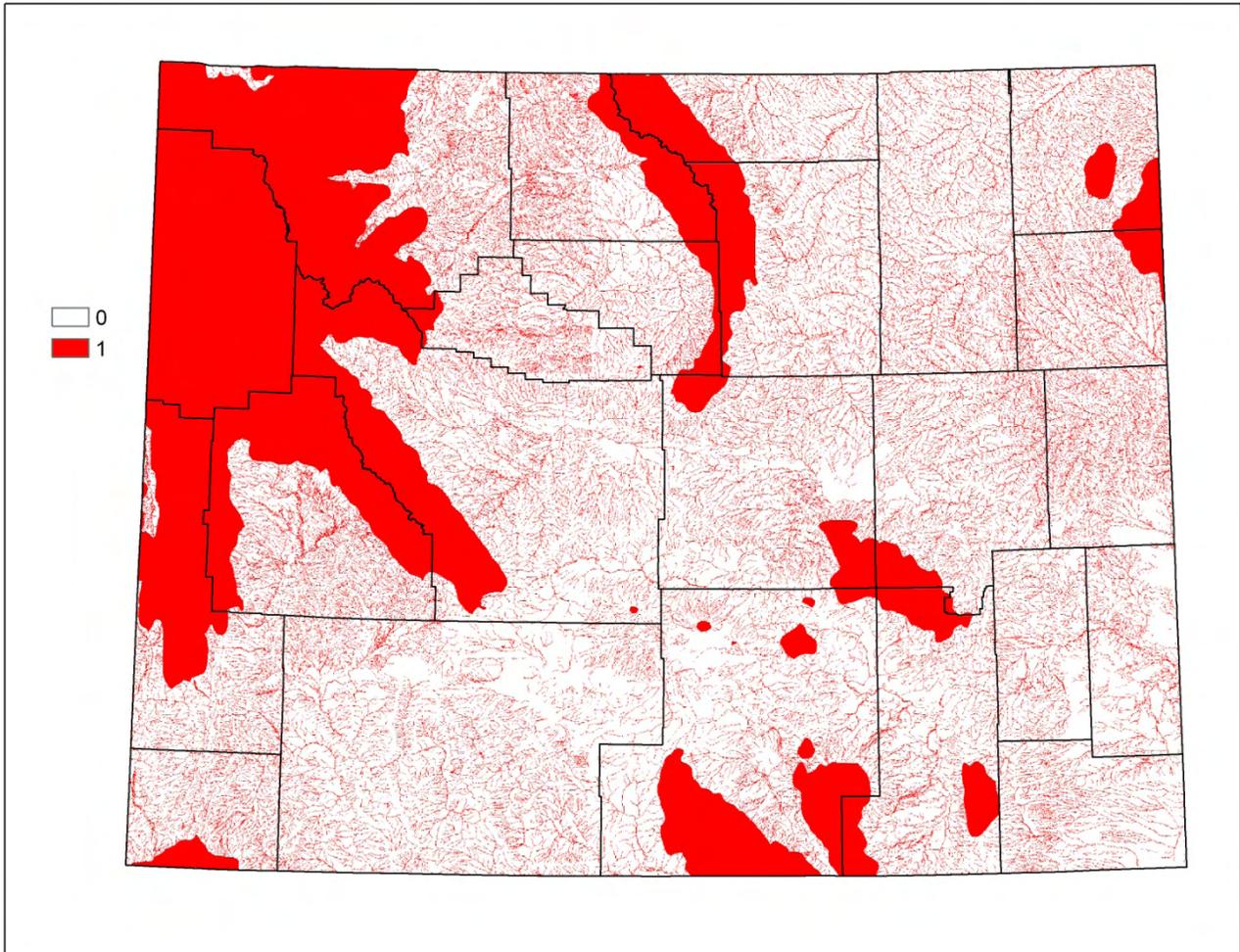
National Theme: Enhance public benefits from trees and forests.

Strategic Objective: Protect, conserve, and enhance wildlife and fish habitat.

National Direction: Assessments should identify forest landscapes that represent or contribute to viable wildlife habitats, contain high species richness, and/or represent core habitat for focal conservation species. Assessments should incorporate state wildlife action plans.

Wyoming Statewide Assessment of Forest Resources

Water Quality and Supply



This data layer was created by WSFD using all areas receiving more than 20 inches of annual precipitation combined with a streamside management zone layer. The intent of this layer is to emphasize the areas where there is sufficient precipitation to provide excess water which travels downstream for use elsewhere and areas where forest management can influence water quality and quantity. Please see Appendix A, page 59, for more detailed information on the water quality and supply layer.

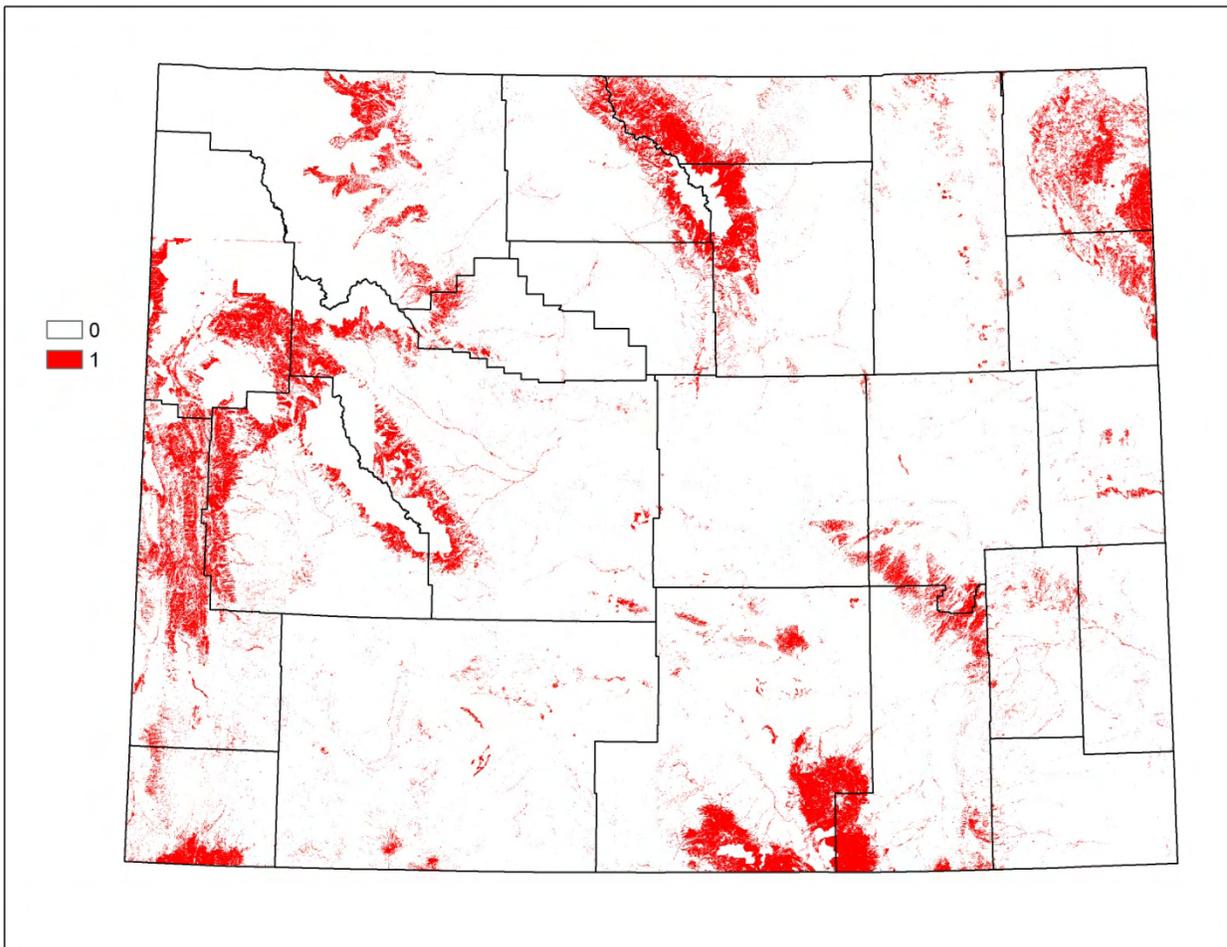
National Theme: Enhance public benefits from trees and forests.

Strategic Objective: Protect and enhance water quality and quantity.

National Direction: Assessments should identify watersheds where continued forest conservation and management is important to the future supply of clean municipal drinking water, or where restoration or protection activities will improve or restore a critical water source.

Wyoming Statewide Assessment of Forest Resources

Economic Potential – Working Forests



This layer represents non-reserved forests of any species on less than 50% slope with site index of 40 or greater (base 100). The source is National Land Cover Dataset limited to the above criteria by a model produced by WSFD. The intent is to represent all working forests – traditional, riparian, and community. Please see Appendix A, page 59, for more detailed information on the working forests layer.

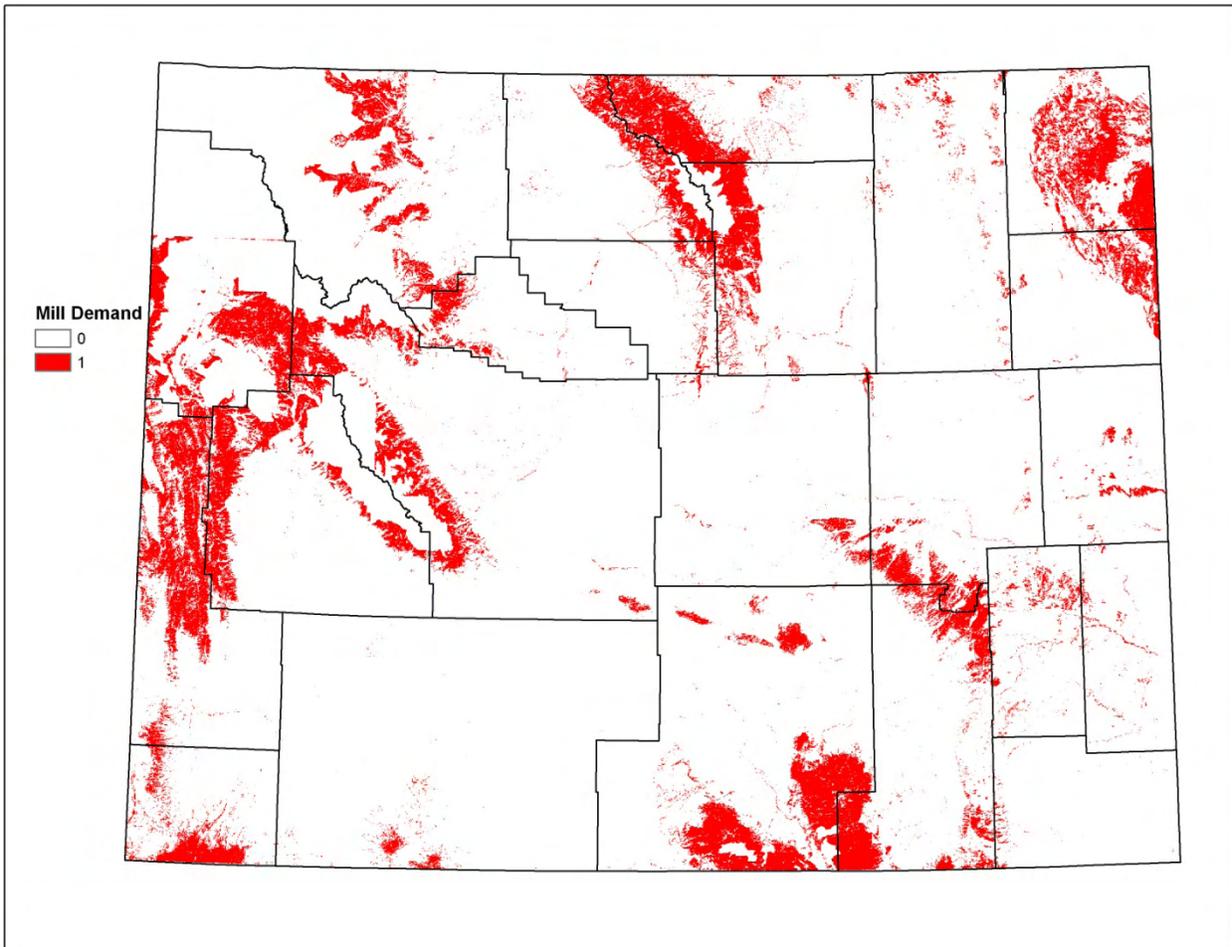
National Theme: Enhance public benefits from trees and forests.
Conserve working forest lands.

Strategic Objective: Maintain and enhance the economic benefits and values of trees and forests.
Actively and sustainably manage forests.

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments and strategies can identify viable and high potential working forest landscapes where landowner assistance programs...can be targeted to yield the most benefit in terms of economic opportunities and ecosystem services. Assessments and strategies can also identify opportunities for multi-landowner landscape scale planning and landowner aggregation for access to emerging ecosystem service markets.

Wyoming Statewide Assessment of Forest Resources

Economic Potential – Mill Demand Forests



This layer represents working forests (coniferous only) within current mill working circles as defined by WSFD. Please see Appendix A, page 59, for more detailed information on the mill demand forests layer.

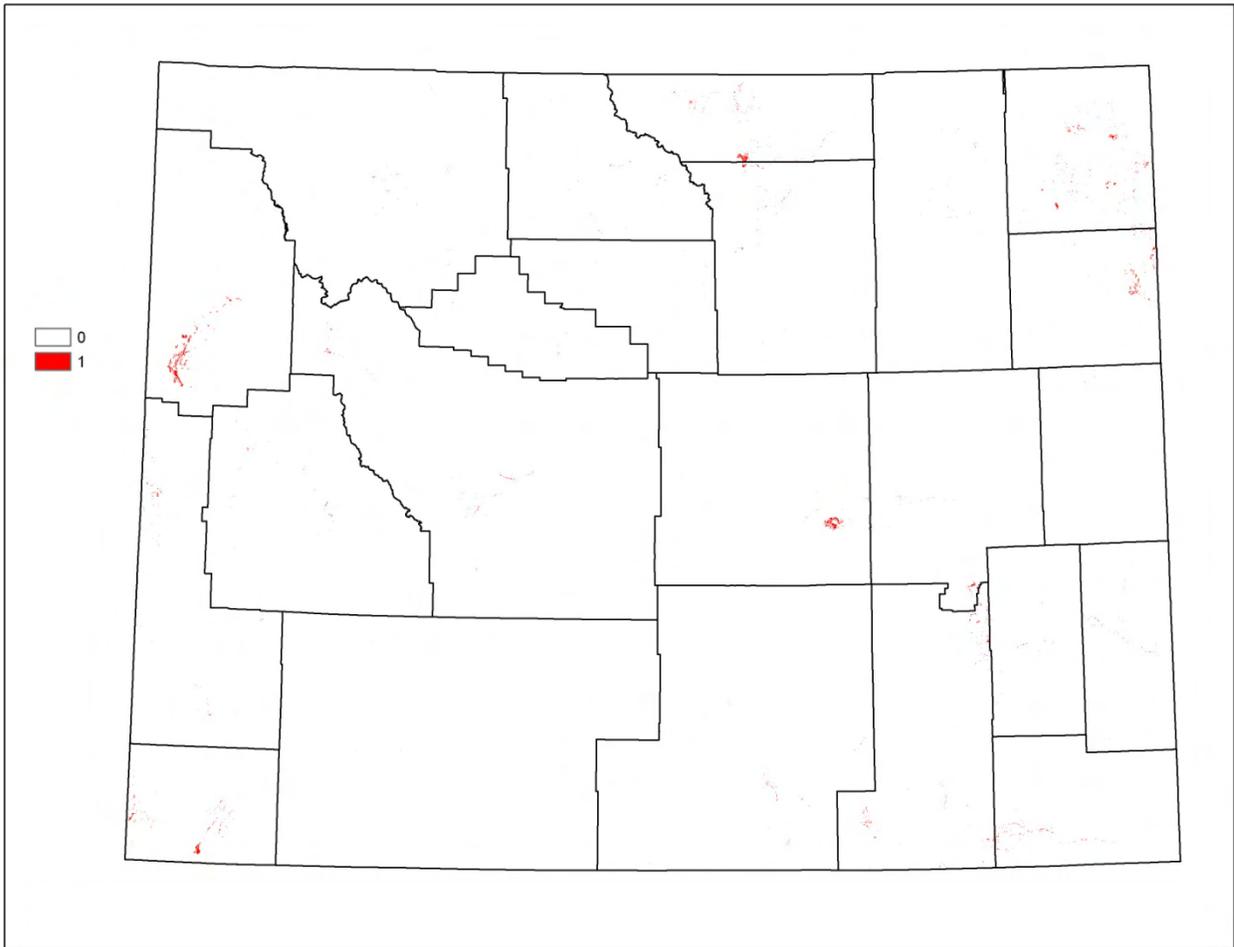
National Theme: Enhance public benefits from trees and forests.
Conserve working forest lands.

Strategic Objective: Maintain and enhance the economic benefits and values of trees and forests.
Actively and sustainably manage forests.

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments and strategies can identify viable and high potential working forest landscapes where landowner assistance programs...can be targeted to yield the most benefit in terms of economic opportunities and ecosystem services. Assessments and strategies can also identify opportunities for multi-landowner landscape scale planning and landowner aggregation for access to emerging ecosystem service markets.

Wyoming Statewide Assessment of Forest Resources

Green Infrastructure



The source for this data layer is high priority private forested lands identified by the Forest Legacy Assessment of Need (<http://slf-web.state.wy.us/forestry/adobe/legacy09.pdf>). Please see Appendix A, page 59, for more detailed information on the green infrastructure layer.

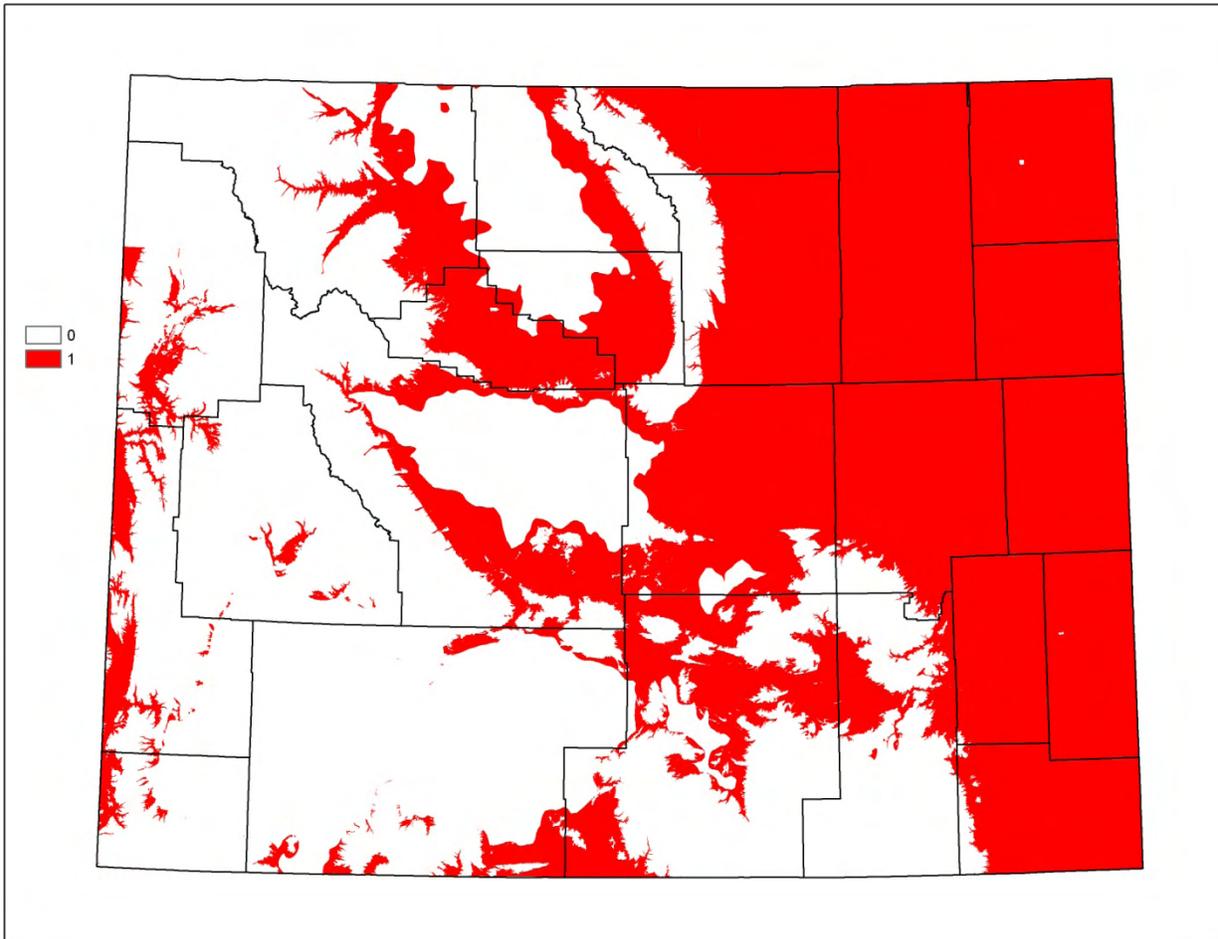
National Theme: Conserve working forest lands.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes.

National Direction: Assessments and strategies should attempt to identify, protect, and connect ecologically important forest landscapes and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.

Wyoming Statewide Assessment of Forest Resources

Agroforestry



This layer is not a specific part of the national direction but was included by WSFD due to the importance of agroforestry practices within the state. The integration of trees and shrubs with livestock and crops provides significant biological and social benefits, facilitating the retention, enhancement and restoration of biological diversity and agroecosystem resilience at field, farm, watershed and landscape levels. The state's commitment to agroforestry and the resources and expertise devoted to it are on a par with other forestry programs. The agroforestry layer from the SAP analysis was used with modification to include public lands for this analysis. Please see Appendix A, page 59, for more detailed information on the agroforestry layer.

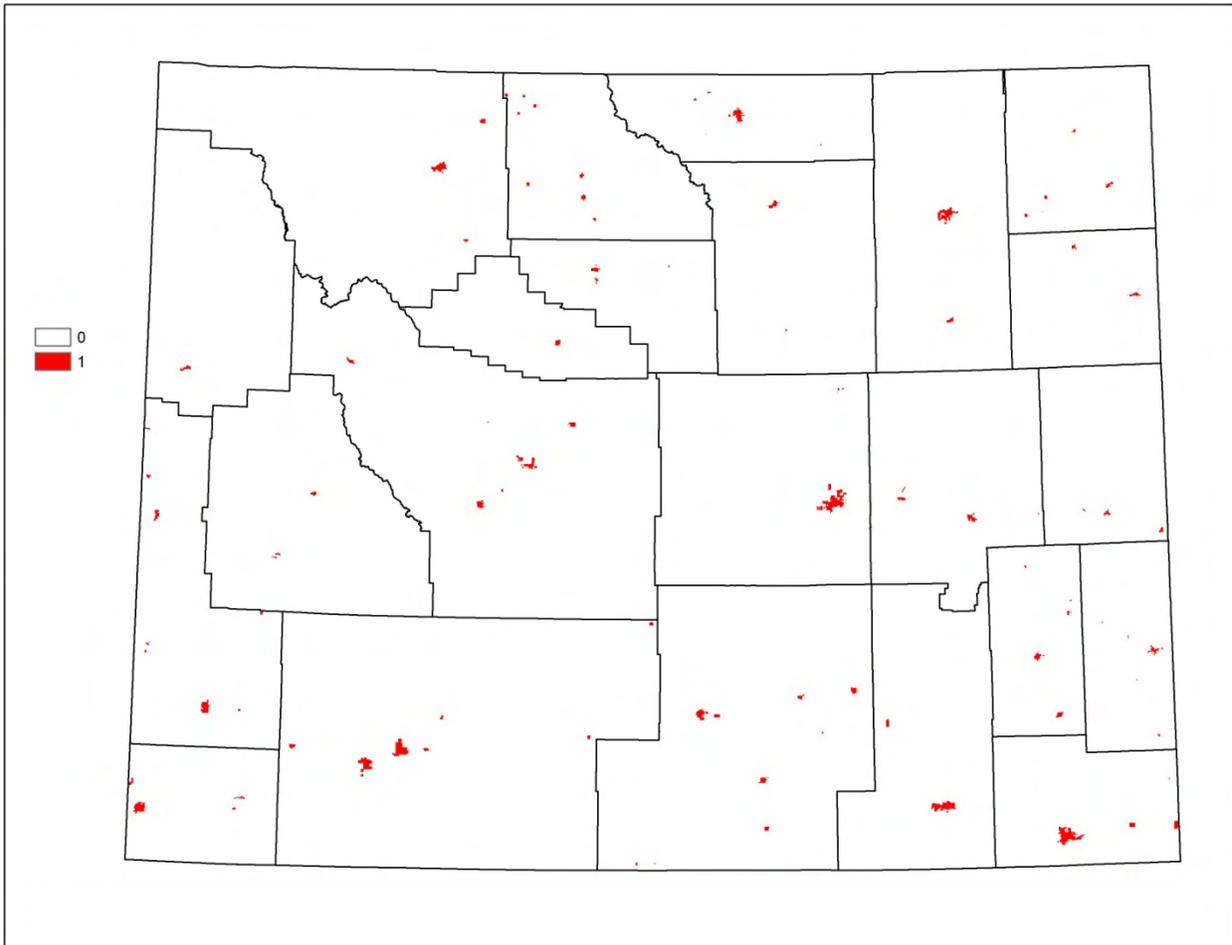
National Theme: Conserve working forest lands.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes. Actively and sustainably manage forests.

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments can identify viable and high potential working forest landscapes...where landowner assistance programs can be targeted.

Wyoming Statewide Assessment of Forest Resources

Community Forestry



Community forestry is a high priority in Wyoming because growing trees in Wyoming communities is difficult and requires commitment, expertise, and funding. Many communities lack expertise or funding and depend on WSFD for assistance. Rather than use a complex analysis to prioritize Wyoming's small number of communities, WSFD chose to use the boundaries of the incorporated communities as a layer in this analysis. Please see Appendix A, page 59, for more detailed information on the community forestry layer.

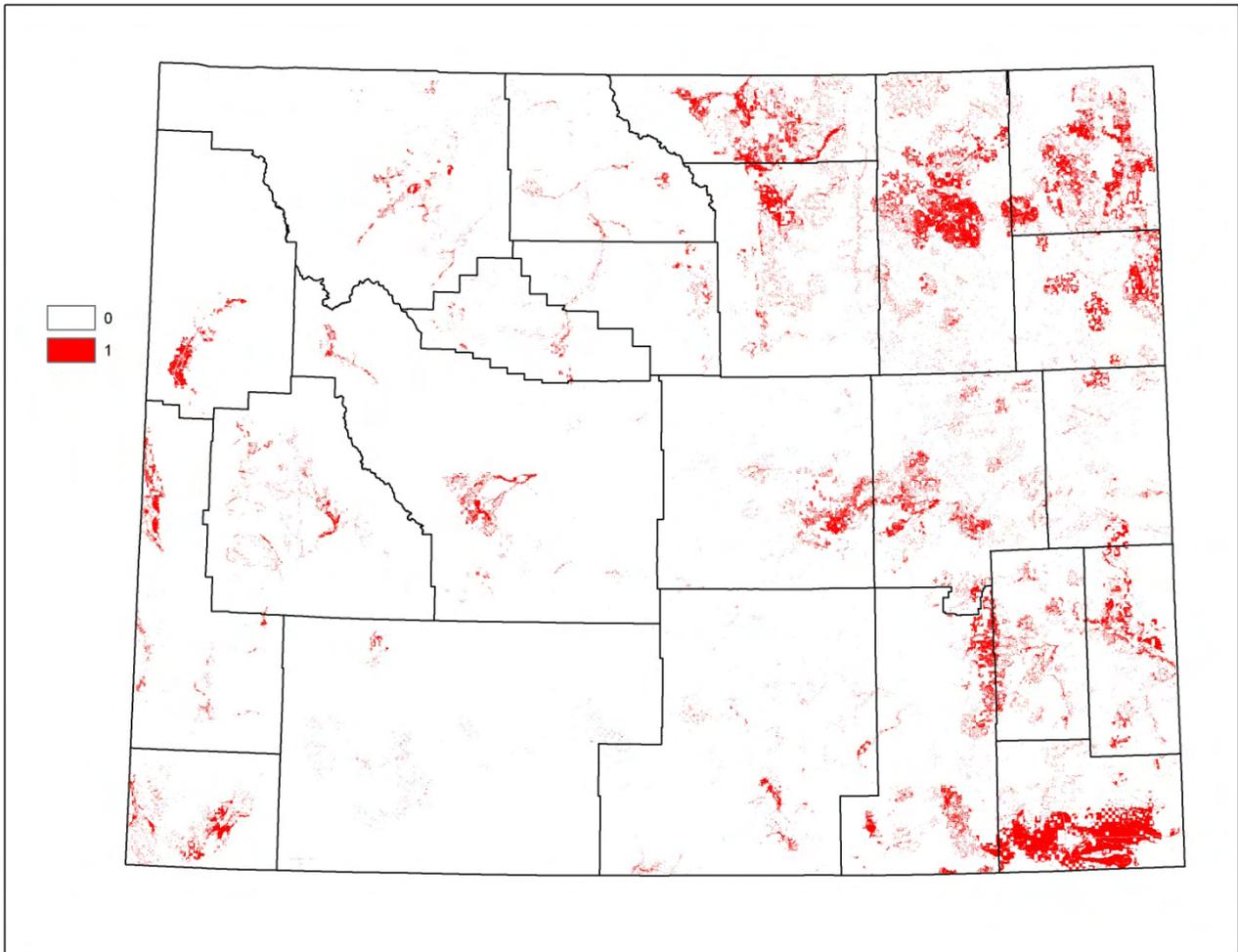
National Theme: Conserve working forest lands.
Enhance public benefits from trees and forests.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes. Actively and sustainably manage forests. Improve air quality and conserve energy.

National Direction: Assessments should attempt to identify, protect, and connect ecologically important forest landscapes and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development. Identify areas where management of the urban or exurban forest will have a positive and measurable impact on air quality and produce substantial energy savings.

Wyoming Statewide Assessment of Forest Resources

Forest Stewardship Potential



The source for this data layer is lands with high priority for forest stewardship as defined by the Spatial Analysis Project. Please see Appendix A, page 59, for more detailed information on the forest stewardship potential layer.

National Theme: Conserve working forest lands.

Strategic Objective: Identify and conserve high priority forest ecosystems and landscapes. Actively and sustainably manage forests.

National Direction: Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. Assessments can identify viable and high potential working forest landscapes...where landowner assistance programs can be targeted.

Wyoming Statewide Assessment of Forest Resources

Analysis

The national direction for state assessments suggested using at least one data layer to represent each strategic objective from the three national themes. WSFD has fulfilled that requirement and decided to include a layer representing one other forestry emphasis – agroforestry – for a total of fourteen layers. The strategic objectives that are not specifically addressed by a data layer are “Connect people to trees and forests, and engage them in environmental stewardship activities” and “Manage and restore trees and forests to mitigate and adapt to global climate change.”

One reason for the exclusion of those strategic objectives from the GIS portion of the state assessment is that fourteen layers are already included. Additional layers reduce the impact of all of the layers in the assessment. WSFD believes that the strategic objectives that are most important to Wyoming are included in the GIS analysis. Objectives such as connecting people to trees and forests and global climate change are addressed in other ways in the state assessment.

National direction encourages regional and multi-state analyses to delineate multi-state priority landscape areas. In the West, states are independently developing state assessments that are appropriate for their unique circumstances. Some states are completing state assessments in house while others are using contractors. Some states are well into the assessment process while others are early in the process. Because there is no West-wide assessment, states will need to work together to identify priority landscapes across state boundaries after the individual state assessments are completed.

National direction also indicated that a state’s geospatial assessment can include one or more weighted overlay analyses to identify priority landscapes. Wyoming’s forest resource assessment includes five separate models/overlay analyses, four of which result in layers used within the fifth weighted overlay analysis. Diagrams of the models used are included in Appendix B, page 68. It is the fifth weighted overlay that results in the composite dataset that is the final geospatial output of the state assessment.

The national direction gives states the opportunity to complete a separate analysis for individual resource management concerns. For example, if state priorities included forest health, community forestry, and wildfire risk, a state could produce a separate analysis to identify priority landscapes for each. WSFD acknowledges that it could take that approach and identify priority landscapes for many different resource management concerns. However, WSFD questions the value of that approach for Wyoming. Most assistance forestry programs are interrelated and management activities are planned to address multiple resource objectives. WSFD believes the GIS portion of the state assessment should identify priority landscapes for assistance forestry activities rather than justify certain program areas through individual analyses.

The GIS analysis was conducted at a maximum 30 meter pixel size. Whenever possible, data layers from previous analyses were utilized. For this assessment document considerable information was obtained from the Forest Legacy *Assessment of Need*.

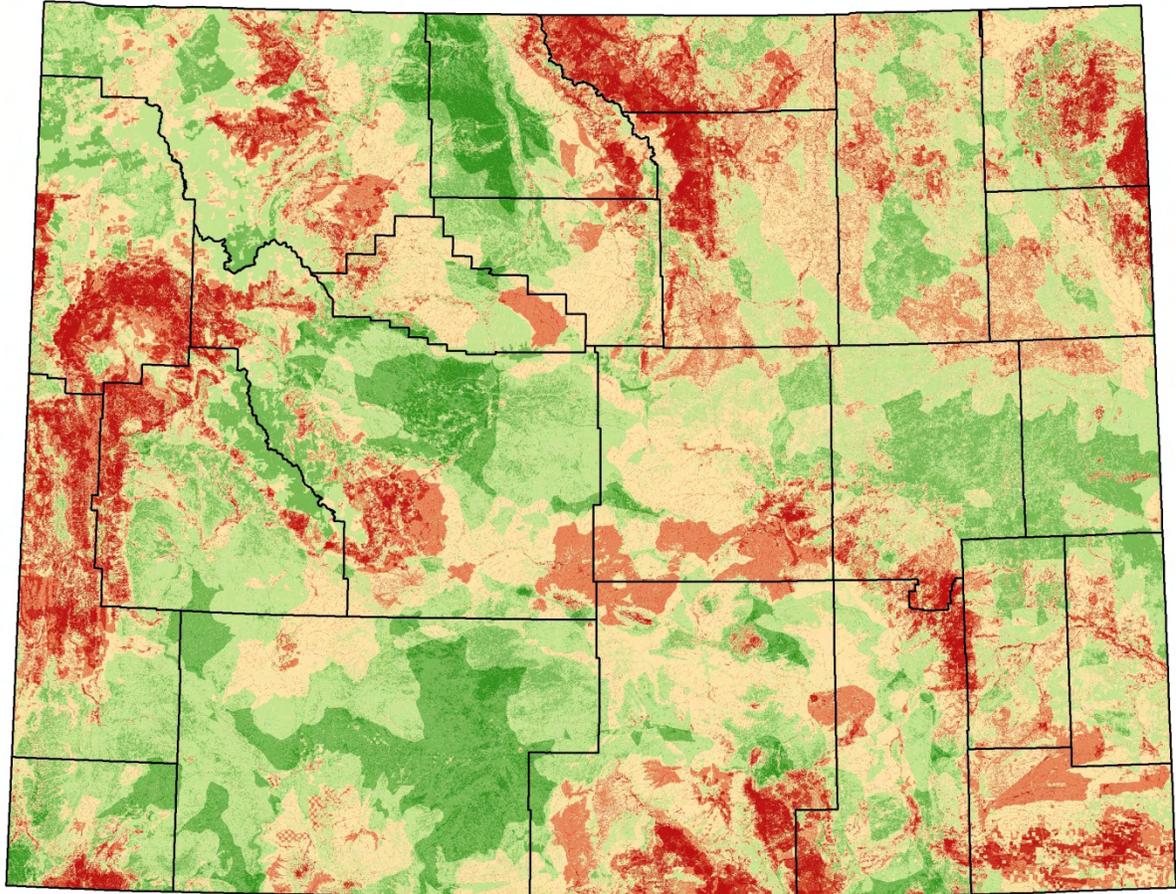
Wyoming Statewide Assessment of Forest Resources

At the start of the analysis some layers were given additional weight. Later in the process, WSFD decided, based on input from cooperators, to give equal weight to all layers. The map on page 35 is the composite dataset which delineates priority landscape areas.

Wyoming Statewide Assessment of Forest Resources

Wyoming Statewide Assessment of Forest Resources

Critical Landscapes
September, 2009



Data Layers

Development Risk: Areas expected to see increased housing development over the next 30 years. National data from CSU research.

Wildfire Risk: Areas where planning and management can reduce risk. Two layers - redzone and fire regime condition class.

Fish and Wildlife Habitat: Areas that provide habitat for valued fish and wildlife species. Game & Fish terrestrial game/non-game and aquatic data plus sage grouse core

Economic Potential: Areas where forests can or do play a major economic role. Two layers - working forests and mill demand for forests - developed by WSFD.

Agroforestry: WSFD decision to include based on importance. Data is non-forested lands below 7000 feet receiving at least 12 inches of precip.

Community Forestry: Areas where management of the community forest can have positive impacts. Data layer is boundaries of incorporated communities.

Forest Fragmentation: Areas becoming more susceptible to ISD due to fragmentation/human activity. National data layer.

Forest Health Risk: Areas where silvicultural treatment can reduce risk of damage. National insect and disease risk map data.

Water Quality and Supply: Identify watersheds where forest conservation and management is important. Areas receiving over 20 inches of annual precip plus streamside management zones.

Green Infrastructure: Emphasize opportunities for an interconnected green space network. Used high priority forest legacy areas.

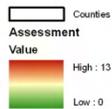
Stewardship: High priority for stewardship planning. Data is high priority from GAP analysis.

Layer Weights

Development Risk	1
Forest Fragmentation	1
Wildfire Risk	1/1
Forest Health Risk	1
Fish & Wildlife Habitat	1/1
Water Quality & Supply	1
Economic Potential	1
Green Infrastructure	1
Community Forestry	1
Agroforestry	1
Stew. Potential	1
Max. Value Possible	14

Purpose of this analysis: Identify, describe, and spatially define forest landscape areas where forestry program outreach and activity will be emphasized and coordinated.

National Priorities:
- Conserve working forest lands
- Protect forests from harm.
- Enhance public benefits from trees and forests.



Disclaimer: These data are intended for reference purposes only and the content, accuracy, timeliness, or completeness is not guaranteed. For more information or for the verification of the information contained on these data the data authors should be contacted. The State of Wyoming makes no responsibility and will not be held liable for any damages incurred as a result of the use or misuse of these data.

Wyoming Statewide Assessment of Forest Resources

Forest Conditions

Forest Health

The GIS analysis revealed that Wyoming has over 1.5 million acres at risk of significant basal area loss associated with bark beetle caused tree mortality over the next 15 years. The at-risk acres are located in every forested part of the state. In addition, during epidemics such as the current mountain pine beetle epidemic in southern and western Wyoming smaller diameter trees not normally considered at risk may be killed due to the high numbers of bark beetles.

Across the state, forest stands are often mature to overmature and overly dense. Lack of age class diversity at the landscape level contributes to increased risk of bark beetle caused tree mortality. For example, in the Medicine Bow National Forest Land and Resource Management Plan (2003), insect risk was considered medium to high on over 500,000 acres, and 64 percent of the forested lands (over 392,000 acres) are classified as Habitat Structural Stage (HSS) 4 or 5, which roughly correlates with ages from 70 to 200+ years. The Bighorn National Forest Land and Resource Management Plan (2005) denotes similar patterns although it depicts size class and age class differently than the Medicine Bow National Forest (NF) plan. The Black Hills National Forest Land and Resource Management Plan (2005) indicates that about 50% of the forest stands are more than 100 years old. On state trust lands, stands are identified by size class rather than age. Across all species and all acres, 42% of the forested state lands are in the largest size class, which roughly correlates with trees over 100 years old. The pattern continues across the state, although reliable stand-level private land data is unavailable.

The results of the lack of age class diversity and overall susceptibility to insect attack are already being observed throughout the state. Bark beetle caused tree mortality has significantly affected the Medicine Bow NF, Shoshone NF, Uinta-Wasatch-Cache NF, and Bridger-Teton NF in addition to surrounding state and private lands. Other areas, such as the Bighorn NF and Black Hills NF and surrounding state and private lands are also experiencing increasing levels of tree mortality caused by bark beetles.

Mountain pine beetle populations are increasing in southern Albany and Carbon Counties. Most of the large diameter lodgepole pine forests in these areas are expected to be attacked by mountain pine beetle within the next 2 – 5 years. Mountain pine beetle susceptible hosts as small as five inches in diameter are currently being attacked and subsequently killed. Forest stand conditions combined with favorable weather conditions allowed mountain pine beetle populations to increase in both southern Wyoming and northern Colorado. An ongoing mountain pine beetle outbreak continues to kill large amounts of ponderosa pine in the Black Hills in northeastern Wyoming.

Limber pine stands statewide are being killed by the combination of white pine blister rust and mountain pine beetle. Tree mortality has continued to spread within these higher elevation forest types, particularly in the Bighorn Mountains, Gros Ventre Range, Wind River Range, and in the southern Laramie Range. Populations of mountain pine beetle are surviving at higher elevations than they have in the past. Whitebark pine and limber pine on the Shoshone NF and Bridger-Teton NF are also being killed by an expanding mountain pine beetle epidemic in northwest Wyoming.

Wyoming Statewide Assessment of Forest Resources

Douglas-fir beetle and spruce beetle outbreaks continue to increase in forest stands with sufficient susceptible Douglas-fir and Engelmann spruce. Engelmann spruce as small as five inches in diameter are being attacked and killed by spruce beetle in the Carter Mountain area outside Cody.

There are potential long term impacts of climate change on Wyoming's forests. Under a long term reduced precipitation scenario, forest health impacts could be significant. Distribution of tree species could be altered as species better able to tolerate warmer and drier conditions expand their distribution. The timing and duration of fire seasons could change.

Invasive plant and insect species are major forest health threats. Exotic insects are a serious threat to forests that did not evolve with the insects. Invasive plants can replace native vegetation and change fire regimes.

Many damaging agents are impacting Wyoming's forests, whether traditional, riparian, or community. Brief descriptions of the current situation follow:

- White pine blister rust is affecting the distribution and vitality of ecologically important whitebark pine and limber pine stands.
- Dwarf mistletoe in lodgepole, Douglas-fir and ponderosa pine forests is present in 30-60 percent of the National Forest lands east of the continental divide and 67 percent of the lodgepole forests and 17 percent of the Douglas fir forests west of the divide in Wyoming (USDA, 2001).
- Douglas-fir beetle has affected scattered stands that have been stressed by the now decade-old drought, fire, root rot, defoliation by western spruce budworm, or windfall, with noted increases in the North Fork of the Shoshone River where Johnson and McMillan (2000) observed dramatic increases between 1998 and 1999. Douglas-fir beetle has also killed extensive areas of Douglas-Fir on the west side of the Bighorn NF and in the lower elevations of the North Platte watershed on the Medicine Bow NF.
- Western balsam bark beetle, fir engraver beetle, and armillaria and annosus root diseases are the major cause of mortality in subalpine fir in Wyoming and have been observed on all national forests in Wyoming (USDA, 2001).
- Saltcedar and Russian olive are exotic plants that are replacing native willow and cottonwood forests that play a significant ecological role in Wyoming.
- Bark beetles have begun to affect community forests with landscape trees facing a significant threat in some communities, even far removed from natural forests.
- While drought conditions have recently subsided, the effects of the previous prolonged drought linger and will continue to affect forest vegetation until moisture levels are average or above average for a sufficient period of time allowing forest vegetation to completely recover from the effects of drought.
- A particular exotic species that was noted by the USDA Wyoming Forest Health Report (2001) as a threat to forests is leafy spurge. This noxious and toxic weed tends to form extensive mono-cultures that are very difficult to contain and control, and can result in tree mortality as an off target consequence of the chemical control process. Herbicide treatments can adversely affect some native vegetation where control treatments are administered. Leafy spurge is dramatically increasing in Wyoming, particularly in the

Wyoming Statewide Assessment of Forest Resources

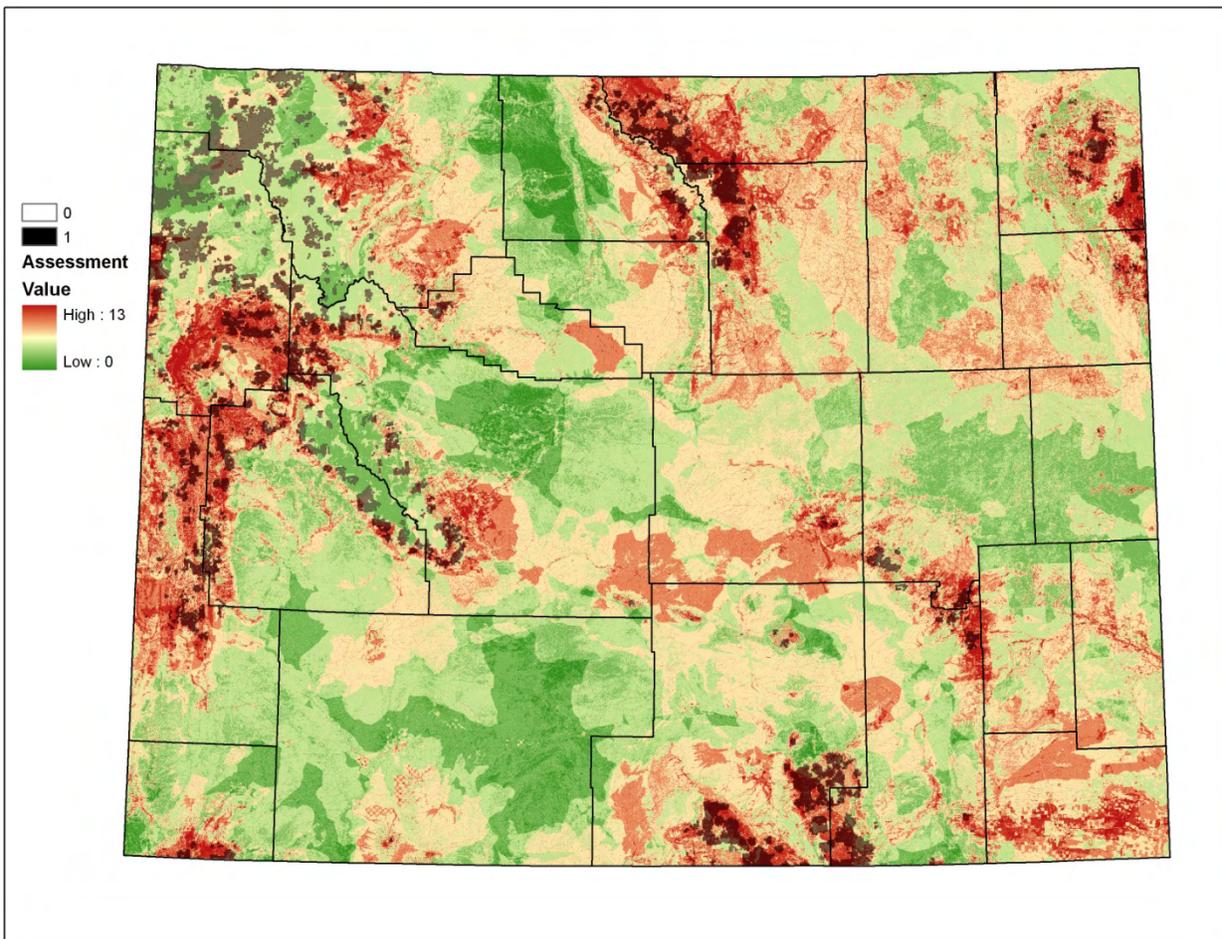
- northeastern area where the most commercially valuable forests in the State reside.
- Other exotic pests pose an ongoing threat to native forests in the state.

Most communities in Wyoming were developed on the prairies. The early source of plant materials was generally confined to cottonwoods growing naturally along rivers and streams. Although fast growing, cottonwoods are not long lived and these over mature trees are rapidly declining in many communities. Many were planted as street trees and are not being replaced with more diverse species or are not being replaced at all.

Drought conditions have lead to the decline of shallow rooted mature spruce and infestations of spruce ips beetle and other detrimental insects in communities around the state. More drought tolerant pines are suffering from the spread of mountain pine beetle from native forests to community forests.

The map below shows the state assessment final map with forest health risk as an overlay. Forest health risk is a significant contributor to many of the priority areas. Efforts to address the forest health risk would be beneficial to the priority areas.

Priority Areas with Forest Health Overlay



Wyoming Statewide Assessment of Forest Resources

The ongoing mountain pine beetle epidemic will probably result in increased aspen regeneration in many parts of the state as competition from conifers is reduced. There are many positive impacts from increased aspen, including diversity, more forage production, and the more fire resistant nature of aspen stands. Aspen is generally considered a disturbance dependent species. Over time, more shade tolerant conifers would be expected to reoccupy the sites where they previously existed. The current debate over “conifer encroachment” versus forest succession will likely continue as management decisions must be made regarding which species should occupy the sites for the long term. Maintaining the increased aspen on the landscape without continued disturbance will prove difficult.

Wildfire Risk

Wyoming has experienced a number of “above average” fire seasons in recent years. Extended drought, extensive areas of beetle-killed trees, aging forest stands, and high fuel loading due to historic fire suppression and reduced active forest management have all contributed to the higher levels of fire activity.

While the longer fire return interval forest types, such as spruce-fir, some lodgepole pine, and moist Douglas-fir sites may not have missed a fire return yet, the shorter fire return interval types like ponderosa pine, dry Douglas-fir sites, limber pine, juniper, and sagebrush may have missed fire return intervals and stand conditions may be outside of historic norms.

One generally accepted measure of the current condition of the different forest types relative to normal fire regimes is Fire Regime Condition Class (FRCC) – one of the data layers in the assessment. FRCC is a classification of the amount of departure from the normal regime. There are three classes, with Class 2 and Class 3 indicating departure from the normal regime and need for some mechanical treatment prior to fire reintroduction, among other things (<http://www.nwcg.gov/teams/wfewt/message/FrccDefinitions.pdf>).

According to the GIS analysis, Wyoming has over 37 million acres of FRCC Class 2 and Class 3 lands. In some cases, those lands would benefit from treatment prior to returning fire to the system to avoid the loss of ecosystem components.

The bark beetle epidemic in progress will be a long term problem for fire managers. Fire danger will initially increase due to the standing dead trees. The initial risk will decrease after a few years, but then increase again as the trees begin to fall in large numbers, probably in about 10 years.

While FRCC is an accepted method of evaluating fire, fuels, and the risk of catastrophic fire, the Wildland-Urban Interface (WUI) requires a different analysis. Fire suppression in the WUI is a high priority due to the risk to public and firefighter safety and other values at risk. WUI fires also tend to be expensive because of the level of effort given to suppression of those fires.

The WUI is expanding in Wyoming, like most of the West, as more homes are built in fire prone areas. There is little interest in regulation to reduce residential development in the WUI. Efforts have instead focused on homeowner education, fuel reduction, and defensible space

Wyoming Statewide Assessment of Forest Resources

development. Some areas have been very proactive, such as Natrona County, where a defensible space is required prior to building a structure on Casper Mountain.

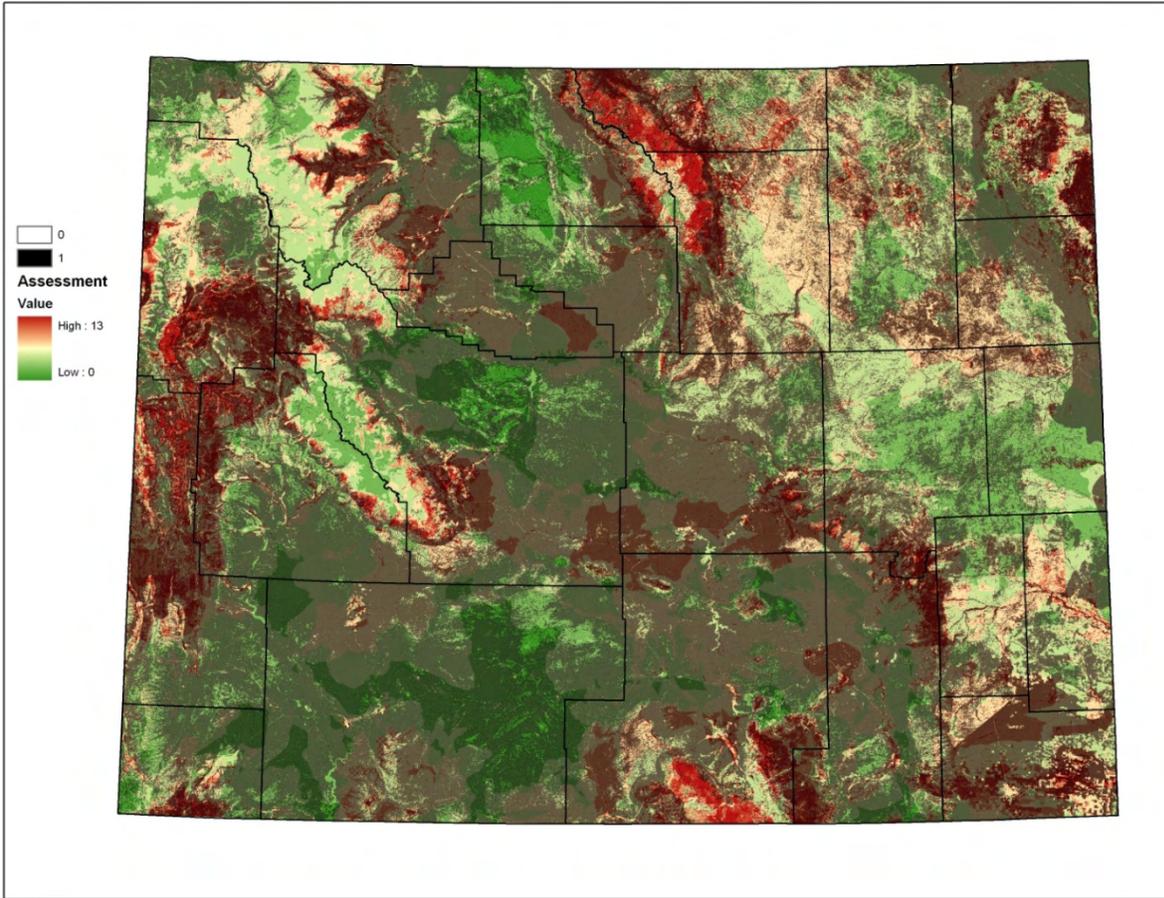
One important tool for county governments, county fire organizations, communities, and land management agencies is the Community Wildfire Protection Plan (CWPP). A CWPP identifies communities at risk and recommends measures to mitigate the risk across ownership boundaries. Land management agencies have begun to pay close attention to CWPP's and in many cases projects recommended by a CWPP have become high priorities for land managers. Cooperative projects across ownership boundaries are critical to mitigate fire risk around a community. Such projects are becoming more common in Wyoming.

Wyoming completed a wildfire hazard assessment in 2001. That analysis focused on fuel loading, risk of fire ignition, and values at risk. One of the outputs was a Wyoming Redzone layer, indicating areas where fuels, ignition risk, and values at risk are all high. The redzone layer was used to represent the WUI and the CWPP identified communities at risk in the state assessment. Wyoming has about 1,880,000 acres of redzone. Based on current and anticipated levels of development, that number can be expected to increase, necessitating continued emphasis on homeowner education, fuel reduction, and defensible space.

The maps below and on page 42 show the state assessment final map with the wildfire risk layers as an overlay. Wildfire risk is a significant contributor to many of the priority areas. Efforts to address the wildfire risk would be beneficial to the priority areas.

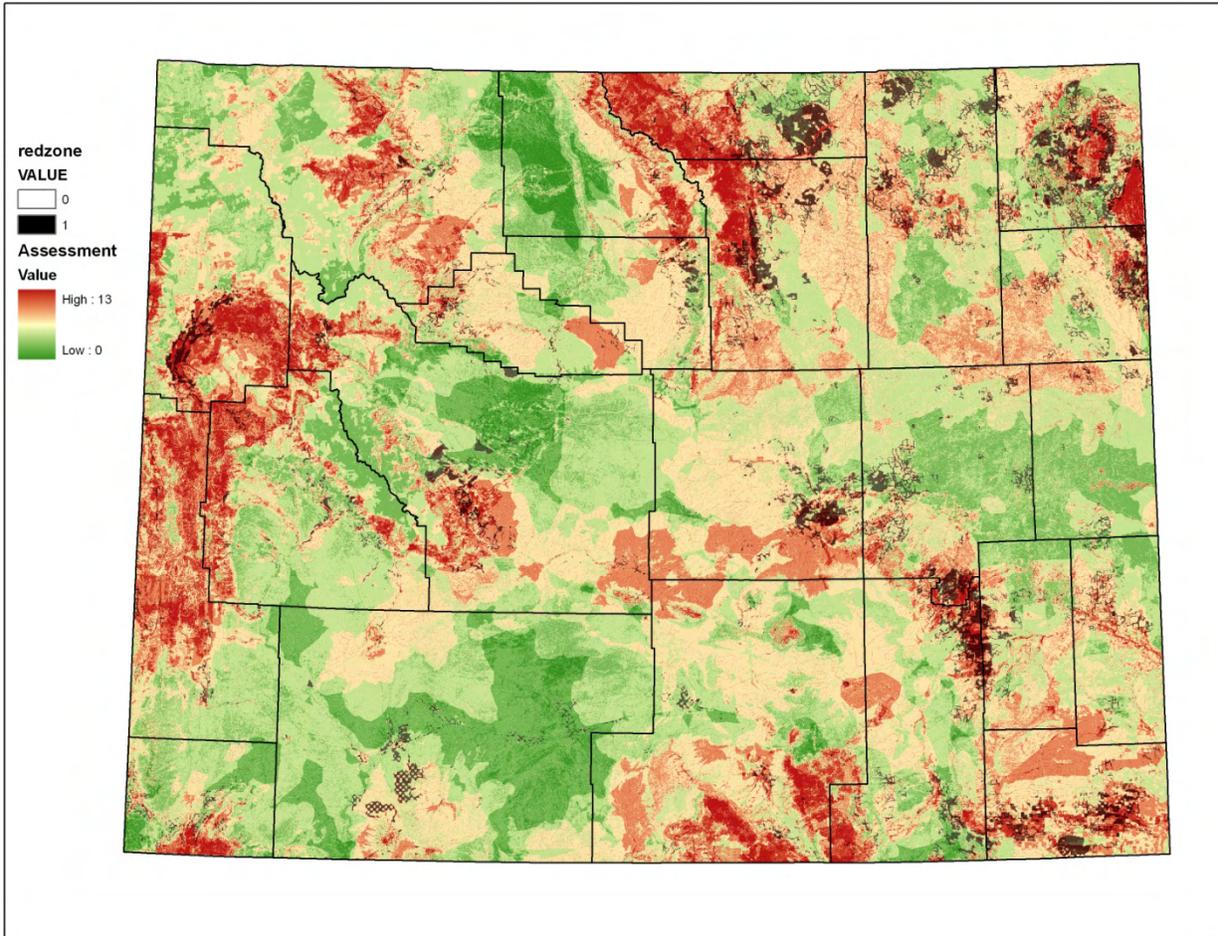
Wyoming Statewide Assessment of Forest Resources

Priority Areas with Wildfire Risk FRCC Overlay



Wyoming Statewide Assessment of Forest Resources

Priority Areas with Wildfire Risk Redzone Overlay



Fish and Wildlife Habitat – Terrestrial Habitat

Wildlife is a valuable resource in Wyoming, important to the economy through hunting and other recreation, and important to the “way of life” in the state. Maintaining quality habitat is a top priority for wildlife managers. In addition to the wildlife action plan, the Wyoming Game and Fish Department also has a strategic habitat plan in place. Habitat considerations influence most natural resource management decisions in the state to some degree.

Among the current issues in Wyoming is the status of aspen, a species that appears to be declining. In some cases aspen is not successfully regenerating and in some cases competition from conifers is impacting aspen. Whether competition from conifers is “conifer encroachment” or forest succession is debatable and probably depends upon the site in question. The lack of successful regeneration could have a number of causes, including drought, herbivory, and the lack of disturbance and/or harvesting of aspen stands. Many projects planned by the land management agencies address retaining or increasing aspen.

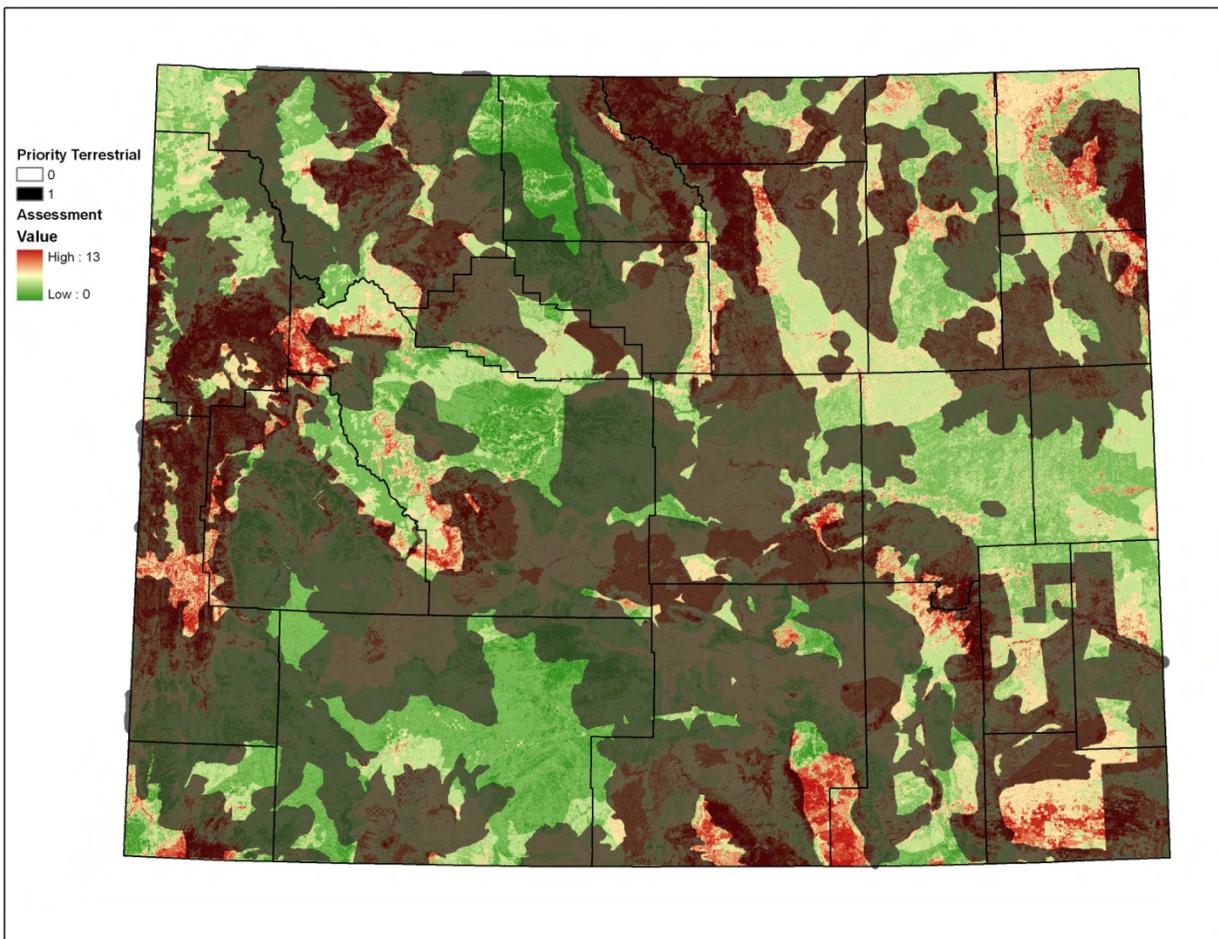
Wyoming Statewide Assessment of Forest Resources

Another important issue is the potential listing of sage grouse under the Endangered Species Act. There is a cooperative effort underway to take action to protect core habitat areas with the goal of preventing a listing. An executive order directs state agencies to evaluate projects for their potential impacts to sage grouse core habitat and apply certain criteria to projects within core areas.

The impacts of a major disturbance like the developing mountain pine beetle epidemic in southern Wyoming (and other areas) are unknown at this time. The scale of this event has not been seen before, at least in recent history. Clearly forest cover will be reduced for some time, perhaps twenty years. Distribution of mature forest will be limited for 60 – 80 years. Available forage, water yield, and aspen are likely to increase.

The map below shows the state assessment final map with priority terrestrial habitat as an overlay. Priority terrestrial habitat is a significant contributor to many of the priority areas and efforts to address the priority terrestrial habitat would be beneficial to the priority areas.

Priority Areas with Priority Terrestrial Habitat Overlay



Wyoming Statewide Assessment of Forest Resources

Water Quality and Supply

In the arid West, water quality and supply has always been a critical issue for people, wildlife, industry, and agriculture. Long term drought, like the recent period in Wyoming, increases the focus on the issue. Pressure on the available water can be intense due to competing demands.

Wyoming's water mostly comes from melting snow from the mountains. Experimental projects are underway to evaluate cloud seeding as a means to increase snowfall. Management actions that can increase water yield while protecting water quality could be helpful.

The large scale insect epidemic in southern Wyoming is predicted to significantly increase water yield in the area. However, as the dead trees become available fuel for a fire, the risk of a large fire with the potential for negative effects on water quality increases.

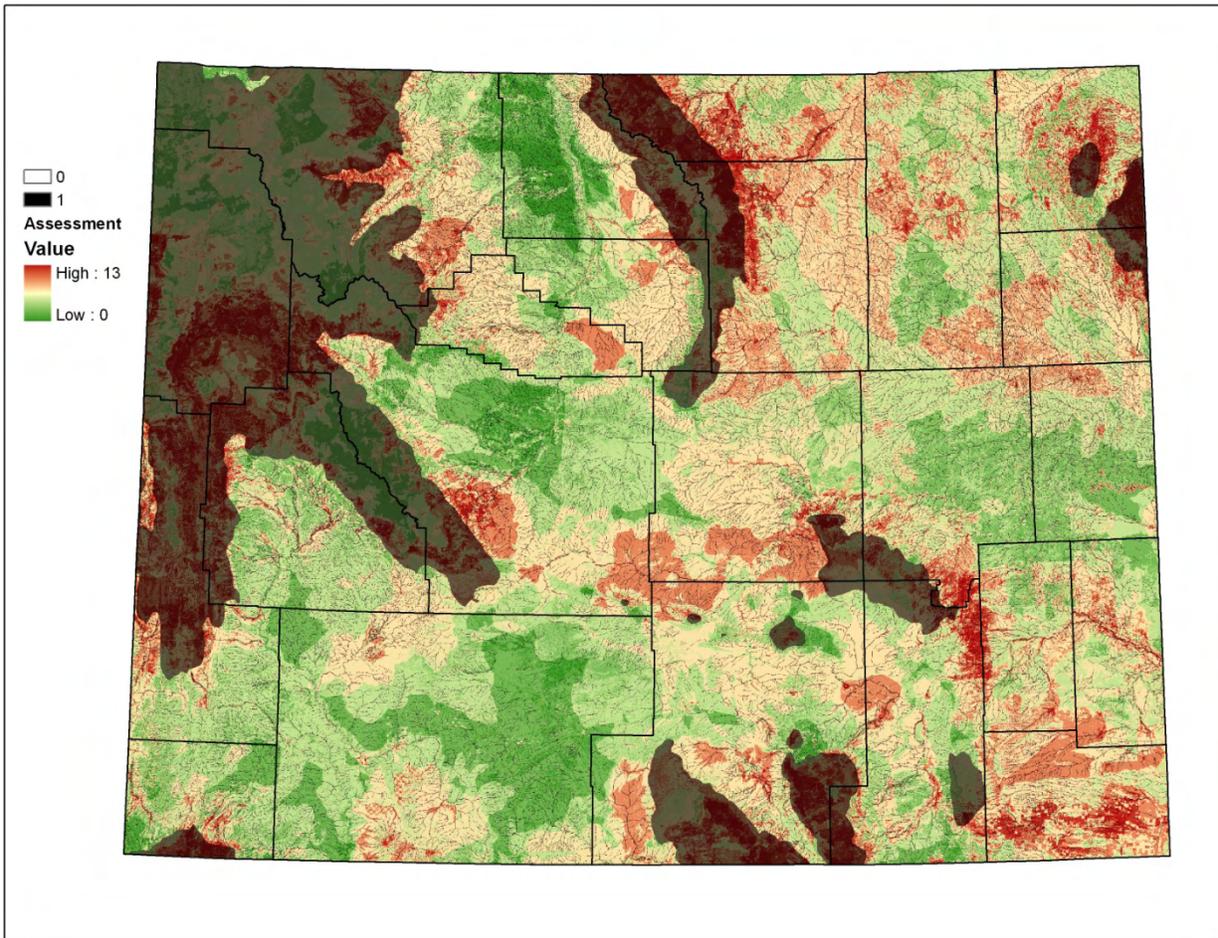
Climate change could impact water quality and supply. Should climate change produce a long term reduced precipitation scenario, water quality would be reduced. The amount and timing of runoff and peak flows could be altered. Increased fire activity during a warmer/drier period could negatively impact water quality as larger, hotter fires affect vegetative cover and soils.

Wyoming has a voluntary mechanism in place to protect water quality. Wyoming's Silviculture Best Management Practices are a cooperative effort between WSFD, the Department of Environmental Quality, the forest products industry, forest landowners, and land management agencies. A system of logger/land owner/land manager education and audits of timber sales exists to help maintain clean water and avoid impacts to streams. The ongoing audits have shown high implementation and effectiveness of the BMP's and provided the information needed to focus training as problems arise.

The map on page 45 shows the state assessment final map with water quality and supply as an overlay. Water quality and supply is a significant contributor to many of the priority areas and efforts to address water quality and supply would be beneficial to the priority areas.

Wyoming Statewide Assessment of Forest Resources

Priority Areas with Water Quality and Supply Overlay



Economic Potential

Wyoming's forests have always played an important economic role. Historic uses included timber harvesting for railroad ties and lumber, livestock grazing, mining, hunting, and fishing. Small sawmills existed in many locations around the state.

Uses of the forests today are similar. Recreation has increased in importance. Old timber harvesting practices have been replaced by modern, efficient practices. The small sawmills have decreased in number while larger more efficient operations have emerged. Livestock grazing remains an important use of the forests.

The forest products industry in the state faces many challenges. Availability of wood for harvest is a limiting factor on the industry. Historically, about 78 percent of the supply for the industry came from federal lands. Today, much less comes from federal lands while 66 percent (2005) comes from private lands and the total wood offered for sale has declined significantly. The sustainability of the current ratio is questionable given that 62 percent of the commercially available forest lands are under federal management. Harvests on private timber lands have

Wyoming Statewide Assessment of Forest Resources

provided a disproportionate share of the log supply since about 1990, due to high prices for private timber and increased demand from the forest products industry. Looking forward, it appears that the amount of private timber available for harvest will be reduced to more sustainable levels. Investment in forest products industry infrastructure requires a consistent and predictable supply of raw materials. Raw material availability is limited despite that fact that growth exceeds mortality and removals by about 123%, and growth exceeds removals by more than 700%. Mortality exceeds removals by more than 500%.

National and global economic factors and the global nature of the forest products industry create difficulties for the industry in Wyoming. The depressed housing market and ongoing financial crisis has resulted in a historic low in the lumber markets. High fuel prices have impacted shipping of products from the forest to the mill to the market, although those prices are currently decreasing. Mills must obtain logs from much longer distances (up to 200 miles and more) than in the past.

Wyoming currently has two medium to large sawmills operating. The number of mills in the State declined from 107 in 1957 to 23 in 2000 and 21 in 2005 with only two major mills remaining today. In 2005 the four largest mills processed 89% of the total volume processed in the state. (Wyoming's Forest Products Industry and Timber Harvest, 2005; http://www.fs.fed.us/rm/pubs/rmrs_rb009.pdf) The largest mill in the state (the former Louisiana-Pacific mill in Saratoga) closed in 2003. More recently, mills in Sheridan, Cody, and Laramie were closed permanently. The Saratoga mill is under new ownership and it has been announced that the mill will reopen. There is a shortage of forest products industry capacity in most of the state.

Without the forest products industry, forest management on a meaningful scale becomes difficult to accomplish. There is an opportunity to use forest management projects to produce the raw materials to sustain the industry while addressing the problems described elsewhere in this document, such as forest health and wildfire risk.

There is interest in a new type of forest products industry to utilize small diameter material, dead trees, and mill residue, which are among the materials generally described as biomass. Using biomass to heat schools, produce wood pellets, and generate electricity have all been explored. Federal and state governments have provided technical assistance and funding to promote new markets. Economic factors, such as the cost to transport materials to a processing facility, have made establishment of these new markets difficult. Economic factors will probably dictate that new markets would be most successful if located near a traditional mill to allow the higher value products to offset the transportation costs for the biomass.

Of course there is non-commodity economic potential related to Wyoming's forests, such as recreation, tourism, clean air, clean water, and habitat value. There is also other commodity related economic potential, such as oil and gas development. These are all important economic issues and the intent of this assessment is not to minimize them. However, the direction for this assessment is clear that economic potential refers to "...areas where there is a real, near-term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services."

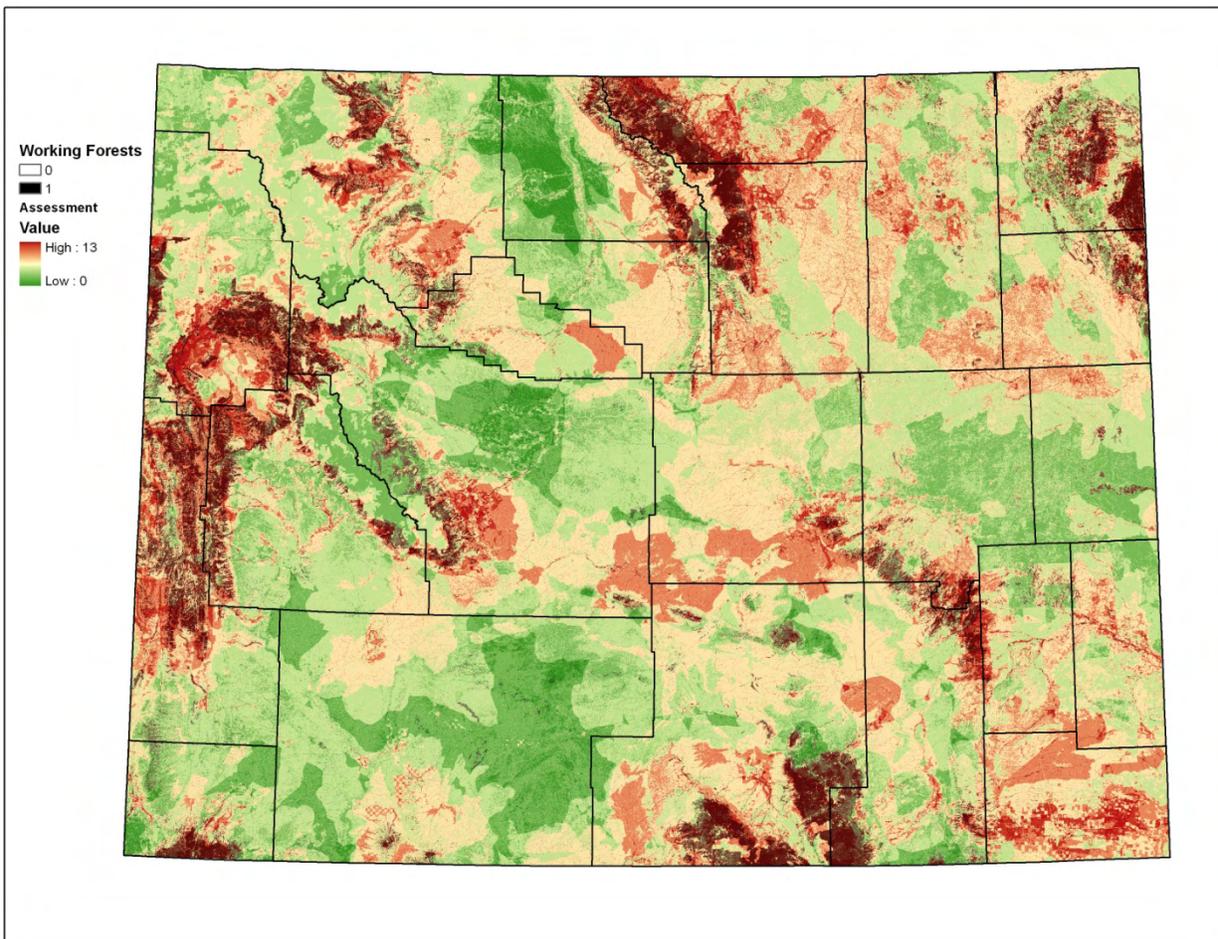
Wyoming Statewide Assessment of Forest Resources

Ecosystem services is another topic of interest, particularly with potential markets for carbon offsets and the role that forests can play through carbon sequestration as a method of mitigating climate change. Forests can sequester significant carbon. According to a University of Wyoming (UW) study in cooperation with WSFD, the most densely stocked forests, even with relatively small diameter trees, contain the most stored carbon. Thinned stands and younger, faster growing stands sequester carbon at a faster rate as they grow. The issue with relying on densely stocked stands to sequester carbon is that they may not be sustainable for the long term due to the risk of loss to insects, disease, and wildfire.

Markets for carbon offsets have been slow to develop for Wyoming landowners. WSFD explored a sale of carbon offsets but one climate exchange was unwilling to allow state governments to participate. Should a “cap and trade” system be implemented in the United States then markets for forest carbon may begin to develop more rapidly.

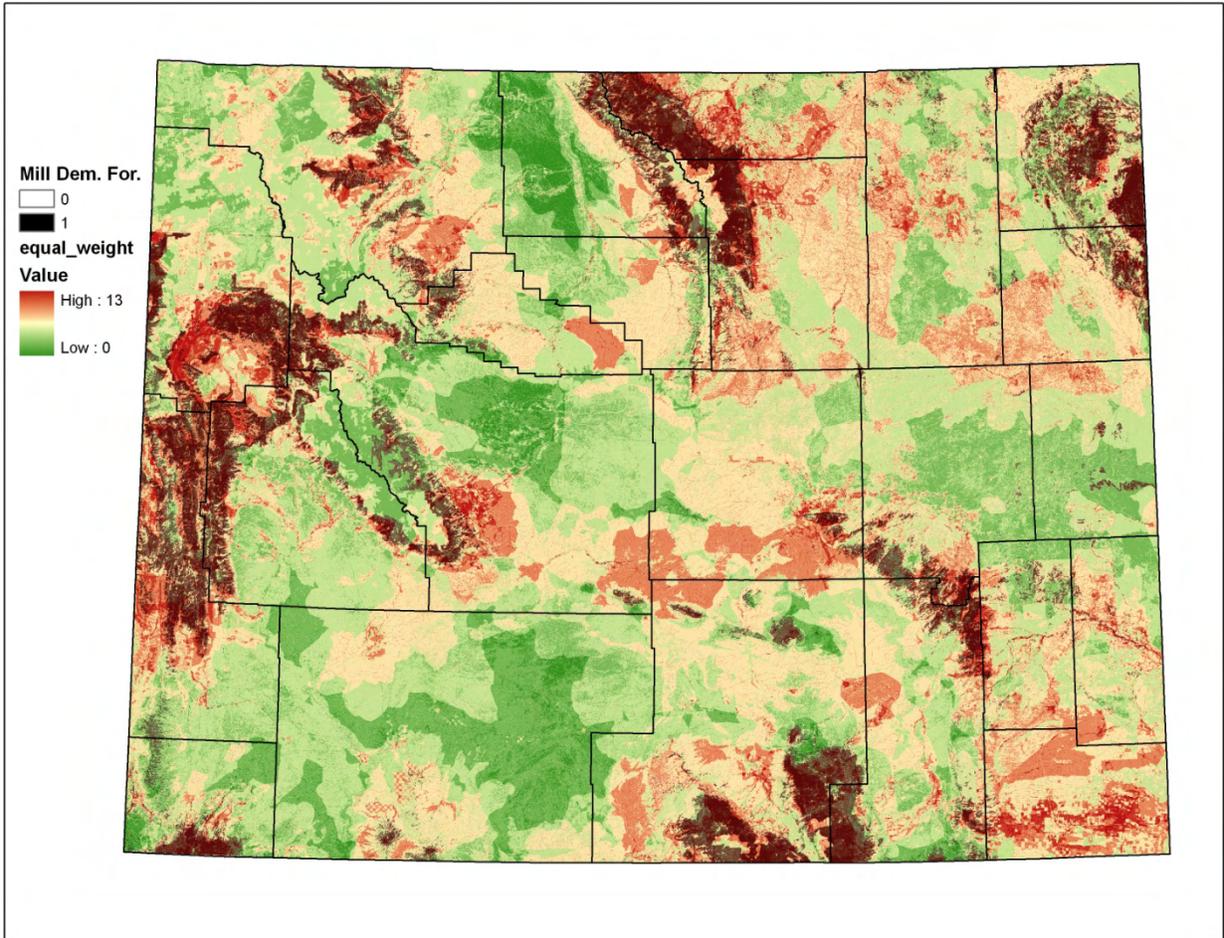
The maps below and on page 45 show the state assessment final map with economic potential layers as an overlay. Economic potential is a significant contributor to many of the priority areas and efforts to address economic potential would be beneficial to the priority areas.

Priority Areas with Economic Potential – Working Forests Overlay



Wyoming Statewide Assessment of Forest Resources

Priority Areas with Economic Potential – Mill Demand Forests Overlay

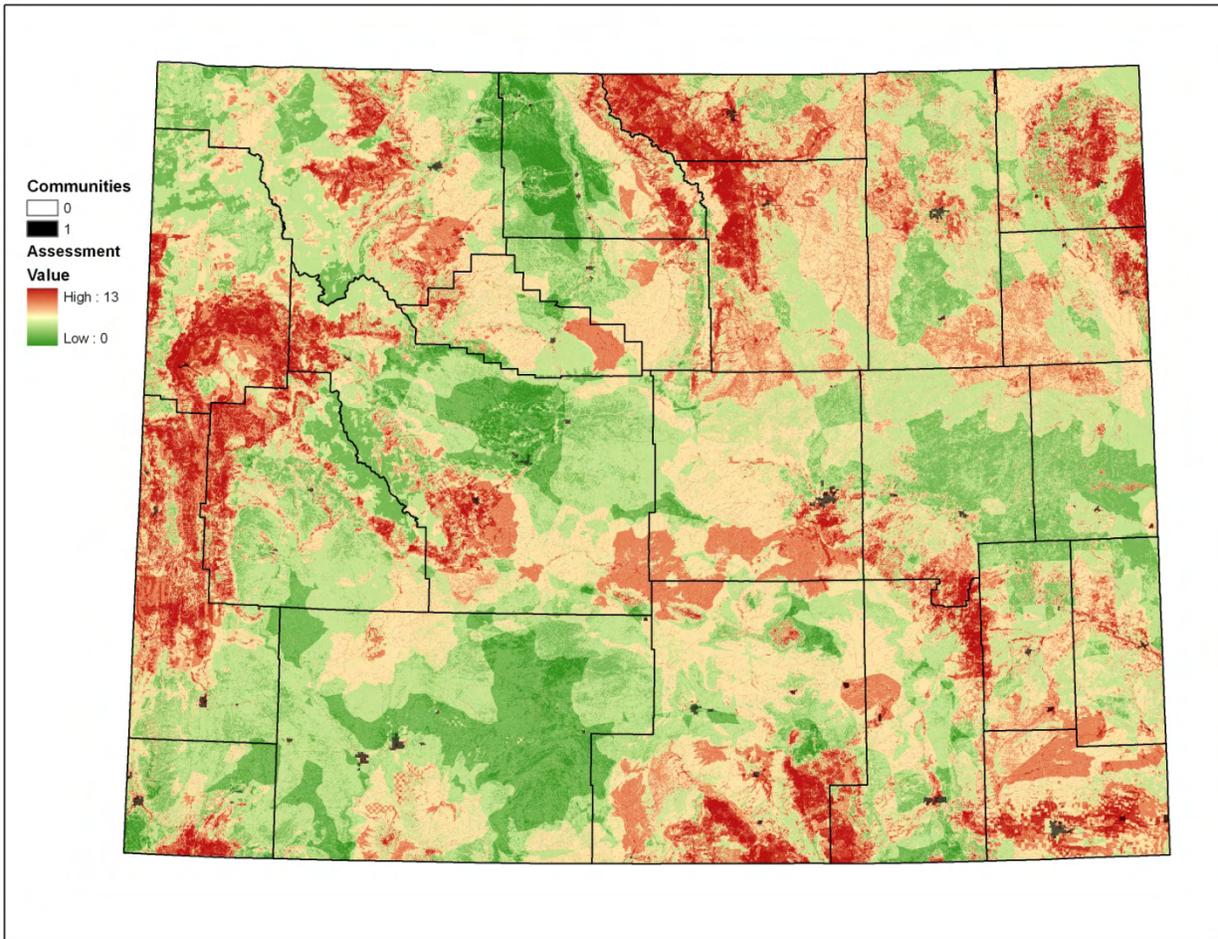


Wyoming Statewide Assessment of Forest Resources

Community Forestry

The map below shows the state assessment final map with communities as an overlay. Communities are often within the priority areas and efforts to address the community forests would be beneficial to the priority areas.

Priority Areas with Community Overlay



Development Risk

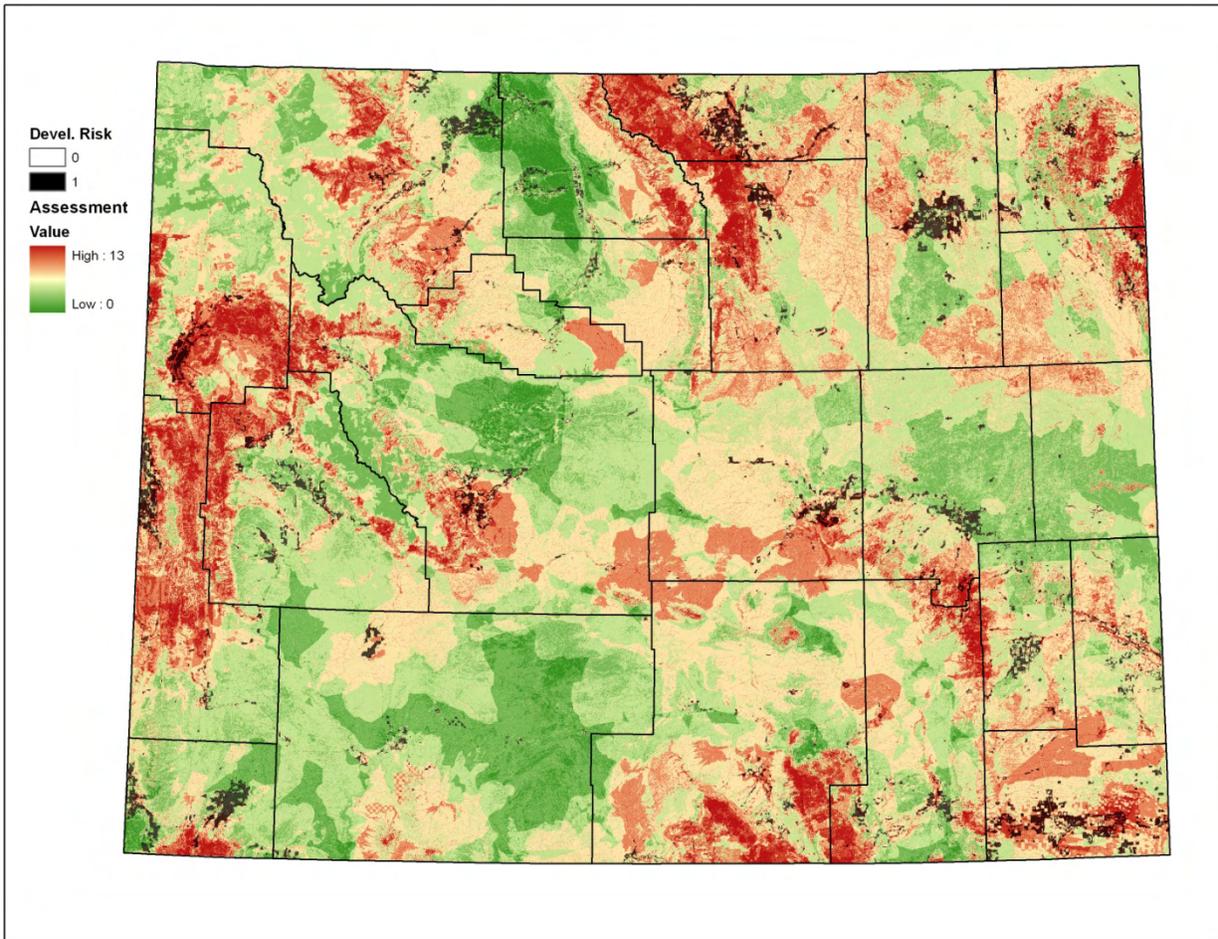
The analysis shows that significant housing development is expected in many parts of the state over the next 30 years. The population in the West is growing rapidly and Wyoming is no exception.

The map on page 47 shows that much of that growth is likely to happen in priority areas. Some of the growth will happen in areas that overlap with forest health issues, wildfire risk issues, green infrastructure issues, and many other state forest resource assessment layers are likely to be affected.

Wyoming Statewide Assessment of Forest Resources

In this case, there may be little that can be done to affect future development. Green infrastructure (Forest Legacy priority areas) establishment could be important. Work in the areas of wildfire risk, forest health risk, economic potential, community forestry, agroforestry, and water quality/supply in advance of the probable development will be important.

Priority Areas with Development Risk Overlay



Agroforestry

Agroforestry practices are site adapted and are applicable to a wide range of locations in Wyoming. Practices broadly fall into three categories; silvopasture, riparian buffer strips and windbreaks. Most forested land, riparian areas and agricultural lands are suitable for one or more agroforestry practice with limitations set by precipitation, elevation and soils. There is extensive overlap with priority areas, though the broad applicability of agroforestry incorporates areas of lower priority, particularly in the eastern half of the state, as shown by the map on page 48.

Practices provide a number of biological and social benefits, assisting in the retention, enhancement and restoration of habitats, provide additional revenue which helps retain the

Wyoming Statewide Assessment of Forest Resources

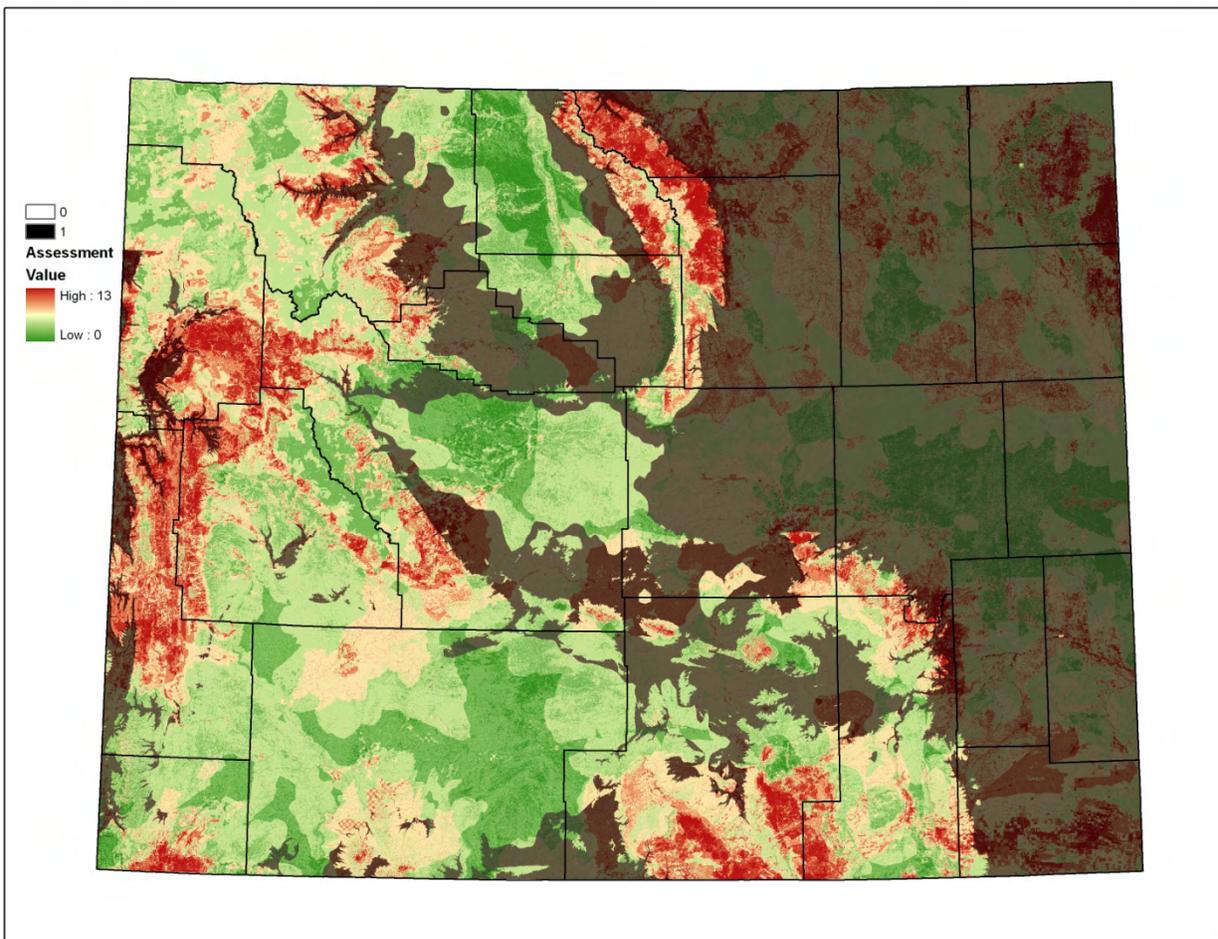
economic viability of working landscapes, moderates adverse weather impacts and enhances aesthetics and recreational opportunities.

Silvopasture is probably the most common agroforestry practice in the state; incorporating forage production with traditional forest management to enhance forest health and diversity, reduce fuel loading and the impact of wildfire and improve product quality and revenues.

Riparian buffer strips maintain and enhance water quality; filtering sediments and non-point source pollutants, stabilize stream banks and retain, enhance and restore aquatic and terrestrial habitats.

Windbreaks moderate wind speed, reducing soil erosion, provide protection to livestock and crops, alter snow drift patterns and provide habitat diversity. The state has a successful living snow fence program, which significantly contributes to public safety and reduces snow control costs. Currently program demand exceeds resource availability.

Priority Areas with Agroforestry Suitability Overlay



Wyoming Statewide Assessment of Forest Resources

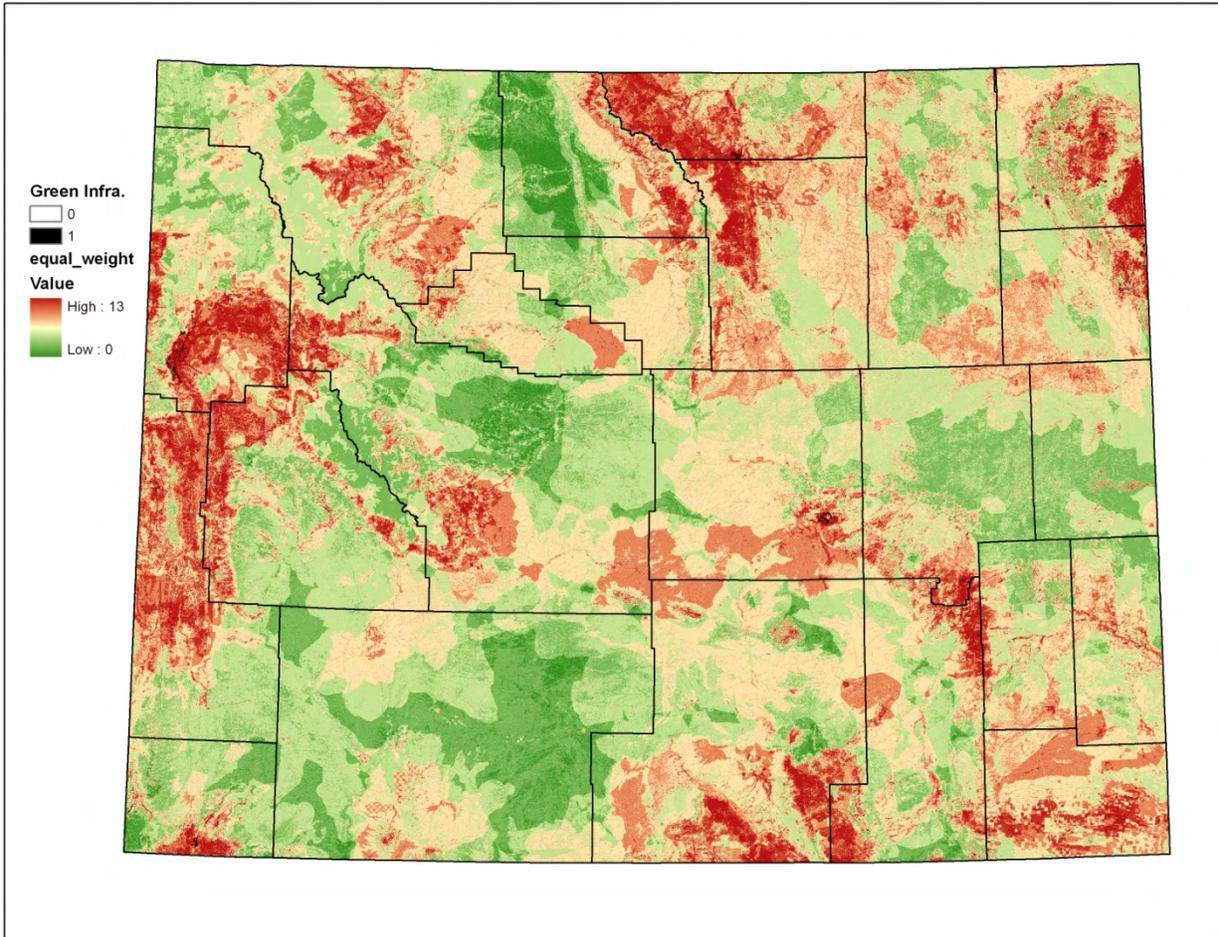
Green Infrastructure

Initially this layer did not seem to be a good fit for Wyoming, a state with a vast amount of public lands and open space. Once the decision was made to use high priority forest legacy areas to represent green infrastructure, the idea made better sense.

Wyoming is facing development pressure on its privately owned open spaces. Ranches face economic pressure from high real estate prices as housing development occurs. Maintaining those privately held open spaces is critical to the concepts of conserving working landscapes, protecting forests from harm, and enhancing benefits of trees and forests.

As shown by the map below, most of the green infrastructure layer is in priority areas as identified by the assessment. Maintaining open space could be beneficial to the priority areas.

Priority Areas with Green Infrastructure Overlay



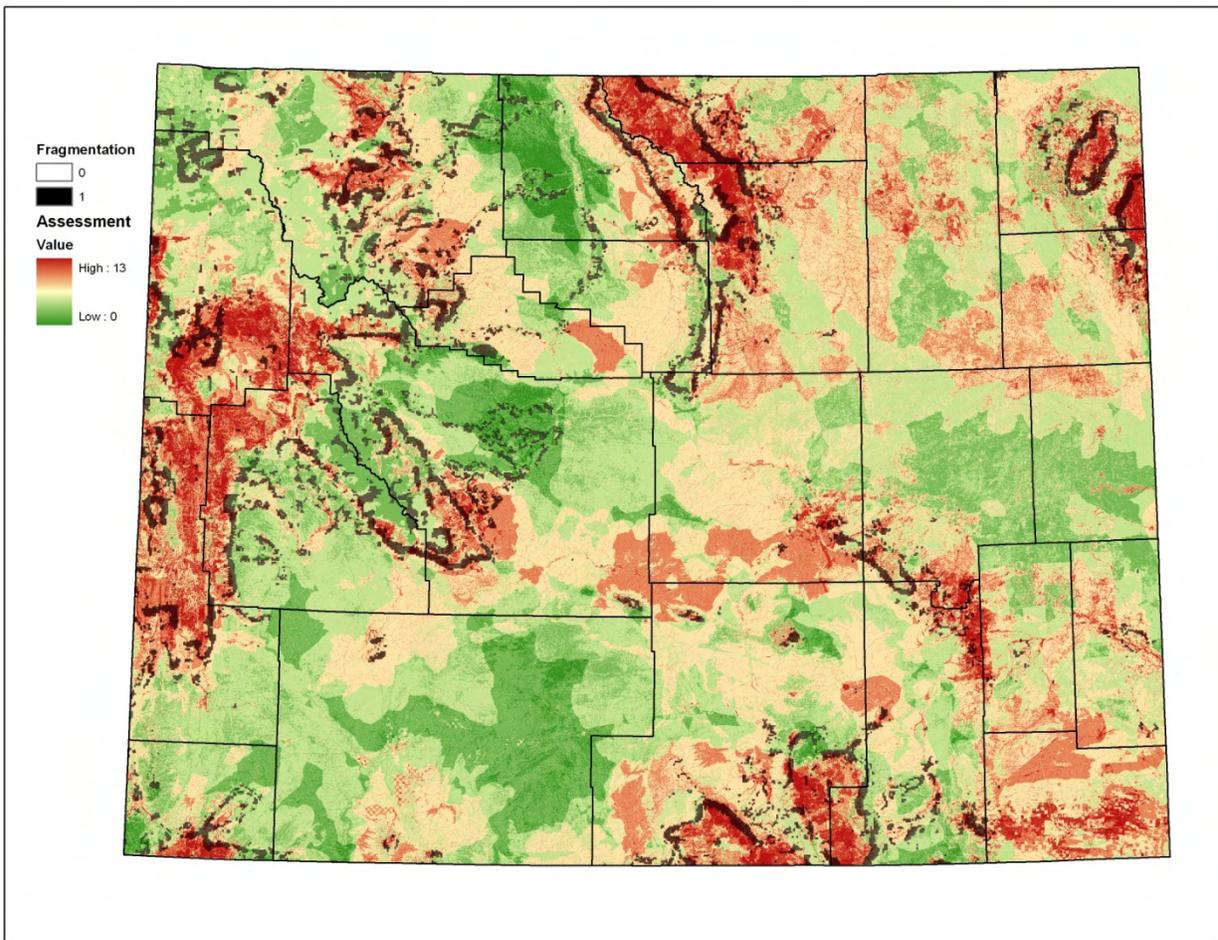
Wyoming Statewide Assessment of Forest Resources

Forest Fragmentation

This layer was included to emphasize areas where fragmentation and human activity makes a forest more susceptible to risk factors such as insects and disease. The layer shows areas that are potentially affected but does not have much value for this analysis when considered alone. It should be considered along with development risk, wildfire risk, and forest health risk.

The map below shows that the forest fragmentation layer is generally around the edges of the national forest boundaries and is sometimes associated with priority areas identified by the state forest resource assessment.

Priority Areas with Forest Fragmentation Overlay



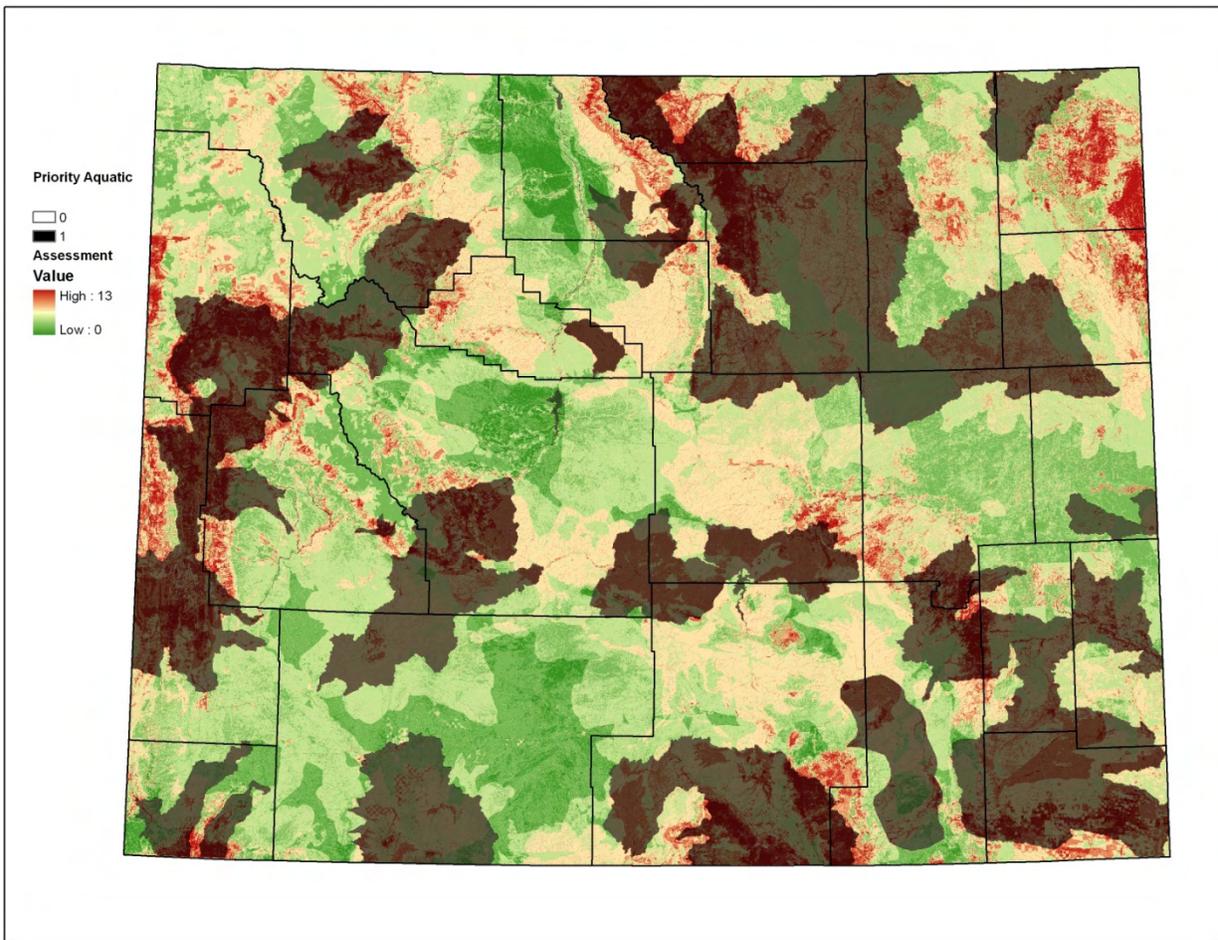
Wyoming Statewide Assessment of Forest Resources

Fish and Wildlife Habitat – Aquatic Habitat

This layer is closely tied to the water quality and supply layer, but is also important because it represents habitat for important aquatic species. Please see the Water Quality and Supply section for further discussion.

The map below shows that priority aquatic habitat sometimes corresponds with priority areas identified by the state forest resource assessment. Management that maintains priority aquatic habitat is likely to benefit the priority areas.

Priority Areas with Priority Aquatic Habitat Overlay



Forest Stewardship – High Priority Private Lands

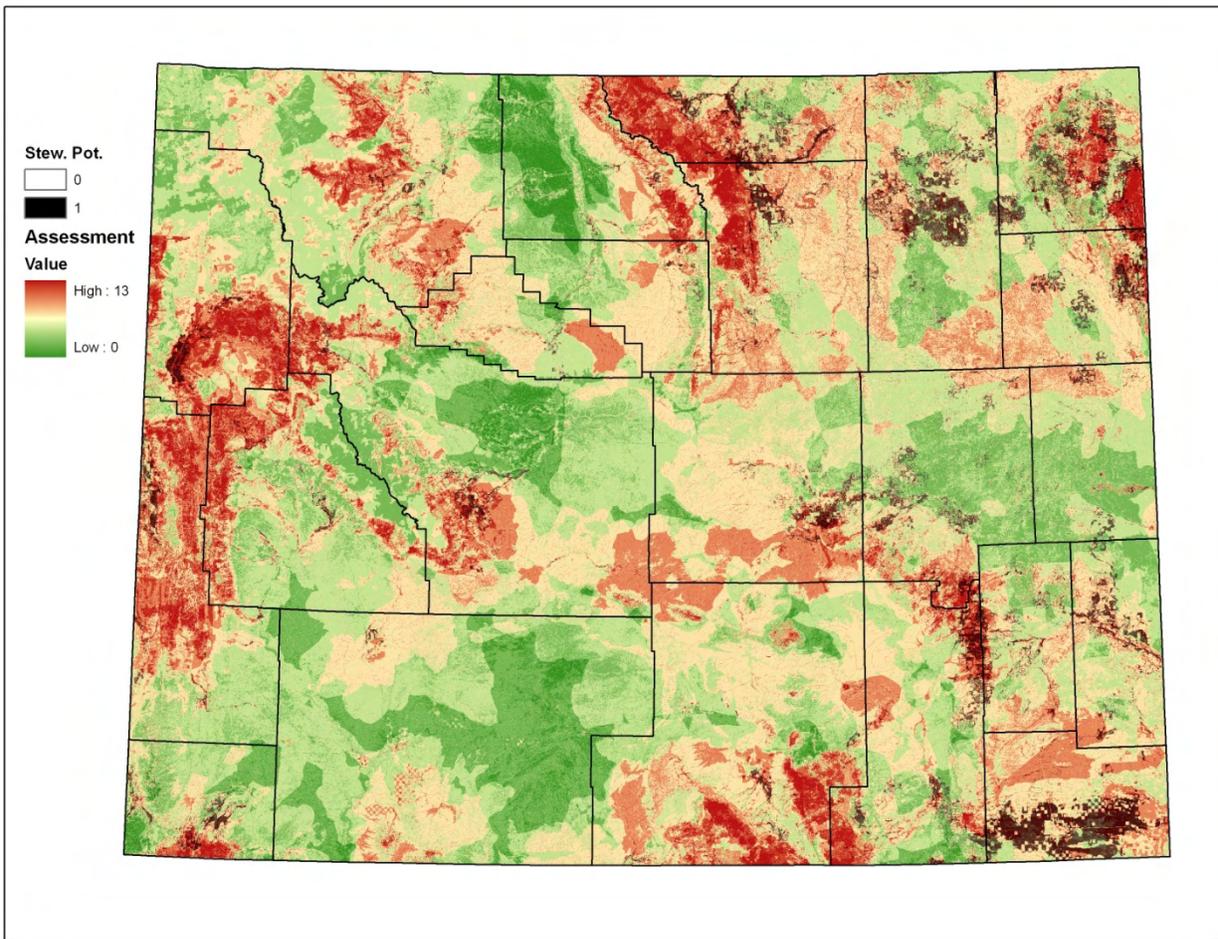
This layer was included to emphasize areas where the Spatial Analysis Project (SAP) identified lands as high priority for stewardship planning. These are private lands where planned management would be the most beneficial to benefit the resources and address the threats identified by the SAP analysis.

Wyoming Statewide Assessment of Forest Resources

As stated earlier in this document, private lands are an increasingly important source of forest products in Wyoming. Planned management will be necessary to sustain the harvest level. Also, investment of resources in management of young stands through thinning and management of mature stands for forest health will be important. Investment in tree planting may be important in some instances. Management to reduce the risk of wildfire and to address fuels issues will be necessary.

The map below shows that priority forest stewardship areas correspond with priority areas identified by the state forest resource assessment on private lands. Investment of resources to ensure appropriate management of private lands will benefit the priority areas.

Priority Areas with Forest Stewardship Priority Overlay



Wyoming Statewide Assessment of Forest Resources

Global Climate Change

One of the strategic objectives for the S&PF redesign is “Manage and restore trees and forests to mitigate and adapt to global climate change.” According to the State Climatologist’s Office, “Climate change is likely to be one of the most important issues facing Wyoming and the western United States over the next century.”

The information in this paragraph was selected from the proceedings of the Climate Change Workshop, held in Cheyenne in 2008: Wyoming is considered highly sensitive to climate change due to several factors, including a naturally dry climate and dependence on mountain snow for surface water. Predictions seem to indicate that the West will be warmer in the future. Predictions about future precipitation are unclear, with forecasts of above and below historic normal precipitation levels. Precipitation could shift from snow to rain with impacts on the amount and timing of runoff and groundwater supply. There may be impacts on the length and severity of the fire season.

Increased atmospheric carbon dioxide levels are believed to be one of the causes of climate change. Forests and wood products offset about 20 percent of carbon emissions resulting from the burning of fossil fuels. Forest management practices that maintain healthy forests and reduce the risk of stand replacing fire could help forests to sequester additional carbon in living trees and wood products. At this point there is no financial incentive for forest managers to focus on carbon sequestration. Markets for carbon credits have excluded public and state lands and looked more favorably upon reforestation and afforestation than traditional forest management. Changes in national policies related to climate change and carbon sequestration could impact forest management in Wyoming in the future.

Connecting People to Forests

Another strategic objective of the S&PF redesign is “Connect people to trees and forests, and engage them in environmental stewardship activities”, one of the strategic objectives that was not included as a data layer in the GIS portion of the state assessment. The suggested data layers for this strategic objective were census data, recreation and trail networks, hunting and fishing areas, and cultural and heritage sites.

Wyoming is a sparsely populated state consisting mostly of rural areas and small communities. Land ownership is about 49 percent public lands managed by federal agencies, plus about 5 percent state trust lands, with the remaining 46 percent privately owned.

Wyoming has abundant opportunities for outdoor recreation of all types, including hunting and fishing, and all other means of connecting with nature. Recreational opportunities are close-by most Wyoming communities.

Farming and ranching and other agriculture are of great importance to the economy and to the residents of the state. Timber harvesting has been a part of the culture of the state since the days of the tie hacks.

There are educational programs in place that provide information on forests and forest management to children and adults. WSFD staff members frequently make presentations to

Wyoming Statewide Assessment of Forest Resources

school children and civic groups regarding forestry issues. Reconnecting people, particularly children, with nature is an emphasis area for the U.S. Forest Service. Numerous initiatives, such as “Kids in the Woods” strive to reconnect people with forests. In Wyoming, Teton Science Schools offers outdoor education programs for children and adults. The National Outdoor Leadership School offers wilderness and leadership education programs to older children and to adults. Those are just a few examples of existing programs emphasizing education about natural resources and forestry.

From the farms to the ranches to the rivers to the forests and public lands, Wyoming residents are aware of agriculture, forestry, and recreation in the state. While the concept of maintaining a green infrastructure to connect people to forests has merit in many states, and in communities within Wyoming, and while conservation education is an important function of WSFD, this strategic objective does not fit as a GIS layer in this statewide assessment.

Priority Forest Landscapes

National direction indicates that state forest resource assessments shall “...identify, describe, and spatially define forest landscape areas where forestry program outreach and activity will be emphasized and coordinated.” This assessment identifies priority forest landscapes on a map, describes the analysis used to determine the priority landscapes, and provides written information describing the current forest conditions in Wyoming. The analysis is conducted and priority landscapes are identified across all ownerships. It is important to remember that in some cases, such as stewardship, “forestry program outreach” is restricted to private lands.

Wyoming’s priority forest landscapes can generally be found on manageable (not administratively withdrawn) federal lands, on the surrounding state and private lands, in areas defined as important for water quality and supply and/or terrestrial habitat, and in and around communities. Administratively withdrawn areas, such as wilderness and national parks, are often lower priority landscapes as defined by this analysis. This analysis emphasizes landscapes where active resource management can play an important role. While wilderness areas and parks have significant resource values that are managed and in some cases actively managed - through prescribed fire, for example - there is a clear preservation mandate for those areas. Forestry program outreach would be less effective in such areas.

The map on page 58 shows the priority landscapes with the highest priorities in red. The red color indicates that more of the analysis layers were counted in those areas. The red areas are priorities for active management in some cases, and in other cases may be important areas for certain resources with or without management.

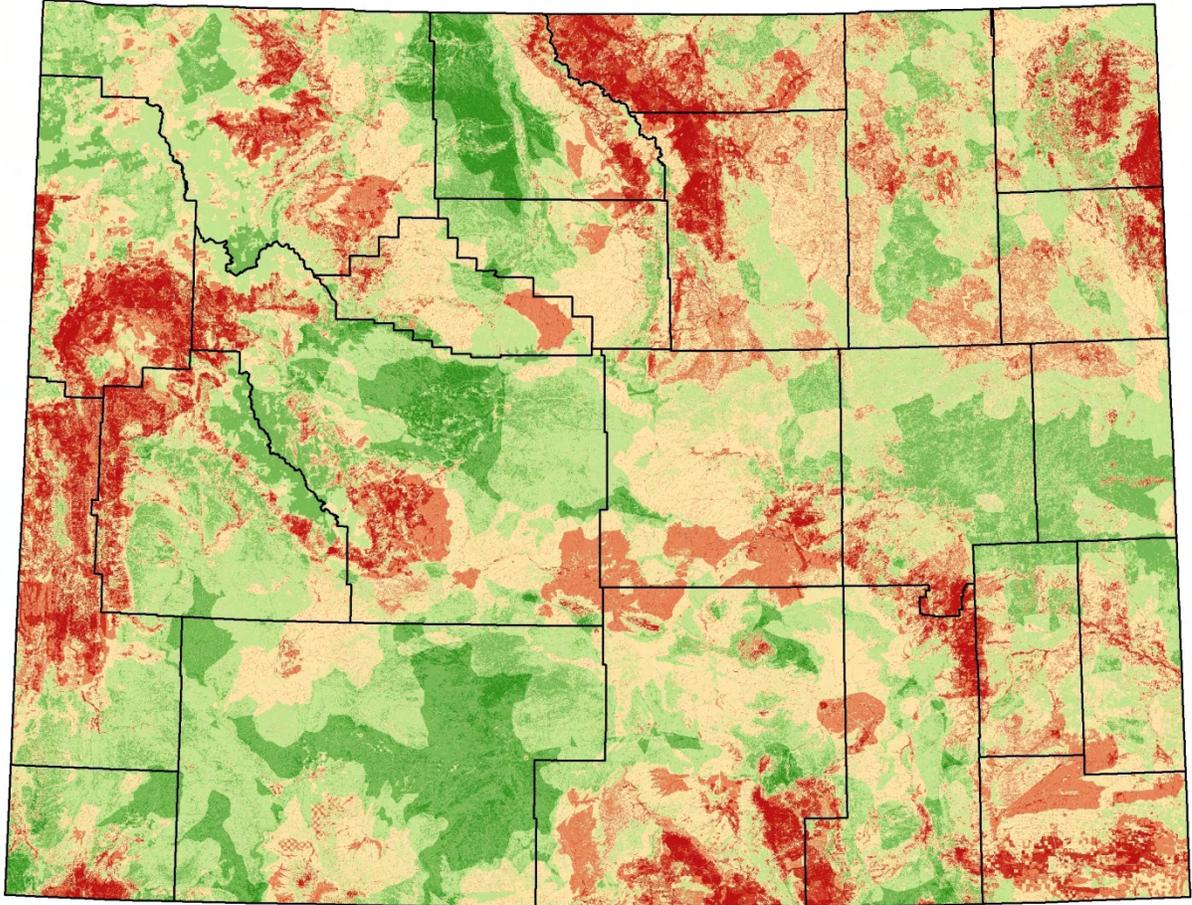
The colors are assigned based on statistics by the GIS software. There is a range of analysis values within the various colors on the map. For example, within the brightest red color on the map, values range from 6 to 13.

The display scale of the map also affects the appearance. When looking at the full map within this document, the areas of bright red may appear more widespread and contiguous than they

Wyoming Statewide Assessment of Forest Resources

Wyoming Statewide Assessment of Forest Resources

Critical Landscapes
September, 2009



Data Layers

Development Risk: Areas expected to see increased housing development over the next 30 years. National data from CSU research.

Forest Fragmentation: Areas becoming more susceptible to ISD due to fragmentation/human activity. National data layer.

Layer Weights

Development Risk	1
Forest Fragmentation	1
Wildfire Risk	1/1
Forest Health Risk	1
Fish & Wildlife Habitat	1/1
Water Quality & Supply	1
Economic Potential	1/1
Green Infrastructure	1
Community Forestry	1
Agroforestry	1
Stew. Potential	1
Max. Value Possible	14

Wildfire Risk: Areas where planning and management can reduce risk. Two layers - redzone and fire regime condition class.

Forest Health Risk: Areas where silvicultural treatment can reduce risk of damage. National insect and disease risk map data.

Purpose of this analysis: Identify, describe, and spatially define forest landscape areas where forestry program outreach and activity will be emphasized and coordinated.

Fish and Wildlife Habitat: Areas that provide habitat for valued fish and wildlife species. Game & Fish terrestrial game/non-game and aquatic data plus sage-grouse core

Water Quality and Supply: Identify watersheds where forest conservation and management is important. Areas receiving over 20 inches of annual precip plus streamside management zones.

National Priorities:
- Conserve working forest lands.
- Protect forests from harm.
- Enhance public benefits from trees and forests

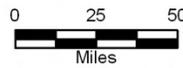
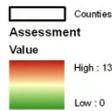
Economic Potential: Areas where forests can or do play a major economic role. Two layers - working forests and mill demand forests - developed by WSFD.

Green Infrastructure: Emphasize opportunities for an interconnected green space network. Used high priority forest legacy areas.

Agroforestry: WSFD decision to include based on importance. Data is non-forested lands below 7000 feet receiving at least 12 inches of precip.

Stewardship: High priority for stewardship planning. Data is high priority from SAP analysis.

Community Forestry: Areas where management of the community forest can have positive impacts. Data layer is boundaries of incorporated communities.



Disclaimer: These data are intended for reference purposes only, and the content, accuracy, timeliness, or completeness is not guaranteed. If more information or for the verification of the information contained in these data, the data authors should be contacted. The State of Wyoming maintains no responsibility and will not be held liable for any damages incurred as a result of the use or misuse of these data.

Wyoming Statewide Assessment of Forest Resources

actually are. When zoomed in on a portion of the state, the color pattern becomes more complex than it appears on the full map in this document.

Wyoming has been described as a state of “island forests” due to the distribution of most of the forested lands around the state’s mountain ranges. The distribution of the forested lands had a significant impact on this assessment and the identified priority landscapes. There are priority landscapes outside of the major forested parts of the state, such as riparian forests and non-forested areas, but most of the priority landscapes are associated with the state’s forested mountain ranges.

The map could give the impression that the priority landscapes are mostly within the national forest system boundaries. Clearly there are significant priority landscapes within the national forest system and national forest management is critical to the state. However, a closer look at the map shows significant priority landscapes outside of the national forest system boundaries on private, state, and BLM lands as well. As stated in the “General Management” section, beginning on page 11, forests on non-federal lands have become increasingly important as a source of raw materials for the forest products industry. Development pressure on those lands can be intense. Therefore, the non-federal priority landscapes may be most important to the national theme “Conserve Working Forest Lands” in Wyoming.

The red areas are the priority landscapes for the Assistance Forestry program and for investment of S&PF funds as defined by this analysis. However, an area that is not red on the map could still be a high priority for management for any number of reasons.

Threats to Priority Forest Landscapes

As a result of this assessment, a number of threats and/or challenges to achieving the three national themes and the strategic objectives have been identified. In some cases, an identified threat may be an opportunity for management to improve the situation. The following list describes many of those threats/opportunities:

- Wyoming is facing forest health issues that are probably unprecedented. The forest health issues are described in more detail in the “Forest Health” section beginning on page 36. Entomologists have stated that it is an anomaly for all of the major bark beetles to be at epidemic levels at the same time. In some areas mortality in mature trees of a species is likely to approach 100 percent. Additionally, whitebark pine and limber pine stands are experiencing significant mortality from a combination of white pine blister rust and mountain pine beetle. There are a number of factors involved, including forest stand conditions, too little active forest management plus effective fire suppression, and climatic factors such as drought and possible climate change. In many areas, age class diversity is lacking, leaving large parts of forests susceptible to a particular damaging agent at the same time. Increased age class diversity and species diversity where practical would result in a more resilient, sustainable forest.
- The threat of fire in the WUI is significant and expanding. This impacts fire suppression strategies, tactics, and costs, and also impacts firefighter and public safety. Private

Wyoming Statewide Assessment of Forest Resources

property rights are important in Wyoming, and regulations to address building in the WUI are often not practical. Lands in the WUI are often desirable for housing development, often due to the presence of forests, which in turn present a hazard to the housing development.

- Wildfires in areas outside of the WUI are also a threat. Conditions on some landscapes are no longer within normal fire regimes or fire return intervals, the result of effective fire suppression, limited forest management, and climatic factors. For example, ponderosa pine stands often burn in an intense, stand replacing manner, rather than the lower intensity fires of the past. With more intense fires there is the risk of the loss of ecosystem components, such as large trees, plus risk of damage to other resources, such as water quality. For some landscapes, before fire can safely be returned, if desired, mechanical treatment would be necessary to reduce fuels to help control fire intensity.
- A viable forest products industry is essential to enable effective forest management on a meaningful scale. The forest products industry is a partner in forest management, and without it, proposed management projects become quite expensive. The forest products industry in Wyoming has been shrinking for some time in terms of number of mills. Mill capacity was significantly reduced with the closure of the Saratoga mill in 2003. More recently, mills in Sheridan, Cody, and Laramie were closed permanently. The current historically low lumber market is a threat to remaining mills. The announced re-opening of the Saratoga mill in 2009 is an encouraging development. A predictable, dependable supply of forest products is critical to retaining the forest products industry infrastructure in the state. The development of non-traditional markets, such as those for biomass, could become important to the state, particularly when located with existing mills to minimize biomass transportation costs.
- Wyoming's low elevation riparian forests are in decline. Aging tree populations combined with a general lack of successful regeneration has resulted in the rapid decline of riparian forests in recent years. Invasive non-native species such as Russian olive and saltcedar have extensively invaded some riparian areas, outcompeting native species, significantly reducing the quality of wildlife habitat, and contributing to diminishing stream flows.
- Aspen is a growing focus of concern within the Rocky Mountain region. Stands are showing significant decline through diminished reproduction, succession to conifers, and browsing pressure from wildlife and domestic livestock. Because aspen is generally a disturbance dependent species, the combination of fire suppression plus a reduction in forest management - including less harvest of more shade tolerant conifers - has contributed significantly to the decline of aspen populations.
- There are numerous challenges to maintaining healthy community forests in Wyoming. Community forests often lack age class diversity with most of the mature trees planted early in a particular community's history and having originated from planting stock available nearby. Community forests also often lack species diversity. In small communities, a lack of community forestry expertise is sometimes a problem. Limited

Wyoming Statewide Assessment of Forest Resources

funding for maintenance, planting, and removals can impact the development of community forestry programs.

- In an arid state like Wyoming, water quality and quantity will always be important issues. Forest management activities, or the lack thereof, can have a positive or negative impact on water resources. Compliance with Wyoming's Silviculture BMP's is critical to protecting water quality during forest management activities. In areas of ample precipitation, forest management can increase water yield. The ongoing bark beetle epidemics are likely to produce significant increases in water yield from many forested watersheds due to major reduction in live trees on the landscape. However, the resulting increased fuel loading and the potential for large, intense wildfires in the future poses a significant risk to water quality.
- Terrestrial habitat is under pressure in Wyoming. There are numerous resource demands on public, state, and private lands, including energy development, housing development, agricultural uses, resource management, recreational uses, and wildlife habitat. The other resource demands have the potential to negatively impact wildlife habitat in some circumstances. In addition, natural processes such as bark beetles and wildfires can impact wildlife habitat, either positively or negatively. Other forestry issues, such as aspen decline and riparian forest decline, can be detrimental to wildlife habitat.
- Fragmentation of land ownership is likely to adversely affect natural resource management in Wyoming. Large blocks of private land have historically been important for issues such as open space, commodity production, agriculture, and wildlife habitat. As large blocks of private land are subdivided resource management becomes more difficult. Forest health issues are more difficult to address and fire management becomes more complex. Small parcels can be difficult to manage for agriculture and/or commodity production. There is economy of scale in forest management, and management of small parcels can become economically unfeasible.
- Access for management is becoming more complicated. More small parcels owned by more landowners can make parcels to be managed more isolated. Easements for use of roads across multiple landowners or for construction of roads can be difficult to obtain. Statutes and rules related to easements can make obtaining an easement expensive and difficult.
- Management guidance for private lands is increasingly important. Private lands are providing a large portion of the commodities available for harvest despite being a small portion of the commercially productive forest lands. Private lands provide numerous non-commodity resource values. Science-based management recommendations would help to ensure that management of private lands is done in a sustainable manner.
- In many areas, older forests are being converted to young forests on a large scale due to bark beetle epidemics. The result will be a new generation of even-aged stands at the landscape scale. Ultimately the cycle will repeat in the future. There must be an increased focus on density management in young stands in the future. Mature,

Wyoming Statewide Assessment of Forest Resources

overmature, and old-growth stands will occupy much less area on the landscape. In many cases management may be needed in order to keep remaining older stands healthy. Management may also be needed to accelerate the growth of younger stands into stands with some late-successional or old-growth characteristics.

- Wyoming will be on the leading edge of the impacts of global climate change. Wyoming is considered highly sensitive to climate change due to several factors, including a naturally dry climate and dependence on mountain snow for surface water. There may be impacts on the amount and timing of water runoff and on the length and severity of fire seasons. Under a long term reduced precipitation scenario forest health would be negatively impacted.
- Invasive species, both insects and plants, pose a threat to forested lands. Exotic insects can be very destructive in forest systems that did not evolve with the insects. Invasive plants can supplant native vegetation and can alter fire regimes within and around forested lands.

Multi-State Priority Areas

At the time of completion of this document most states have not completed State Assessments. As a result identifying multi-state priority areas based upon the results of Assessments completed by neighboring states is not possible.

Many of the states in the west are facing similar natural resource management issues. Each state will address its threats and priorities in the State Assessment and Resource Strategy documents. In order to be most effective, however, bordering states should work collaboratively across boundaries on similar issues.

Wyoming is unique in that it shares a border with 6 other western and Midwestern states. Many of the threats that Wyoming faces are cross-boundary issues that other states share as well. It is reasonable to expect that, for example, threats and priorities in the Black Hills in Wyoming are similar to those in the Black Hills in South Dakota.

As part of the implementation and monitoring of the Statewide Assessment and Resource Strategy, Wyoming will work collaboratively with its 6 neighboring states to address common issues on priority landscapes as identified by each state's Statewide Assessment of Forest Resources.

Appendices

Appendix A

State Forest Resource Assessment GIS Methodology

This is a relatively simple analysis because either a layer is represented on a given pixel (30 meter pixel, or a 900 square meter area of the state), resulting in a value of 1, or it is not, resulting in a value of 0. The layer weights are also simple with all layers weighted equally.

The 14 layers are basically stacked on top of one another using a weighted sum analysis with each pixel getting a 1 or 0 from each layer. The resulting total of the layer values on any given pixel is the value of that pixel for the final analysis. The highest total value any pixel could have is 14.

This analysis uses the layers recommended for a standard statewide assessment by national direction or a substitute layer as determined by WSFD.

Included Layers

Development Risk (Weight = 1, Values = 0, 1)

This layer is intended to “identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.” The housing density/development level layer from the Spatial Analysis Project (SAP) was used for this analysis. Areas likely to be developed have a value of 1 while other areas have a value of 0. The layer was properly classified and ready for use as a result of SAP.

Forest Fragmentation (Weight = 1, Values = 0, 1)

The intent of this layer is to “identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.”

The forest fragmentation data was obtained from nationalatlas.gov (“Classification of Forest Fragmentation of North America”). The original data analyzed 91 square kilometers around each pixel to determine fragmentation. The original data was for all of North America and for analysis purposes was clipped to the state boundary. The data was exported to a new raster to reduce 1 km pixels to 30 m pixels.

The original raster contained values from 0-7, with 0 = water, 1 = edge, 2 = undetermined, 3 = perforated, 4 = interior, 5 = patch, 6 = transitional, and 7 = unlabeled.

The following are explanations of the values above according to the metadata:

Water (0): Surface water which has no trees.

Edge (1): Most of the surrounding pixels are forested and this pixel appears to be part of the outside edge of a forest patch.

Undetermined (2): Most of the surrounding pixels are forested but this pixel could not be classified as to the type of fragmentation in the surrounding area.

Wyoming Statewide Assessment of Forest Resources

Perforated (3): Most of the surrounding pixels are forested and this cell appears to be part of an inside edge of a forest patch (near a non-forest inclusion within a forest patch).

Interior (4): All of the surrounding pixels are forested.

Patch (5): Most of the surrounding pixels are non-forested and this pixel is part of a forest inclusion or patch of forest in a non-forest background area.

Transitional (6): About half of the surrounding pixels are forested and this pixel is likely to be part of a patch, edge, or perforation.

Unlabeled (7): Generally representative of non-forested areas.

Given those values and explanations, the data must be reclassified to meet the intent of the forest fragmentation layer in the analysis. Remembering the intent of the layer as stated above, it appears that “edge” and “patch” values represent those areas that would be most affected by fragmentation and human activity while “interior” values would be least affected.

To make the data useful for this analysis, areas with values of 1 (edge) and 5 (patch) were reclassified to 1 while all other values were reclassified to 0.

Wildfire Risk (Weight = 1, Values = 0, 1, for each of two layers)

This layer “should identify areas where management can significantly reduce the risk of catastrophic wildfire while enhancing multiple associated forest values and services” and “identify areas where the effects of fire exclusion can feasibly be mitigated or countered through sound management, particularly where there are opportunities for federal, state, and community partnerships.” There are two areas to address: The Wildland-Urban Interface and the risk of fire outside of the interface. The suggested data was LANDFIRE data. However, Wyoming chose to use two layers to adequately represent wildfire risk in the state.

Redzone: The Wyoming Wildfire Hazard Assessment was conducted in 2001. The analysis included fuel hazard, fire risk, and values at risk to produce a final hazard map. This is a quality analysis that gives higher wildfire hazard ratings to areas where the fuel hazard is high, the fire risk (lightning) is high, and the values at risk (communities) are high. The final analysis layer contained values from 2 – 15 for each pixel. As part of that analysis, a redzone layer was produced from areas of high risk. For this analysis, the redzone layer was reclassified with redzone areas classified as 1 and other areas as 0.

Fire Regime Condition Class: This data, obtained from Landfire, was used to represent fire risk in other areas in addition to those near communities. Wildfires can be good and bad and are often both, but it must be recognized that there are risks to values other than communities. For example, the loss of ecosystem components, such as large trees, is a lost value even in the most remote parts of the state. To capture that risk the fire regime condition class data was used as part of wildfire risk. Condition classes 2 and 3 were selected for this analysis because those classes represent areas where the fire regime is outside of historic ranges and fires in those areas pose the risk of loss of ecosystem components. Additionally, classes 2 and 3 require at least some level of mechanical treatment before fire can be returned to the system. For use in this analysis, areas of condition class 2 and 3 were reclassified to 1 and other areas were reclassified to 0.

Wyoming Statewide Assessment of Forest Resources

Forest Health Risk (Weight = 1, Values 0, 1)

The purpose of this layer is to “identify high value forest landscape areas that are especially vulnerable to existing or potential forest health risk factors where forest management practices are most likely to prevent and mitigate impacts.” The National Insect and Disease Risk Map (NIDRM) data was obtained from the Forest Health Technology Enterprise Team (FHTET) website. NIDRM data was clipped to the state of Wyoming. The data estimates basal area loss over the next 15 years as a percentage of stand basal area. For this project, the data was reclassified with 0-10% being low (1), 11-30% moderate (2), and 31-100% high (3). Finally, areas of moderate to high risk were reclassified to 1 and all other areas to 0.

Economic Potential (Weight = 1, Values = 0, 1 for each of two layers)

This layer is intended to “identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services.” For Wyoming, this layer has added importance as the state struggles to retain existing traditional forest products industry capacity and looks for opportunities for alternative forest products industry capacity. The traditional forest products industry capacity is especially important both for forest management needs and for developing alternative uses for biomass.

Wyoming chose to use two layers to address economic potential. One layer is **working forests**, which addresses all forested lands with the potential to be productive forests (traditional forest products, biomass, or ecosystem services) based on several factors. The other is **mill demand forests**, which addresses the forested lands that are important for producing the raw materials necessary to help retain existing forest products industry infrastructure.

Layer 1: Working Forests (Result of a weighted sum analysis of four layers)

Site Index: A layer for site index data is not available for all lands in Wyoming. A new approximate site index layer was developed using precipitation, elevation, and aspect. The precipitation layer was reclassified with less than 15” = 0, 15 – 20” = 2, 20 – 25” = 4, and 25”+ = 6. The elevation layer was reclassified with < 4000’ = 0, 4000 – 8000’ = 2, 8000 – 9500’ = 1, 9500 – 10,000’ = 0, and > 10,000’ = -1. Aspect was created from a 30 meter DEM and reclassified based on azimuth so that 0 – 45 and 315 – 360 = 2, 225 – 315 and 45 – 135 = 1, and 135 – 225 = 0. A weighted sum analysis was conducted to produce the site index layer (base 100), which was then reclassified as appropriate for the analysis. Final outputs ranged from 0 – 10, which were assigned to site indices of 20 – 90 throughout the state. For the final reclassification of this layer, site index values 50 and greater were classified as 1 with all other lands classified 0, under the assumption that site index values less than 50 do not represent commercially important lands.

Slope: A 30 meter DEM for Wyoming was used. Slope was calculated using Spatial Analyst and the slope layer was reclassified. Areas with slope less than or equal to 50 percent were classified as “1” and other areas were classified as “0”. Fifty percent was used because although that is often considered too steep for typical ground based systems, there are other areas with greater slope that could be harvested using cable systems not often used in Wyoming. In order to account for some of the steeper areas the maximum slope was raised to include more acres of forest land.

Wyoming Statewide Assessment of Forest Resources

Forest Cover: NLCD data was used to create a layer of forested land. The values 31-33, 41-43, and 91 were used to create the layer. The forested areas were reclassified to “1” and non-forested areas were reclassified to “0”.

Non-reserved Land: The purpose behind this layer was to remove wilderness, national parks, and research natural areas from analysis. While those areas provide other values, for this analysis working forest lands cannot be within those areas. Reserved lands were classified as “0” and non-reserved classified “1”.

Roadless areas were not considered reserved land because they have been withdrawn from active management as a result of USFS management decisions, not as a result of any legal requirement in effect in Wyoming at this time.

A weighted sum analysis was conducted on the four layers above. Briefly, the four layers made up of “1” and “0” data were stacked on top of one another and the pixel values summed using equal weights. Any pixel within the resulting layer could have a value from 0-4. In order to be considered “working forest” a pixel needed to have a resulting value of 4, meaning it met the requirements in all 4 layers above. The resulting data was reclassified so that values of 4 became 1 and all other values became 0.

Note that the term “working forest” is not restricted to productive timber lands. Riparian and community forests are also included in this layer. This separates the working forest layer from the mill demand forests layer below.

Layer 2: Mill Demand Forests

In order to depict forest products industry demand for timber, locations for major mills were selected from a mill location data layer. Major mill locations were buffered based on observed (subjective) haul distances for sales purchased by each mill. The individual buffers were then combined into one raster dataset and reclassified to “1” for within a demand area and “0” outside of demand areas. The ability to show the intensity of the demand would be helpful for future analysis. Mill working circles were then combined with the working forests layer via overlay analysis and reclassification to produce a data layer called Mill Demand Forests. That layer represents the working forests within mill working circles.

Water Quality and Supply (Weight = 1, Values = 0, 1)

The purpose of this layer is to “identify key watersheds necessary to maximize the forest benefits and where restoration or protection activities are particularly critical to water quality.” This layer includes all areas receiving greater than 20 inches of annual precipitation (areas where water quantity can potentially be enhanced) and streamside management zones as a 50 foot buffer on all streams (areas where forestry practices can impact water quality). Any pixel in one or both of those areas was reclassified to “1” while other areas received a “0”.

Wyoming Statewide Assessment of Forest Resources

Fish and Wildlife Habitat (Two layers: Weight = 1, Values = 0, 1 for terrestrial habitat, Weight = 1, Values = 0,1 for aquatic habitat)

The purpose of this layer is to “identify forest landscapes that represent or contribute to viable wildlife habitats, contain high species richness, endemism, and/or that represent core habitat for focal conservation species.”

The Wyoming Game and Fish Department (WGFD) recommended that their data for priority habitat be utilized in the analysis. This includes priority habitat for aquatic species, terrestrial species, and non-game species. These are often the types of habitat that limit game populations and distribution. This data was obtained via ftp download from WGFD and used to create a layer that is relevant to the analysis for the statewide assessment. Additionally, due to the ongoing conservation effort in Wyoming, sage grouse core areas were included in the fish and wildlife habitat layer.

First, the priority terrestrial habitat, priority non-game habitat, and sage grouse core areas were combined into one polygon layer using the Union tool and then converted to a raster and reclassified to values of 0 and 1. Second, the priority aquatic habitat layer was converted to a raster and reclassified to values of 0 and 1. The resulting terrestrial habitat and aquatic habitat layers were then incorporated into the analysis. The terrestrial habitat layer was given a weight of 2 due to importance. The aquatic layer was given a weight of 1 because it is often a duplicate of the “Water Quality and Supply” layer which already has a weight of 2.

Green Infrastructure Potential (Weight = 1, Values = 0, 1)

The purpose of this layer is to “identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development.” This layer is probably very appropriate and important as a planning tool for more densely populated states with limited public lands. For Wyoming, with sparse population and abundant public lands and open spaces, the value of this layer for the statewide assessment is questionable.

One of the suggested data sources for this layer is the protected lands database from the Conservation Biology Institute. The Wyoming GAP Analysis provides similar information through its “Land Stewardship” data. Both of those data sources address the biological diversity and attribute greatest protection of biological diversity to lands where no active management occurs and least protection to private and state trust lands. WSFD believes the logic and the application of that concept are subjective and debatable. Additionally, the data does not address the idea of “green infrastructure” as it is described above. This type of data was abandoned as Wyoming attempted to meet the intent of the green infrastructure potential layer.

Green infrastructure in Wyoming is provided by extensive public lands (including state trust lands as “public” for this analysis) and private lands with conservation easements. Many other private lands may also contribute to parts of Wyoming’s green infrastructure. The most important of those lands were identified by Wyoming’s assessment of need for the Forest Legacy program.

Wyoming Statewide Assessment of Forest Resources

Wyoming initially chose to use a combination of public lands and the high priority private lands described above as its green infrastructure potential layer. However, this did not meet the intent of the layer.

It was finally decided to use the high priority private lands as the green infrastructure layer. Those lands are the important areas for protecting existing green infrastructure and expanding it. For the high priority private lands, the forest legacy analysis was used. The data was converted to raster format and priority private lands identified by the analysis were reclassified to 1 while other areas were reclassified to 0.

Community Forestry (Weight = 1, Values = 0, 1)

The purpose of this layer is to “identify, protect, and connect ecologically important forest landscapes, and open space, thus maintaining a green infrastructure, particularly around and within areas of population growth and development” and “identify areas where management or restoration of the urban or exurban forest canopy will have significantly positive and measurable impacts on air quality and produce substantial energy savings.” Polygon data was obtained for the boundaries of Wyoming’s cities and towns. The polygon data was converted to a raster and reclassified to values of 1 for communities and 0 for all other lands. Community forestry is a high priority in Wyoming because growing trees in Wyoming communities is difficult and requires commitment and expertise. This layer is an attempt to include communities as part of this analysis since they were not included in the national direction.

Agroforestry (Weight = 1, Values = 0, 1)

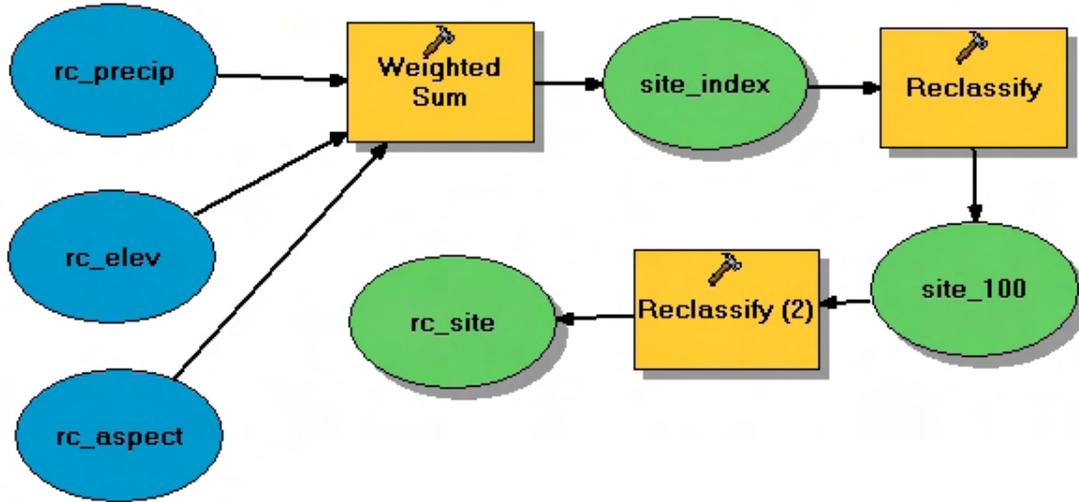
This was not included in the national direction, but was important to include in Wyoming’s analysis due to the biological and social benefits provided by the program. The agroforestry layer from the SAP analysis was used with modifications, with 1 representing areas suitable for agroforestry practices and 0 representing other areas. The modifications to the SAP layer were inclusion of public lands and forested lands for this analysis. Suitability was determined for non National Park Service lands based on elevation (below 7000’) and precipitation (>12”).

High Priority Stewardship (Weight = 1, Values = 0, 1)

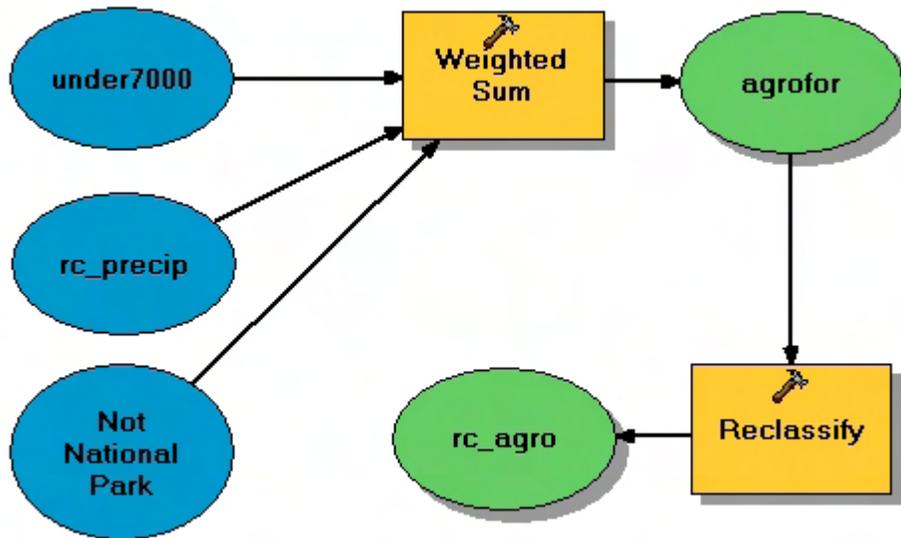
This layer was included to “represent high priority private lands where management and science-based management direction have the potential to affect multiple resources.” The final output layer from the SAP analysis was used. Areas of high stewardship priority were classified as 1 with other areas classified as 0.

Appendix B
State Forest Resource Assessment GIS Models

Site Index

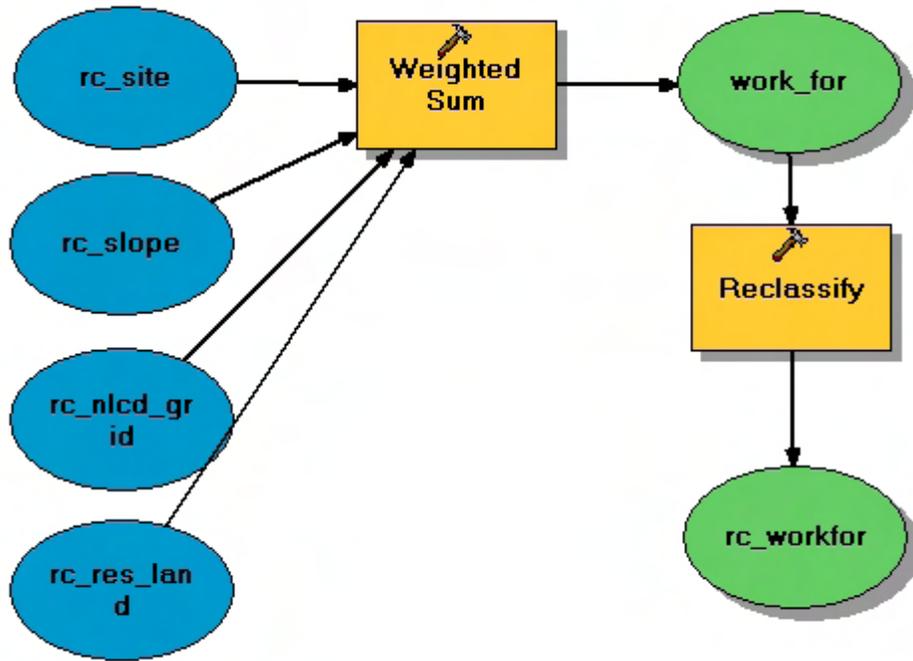


Agroforestry

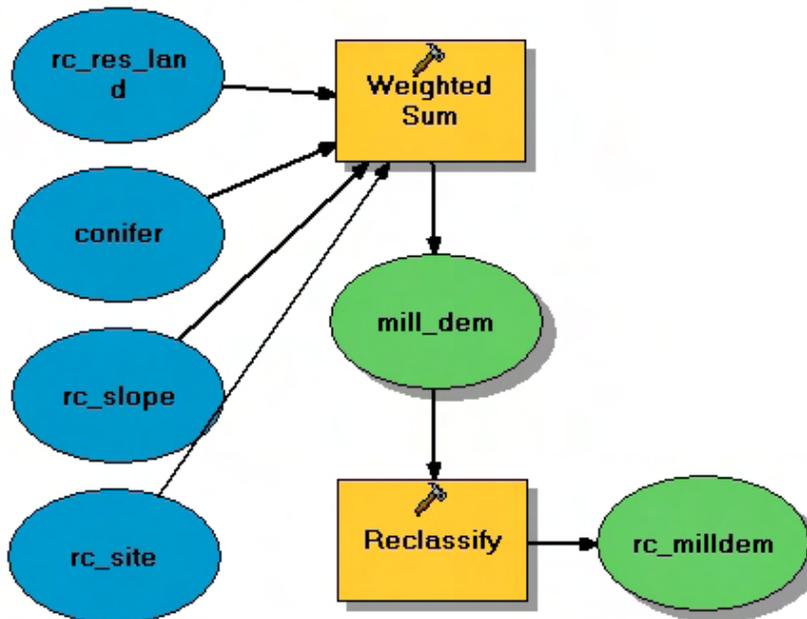


Wyoming Statewide Assessment of Forest Resources

Working Forests



Mill Demand Forests



Wyoming Statewide Assessment of Forest Resources

Final Weighted Sum Analysis

