receipts (e.g., grazing, special uses, recreation) are important, they cannot be used for species viability, or fire-hazard and insect-risk reduction on the Forest, the main topics of discussion in this Final EIS. For this reason only timber receipts are discussed.

3-11.1.3.1. Forest Budget Effects

From 1998 to 2004 the Black Hills NF budget increased 65 percent (see Monitoring Item 37, USDA Forest Service 2005d). The estimated total annual budget for all alternatives (**Table 3-64**) falls within 16 percent of the most recent 3-year funding levels. Forest budgets may fluctuate 10 percent from year to year, thus the estimated budgets indicated are within reasonably predicted range in total over the decade, although levels may vary considerably within general budget categories.

KV funds and stewardship contracts use timber sale revenues that would otherwise go directly to the U.S. Treasury and instead spend them on projects in the Black Hills. The Forest has used KV funds for many years; $2 million a year in KV funds is included in the recent 3-year funding level. Stewardship contracts are relatively new to the Forest and their advantage is they are a more flexible method to complete a variety of projects including species-viability improvement, fire-hazard and/or insect-risk reduction than through the use of KV funds.

Historic timber receipts are displayed in **Table 3-68**. From 1998 to 2004 the Forest averaged $11.7 million in annual timber receipts. The conclusion drawn is that it is possible to fund all of the existing alternatives using appropriated funds, cost reduction methods, grants, cost/share agreements, KV and stewardship contracts. If full funding of any of the other alternatives cannot be achieved, then it will take longer than a single decade to attain the objectives of these alternatives.

Table 3-68. Black Hills NF Timber Receipts – Millions of Dollars

FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
$16.7	$15.1	$13.9	$6.5	$9.0	$6.9	$13.9

3-11.2. Direct And Indirect Effects

For resources programs other than timber, no change is projected under any alternative. For example, there will be no changes by any of the alternatives to the number of AUMs offered in the future for livestock grazing. The specific allotment locations may change, which could affect an operation in terms of travel time, fencing, or other construction requirements, or other operational impacts. Outfitters and guides that depend on using Forest lands to continue offering their services for visitors may have to find substitute sites for continued operation. Such changes would need to be further evaluated and documented through a separate, project-level analysis. Mineral changes by alternative are associated with the effort and costs associated with additional requirements outlined by each alternative, but overall, no change to mineral output is expected under any alternative. As a consequence, direct and indirect effects are evaluated for changes in the timber program and Forest expenditures on vegetation management (restoration), thinning, and fire/fuels (excluding fire suppression).

3-11.2.1. Employment And Income Effects

This analysis examines the potential effects of each alternative on total employment (direct, indirect, and induced) and associated labor income opportunities within the analysis area. The IMPLAN model (MIG, 2002) is used to estimate complex economic relations in order to approximate the effects of each alternative on the economy as a whole. The IMPLAN model is an input-output model that estimates and uses multipliers as a means to estimate the change in direct, indirect, and induced effects as a result of an adjustment in the level of final demand for the goods or services provided by a given sector of the economy. Appendix B provides additional information and explanation of modeling processes and assumptions.

The IMPLAN model uses projected value of products from the Forest to quantify economic impacts. For all resources, except timber sales and forest service expenditures on fire/fuels (excluding fire suppression), thinning, and vegetation management (i.e., restoration), no change is projected. For example, there will be no changes by any of the alternatives to the number of AUMs offered in the future. The specific allotment locations may change, which could impact an operation in terms of travel time, fencing, or other construction requirements, or other operational impacts. Outfitters and guides that depend on using Forest lands to continue offering their services for visitors may have to find substitute sites for continued operation. Such changes would need to be further evaluated and documented through a separate, project-level analysis.

No change in available RVDs or future mineral production is proposed in any alternative. Therefore, inputs for these categories of Forest products are assumed the same across all alternatives. The analysis therefore highlights the changes in wood products and related timber industry from implementing each alternative, and the consequential impact on the regional economy. The results account only for jobs and income related to wood product outputs on the Forest, and do not represent total industry participation or activities associated with other resources outside the Black Hills NF. Narrative discussion is included to consider these larger impacts beyond the Forest outputs.

Table 3-69 summarizes forest production employment contributed by the Black Hills NF timber program and forest expenditures on timber and vegetation management only (no changes in other forest-related resource activities or programs are assumed to occur for the purpose of this analysis). As shown in **Table 3-70**, estimated forest production employment associated with wood products is lower than the 10-year average under Alternative 2 due to a reduction in Black Hills NF timber supply to local mills. This decline in job opportunities would translate to impacts on employers, employees, and their dependent families under these alternatives.

Alternatives 1, 3, and 6 are estimated to increase forest production employment in wood products and related forest management activities by 31 to 33 percent, and all have the highest level of wood products employment opportunities. Alternative 4 has a slight increase. Each alternative has a variety of resource objectives that affect timber harvest levels, depending on the actual impact of implementation as compared to the estimated impact; the numbers presented here should therefore be viewed as rough estimates. The impact of job shortfalls will be more pronounced in small communities where losses could represent a large portion of a community's employment base.

Table 3-69. Estimated Forest Production Employment Contributed By Black Hills NF, By Alternative

Resource	Estimated Jobs Contributed by Black Hills NF					
	10-Year Average	Alternatives				
		1	2	3	4	6
Wood Products	1,067	1,472	886	1,472	1,163	1,472
Payments to States/Counties[1]	125	125	125	125	125	125
Affected Forest Service Expenditures[2]	155	172	126	195	135	201
Total	1,347	1,769	1,138	1,791	1423	1,797
Percent Change from 10-year	- -	31%	-16%	33%	5.6%	33%

[1]Payments to States/counties are assumed stabilized and therefore constant at current levels

[2]Forest Service Expenditures include only those expenditure categories that are projected to change under the alternatives: Commercial timber program, thinning and mechanical fuel treatment, Vegetation management/restoration, and Fire/Fuels (excluding fire suppression).

Source: MIG 2002 (IMPLAN)

Table 3-70 highlights the same trends for estimated labor income from forest production by alternative as the employment analysis; the higher the volume available for harvest, the greater the associated income. Those communities with mills currently in operation or with associated firms that support mill activity, would likely experience a magnification of the potential impacts of each alternative, negative and positive: a mill closure due to limited supply would likely result in a larger ripple effect to the local community than to the larger study area modeled here.

Table 3-70. Estimated Forest Production Labor Income Contributed From Black Hills NF By Alternative

Resource	Estimate labor income contributed by Black Hills NF (millions, 2004$)					
	10-Year Average	Alternatives				
		1	2	3	4	6
Wood Products	$31.5	$43.5	$26.2	$43.5	$34.4	$43.5
Payments to States/Counties[1]	$3.9	$3.9	$3.9	$3.9	$3.9	$3.9
Affected Forest Service Expenditures[2]	$12.8	$14.2	$10.4	$16.0	$11.1	$16.5
Total	$48.2	$61.6	$40.5	$63.4	$49.4	$63.6
Percent Change from 10-year	---	28%	-16%	32%	2.5%	33%

It is important to note that impact modeling results using IMPLAN or related models represent ‘snapshots’ in time and do not capture changes in underlying market structure nor acknowledge capacity limits or operating thresholds for local facilities. Market structure in this case is based on 2002 conditions and accounts. As such, changes in the availability of production inputs or supplies that would affect facility operations and/or closure are not represented (e.g., impacts from potential decreases in timber supplies from private sources are not addressed).

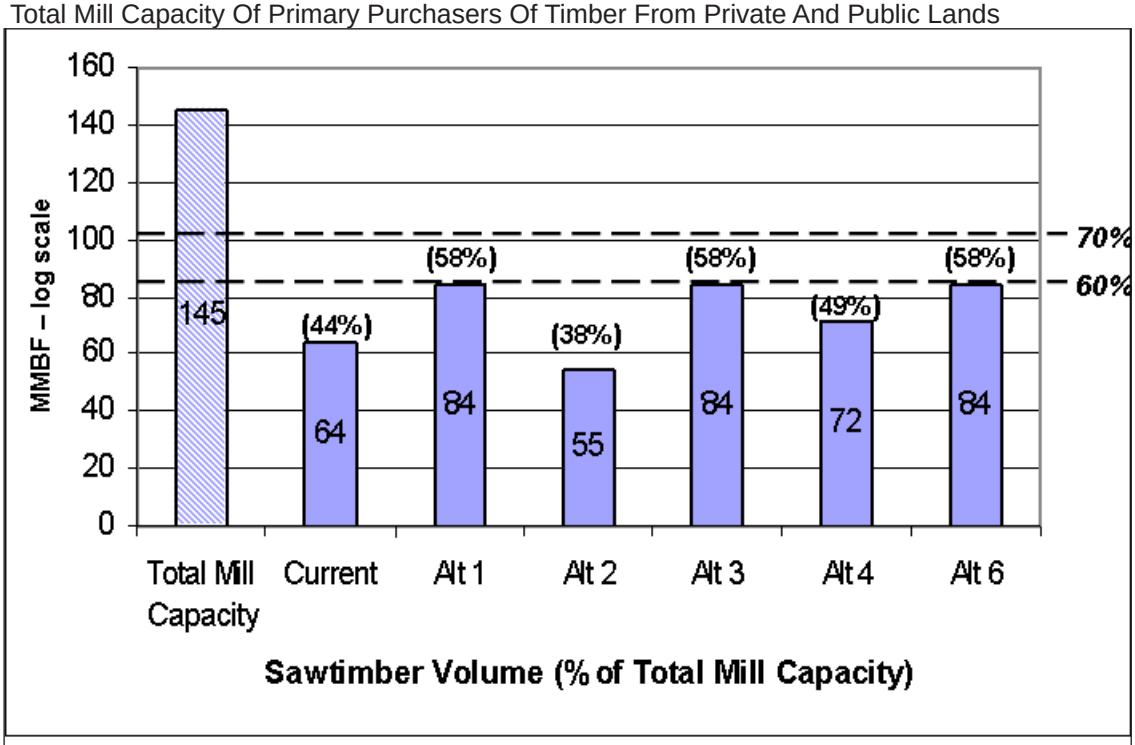
3-11.2.2. Wood Products Industry Effects

Estimates of potential timber sale levels that could affect the wood products industry are presented in the Forest Ecosystem Section (Section 3-2) and Appendix B. Estimates were based on assumed full funding of Forest Plan timber objectives in the 1997 Forest Plan (USDA Forest Service, 1997a), the goals and objectives of each of the Phase II alternatives, and the limitations imposed by the standards, and guidelines of each of the Phase II alternatives. Key standards and guidelines in several alternatives are expected to reduce timber sale levels (see Appendix B for further discussion).

It is recognized that the Black Hills area timber mills are a critical component of the Forest's ability to manage forest vegetation to reduce fire and insect hazards, restore aspen and riparian areas, and address other species-viability concerns such as the American dipper. The ability of these mills to remain viable depends on timber supply from the Forest, as well as the decisions made by the mill owners. **Figure 3-28** displays estimated sawtimber sale volume attributable to Black Hills NF under each alternative compared to total capacity of area mills. It has been suggested that the current levels of harvest from state and private lands cannot continue and industry will need to have at least 60 percent of their supply from the Forest to maintain operations at current levels (Teasley 2004). Timber from non-Black Hills NF sources is currently estimated to be approximately 40 percent, based on market survey data summarized by Teasley (2004).

The reader will note that estimated sawtimber volumes for Alternatives 1, 3, and 6 are at 58 percent of total mill capacity. If similar conversions from ccf to mmbf are applied across all alternatives (i.e., volumes not constrained by current Forest Plan volumes), then estimated sawtimber volumes under Alternatives 1, 3, and 6 are estimated to be 90.5 MMBF (0.5mbf/ccf x 181,000 ccf) or 62 percent of total mill capacity.

Figure 3-28. Comparison Of Estimated Volumes Of Sawtimber From Black Hills Natonal Forest Total Mill Capacity Of Primary Purchasers Of Timber From Private And Public Lands



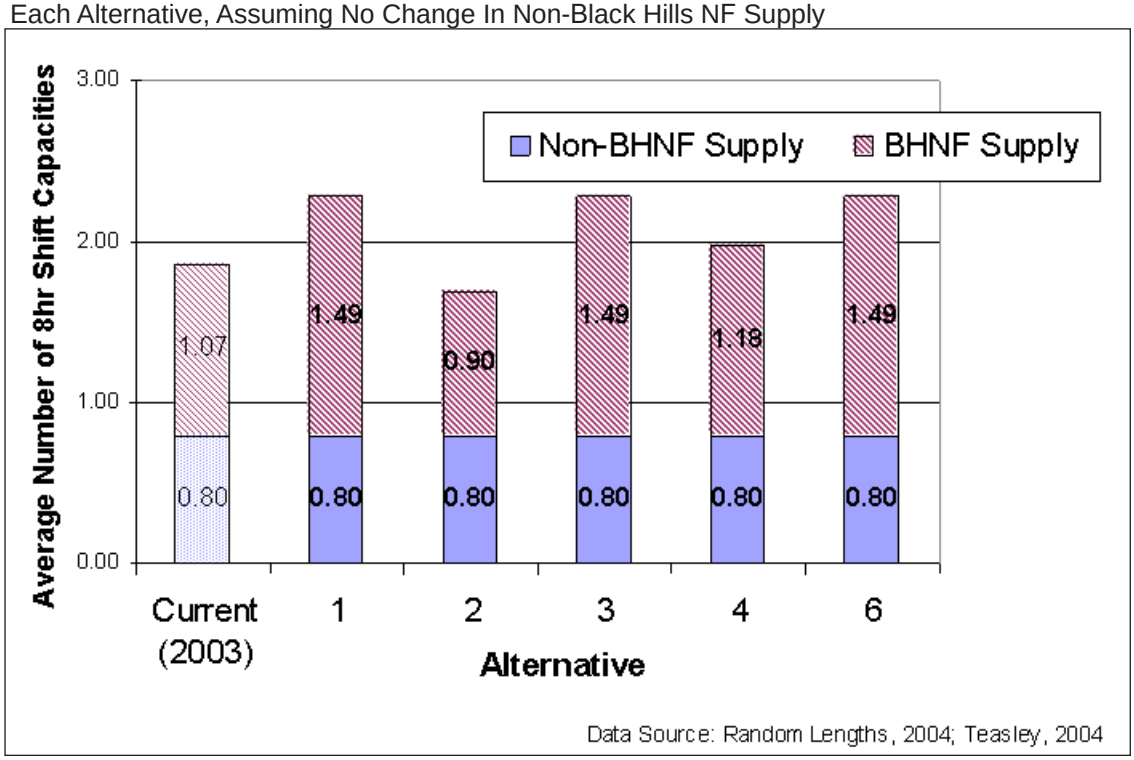
Sources: *Total Mill Capacity*: primary purchasers of inputs from all ownerships - Region 2 Timber Strategy, App. A (USDA Forest Service, 2003h); *Current*: 10 yr avg sale volume (129,000 ccf), Black Hills (1994-2003); *Alternatives*: Sale volume (log scale) (see Chapter 3 – Use of Forest, Timber Production)(e.g., alt 2 = 109,000 ccf) Conversions (Alt 2, 4): ccf x 0.5MBF/ccf/1000 = MMBF, (Alt 1,3,6): 181,000ccf = 84MMBF ('96 Plan volume output

Effects on forest/wood products facilities in the Black Hills area are expected to differ across primary and secondary producers. Background information about primary and secondary producers are summarized in Section 3-11.1.2.4 of this document.

3-11.2.2.1. Primary Producer Impacts

Three sawmills, two of which are owned by one company, are currently producing greater than 20 MMBF annually, obtain 50 percent or more of their raw inputs from the Forest, and account for 90 percent of production capacity in the Black Hills area. Information about 2003 production, 8-hour shift capacities, and percentage of raw inputs derived from the Forest is used to evaluate potential for changes in average number of shifts at these mills under each alternative (see Appendix B for details about analysis). **Figure 3-29** shows estimated average number of 8-hour shifts under current (2003) conditions and projected number of shifts under each alternative for the three large mills, assuming current supply by non-Black Hills NF (local private, supplies from outside Black Hills area) sources remains constant.

Figure 3-29. Comparison Of Average Number Of 8-hour Shift Capacities For Large Mills Under Each Alternative, Assuming No Change In Non-Black Hills NF Supply

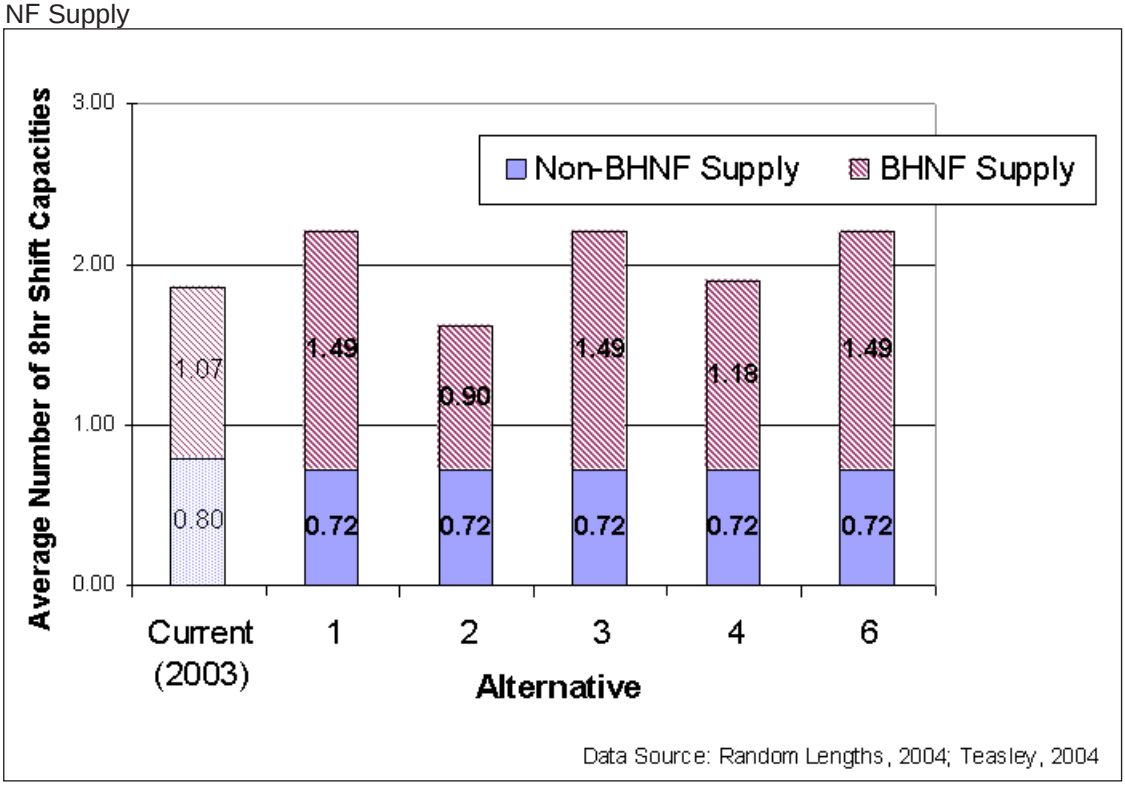


It is suggested by industry experts[1] that current non-Black Hills NF supplies may not be sustainable due to a variety of factors including trends in land ownership, fragmentation of forest land, and elevated harvests on private lands in response to market conditions within the last decade. Teasley (2004) notes that there has been a slow increase in the use of local private forest resources as a source of raw material, but that non-Black Hills NF resources do not have the volume to replace Black Hills NF resources.

Net volume of live trees (ponderosa pine) on private forest land in South Dakota has decreased by 16 percent between 1996 and 2003, indicating that current harvest rates from private lands may not be sustainable and that declines in harvest are therefore likely. Though this decline may over or underestimate change in volume of ponderosa pine sawtimber due to a variety of factors, it is indicative of the potential magnitude of future shifts in harvests away from private lands. Ten-percent reductions in supplies from non-Black Hills NF are therefore assumed to represent declining non-Black Hills NF supply conditions, and average numbers of 8-hour shift capacities are re-calculated (**Figure 3-30**).

1 Personal communications: C. Miller with T. Troxel (Intermountain Forest Industry Association) on 9/13/05, and G. Josten (South Dakota Department of Agriculture, Resource Conservation and Forestry) on 9/14/05.

Figure 3-30. Comparison Of Average Number Of 8-hour Shift Capacities For Large Mills Under Each Alternative, Assuming 2003 Baseline Production And 10-percent Reduction In Non-Black Hills NF Supply



Information in **Figures 3-28 through 3-30** suggests the potential for two-shift operations under Alternatives 1, 3, and 6, but this possibility is diminished somewhat when considering non-Black Hills NF supplies. Conversely, a decrease in average number of shifts is projected for Alternative 2, but this decrease is not predicted to result in conditions that approach average single shift capacity thresholds. The average number of shifts for Alternative 4 is estimated to be similar to current levels if non-Black Hills NF supplies decrease. The average number of shifts estimated for Alternative 4 drops below current (2003) levels if 15-percent reductions in non-Black Hills NF supplies are assumed to occur, and 35-percent reductions in non-Black Hills NF supplies eliminates potential for two-shift operations, on average, for Alternatives 1, 3, and 6. Overall, these projections do not indicate strong potential for the addition or elimination of a shift, but other factors such as the financial health of mills should be considered when characterizing impacts and vulnerability of mills.

Information from the Forest Wood Products Market survey (Teasley 2004) includes 2002 operating expenses and sales for some facilities in the Black Hills area. Comparisons of sales and expenses indicate that the financial health of the three large mills could be marginal[2]. These observations may imply potential financial vulnerability if these facilities experience subsequent adverse changes in market conditions, including decreases in the percentage of raw material obtained from the Black Hills NF or decreases in non-Black Hills NF supplies under current conditions. Marginal financial conditions suggest potential closure vulnerability under alternatives that require mills to consider reducing average number of shift capacities (e.g., Alternative 2). Increased competition for raw inputs under these conditions may increase the likelihood that one of the two companies would close a mill.

2 Confirmation of financial health requires additional information such as debt and asset data.

Primary producers, other than mills operated by Pope and Talbot and Neiman, derive little to none of their raw material from the Forest (Teasley 2004), and as a consequence, are less vulnerable to changes in Black Hills NF supply.

3-11.2.2.2. Secondary Producers

A total of nine secondary producers are identified in the Forest Wood Products Market survey (Teasley 2004), and these facilities produce engineered fiber-board for kitchen cabinets and remanufactured wood components for cabinets, furniture, crates, windows, and doors. Other products include posts, laminated posts, poles, and lawn products.

Many derive significant inputs from, but are not reliant on the Forest, as a sole supplier. Many of these facilities are able to use different forms of inputs (chips, dust, small diameter logs) from a variety of sources and have adopted new technology to efficiently produce wood and engineered products that are in high demand. Teasley notes that trade has increased in value-added (processed) wood products and that engineered wood products is a growing industry.

As a consequence of input flexibility and technical adaptation, this sector is less likely to be impacted by changes in Black Hills NF timber availability. However, larger secondary producers that currently purchase raw inputs derived from the Forest timber may be impacted and/or consider changing locations if Black Hills NF supplies continue to decline.

3-11.2.3. Wood Products Community Effects

Teasley (2004) reported the following: The Black Hills forest products industry maintains close relationships with the communities that are invaluable to their sustainability. The companies' employees typically live where the facility is located and are involved in their communities. In some communities the forest product company is the primary employer through which the local economy is supported with direct, indirect, and induced jobs.

The smaller the community, the more economically dependent the community is on a forest product company(s) that resides within its borders. Hulett, Hill City and Spearfish are examples of small communities that are significantly affected by their respective forest-product companies. For example, Hulett's largest employer is Devil's Tower Forest Products. If it closes, the city loses its largest employer and economic contributor.

In the previous section, the impacts associated with changes in timber sale volumes were modeled based, in part, on changes in final demand for sawmill output, where impacts capture indirect effects on other sectors of the economy that support sawmill production (e.g., transportation) and induced effects associated with changes in personal consumption in the area. For every $1 million change in sawmill output, there is a corresponding change of $860,000 in indirect and induced effects in the region. Correspondingly, for the creation or loss of 6 sawmill jobs, there is a projected change in 7 to 8 additional jobs in other sectors. This type of multiplier effect demonstrates the potential magnitude of the more widespread importance of sawmill operations, though these multipliers are not necessarily applicable to events such as mill closures where changes to regional or community-level infrastructure may result.

Company management and staff also assume roles in community leadership. Plant managers and presidents often sit on the board of directors for banks, utilities, schools, non-profits and other organizations. Some employees are volunteer fire and emergency medical technician staff and are active

in the local Parent Teacher Associations. These men and women provide many volunteer hours working with various public and private organizations to improve the quality of life for themselves, their families, neighbors, and communities. Others are elected officials sitting on city councils, county commissions, school boards, and other public servant tasks.

Forest-product companies contribute to local social service organizations. In 2002, these companies donated more than $1,000,000 in cash, employee contributions, volunteer hours, and in-kind services to local schools, churches, clubs, libraries, civic clubs, children organizations, and others. The impact of their charitable contributions is greatest in the communities in which the mills reside: Hill City, Hulett, and Spearfish. Without the charitable contributions many of the organizations that receive their support would have to reduce or discontinue services.

Generally, Black Hills forest-products companies use existing infrastructure, zoning, etc. thus reducing the need to build new facilities on green space. Closure of a forest-products company, which includes abandonment of its property, will create abandoned and/or underutilized industrial property in a community. This creates potential blight and a land reuse challenge for the community that could take a long time to restore or reuse.

3-11.3. Cumulative Effects

Forest uses such as recreation, total livestock grazing, hunting, fishing, and wildlife viewing are not expected to change by alternative for this plan amendment. Forest management direction can affect the cost of some commercial uses of the forest: logging, mining, and livestock grazing. At times, forest management costs, in addition to markets, taxes, and other operating costs determine an operations profit or loss. As noted in Section 3-11.2.2, available data suggest that large mills in the region may become financially vulnerable under additional adverse changes in market conditions.

Forest plan direction will also remove some areas from mineral entry and will impose seasonal and surface occupancy restrictions on mineral activities. Although mineral activities are influenced to a great degree by market prices, Forest Plan direction such as surface occupancy restrictions, mineral withdrawals in RNAs (although a very small amount of acres), and added costs to comply with Forest species-viability and diversity requirements can result in increased production costs and the removal of areas in the Forest from profitable mining enterprises.

In the case of tourism and recreation use, visitor numbers are more likely to be influenced by overall economic conditions in terms of employment, gasoline prices, or the international value of the dollar. Those communities dependent on tourism may benefit from those alternatives which focus on active forest health restoration for management of the resources that attract visitors to the area. Future livestock grazing activities will be influenced by national market prices as well as availability of Forest allotments. Other factors, such as changing demographics from incoming retirees and seasonal residents, will continue to influence the economy. However, as stated above, specific communities could be greatly affected by a mill closure that could cause losses in manufacturing and forestry jobs.

The wood products industry is dependent on Forest timber supply and as discussed earlier would be directly affected by changes in forest management. In terms of the cumulative impacts that may be tied to changes in supply, communities with large wood-production facilities would have economic ripples through all businesses supporting or supported by the wood production. Some small operations may be able to develop a new niche for production or find another supply source, and this may cause greater competition among firms searching for supply.

In terms of fuel management, an alternative that decreases the wood production and industry infrastructure available around the Forest would make it much more difficult to find people to complete fire and insect hazard reduction projects by eliminating or limiting the ability to make a profit. Similar fuel-reduction work done without some revenue return from product removal would cause a significant increase in contracting costs. Such conditions may result in fewer fuel projects, higher concerns for the WUI, and potential loss of other resource values from fire and insect events.

Over the next 10 to 15 years, within the seven-county Black Hills region, Alternatives 1, 3, and 6 demonstrate the greatest potential for increasing timber sales and positive cumulative economic impacts associated with the wood products industry. Alternative 2 places the greatest potential restrictions on forest timber supplies which, in combination with other possible market changes and decreases in supplies from private lands, could result in the greatest adverse cumulative direct, indirect, and induced economic impacts associated with the wood products industry and corresponding fuels management services provided by that industry. Alternative 4 has a moderate rate of economic return between Alternatives 1, 3, and 6 and the lowest return with Alternative 2.

Cumulative economic impacts are not quantitatively differentiable across alternatives for other industry sectors because forest uses affecting these industries are not expected to change by alternative under this amendment or changes cannot be discerned until project level implementation occurs.

Cumulative economic impacts associated with changes in species viability and diversity, fire-hazard reductions, and insect hazard reductions projected to occur under this amendment are not quantified in this analysis due to the non-market nature of these goods and services (see Appendix B). Expenditures for management programs and activities that affect these resources are expected to have relative direct, indirect, and induced cumulative economic effects (see Section 3-11.1.3 for expenditures), but expenditures, by themselves, cannot be used as indicators of overall cumulative economic effects associated with changes in these resource attributes. The reader is referred to resource-specific sections in Chapter 3 for discussion of non-economic cumulative effects.

3-12. Financial and Economic Efficiency

Financial efficiency examines revenue and cost implications from the perspective of the Forest Service or the taxpayer. Only those revenues and costs that are recorded in financial records are included in this portion of the analysis.

Economic efficiency examines a broader definition of benefits than a financial analysis by including values for NFS uses that are not captured in the marketplace. Recreational values based on Resource Planning Act figures are the primary additions over a financial analysis.

Many non-market or passive use values and externalities are excluded from this economic efficiency analysis. Some outcomes or effects, such as biological diversity, visual amenities, and some social impacts have no monetary values or costs that have been established by the USDA or the Forest Service. These benefits and costs, while not valued through dollars, are still important to be considered and will be discussed qualitatively.

Net public benefit is defined as the overall value to the nation of all outputs and positive effects (benefits) minus all the associated NFS inputs and negative effects (costs) for producing those primary benefits, whether they can be quantitatively valued or not. Thus, net public benefits conceptually are the sum of this economic analysis plus the net value of non-priced outputs and costs. It is not the result of an economic analysis alone. This concept is the basis upon which the responsible official selects an alternative for implementation. Net public benefits are discussed in the ROD.

3-12.1. Method For Estimating Financial And Economic Efficiency

The main criterion used in assessing financial and economic efficiency is present net value (PNV), which is defined as the value of discounted benefits (or revenues) minus discounted costs. A financial efficiency analysis is completed to determine the net financial returns of each alternative. A financial efficiency analysis is the PNV of Forest Service costs and revenues. The economic PNV analysis includes all outputs to which monetary values are assigned, including monetary values of both market and passive use values received by the public.

For both PNV analyses, monetary values are expressed in constant dollars with no allowance for inflation. Values are accounted for over the 50-year planning horizon and discounted using a 4-percent discount rate. Total revenues are not reduced for payments made to states and counties in the PNV analysis. The reduction of PNV in any alternative as compared to the most financially or economically efficient solution is the economic tradeoff or opportunity cost of achieving that alternative.

Recreation benefits to the public in the form of willingness to pay values are included over the life of the Forest Plan for all alternatives and are assumed to not change from alternative to alternative. This assumption is made because the number of people who visit the Forest for recreation is not a direct function of the Forest condition. People are more influenced by the state of the economy, population-age structure, price of oil and gas, options for activities in other areas, advertising, etc. Arguments can be made for increases in recreation use, but the Forest does not have defensible research to support such speculation.

Livestock grazing outputs are expected to be the same for all alternatives. This assumption is based on the Forest having additional allotments available for permittees if any alternative were to change a current allotment. In terms of values, using other allotments to maintain head-months would not show any difference across alternatives. However, it should be recognized that a permittee might encounter social costs if required to move to a different allotment. Travel time, ease of access, and "sense of place" associated with allotments should be considered although this is difficult to do within a quantitative analysis.

Timber activity was included by alternative in terms of the budget needed to produce the estimated outputs, and the total revenues provided to the Forest in terms of stumpage.

There are many costs and benefits that should be considered within the economic PNV for which there were not enough data to support values to be used or consistent values were not available for all counties in the study area (as in the case of South Dakota wildlife surveys). While these values are not included in this analysis, it should not be taken as an indication that they are not important to consider. In most cases, the values that are most difficult to include in a numeric analysis are those that are most important to people.

Costs that have not been included in the PNV but that should be considered in selection of an alternative include, but are not limited to, sedimentation downstream, species impacts, soil and water conditions, and stand-replacing fire and insect occurrences. A number of benefits have not been included such as amenity values, fire protection, water yield, non-market resource values, and continued quality of life for residents.

3-12.2. Financial And Economic Efficiency Effects

Table 3-71 summarizes the results of the PNV analyses by alternative. The financial analysis includes only those costs and revenues the Forest paid out or collected. The economic analysis includes all costs and benefits for which market values exist or for which the Forest Service has determined a non-market value. Specific information of values and outputs used can be found in Appendix B.

Table 3-71. Economic and Financial Efficiency PNV Analysis (2004$)

Discounted Values	Alternatives In Millions of Dollars				
	1	2	3	4	6
Economic PNV	$464	$496	$406	$514	$390
Financial PNV	-$558	-$526	-$616	-$508	-$632

Source: Quicksilver Project Analysis Tool for Economic Performance (USDA Forest Service, 2004e) (see Appendix B for details)
PNV = Present Net Value; "Economic" represents all partners; "Financial" represents Black Hills NF only.

Because the economic PNV includes benefits to the public for recreation, to ranchers for livestock grazing, and to wood producers for volume, all alternatives have a positive economic PNV as displayed in **Table 3-71**. Unlike much of the other social and economic analysis, the PNV figures may not follow with the intensity of timber sale because of the inclusion of budget figures to implement each alternative as a cost to the analysis. Alternatives 1 and 4 provide the largest economic PNVs because they require comparatively smaller budgets for implementation. In contrast, estimated timber sales volumes for Alternatives 3 and 6 are equal to that of Alternative 1 but require the largest Forest Service budget for implementation. So the expected economic PNV figures are lower to account for the stewardship and management projects that will not produce commercial or market valued goods and services.

All alternatives show a negative financial value because the Forest spends more on providing goods and services than are returned directly in dollars. Alternative 6 has the highest financial cost to the Forest, followed closely by Alternative 3, due to increased budget needed to implement these alternatives. This analysis is only one part of the entire economic and social analysis. Other benefits by alternative exist that were not captured in dollar terms for this analysis (e.g., benefits from ecosystem improvements and reduced fire risk), but these benefits are highlighted in each resource section of this document. As a consequence of not quantifying the benefits of these non-market goods and services, financial PNV values are under-estimated.

3-12.3. Payments To States And Counties

Under the 25 Percent Fund Act of 1908, counties receive payments from the federal government based on the proportion of the acres each county has on the forest. The funds were to be spent on public schools or roads in the county. In October of 2000, the Secure Rural Schools and Community Self Determination Act of 2000 passed and changed the amount of these payments. Recognizing recent losses of income to many counties of income from reduction of traditional uses on federal lands and fluctuating payment amounts, the law allows counties to select a stabilized payment level (their full payment amount based on the average of the three highest 25 percent payments made to the state between fiscal years 1986 and 1999) or continue the traditional 25 percent payment. All of the counties receiving funds from the Black Hills NF have selected the stabilized payments for the first 5-year period. In 2005, counties will be able to again select stable payments or 25 percent payments.

Table 3-72 displays the full payments made to the seven counties based on the Secure Payment language and the payments related to Forest receipts under Titles I, II, and III of the Act. Title I funds are to be used for education and roads. Title II and III funds are required when counties receive a full payment of $100,000 or more. These counties are required to reserve no less than 15 percent and no more than 20 percent of the distribution for Forest restoration, maintenance, or stewardship projects. Title II funds are to be spent on special projects and are intended to foster cooperation and consensus among a wide array of Forest users. Title III funds are to be spent on county projects. The Forest's total payment is about $4.2 million.

Table 3-72. Black Hills NF 25 Percent Fund Payments In 2002

	Full Payment	Title I	Title II	Title III
Custer County, SD	$1,066,689	$1,066,689	-	-
Fall River County, SD	$160,459	$136,390	-	$24,069
Lawrence County, SD	$930,846	$791,219	-	$139,627
Meade County, SD	$147,493	$125,369	-	$22,124
Pennington, SD	$1,351,646	$1,148,899	-	$202,747
Crook County, WY	$496,534	$419,534	$66,627	$7,403
Weston County, WY	$18,943	$18,943	-	-
Total Payment	$4,172,610	$3,707,043	$66,627	$395,970

Source: USDA Forest Service 2002c

Under the Payments in Lieu of Taxes (PILT) Act of 1976, counties receive payments from the federal government for having federal lands within their counties to make up for lost revenues. Congress appropriates PILT payments based on a complex formula developed at a national scale using population and acreage of federal lands and the value of other federal revenues as key factors. The final annual PILT appropriation is not only based on the formula but also is sensitive to politics and other national funding priorities from year to year. Because all counties have selected stable payments, the Forest's role in determining yearly PILT payments will be stable unless counties select to return to 25 percent payments in 2005. **Table 3-73** displays the amount of PILT payments to counties in fiscal years 1999 to 2002.

Table 3-73. PILT Payments Fiscal Year 1999 – 2002

County	FY 1999	FY 2000	FY 2001	FY 2002
Custer County, SD	$67,390	$87,653	$166,103	$206,014
Fall River County, SD	$171,699	$185,505	$279,761	$298,984
Lawrence County, SD	$27,151	$29,306	$66,371	$97,301
Meade County, SD	$30,952	$35,559	$56,510	$58,115
Pennington County, SD	$218,046	$250,924	$415,155	$475,414
Crook County, WY	$33,289	$35,348	$87,352	$124,221
Weston County, WY	$161,403	$185,529	$207,491	$221,308

Source: USDI Bureau of Land Management 2002

Table 3-74 highlights the contribution of federal payments to county budgets in the past fiscal year. The level of support depends on both the size of the county's budget as well as the funding from 25 percent and PILT payments. In general, the federal funding provides a significant portion of each county's budget.

Table 3-74. County Budgets, Fiscal Years 2001-2002

County	FY 2001 - 2002	Percent of 25 Percent Fund	Percent PILT	U.S. Forest Service Payments (Percent)
Custer County, SD	$3,799,576	28.1	5.4	33.5
Fall River County, SD	$3,037,550	5.3	9.8	15.1
Lawrence County, SD	$6,414,690	14.5	1.5	16.0
Meade County, SD	$9,763,545	1.5	0.6	2.1
Pennington County, SD	$38,675,746	3.5	1.2	4.7
Crook County, WY	$7,353,574	6.8	1.7	8.4
Weston County, WY	$4,457,132	0.4	5.0	5.4

Source: Payments to States (USDA Forest Service, 2005k)

3-12.4. Payments To States And Counties Effects

Table 3-75 displays the potential total return to the states under the 25 percent payment option if counties were to change from stable payments to the 25 percent funding level. While the total revenue figure includes all receipts to the Forest Service, the majority of revenues are generated within the timber program.

Neither the estimated revenues for all alternatives nor the 10-year average come near the current stable payment total of about $4.2 million. These shortfalls would have the greatest impact on Custer County that receives about 25 percent of its county revenues from 25 percent funds, followed by Lawrence County that relies on these payments for 14.5 percent of its funds. Based on projected reductions in payments, it is likely that counties may select to continue stable 25 percent payments in 2005 to avoid losses in revenues and impacts to county budgets.

Table 3-75. Estimated Annual Total Receipts And 25 Percent Payments To States In 2003 Dollars (Millions)

	10-year Average[3]	Alternatives				
		1	2	3	4	6
Total Receipts from Forest[1]	$7.7	$10.3	$6.4	$10.3	$8.2	$10.3
Estimate of 25 Percent Payments to States[2]	$1.9	$2.6	$1.6	$2.6	$2.0	$2.6

[1]Estimated Total Receipts = Average non-timber program gross receipts (1999-2004) $350,000 + [timber sales volume (ccf) x $56.48/ccf (Adj BPP, June, 2005 Transaction Evidence bulletin)], converted to 2003 dollars.
[2]25 percent payments are estimates of what states would have received if they were not operating under stabilized payments.
[3]Actual total gross receipts for Black Hills NF range from $6.8 million to $17.0 million (1999-2004) with an average of $12.1 million (Final budget spreadsheet (USDA Forest Service 2005l).

PILT payments would continue to be based on formulas; implementation of the alternatives would have little influence on the calculation of PILT payments from year to year.

Indirect effects from reductions in 25 percent payments based on funding levels could affect funds available to counties for schools, roads, and other services; however, without information about locations of actual changes in timber sales, effects to individual counties cannot be estimated.

3-12.5. Cumulative Effect On Payments

Cumulative impacts on county budgets from a loss of 25 percent payments under all the alternatives and trends for declining school enrollments could further reduce funds available for education in some counties.

However, it is likely that counties within the seven-county Black Hills area will continue to select stable payments over the next 10 years, given evidence presented in **Table 3-73** showing the differences between current levels of stable payments and estimates of 25 percent payments. This speculation implies no difference in cumulative impacts associated with payments across alternatives.

3-13. PHYSICAL ELEMENTS OF THE ENVIRONMENT

3-13.1. Air Quality

3-13.1.1. Affected Environment

The Final EIS for the 1997 Revised LRMP (USDA Forest Service 1996a) presented information on the affected environment of air quality in the Black Hills region on pages III-15 to III-18. The 1996 Final EIS generally presented information on the National Ambient Air Quality Standards (NAAQS) and described the overall excellent air quality of the Black Hills area. The Final EIS also identifies some activities that could potentially affect air quality in the Forest.

Regional air quality is influenced by the interaction of several factors including meteorology, climate, the magnitude and spatial distribution of local and regional air pollutant sources, and the chemical properties of emitted air pollutants. Air pollution impacts are generally discussed in three different ways. The first is ambient concentrations of chemicals or particulates in the air. The second is impacts to visibility, meaning the ability to see clearly through the air. And the third is atmospheric deposition of pollutants.

3-13.1.1.1. Ambient Concentrations

Information related to non-attainment areas (areas that do not meet the national standards for one or more criteria pollutants) included in the EIS has changed since it was published. The Final EIS identifies Rapid City as a non-attainment area for particulate matter less than 10 microns in size (PM10) as designated by the Environmental Protection Agency (EPA). New information from the EPA as of February 2003 does not cite any locations in the Black Hills area as non-attainment areas (EPA, 2003). Since the Final EIS was written, the EPA has developed a PM2.5 standard for particulate matter less than 2.5 microns in diameter. There are no PM2.5 non-attainment areas in South Dakota as of March 2005. Upwind sources of air pollution have also increased since the Plan was written. Upwind development is expected to continue increasing in the foreseeable future. These upwind sources add to cumulative effects.

Fixed location ambient air quality monitors are located throughout the State of South Dakota and are operated by the South Dakota DENR. The closest monitors are in Gilt Edge, Black Hawk, Rapid City, Custer, Wind Cave National Park, and Badlands National Park. For more information, see http://www.state.sd.us/denr/DES/AirQuality/Monitoring/state-mo.htm. Adjacent states also operate fixed location ambient air quality monitoring networks.

3-13.1.1.2. Visibility

Viewing the scenery and experiencing clean, fresh air are among the most important uses of NFS lands in the West according to visitor feedback and surveys. Federal and state laws provide visibility protection for the 156 mandatory Class I areas in the U.S. Class I areas include wilderness areas designated as of August 7, 1977, that are at least 5,000 acres in size, and all national parks over 6,000 acres in size. The Clean Air Act states “Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I federal areas which impairment results from man-made air pollution.”

Class I air sheds include Wind Cave National Park and Badlands National Park in western South Dakota. In addition to these Class I areas, there are several areas of important scenic value on or near the forest including Mount Rushmore, Crazy Horse Memorial Monument, Devils Tower, and the Black Elk Wilderness Area.

Within Class I areas, there are visibility goals limiting the additional amounts of pollutants that may be added to the baseline pollution concentrations to prevent visibility impairment from human caused air pollution.

There are visibility monitors in Badlands National Park, and Wind Cave National Park. The State of Wyoming has three visibility monitors near the Black Hills NF. They are located approximately 14 miles west of Buffalo, approximately 32 miles north of Gillette, and approximately 15 miles south of Gillette. Additional visibility monitors are located in surrounding states such as Nebraska and Montana.

3-13.1.1.3. Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area (kilogram per hectare per year). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of particles and adherence of gaseous pollutants to soil, water, and vegetation). Substances deposited include:

Acids: such as sulfuric acid (H2SO4) and nitric acid (HNO3); this acid deposition is sometimes referred to as "acid rain"

Air toxics: such as pesticides, herbicides and volatile organic compounds (VOC)

Nutrients: such as nitrate (NO3-) and ammonium (NH4+)

The estimation of atmospheric deposition is complicated by the contribution to deposition by several components: rain, snow, cloud water, particle settling and gaseous pollutants. Deposition varies with precipitation, which in turn, varies with elevation and time.

Atmospheric deposition monitors are located in Weston County, Wyoming; Wind Cave National Park, and Jackson County, South Dakota.

3-13.1.2. Resource Conservation Measures

Standards, guidelines, goals, and objectives for the Forest as a whole and for specific MAs have been developed and are used to manage Forest air quality. These were discussed in the Final EIS for the 1997 Revised LRMP (USDA Forest Service 1996a) or in the Phase I Amendment (USDA Forest Service 1997a). Specifically, U.S. FSM 2323.61 discusses protecting air quality related values in designated wilderness areas. There are no changes to air quality management in the 1997 Revised LRMP being considered under the Phase II Amendment alternatives; however, additional air quality monitoring (i.e., lake chemistry, short-term smoke monitoring) may be initiated as needed. Appendix C-1 of the Plan references applicable laws including the Clean Air Act and amendments. The Black Hills NF must comply with all applicable State, Federal, and local air quality laws, rules, and regulations regardless of alternative under consideration.

3-13.1.3. Direct And Indirect Effects

Activities implemented or permitted by the Forest that may directly or indirectly impact air quality include prescribed burning, use of travel ways, oil and gas development, mining, and recreation use. Indirect impacts to air quality can occur from management decisions (such as issuance of special use permits to allow use and disturbance) that result in expansion of a population center's infrastructure (e.g., roads and utilities) to accommodate more residents.

3-13.1.3.1. Fire

Smoke from wildfires and prescribed fires have the greatest potential to adversely affect air quality and the health and well being of human populations. Though these fires are relatively short in duration, they can have significant temporary impacts on air quality. Because there is little or no control over what is emitted or the rate at which emissions occur, large, uncontrolled and unwanted wildland fires would likely produce more air pollution over time than any other Forest activity. The EPA addresses smoke from wildland fire under their natural events policy at http://www.epa.gov/ttn/caaa/t1/memoranda/nepol.pdf.

Both wildfires and prescribed fires generate smoke and particulates, which can temporarily degrade visibility and ambient air quality conditions in downwind areas. Unwanted wildland fire has the potential to cause a large amount of smoke. There is a tradeoff between smoke generated by unwanted wildland fire and smoke generated from prescribed fire. Although management ignited fires increase emissions in the short term, these burns decrease the emissions from catastrophic wildfires by reducing the fuel loading over the long term. When using prescribed fire, smoke is generated under controlled conditions and can be mitigated, but smoke generated by unwanted wildfire is usually greater and cannot be mitigated. When using prescribed fire, smoke dispersal is taken into consideration in the fire plan. Prescribed burning is planned on days when air quality degradation can be minimized and during the time of the year when temperature inversions are less likely. Prescribed fire is not usually implemented during conditions of winter season inversions

Prescribed burning is a land management treatment, used during specified conditions, to accomplish natural resource management objectives. Prescribed fires are conducted within limits of a burn plan and prescription that describes the conditions under which the burn can be conducted to meet these resource objectives. Prescribed fire is a cost-effective and ecologically sound tool for forest, range, and wetland management. Its use reduces the potential for high intensity wildland fires and thus has the potential to better maintain long-term air quality.

Wildfire smoke is subject to the vagaries of weather, topography, fuels, and fire suppression effectiveness. Smoke from prescribed fire is constrained by federal, state, and local air quality standards through the regulatory process. The Regional Haze Rule and the new fine particulate (PM 2.5) standards established by the EPA further constrain prescribed fire smoke. The Regional Haze Rule is designed to improve visibility in protected Class I air sheds, while the PM 2.5 standard is designed to protect human health from exposure to high levels of very fine particulates. More information can be obtained from: (http://www.epa.gov/air/visibility/program.html) and from: (http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html)

As the use of prescribed fire increases due to its effectiveness as a tool to reduce fuel loadings and restore ecosystems, the Black Hills NF will actively plan for and utilize appropriate smoke management, mitigation, and monitoring techniques. Prescribed burning practitioners consider the best available control methods for smoke management with the objective of mitigating smoke impacts to visibility and human health. Prescribed burns are ignited when conditions favor good-to-excellent smoke dispersion and when impacts to air quality would be acceptable.

Smoke from prescribed burning is subject to project-level NEPA analysis and disclosure in a dynamic air quality regulatory framework. Prescribed burning project planners must take into consideration all applicable U.S. Forest Service guidance prior to and during the NEPA process. The national Smoke Management Guide for Prescribed Fire and Wildland Fire (NWCG 2001) is a comprehensive document describing all aspects of smoke management including policies, techniques, documentation, and communication and it can be found at http://www.fs.fed.us/pnw/pubs/ottmar-smoke-management-guide.pdf. Current guidance for South Dakota can be found at www.fs.fed.us/r1/gallatin/resources/air/index.shtml. For prescribed burning projects of certain sizes, smoke modeling may be conducted prior to the burn.

Project-level NEPA documents involving prescribed burning will consider the EPA Interim Air Quality Policy on Wildland and Prescribed Fires, and disclose how the U.S. Forest Service develops smoke management plans. (See: http://www.epa.gov/ttn/oarpg/t1/memoranda/firefnl.pdf.)

As of March 2005, the State of South Dakota does not have a coordinated smoke management program as recommended by the EPA. The Black Hills NF must adjust policies and procedures related to smoke management to meet any new State program requirements. This is based on the universal requirement to comply with all applicable State, Federal, and local air quality laws, rules, and regulations for management activities within all resource program areas.

A tradeoff exists between reducing fire hazard and wildfire. With reduced fire hazard comes the expectation that the extent and intensity of future wildfire will be reduced as will the smoke resulting from wildfire. Also with wildfire, the ability to control the timing of smoke production and dispersal is greatly limited. The more an alternative reduces fire hazard, the greater the ability to meet air quality standards. Alternative 6 provides the greatest reduction in fire hazard followed by Alternatives 3 and 1 (which have similar fire-hazard ratings), and Alternatives 2 and 4 (which have similar fire-hazard ratings) (see Final EIS Section 3-7.1 Natural Disturbance Processes, Fire).

3-13.1.4. Cumulative Effects

Cumulative effects for air quality results from the incremental impact (direct and indirect effects) associated with the alternatives when added to past, present, and reasonably foreseeable actions. The current air quality situation describes past actions. The foreseeable cumulative effects analysis area is bounded in time as the next 10 to 15 years. This temporal scale corresponds to projections for the desired future condition described for each alternative (Chapter 2).

The spatial scale for the cumulative effects analysis generally encompasses the Black Hills Ecoregion as defined by Bailey (1995).

For all alternatives, cumulative impacts on air quality from Forest management would be small, and in general, temporary and localized. All areas of the Black Hills NF are currently meeting air quality standards. As the population grows, and people's desire to find places to get away increases, so does the potential for development on private lands near the Black Hills NF. Along with growth comes an increase in vehicle use, development of additional travel ways, new developed recreation sites to accommodate users, and more demands for electricity or other fuels to supply homes and developed recreation sites. Mineral extraction activities upwind, such as the planned coal bed methane development in the Powder River Basin in Wyoming on both public and private lands, continue to increase. All of these changes increase the potential for greater emissions and cumulative effects to air quality.

The contribution of activities outside the direct jurisdiction of the Forest can change quickly and is difficult to quantify. These activities can limit management on the Black Hills NF. If NAAQS were at or above the upper limit, the Forest would not be able to conduct a prescribed burn. Under all alternatives, individual Forest management activities are not expected to individually, or cumulatively, exceed NAAQS. All planned National Forest resource management activities must take into consideration the current or anticipated air quality impacts of adjacent activities including planned coal bed methane operations in Wyoming not under control of the Black Hills NF as part of the implementation process. The end result is that NAAQS will not be exceeded by planned Forest activities.

As described above, with increased fire-hazard reduction among all alternatives provides a greater ability to control the timing and extent of smoke resulting from wildfire and a greater ability to control the cumulative air quality effects.

The system of air quality discharge or burning permits administered by the States and EPA is a system designed to manage the cumulative effects on air quality. If the cumulative air quality conditions cannot absorb smoke from prescribed fires on the Forest, those prescribed fires will not occur. Given that situation, all alternatives will meet air quality standards.

The second aspect of cumulative air quality impacts is the ability to control the timing of smoke discharge. The more an alternative manages fuels to decrease the extent and intensity of future wildfire, the greater the probability that future cumulative air quality impacts can be kept within established air quality standards for longer periods of time. Alternative 6 would do the most to manage fuels followed by Alternatives 3, 1, 2, and 4.

3-13.2. Soils

3-13.2.1. Affected Environment

Information was presented on the affected environment of soils located within the boundaries of the Forest and can be referenced in Chapter 3 of the Final EIS for the 1997 Revised LRMP (USDA Forest Service 1996a p. III-19 to III-35). The EIS generally discussed the types and distribution of soils on the Forest; the predominant soil forming factors contributing to the development of Forest soils, some activities that may potentially affect soil conditions (such as erosion rates and surface organic matter), and some other concerns and limits that are expected to be considered during management decisions and project design. Primary factors that are associated with potential alterations of soil conditions were described in the 1996 Final EIS and are summarized in **Table 3-76**.

Table 3-76. Factors Associated With Potential Alterations Of Soil Condition

Soil Factors	Relevance	1996 EIS Chapter 3 Page Numbers
Soil Erosion	Depending on site conditions and extent, varying percentages of erosion can result in a loss of the fertile soil surface layer, thereby contributing to reductions in organic matter and site productivity. This can reduce the ability of native vegetation to be established, and the growth of the biomass (trees, forage) can be decreased. In addition, erosion can contribute to a decrease in surface water infiltration and, depending on location, erosion can be expected to increase potential for sedimentation that may affect downstream surface water quality.	Further discussion III-20
Soil Displacement	The effect of mechanical forces (surface disturbing activities) on soil movement are similar to, but may be greater than, natural soil erosion effects. Disturbances can be expected to contribute to the removal of soil surface cover (vegetation and litter) and various depths of upper surface layers of the soil, therefore affecting a site's soil biological activity.	Further discussion III-21
Soil Compaction and Soil Puddling	Can result in alterations to soil structure leading to reduced soil aeration available for plant growth, decreased surface water infiltration, contribution to increased surface water runoff, reduced soil moisture holding capacity, and limited extent of plant root penetration. Any combination of these factors can result in lower site productivity and a reduction in biomass production (stress to plants that lower site indices for ponderosa pine or lower total pounds of forage produced in meadows).	Further discussion III-21
Soil Nutrient Reduction or Loss	Results from erosion, displacement, compaction, and reduction of soil organic matter, such as through burning, can all contribute to lower site productivity including reduced nutrients available for plant growth.	Further discussion III-21-III-23
Severe Burning Conditions	High severity conditions resulting from high intensity fires with soil heating can potentially result in high severity effects to soil conditions, such as complete consumption of ground cover vegetation, litter and duff, development of water repellency, extensive soil erosion, decreased soil biological activity, and disturbance of the soil nitrogen pool. These and other altered conditions of the soil affect long-term vegetation productivity of sites.	III-22

3-13.2.2. Resource Conservation Measures

Goals, objectives, standards, and guidelines for the Forest as a whole and for specific Management Areas have been designed to prevent or reduce effects to Forest soils as associated with management activities. These were discussed in the Final EIS for the 1997 Forest LRMP (USDA Forest Service1996a). A section in the 1996 Final EIS Soils Resource Protection Measures (pages III-23 to III-25) discusses the Forest Service's intent to target conserving the maintenance or improving long-term soil productivity as a component of overall site productivity. Full implementation of the LRMP Forest-wide standards and guidelines targeted at soils, as well as the implementation of guidance from other USDA Forest Service sources, is targeted at avoiding and reducing the likelihood of impacts and focusing on taking actions to restore productivity of sites that had been impacted (e.g., historical mining, high severity fire-burned areas, etc.). After the 1996 Final EIS was published, the Rocky Mountain Region completed the Watershed Conservation Practices Handbook (FSH 2509.25 R2 Amendment 2509.25.96-1), which provides guidance for the protection of soil, hydrologic, aquatic, and riparian systems on public land administered by Forests in the Rocky Mountain Region.

The following Forest-wide goals, objectives, standards, and guidelines from the 1997 LRMP targeted at maintaining or improving conditions of the soil resource do not change among the Phase II Amendment no action (Alternatives 1 and 2) and action alternatives (Alternatives 3, 4 and 6): Standards 1101, 1102, 1103, 1105, 1106, 1107, 1108, 1109, 1112, 1113, 1116, 1302, 1501, and 1506; and Guidelines 1110, 1102a, 1102b, 1104, 2307, 4105, and 9202 (see the1997 Forest LRMP). Various changes to LRMP goals, objectives, standards, and guidelines (primarily focusing on wildfire and fuels, emphasis species conservation, and candidate RNAs have been included in the Phase II Amendment action alternatives (Alternatives 3, 4, and 6) and can be compared to direction in the no action alternatives (Alternatives 1 and 2) (refer to Appendix D to compare additions or changes to direction). Changes in the Phase II Amendment action alternatives that may generally be expected to contribute to changes in effects to the soil resource are discussed in the various effects sections below.

Further specific clarification on maintaining rangelands in satisfactory range condition, and to implement actions to achieve that condition is included in Objective 302 under Alternatives 3 and 4. The target objective for the no action alternatives (Alternatives 1 and 2), as well as Alternative 6, calls to maintain rangelands in satisfactory range condition, but no specifics are provided.

Guideline 1110 specifies direction for the revegetation of disturbed sites in Alternatives 1 and 2. The direction includes more specifics and is strengthened to a standard (Standard 1110) in Alternatives 3, 4, and 6. Revegetation of disturbed sites is targeted to occur within a timely manner to prevent or limit soil erosion, while still targeting retention of native species diversity and preventing or limiting the invasion by noxious weeds and other non-native invasive plant species.

Guideline 4102c under Alternatives 1, 2, and 4 specifies that areas are to be revegetated that are not expected to naturally revegetate quickly, but defers to specific direction when addressing revegetation within the Black Elk Wilderness. Modifications were included to specify direction for RNAs, and direction was strengthened to a standard in Alternatives 3 and 6.

3-13.2.3. Direct And Indirect Effects

3-13.2.3.1. Species Conservation Management

While differences exist among objectives, standards, and guidelines across alternatives, these differences targeted at the conservation of species would still be expected to be designed to include the implementation of Forest direction targeted at conserving the soil resource. Full implementation of some of the management direction targeted at species conservation would generally be expected to potentially benefit various soil types to a limited extent in localized areas. Therefore, effects to the soil resource from activities targeted at species conservation would generally be expected to be within the effects analysis completed for the Final EIS for the 1997 LRMP.

13-3.2.3.2. Research Natural Area Management

The amount of land included within candidate RNA boundaries varies among the Phase II Amendment action alternatives (Alternatives 3, 4, and 6), with Alternative 4 having the most acreage (approximately 7,800 acres), followed by Alternative 3 (approximately 2,500 acres), and Alternative 6 (approximately 2,300 acres). No candidate RNAs are included in the no action alternatives (Alternatives 1 and 2). The majority of the candidate areas are in locations that have generally had low levels of soil disturbance associated with human activities, with the exception of varying levels of livestock use (see Section 3-6.2 Research Natural Areas). Since management area direction (see MA 2.2 Objectives, Standards and Guidelines, in Appendix D of the Phase II Amendment Final EIS) targets the restriction of many activities within the boundaries of any candidate RNA that may be proposed through the Phase II Amendment Decision for designation. It is generally expected that with full implementation of the direction, potential soil disturbance effects (compaction, erosion, etc.) associated with the various activities that are currently occurring at each site would be reduced or would cease (see description of candidate RNAs in Chapter 3, Section 3.6.2 Research Natural Areas). However, the individual candidate RNAs with forested conifer types could be expected to have gradual increases in tree canopy cover and, therefore, would also generally be expected to have long-term increases in material that could contribute to increased fire intensities if an event would occur at the sites. Higher potential for higher intensity fire events could be expected to result in an increased potential for adverse effects to the soil resources that occur within the boundaries of any site that may be designated. Although canopy covers and fuels can be expected to increase in some of these areas, no candidate RNA location is larger than 2,000 acres. Less than 0.7 percent of the total Forest land base is included within the candidate areas, even if all areas were proposed for designation under the Phase II Amendment Decision, and the percentage is much less in Alternative 6 (the designated preferred alternative). Also, it is expected that fires on the Forest will be targeted for suppression, even within any candidate RNA that may be proposed for designation through the Phase II Amendment Decision. Therefore, any increases in effects to soils from high-severity fires would be expected to be of limited acreage. In addition, aggressive and full implementation of fuel treatments (Chapter 3, Section 3.6.2 Research Natural Areas) could be expected to contribute to the likelihood of reducing fire intensities and severities surrounding those areas, and therefore would be expected to reduce the severity of some effects to the soil resource that is associated with fire. Generally, fuel treatments would not be expected to occur within any area that is designated as a RNA, unless it was done to restore ecological processes within these areas. Standard 4102c specifies that revegetation activities will not occur within any RNAs that may be designated (see Appendix D of the Phase II EIS) so that ecological recovery rates would not be altered. It could be expected that this could result in altering rates of soil erosion reduction following fires.

13-3.2.3.3. Fire-hazard And Insect-risk Management

The implementation locations of fire-hazard reduction activities that would be expected to affect soil conditions vary among alternatives, and some of the general overall effects on site productivity, nutrient cycling, soil surface disturbance, soil compaction, and soil erosion would be expected to be similar. However, differences in effects to various soils would be associated with the type and intensity of fuel- and insect-hazard reduction treatments used at each site as well as specific site and soil characteristics (rock or clay in the soil, presence of surface rock fragments, etc.) at each location. All alternatives have direction targeted at reducing higher levels of mountain pine beetle infestations within ponderosa pine stands. Alternative 6 targets the greatest number of acres. Therefore, it is assumed that Alternative 6 would be expected to have the greatest probability of reducing the susceptibility of various stands to mortality by insects (see Section 3-7.2 Insects) and in the long term, less dead, woody material that could contribute to higher intensity fires. Alternatives 3, 4, and 6 focus fuel treatments in the WUI areas around designated ARCs (see discussion of this fire-hazard and fuel-treatment focus in Section 3-7.1 Fire). Alternative 6 targets the implementation of additional WUI fuel reduction on acreage along non-federal lands, which is not included in the other Phase II action alternatives, and similar associated soil and site productivity disturbance effects would be expected to be associated with these activities. Alternative 4 targets less fuel-reduction activities and would, therefore, be expected to have lower soil surface disturbance associated with those activities. However, as described in the effects analysis completed for the Final EIS for the 1997 Revised LRMP (USDA Forest Service 1996a), when fuels are not actively reduced in areas (such as would be associated to a higher percentage with Alternative 4), it is expected that there is a greater potential for the likelihood of high intensity larger scale fires (see Section 3-7.1 Fire). Higher severity fires are of concern because they have some of the greatest potential for adversely affecting onsite soil productivity. Increased erosion is one of the most visible impacts that fire has on soil productivity (Robichaud et al. 2000).

No matter how much fire hazard is reduced (fuels reduction), wildfires will still occur on the Forest (see Section 3-7.1 Fire). The existing Forest Plan in Alternatives 1 and 2 provides basic direction for reducing effects to soils and watersheds from fires. Additional direction in Alternatives 3, 4, and 6 further targets the reduction of effects associated with wildfire. New Objective 11-01 was included and targets a non-emergency watershed condition as soon as possible after an event but generally no later than 3 to 5 years. Implementation of this objective through various methods would generally be expected to reduce rates of erosion associated with post-fire responses. New Objective 11-02 targets the creation of a fuelloading mosaic that would be expected to generally decrease the likelihood of another event burning dead fallen timber that could result in soil heating conditions and associated post-fire erosion levels. New Objective 11-04 targets the establishment of shrubs in burn areas following fires, which would generally be expected to contribute to the reduction of soil loss following fires. Guideline 4102 and subcomponents have been strengthened to a standard in Alternatives 3 and 6 and increase the extent of areas where earth-moving equipment is to be avoided, and effects to the soil resource with this activity would be expect to be less as compared to the other alternatives. It is expected that full implementation of this direction would contribute to reduce the effects that continue to occur to soil conditions following high-severity-wildfire events. Alternatives 6 and 3 target the most aggressive fuels reduction and post-fire watershed recovery (both in direction and acres), so it is generally expected that these alternatives would likely have the least soil effects associated with high intensity fires.

3-13.2.4. Cumulative Effects

Generally, cumulative effects for site-specific soil conditions would be expected to be associated with site-specific disturbances during implementation of alternatives when added to past, present, and reasonably foreseeable actions. The current soil resource situation describes past actions. The foreseeable cumulative effects analysis area is bounded in time as the next 10 to 15 years. This temporal scale corresponds to projections for the desired future condition described for each alternative (Chapter 2). The spatial scale for the cumulative effects analysis generally encompasses the Black Hills Ecoregion as defined by Bailey (1995).

Several large fire events have occurred on land administered by the Forest since the Final EIS for the 1997 Forest LRMP was prepared, with the majority of those events occurring from 2000 and continuing through the time this section was prepared. As indicated in Section 3.7-1 Fire, this has occurred during the same period that the Forest has experienced below normal precipitation (NOAA 2005). Close to 20 percent of the Forest land base has been affected by these fires since 2000. Maps from these fires reveal that generally there is a mosaic of fire severities associated with these events. Therefore, affects to soil conditions and site-specific productivity across these areas have also occurred within a mosaic. Post-fire assessments were often completed on areas where the larger fires have occurred and various efforts to reduce associated fire and suppression impacts to soils and watersheds have been implemented. In addition, a study looking at various effects and recovery of the Jasper Fire area is ongoing and a report about what has been learned is expected to be finalized in 2006.

Data collection of conditions associated with site productivity (such as revegetation, coarse, woody debris information, soil bulk densities) has occurred in various areas of the Forest and discussions are available in the Forest 5-year evaluation report. (USDA Forest Service 2004a). Information for future data collection is available in the Forest Plan Monitoring Implementation Guide (USDA Forest Service 2005f). This monitoring guide can be expected to change periodically based on new information.

Since Forest-wide direction specific to the soil resource in the Phase II action alternatives has few changes, full implementation of objectives, standards, and guidelines related to management activities under the Phase II action alternatives would generally be expected to conserve or improve soil conditions on the Forest and cumulative effects would be expected to be similar to those that had been presented in the 1996 Final EIS to the 1997 LRMP.

3-13.3. Water Resources

3-13.3.1. Affected Environment

The EIS for the 1997 Revised LRMP (USDA Forest Service 1996a) presented information on the Affected Environment of Water Resources in three sections: Water Yield on pages III-37 to III-44; Flooding and Floodplains on pages III-61 to III-65; and Water Quality on pages III-71 to III-87.

3-13.3.1.1. Surface Water

Under Water Yield, the 1996 Final EIS generally presented information on the interconnection between surface water and groundwater in the Black Hills; on factors that have historically affected surface water runoff; the quantity of stream flows and water available from the major aquifers; and the demand for water in the region. Most of the information presented in the 1996 EIS is the most recently available. By taking into account the most recent years of streamflow data from U.S. Geological Survey (USGS 2003a), the average annual streamflows can be updated. Average annual streamflows above Rapid City range from 11 cubic feet per second (cfs) on Castle Creek above Deerfield Reservoir, to 40 cfs on Rapid Creek below Pactola Dam, to 56 cfs on Rapid Creek at Rapid City.

3-13.3.1.2. Groundwater

The information presented in the 1996 Final EIS on groundwater was discussed in two sections. The factors that affect groundwater recharge, descriptions of the major aquifers, and the demand for groundwater resources are presented under Water Yield. The information on groundwater quality is presented in the Water Quality section (refer to the 1996 Final EIS). The information presented in the 1996 Final EIS is current but more detailed information from a recent study can be found in the publication Ground-Water Resources in the Black Hills Area, South Dakota (Carter et al. 2002), summarized here. The availability of groundwater resources in the Black Hills area is influenced by many factors including location, local recharge and groundwater flow conditions, and structural features. Thus, the availability of groundwater can be extremely variable throughout the Black Hills area, and even when water is available, it may not be suitable for various uses depending on the water quality. Water quality of the major aquifers generally is very good in and near outcrop areas but deteriorates progressively with distance from the outcrops. In the Minnelusa aquifer, an abrupt increase in concentrations of dissolved sulfate occurs downgradient from outcrop areas. Most limitations for the use of groundwater are related to aesthetic qualities associated with hardness and high concentrations of chloride, sulfate, sodium, manganese, and iron. Very few health-related limitations exist for groundwater; most limitations are for radionuclides, such as radon and uranium. In addition, high concentrations of arsenic have been measured in a few samples from the Minnelusa aquifer.

3-13.3.1.3. Floods And Floodplains

Under Flooding and Floodplains, the 1996 Final EIS presented information on the highest recorded flood events in the Black Hills and factors occurring within watersheds on the Forest that may affect downstream flooding. The information presented in the 1996 Final EIS is the most recently available information.

3-13.3.1.4. Water Quality

Under Water Quality, the 1996 Final EIS presented information on the designated and beneficial uses of the streams and lakes in the Black Hills region, the factors that influence both groundwater and surface water quality, the types of pollutants for which each state has set surface water quality standards, and the results of some surface water quality monitoring. It also summarized whether each major stream met its state-designated use according to the South Dakota and Wyoming 305(b) Water Quality Assessments.

The Black Hills region traditionally has some of the best surface water quality in South Dakota (SDDENR 2004a). This is due in a large part to a cooler climate and higher rainfall than the surrounding plains as a result of greater elevation and forest cover. Also contributing to the water quality in this region is the nature of local bedrock formations which are much less erodible than the highly erosive and leachable marine shales and badlands on the surrounding plains.

Some of the determinations on designated uses in South Dakota included in the 1996 EIS have changed since it was published. The changed information is provided below from the 2004 South Dakota Integrated Report for Surface Water Quality Assessment (SDDENR 2004a) that covered the water years 1998-2003. The information for Wyoming has not changed for the streams that flow through the Forest. Some impairment of waterbodies may occur due to natural causes or non-NFS activities.

Belle Fourche River Basin

- Past and current assessments show Spearfish Creek generally supports its beneficial uses. However, a segment near Elmore and Spearfish, recorded violations of the water quality standards due to elevated pH. It is believed that the higher pH is due largely to the limestone formations located along the course of the stream (natural conditions).
- Bear Butte Creek has fully supported all assigned beneficial uses during the last assessment (water years 1996-2001) and during the current assessment for the entire monitored length.
- Strawberry Creek, approximately 5 miles southeast of Deadwood, is a western tributary of upper Bear Butte Creek. The stream is currently non-supporting for high levels of zinc, cadmium, copper, total dissolved solids (TDS), specific conductivity, and pH.
- Upper Whitewood Creek fully supported beneficial uses from the headwaters to the Gold Run Creek confluence at Lead during the last reporting cycle. Currently, the upper creek is also meeting all beneficial use criteria. Downstream of the confluence with Gold Run Creek, the water quality of middle Whitewood Creek routinely declines. During the present and last two reporting periods, nonsupport of this reach was attributable solely to high fecal coliform levels. Cause for impairment during this assessment was elevated water temperature in the segment below Deadwood and high pH in a 5-mile segment above Whitewood. The lower half of Whitewood Creek fully supported its assigned uses this reporting period as during past assessments. Monitored heavy metals levels again showed no violations. The entire length of Whitewood Creek is currently meeting heavy metals criteria. Sources of the high fecal coliform numbers to the stream's middle reach may be due to aging septic and sewer systems in the area. Sewage pipes in this area have deteriorated with age and are gradually being repaired or replaced. Another source of coliform to the creek is from the combined sewer overflow (CSO) in Lead. A surface water discharge permit has been issued to the city of Lead for the CSO, requiring compliance with EPA's nine minimum controls. The majority of the Whitewood Creek watershed is non-NFS lands.

- West Strawberry Creek, a southeastern tributary of upper Whitewood Creek, was impaired by elevated water temperatures (>65 °F), total suspended solids (TSS), and high pH during the 1994 assessment report (water years 1989-1993). Lack of adequate flows may have been a major contributing factor for the impairments at that time. West Strawberry Creek fully supported assigned beneficial uses during the present and previous three assessments.
- Annie Creek, Cleopatra Creek, False Bottom Creek, Stewart Gulch Creek, Fantail Creek, Deadwood Creek, and Whitetail Creek are seven small tributaries investigated during this assessment. These are tributaries of Spearfish Creek, Redwater River, and Whitewood Creek, respectively. All of these tributaries supported the assigned uses and met the metals water quality standards.
- Only one (Iron Creek Lake) of the five lakes assessed failed to meet its water quality target criteria (Trophic State Index < 45). The source of impairment was not identified.

Upper Cheyenne River Basin

- No TSS violations were noted for the upper Cheyenne River (Wyoming border to Angostura Reservoir) during 1994-1995 contrasted with 38 percent of samples exceeding the standard during 1996-1997. Below average rainfall in the upper drainage during the 1994 water year may have been largely responsible for the decrease in TSS. TDS remained high during both periods (25% and 43% exceedance) for this upper river segment. During the current and last two assessments the upper Cheyenne River was again impaired for high TDS. During the present evaluation, this reach was also impaired for irrigation use by high sodium adsorption ratio (SAR), and the lower river segment was additionally impaired for excessive TSS. The elevated concentrations of TDS and TSS are largely of natural geologic origin from runoff leaching and eroding the extensive shale formations in the upper Cheyenne River drainage. Changes in the other measured parameters were minor between the previous and present reporting cycle.
- Rapid Creek water quality typically ranges from good to satisfactory in its upper reaches with fair to poor quality downstream of Rapid City. During the current and previous assessments, the creek upstream of Pactola Reservoir supported its assigned uses.
- The entire monitored length of French Creek fully supported designated beneficial uses during the present reporting cycle and the last several assessments. Overall water quality has remained in the good to satisfactory range for more than 15 years.
- Flynn Creek, a small tributary of the south fork of Lame Johnny Creek, supported its fishable beneficial use during the last three assessments. This small stream has fully supported all its designated uses during earlier reporting cycles, indicating Flynn Creek has consistently good water quality.
- Lower Battle Creek was impaired during this and previous assessments due to elevated water temperature and pH. Upper Battle Creek is also non-supporting due to temperature and pH during this evaluation. Generally, in past reporting periods, these streams were moderately impaired by either or both high pH (>8.6) and water temperature. The nonsupport may be caused largely by natural conditions such as low stream flow.
- Upper Spring Creek was listed as moderately impaired in two reporting periods of the early 1990s due to excessive fecal coliform. During the current and the last two assessments, the stream rated as fully supporting. This is a reasonably good indication that water quality is now consistently acceptable over the entire length of Spring Creek.

- Castle Creek below Deerfield Reservoir supported designated uses during the present as well as the last three assessments. In the past, slightly elevated pH was frequently recorded in the lower reach.
- Box Elder Creek was fully supporting its designated uses.
- Insufficient information existed on Reno Gulch, Grizzly Bear Gulch, Sunday Gulch and Rhoads Fork to determine if assigned designated uses, other than irrigation waters, were being supported.
- Victoria Creek was non-supporting its designated use of coldwater permanent fish life due to water temperature exceedance from an unknown source.
- Deerfield Reservoir and Pactola Reservoir met their ecoregion target water quality criteria (Trophic State Index < 45). These two reservoirs were rated as oligotrophic/mesotrophic during previous reporting periods with the former the more productive waterbody. However, the most recent average TSI value obtained for Pactola Reservoir and Deerfield Reservoir are 35 and 45 respectively. Data collected in 1997 suggested moderate nutrient enrichment had taken Deerfield to a higher mesotrophic status from a TSI of 40 in 1996 to 47 in 1997. The significantly higher TSI for Deerfield, relative to 1996, was due in large part to a larger chlorophyll a concentration in 1997. More data are needed to establish a trend for the two reservoirs.
- Bismarck Lake and Lakota Lake were non-supporting their designated use of coldwater marginal fish life due to pH and TSI impairment from nonpoint sources.
- Horsethief Lake was non-supporting its designated use of coldwater permanent fish life due to pH and TSI impairment from nonpoint sources.
- Sheridan Lake was non-supporting its designated use of coldwater permanent fish life due to TSI impairment from nonpoint sources. An assessment to develop a Total Maximum Daily Load (TMDL) was initiated in May 2003.
- Stockade Lake was non-supporting its designated use of coldwater marginal fish life due to TSI impairment from nonpoint sources. The lake is an impoundment on French Creek within Custer State Park. The watershed is a mix of private and NFS lands. The floodplain is largely under private ownership and includes the town of Custer.

Few consistent long-term trends in water quality were evident for the monitored smaller creeks in the Black Hills (SDDENR 2004a). Probably for most of these small streams, moderate water quality fluctuations can be expected to occur between monitoring periods largely as a result of natural climatic and hydrologic factors. Angostura, Deerfield, and Pactola Reservoirs are sizeable high quality waterbodies vulnerable to nutrient enrichment and sedimentation from natural soil erosion, recreational activities, and various silvicultural activities (SDDENR 2004a). There are presently four ongoing assessment projects in the Cheyenne River basin: Custer State Park Lakes Assessment (Center, Legion, and Sylvan reservoirs), Upper Cheyenne River Assessment (including Angostura Reservoir), Spring Creek Assessment (including Sheridan Lake and Lake Mitchell), and Lower Rapid Creek and Upper Rapid/Castle Creek Assessment.

3-13.3.2. Resource Conservation Measures

Goals, objectives, standards, and guidelines Forest-wide as a whole and for specific MAs have been developed and are used to manage water resources on the Forest. These were discussed in the Final EIS for the 1997 Revised LRMP (USDA Forest Service 1996a). The following captures the changes to water resource management in the LRMP that are being considered under the Phase II Amendment alternatives.

- Objective 215 under Alternatives 1, 2, and 4 targets implementation of riparian rehabilitation projects for at least three stream reaches during the Plan period. Under Alternatives 3 and 6, the target is increased to five stream reaches.
- Objective 200-03, under Alternatives 3 and 4 protects aquatic and shoreline vegetation around 50 ponds or water catchments over the life of the Plan. In Alternative 6, this objective protects aquatic, shoreline and upland vegetation around ponds or water catchments containing leopard frogs.
- Objective 11-01 under Alternatives 3 and 6 strives to achieve a non-emergency watershed condition as soon as possible after an event but generally no later than 3 to 5 years.
- Guideline 1214, common to all alternatives, states where natural background water pollutants cause degradation, it is not necessary to implement improvement actions. Short-term or temporary failure to meet some parameters of applicable federal or state standard may be permitted in special cases.
- Guideline 3106 under Alternatives 1, 2, and 4 recommends protection of riparian areas or wetlands during and after trail, road, and highway construction where populations of sensitive plants are located. Under Alternatives 3 and 6, this is a standard.

The implementation of standards and guidelines, watershed conservation practices, and BMPs protect water resources. Refer to the 3.2-3 Riparian and Wetlands Ecosystem section and the 3-2.4 Aquatic Ecosystems section for a comprehensive listing of these conservation measures across the range of alternatives.

In March 2003, the Forest completed an assessment of BMPs titled Forest Plan Best Management Practices Evaluation that identifies the key assertions listed in the Final EIS and 1997 Revised LRMP related to the impacts of Forest-management activities (USDA Forest Service 2003e). It describes the effectiveness of BMPs, standards and guidelines, and other mitigation measures in minimizing impacts. The evaluation (USDA Forest Service 2003e) compared the effectiveness of BMPs to specific elements/functions, (i.e., buffer zones, erosion and sediment, flow regime, ground cover, water quality) relevant to the Black Hills and provided key literature citations to support the effectiveness determination. In summary, the implementation of BMPs and standards and guidelines on the Forest will be as effective or more effective at preventing erosion, sediment delivery, and flow regime changes as those studied in the literature because of the less erodible soil types, the seasonal rainfall pattern, and the gentler topography existing here.

In 2001, BMP evaluations were completed in the Black Hills both in Wyoming and South Dakota. Both audits indicate that BMP objectives are being met (Wyoming Timber Industry Association 2001, Black Hills Forest Resources Association 2001). The South Dakota audit of BMPs report said, “The team concluded that South Dakota’s Silviculture BMPs are being properly installed and are effective.”

A second BMP audit was done in 2004 in the South Dakota portion of the Black Hills (Black Hills Forest Resources Association 2005). A total of seven timber sales were evaluated, two sales were on NFS lands. Audit results on BHNF timber sales found a 91 percent incidence of meeting or exceeding BMP application standards and 96 percent effectiveness in providing adequate protection or improving pre-project conditions.

Additional project-level monitoring of BMPs and watershed conservation practices (WCPs) occurred in 2002, 2003, and 2004 on timber sales on the Forest. Thomas (2002a, 2002b, 2004a, 2004b, 2004c, 2005) concluded that logging practices on the Hell Canyon and Mystic Ranger Districts did not have any negative impact on the watershed and streams. The roads in general were okay, but some needed better drainage to minimize surface erosion that was creating rills and ruts. BMP application and effectiveness was reviewed on the Radio Timber Sale in 2004 (Tangenberg 2004). Several departures from BMP application existed related to roads, skid trails, landings and stream crossings, but no major and prolonged impacts on soil and water resources were identified.

Based on the information referenced above, BMPs are effective at protecting water quality and aquatic resources when properly implemented. Narrative and antidegradation water quality standards are met through the use and monitoring of standards and guidelines, watershed conservation practices, and BMPs primarily at the project-level.

The Phase II Amendment tiers to the watershed analysis provided in Appendix J of the 1996 EIS. Prior to 2003, compliance with state water quality standards were monitored by collecting grab samples at 19 stations Forestwide (USDA Forest Service 2004a). Past water quality data from the Forest are stored in the Environmental Protection Agency's STORET database (http://www.epa.gov/STORET/dbtop.html) and are available for the State's to evaluate in their water quality assessments. The Forest will also rely on water quality monitoring data collected by State and other federal water resource agencies. Monitoring activities are identified in Chapter 4 of the Forest Plan. Further details about water quality monitoring are identified in the Monitoring Implementation Guide.

3-13.3.3. Direct And Indirect Effects

Water resources are potentially affected by a variety of activities related to Forest management. The 1996 Final EIS addressed potential effects on water resources associated with Forest management activities described in the 1997 Revised LRMP. That analysis is incorporated here by reference. The following analysis addresses specific effects of the Phase II Amendment alternatives to the extent that they differ from those presented in the 1996 Final EIS. Resource conservation measures related to water resources considered under the Phase II Amendment alternatives are primarily concerned with streamflow, erosion control, and sediment transport. As such, the focus of the presentation is on surface water streamflow and water quality. Other water resource components discussed in the 1996 Final EIS are not explicitly targeted by the Phase II Amendment alternatives and are only mentioned here. In this regard it should be kept in mind that on the Forest, groundwater and surface water resources are closely linked. As a result, any change in surface water flow and water quality could have indirect effects on recharge and groundwater quality. Also, changes in surface water flow would affect flooding and floodplains as discussed in the 1996 Final EIS. Those watersheds that have multiple stream crossings with culverts are susceptible to increased habitat fragmentation. These culverts may also block fish passage, contribute sediment, and modify or remove aquatic habitat.

Direct and indirect effects to water resources are also discussed in the 3-2.3 Riparian and Wetlands Ecosystems section and the 3-2.4 Aquatic Ecosystems section.

3-13.3.3.1. Effects Of Species-viability Management On Water

Preservation of habitat (riparian, streams, and vegetation cover) for species or restoration of vegetative cover in riparian areas to preserve habitat may provide protection for water resources through improving buffer zones and vegetation that reduces peak flows, erosion, and sedimentation. These areas, with adequate ground cover, would act as a buffer to minimize sedimentation entering a stream or other water body. Alternative 3 would double the amount of riparian shrub habitat to be restored (Objective 214) to promote habitat for emphasis species over existing conditions, resulting in improved vegetative cover that would minimize sedimentation entering surface water bodies.

Objective 200-03 under Alternatives 3, 4, and 6 would install structures to provide water for livestock and to conserve the aquatic and shoreline vegetation around ponds or water catchments. In Alternatives 3 and 4, 50 ponds would be treated, and ponds or water catchments would be treated in Alternative 6 where leopard frogs are found. Objective 200-03 would benefit water resources by reducing livestock damage to vegetation in riparian areas.

3-13.3.3.2. Effects Of Research Natural Area Management On Water

RNAs would provide additional protection to surface water through revegetation of disturbed areas, restrictions on forest harvest, mineral entry, and motorized or mechanized travel, and possible restrictions on grazing and public access. Five of the nine potential RNA sites have riparian plant associations within them. The Canyon City, Castle Creek, and Geis Spring candidate RNAs contain riparian associations adjacent to perennial streams. Stream mileage across the range of alternatives is described in the 3-2.4 Aquatic Ecosystems section. Alternative 4 has the highest stream mileage within or bounded by candidate RNAs, followed by Alternative 3 and then Alternative 6. Water resources in these candidate RNAs would benefit from these restrictions should the RNAs be designated. If RNAs are affected by wildfire, surface runoff from burned slopes may contribute sediment into water bodies. Sediment input would be dependant on site-specific conditions including fire severity, soil type, gradient, etc. Vegetation would recover under natural conditions except for the potential noxious-weed treatment. RNAs comprise a small percentage of their respective watersheds and are likely to have a proportionate impact on water resources due to sediment input. In Alternatives 3, 4, and 6, Objective 10-03 strives for a low fire-hazard rating between RNAs and ARC and the WUI, excluding the Upper Pine Creek RNA, to reduce the potential for catastrophic fire affecting RNAs and potentially water resources.

3-13.3.3.3. Effects of Fire-hazard and Insect-risk Management on Water

As discussed in the 1996 Final EIS, loss of vegetation due to fire can have a significant effect on surface water runoff and peak flows. Fires on the Forest may contribute to increased runoff, soil loss, and subsequently, to changes in surface water quality. Fire-management practices affect fire hazard and hence the potential for changes to water resources due to fire. In addition, fire-suppression activities can adversely affect surface water quality through a variety of mechanisms such as side-slope erosion, fire-line construction, streambank instability, loss of riparian vegetation, and fire retardant entering streams.

All the Phase II Amendment alternatives reduce the area of high fire hazard. With the potential for fewer acres exposed to stand-replacing fires, there would be a decrease in the potential for soil erosion and increased runoff potential. As a result, a reduction in the potential for adverse changes in water quality would be expected.

Wildfire can have a profound influence on watersheds and streams and associated aquatic organisms. In the short-term, fires and post fire flooding and debris flows may have ecologically catastrophic effects. Driscoll et al. (2004) reported the hydrologic effects of the 1988 Galena Fire in the Black Hills. Moderately burned areas did not experience a substantial increase in the rate of surface erosion; however, severely burned areas underwent surface erosion nearly twice that of the unburned areas. Substantial degradation of stream channels within the severely burned headwater areas of Bear Gulch was documented. Farther downstream, channel aggradation resulted from deposition of sediments transported from the headwater areas. The most notable water-quality effect was on concentrations of suspended sediment, which were orders of magnitude higher for Bear Gulch than for the unburned control area. For most water quality constituents sampled, differences in concentrations between burned and unburned areas were no longer discernible within about 1 year following the fire. Annual-yield for Grace Coolidge Creek increased by about 20 percent as a result of the fire. Various analyses of streamflow data indicated substantial increases in peak-flow response for burned drainage areas; however, quantification of effects was particularly difficult because peak-flow response diminished quickly and returned to a generally pre-burn condition by about 1991. Establishment of grasses and forbs occurred within a similar timeframe. Comparison of pre-fire peak flows to post-1991 peak flows indicates that these grasses and forbs were equally effective in suppressing peak flows as the predominantly ponderosa pine forest was prior to the Galena Fire.

The treatment acreage and resulting fire-hazard reduction under each alternative varies greatly. Alternative 4 proposes the least amount of treatments while Alternative 6 proposes the highest level of treatments. Alternative 6 provides the greatest reduction of high or very high fire hazard followed by Alternative 3, Alternative 1, and Alternative 2. Alternative 4 provides the least improvement in reduced fire-hazard rating.

Management actions to reduce fire hazard and insect risk will result in ground disturbance and vegetation removal that may increase surface water runoff and increase the potential for sediment transport into surface waters. Alternatives 1, 3 and 6 propose to treat the most acreage annually (Appendix B; Table B-1) for commercial timber harvest followed by Alternative 4 and 2. Activities such as prescribed burning, hardwood restoration, and pre-commercial thinning were assumed to use the road network serving commercial timber treatments. Treatment acres of small diameter fuels and prescribed burning vary between alternatives (Appendix B; Table B-1). Alternative 6 proposes the most treatment acres, followed by Alternative 3, 1, 2 and 4.

Non-commercial treatments would have minimal impacts to water resources based on the assumptions that no roads are constructed, treatments are generally done by handcrews or rubber-tired equipment and some non-commercial treatment acres overlap areas of commercial tree harvest resulting in no or minimal additional ground disturbance. Prescribed burning usually result in a low-to-moderate severity fire, which protects soil characteristics and allows for the rapid recovery of organic material and ground cover. This, in combination with vegetative buffers, limits the potential for adverse impacts to water resources. Implementation of Forest Plan standards and guidelines, watershed conservation practices, and BMPs would mitigate the effects of timber harvest and road construction under all alternatives.

The forested landscape has been altered over time by suppression of fires resulting in an increased density of ponderosa pine trees. “Higher leaf area from increased woody biomass will increase evaporation and interception, resulting in lower streamflows and the drying of springs” (USDA Forest Service, 2003f). Management activities or natural disturbance (fire, insect, disease, etc.) that reduce tree basal area may increase water yield and potential ground water recharge although streamflows may not necessarily increase (USDA Forest Service 1996a). The change is proportional to the amount of trees removed, but usually 25 to 30 percent of the growing stock in a forested watershed must be removed before there is a

measurable increase in water in the stream leaving the watershed (Sheppard and Battaglia 2002). In areas of precipitation greater than 23 inches, reducing the tree basal area below 80 will lead to an increase in water yield (USDA Forest Service 1996a). Conversely, the introduction of new trees or the growth of existing trees will potentially decrease water yield.

In the next decade, Alternative 6, with its increased emphasis to reduce fire-hazard and insect-risk ratings by reducing tree density (basal area) is likely to have the greatest potential to affect water yield, followed by Alternative 3, Alternatives 1 and 2, and Alternative 4.

3-13.3.4. Cumulative Effects

Cumulative effects related to water resources were described in the 1996 FEIS (USDA Forest Service 1996a) in the Groundwater, Water Yield and Streamflow Regimes and the Water Quality sections and are incorporated by reference. The cumulative effects analysis area is bounded in time as the next 10 to 15 years. This temporal scale corresponds to projections for the desired future condition described for each alternative (Chapter 2). The cumulative effects analysis area is bounded in space as the fourth-level watersheds that encompass the Forest. This equates to the headwaters of the Belle Fourche and Cheyenne rivers downstream to their confluence. This bounding was determined because effects to water quality or quantity from Forest Service activities may extend downstream of the Forest boundary but become negligible at a downstream point due to the underlying Black Hills geology and the overriding effects of other non-Forest activities in an ever-increasing watershed scale.

Water resources on the Forest are affected by landscape pattern, geology, and land use in the Forest. All alternatives generally maintain or provide an improvement to water resources (increased groundwater recharge, lower peak flows, and reduced sedimentation), with the implementation of resource conservation measures. These measures may not completely eliminate all potential stressors, such as sediment input, so an incremental impact will occur that would be additive to natural sources and/or past management activities. These additive impacts may be small in volume but may occur cumulatively over a long period of time, such as sediment input from roads or contaminants from mine tailings. Even with full implementation of all resource conservation measures in any alternative, attainment of State water quality standards and beneficial uses may be impaired due to actions on non-NFS lands or natural background water pollutants.

Increased environmental awareness and regulation beginning primarily in the 1970s has resulted in additional protection to water resources. This has avoided, minimized, and compensated the adverse impacts to water resources to a large degree for ongoing or proposed activities, but some historic or inactive activities may still be having long-term effects. BMPs became a standard part of forestry operations in the 1970s as a result of the Clean Water Act and subsequent amendments. The Regional watershed conservation practices were adopted in 1996.

BMP audits conducted in 2004 on the South Dakota portion of the Black Hills, averaged across timber sales on state, private and NFS lands, revealed that the BMP standards for application were met or exceeded on 92 percent of the total rated items (Black Hills Forest Resources Association 2005). Ratings for BMP effectiveness confirmed adequate or improved protection of soil and water resources on 95 percent of the total rated items. In comparison, the 2001 audit showed 82 and 84 percent compliance for application and effectiveness, respectively (Black Hills Forest Resources Association 2005). No instances of gross neglect were recorded during the 2004 audits. Among a total of 405 rated items on all timber sales, one instance of major and prolonged effects on water quality was recorded. This was related to improper culvert installation on non-NFS lands. Comparing 2004 audit results to 2001 audit results, BMP application and effectiveness improved 10 and 11 percent, respectively. The incidence of minor departures or major departures declined in 2004 compared to 2001.

Mining activities have altered aquatic habitat and may create a contaminant source affecting water quality depending on the material being mined and the process for extraction/separation. The majority of existing and permitted mine areas in the Lead-Deadwood and Galena area are on privately owned land (USDA Forest Service 1996a). Previous studies in the 1970s and 1984 revealed mercury levels in game fish that exceeded recommended Food and Drug Administration levels for consumption (SDDENR 2004a). The mercury appeared to originate from gold mining operations in the northern Black Hills region and entered the Cheyenne via the Belle Fourche River. Mining operations had used mercury in their gold recovery process but mercury use was discontinued in 1970. Mercury concentrations have declined in fish and sediment of the Belle Fourche River, Cheyenne River, and the Cheyenne River arm (Foster Bay) of Lake Oahe between 1970-71 and 1984-88. Results of fish flesh samples collected in 1998 concluded mercury levels in fish from the Cheyenne River Basin were not significantly higher than mercury in fish from the Moreau River, and the fish did not pose a health hazard to sport fisherman (SDDENR 2004a).

There were no new mine permits issued to large scale gold and silver mining operations in 2003 (SDDENR 2004b). About 55 percent of the land in the Black Hills that was disturbed by permitted large scale gold mines has now been reclaimed (SDDENR 2004b). Reclamation activities at the Richmond Hill Mine, an open pit heap leach gold mine that developed an acid mine drainage problem during operations, continue to be successful. Biological assessments of Cleopatra Creek below the mine show that the stream remains healthy and supports a viable cold water fishery (SDDENR 2004b).

Commercial streamside placer mining activities are no longer a significant source of water quality problems in Black Hills streams (SDDENR 2004a). Restoration activities on Whitewood Creek reclaimed approximately 16 acres of mine-affected lands along Whitewood Creek, and the stream channel was reconstructed and stabilized throughout the site. Bear Butte Creek from the headwaters to the Lawrence County line was historically severely impaired by heavy metals and elevated TSS. The sources of excessive heavy metals were old streamside mine tailings along Strawberry Creek and in-place contaminants in the Bear Butte streambed. In past years, upper Strawberry Creek was severely impacted by mine tailings and by Brohm Mining Corporation's Gilt Edge Mine; seepage and runoff from which produced conditions of low water pH (avg. 4.1) and excessive TSS in this stream during the period 1993 to 1995. In addition, there was impairment due to elevated TDS and specific conductivity. However, there was dramatic improvement in stream pH (avg. 7.2) and conductivity starting with the November 1994 samples and some improvement in TDS although not in TSS. The improvements were due to collection and treatment of acidic mine water at the Gilt Edge Mine. During 1996-1997, water quality in Strawberry Creek declined. Nonsupport was caused by TDS, conductivity, elevated TSS, and low pH. Average water pH fell to 6.85 for this recent period. In the late 1990s, average pH improved slightly to 7.0 and TSS decreased to acceptable levels. However, the stream was non-supporting due to high TDS and zinc concentrations. Last assessment, stream pH maintained acceptable levels, but the creek again failed to support beneficial uses for TDS, and was impaired for elevated zinc, cadmium, copper, and cyanide concentrations. During this assessment, the average stream pH was recorded as 7.1. However, there appeared to have been a wide range of fluctuation for this parameter (4.3-9.3).

One notice of violation was issued to large-scale gold and silver mines in 2003 (SDDENR 2004b). Wharf Resources was issued a notice of violation by the South Dakota Department of Environment and Natural Resources for violating its surface water discharge permit limits for total ammonia in its denitrification plant discharges. The company also violated its ground water discharge permit and drinking water limits for nitrates, and drinking water limits for total coliform.

All alternatives provide similar levels of cumulative protections to the water resources through the implementation of standards and guidelines, watershed conservation practices, and BMPs that maintain water quality and quantity on the Forest and downstream of the Forest boundary.

Additional discussion of cumulative effects to water resources is included in the 3-2.4 Aquatic Ecosystems section.

3-14. Energy Requirements of Each Alternative

Energy requirements for operation of the Forest are presented in the 1997 Revised LRMP EIS (USDA Forest Service 1996a) on pages III-535 to III-538. This information is incorporated into this discussion by reference. Energy consumption is updated to reflect consumption under the Phase II Amendment alternatives.

Energy is consumed in the administration and use of natural resources from the Forest. For the purpose of the Phase II Amendment, energy sources are gasoline, diesel fuel, liquified petroleum, natural gas, electricity, and wood. The main activities that consume energy are timber harvest, range use, recreation, road construction or reconstruction, and administrative activities of the USDA Forest Service. Although other activities are consumers of energy, the following are those considered significant in estimating consumed quantities.

Energy consumed in harvesting timber is the estimated amount required for felling, bucking, skidding, loading, hauling, performing road maintenance commensurate with the volume hauled, and the industrial traffic associated with the logging activities. Non-commercial treatments are assumed to take 50 percent of the energy of timber harvesting, as they do not require loading, hauling, and associated road maintenance.

Energy consumed in utilizing range vegetation is the estimated amount required for hauling livestock to and from the range permittees, range-improvement activities, watering, salting, and herding.

Energy consumption related to recreation is based on the estimated number of dispersed and developed recreation visitor days, estimated trip lengths, and facility construction.

Energy consumed in road construction and reconstruction activities is that used by timber purchasers or contractors in completing road development.

Energy consumed by Forest Service administration includes vehicle use for all administrative activities, the lighting of buildings, heating and air conditioning, road maintenance and construction projects performed by Forest Service personnel, and fuel used in such equipment as small engines and burners.

Table 3-77 displays an estimate of average annual energy consumption by the above categories.

Table 3-77. Average Annual Energy Consumption, Decade 1 (billions of BTUs)

Categories	Alternatives				
	1	2	3	4	6
Timber Harvest	114	114	131	112	167
Range Use	2	2	2	2	2
Recreation	1,814	1,814	1,814	1,814	1,814
Road Construction/Reconstruction	14	14	14	14	14
Forest Service Administration	10	10	10	10	10
Totals	1,954	1,954	1,971	1,952	2,007

See spreadsheet “energy”

3-15. Unavoidable Adverse Effects

Selection of one Phase II Amendment alternative would establish the overall goals for management of the Forest. Implementation of the associated objectives, standards, and guidelines associated with those goals may lead to changes in the Forest environment.

Some of those changes will be desirable; others will be adverse. Application of Forest-wide standards and guidelines and the resource protection measures considered for these alternatives, would limit the extent and duration of any adverse environmental effects. Nevertheless, some residual adverse effects would occur under any alternative.

- Air Quality. Road construction, timber harvest, prescribed burning, and some recreational activities cause temporary and localized reductions in air quality due to dust, exhaust fumes, and smoke. Smoke from wildfires temporarily reduces air quality and visibility. Firewood gathered on Forest System lands and burned for heat contributes gases and particulate matter to the atmosphere.
- Soils. Wherever vegetation cover and soils are disturbed, there is some short-term erosion. Activities involving vehicles or heavy equipment cause soil compaction.
- Water Resources. When vegetation cover is removed, or soils are disturbed or compacted, there is a short-term increase in sedimentation in surface water features. Natural precipitation and flood events can cause sedimentation.
- Social Environment. Reductions in timber-harvest levels may cause corresponding reductions in local timber industry employment and income. RNA establishment may increase the cost of permittee grazing on the Forest as permittees might have to transport livestock greater distances to use permitted National Forest forage or reduce grazing. The cost of emphasis species mitigation may be borne by livestock-grazing permittees. Allowing the fire-hazard and insect-risk to remain high in some areas to provide for mature dense forest and the species dependent on that habitat, may cost others in the effects of insect damage and stand-replacing wildfire.
- Emphasis Species Population. Reductions in emphasis species may be needed for the following reasons as long as all emphasis species remain viable on the Forest.
  - Reducing the habitat for one emphasis species for habitat for another emphasis species, for example taking mature dense pine forest suitable for Brown Creeper or Goshawk and converting it to an aspen forest suitable for beaver or ruffed grouse.
  - Breaking up large contiguous expanses of dense forest to reduce fire-hazard and insect-risk will produce lower populations of species requiring dense forest.
  - Removing spruce stands within 300 feet of structures to protect human life and property would be at the expense of habitat for spruce dependent species such as American Marten.
  - As management occurs for early successional species such as those dependent on aspen, late successional species may decline.

3-16. Short-Term Uses Versus Long-Term Productivity

Short-term uses are those expected to occur on the Forest during the immediate future, approximately 5 years, and include timber harvest, recreational use, mining, and grazing. Long-term productivity refers to the capability of the land to provide resource outputs for a period of time beyond the immediate future. Minimum management requirements, established by regulation (36 CFR 219.27), provide for the maintenance of long-term productivity of the land. Minimum management requirements, reflected in the Forest-wide standards and guidelines, will be met under all alternatives. They assure that the long-term productivity of the land is not impaired by short-term uses.

Monitoring, as described in Chapter 4 of the 1997 Revised LRMP, apply to all Phase II Amendment alternatives considered in this Final EIS. One purpose of such monitoring is to assure that long-term productivity of the land is maintained or improved. If monitoring shows that Forest-wide standards and guidelines are inadequate to protect long-term productivity, the Phase II Amendment to the 1997 Revised LRMP will be amended.

Although all alternatives are designed to maintain long-term productivity, there are differences among the alternatives in the long-term availability or condition of resources. There also may be differences among alternatives in long-term expenditures necessary to maintain desired conditions.

3-17. Irreversible and Irretrievable Commitments

3-17.1. Affected Environment

An irreversible commitment of resources means a total loss of something. Mineral extraction is an example. Once the minerals are extracted from the soil, they cannot be replaced. An irretrievable commitment of resources is a temporary loss of something. Loss of forage production in an area being used as a ski run is an example. If the ski run is abandoned, the grass will once again begin to colonize the area, and forage will once again be produced (US Forest Service – Forest Plan Implementation Course 1900-1).

Generally programmatic decisions such as an LRMP will not have irreversible or irretrievable commitments of resources as they do not authorize on the ground activities, they only set the rules by which such activities can occur if they in fact do occur. There are exceptions, such as if an LRMP land classification would prohibit current or future timber harvesting like RNA establishment. The wood fiber that could be harvested and utilized is lost as trees grow old, die, and decompose. This is an irretrievable commitment of resources as it is possible that some day the area would no longer be RNA and the area could again be utilized for wood-fiber production.

3-17.2. Direct And Indirect Effects

Effects on locatable or leaseable minerals would occur if mining or oil and gas exploration or production were limited by any of the Phase II Amendment alternatives. Standards 3100-2 and 3100-10 may limit the operating season of mineral operations and increase net operating costs.

3-17.2.1. Species-viability Management

Objectives, standards, and guidelines relating to species-viability management would, in general, have minor effects on mineral or oil and gas leases. There are, however, two standards (3100-2 and 3100-10) that prohibit gravel mining and construction of oil and gas facilities within varying distances of active raptor or mountain plover nests.

3-17.2.2. Research Natural Area Management

If and when any candidate RNAs are selected for designation, land would be withdrawn from locatable mineral entry in a separate NEPA decision, a leaseable mineral entry stipulation of "no surface occupancy would be added to the area, and the areas would be unavailable for common variety or salable minerals such as gravel." One of the factors considered in the selection of RNAs, however, was the presence of existing locatable mining claims in these areas, so a small number of claims would likely be involved. Since the RNA candidates have been identified new claims have been staked in at least one of the candidate RNA's. From a minerals standpoint the RNA's would have fewer irreversible commitment of mineral resources in that fewer minerals could be extracted from these areas than under the 1997 LRMP.

The designation of research natural areas may remove domestic livestock grazing from those areas. This would be an irretrievable commitment of the livestock forage that would not be utilized and lost over time.

Timber production will be an irretrievable commitment of resources in each RNA that is finally designated as a result of the Phase II decision.

3-17.2.3. Fire-hazard And Insect-risk Management

Managing a timber stand for reduced fire-hazard or insect-risk does not provide optimal stocking levels for maximizing future timber production. Thinning stands to a 50 or 60 basal area and to some degree maintaining that condition through understory management may significantly reduce future timber production for the area. The actual decision to implement 50 or 60 basal area thin will be made in project level NEPA

3-17.3. Cumulative Impacts

Except for the species-viability and RNA restrictions, there are no planned or reasonably foreseeable activities in the vicinity of the Forest that would affect locatable or leaseable mineral production. RNA restrictions and species-viability direction in conjunction with operating costs, worldwide market prices, and South Dakota or Wyoming State regulations, may cumulatively make mineral extraction uneconomical.

Implementing fire-hazard and insect-risk timber prescriptions over a broad area of the Forest may have the cumulative impact of reducing the ability of the Forest to sell enough timber in future decades to sustain local timber industry.

3-18. Summary of Cumulative Effects

The CEQ defines cumulative effects as:

> "The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7)."

As with the Final EIS, incremental impacts to individual resources and species from alternatives for the 1997 Revised LRMP Phase II Amendment are discussed in the respective sections of Chapter 3. This section provides a summary of the cumulative effects analysis conducted for the Phase II Amendment EIS. Much of the terminology and process for assessing cumulative effects followed CEQ guidance (Considering Cumulative Effects Under the National Environmental Policy Act [CEQ 1997]).

A cumulative effects analysis looks at past, present, and reasonable foreseeable future effects. Past and present effects are discussed in the affected environment or current situation of each effects section in chapter 3 of the Phase II Final EIS. The Phase II Amendment is a programmatic decision. In discovering cumulative future effects, the Phase II effects analysis looks at the reasonably foreseeable effects of programmatic policies of agencies and private landowners. A cumulative effects analysis is bounded in space and time, meaning the time one looks forward to look for effects that may have significant cumulative effects and the distance away one looks for effects that may have significant cumulative effects.

Once the Phase II decision is completed, cumulative effects will once again be reviewed at the project level which will look at site specific past, present, and reasonable foreseeable future effects.

The analysis of cumulative effects for alternatives considered in detail for the Phase II Amendment considered the 10- to 15-year planning timeframe for LRMPs for relatively short duration effects (economic, social, air quality, etc.) and a 50-year planning timeframe for longer duration effects.

The longer temporal scale corresponds to the time it takes natural systems to change. The cumulative effects analysis for wildlife and fish species viability is bounded in time as the next 50 years. This temporal scale is based on: a) the planning horizon (usually 50 years for a forest plan); b) the biology of the species (e.g., generation time, response time to changed conditions, recolonization capability); and c) the time needed for the overall ecosystem to respond to proposed management (Liggett et al. 2003).

The Final EIS for the 1997 Revised LRMP assessed cumulative effects for a similar planning period and cumulative effects will be assessed once again for a similar planning period during the next LRMP revision (2007 to 2012). Moreover, cumulative effects of subsequent site-specific projects will be analyzed as part of any environmental analysis.

The spatial scale for cumulative effects analysis of Phase II Amendment alternatives generally encompasses the Black Hills Ecosystem as defined by Bailey (1995) for ecosystem effects and the seven counties affected by activities on the Forest for social and economic effects. The cumulative effects analysis for fish is bounded in space as the fourth-order watersheds that encompass the Forest. This equates to the headwaters of the Belle Fourche and Cheyenne Rivers, and their associated tributaries, downstream to the Belle Fourche/Cheyenne River confluence. This bounding was determined because effects to water quality and/or quantity from Forest Service activities may extend downstream of the Forest boundary but become negligible at a downstream point due to the underlying Black Hills geology and the overriding effects of other non-Forest activities at an ever-increasing watershed/geographic scale.

About 18 percent of the land within the Forest boundary is privately owned. Much more private land is found outside and adjacent to the Forest Boundary. The trend in the 1990s, and which continues today, is for development of private land adjacent to or within the Forest boundary. About 60 percent of the lands within the Forest boundary in Fall River County is privately owned, whereas, private land represents about 12 to 18 percent of the Forest in the other counties, with the exception of Weston County that has no private land within the Forest boundary. Because private land development is interspersed throughout the Forest, WUI issues are increasing. The proximity of private lands to NFS lands combined with a well-developed highway system, improvements in information technology, and increases in personal wealth all contribute to development of the WUI in ways that do not provide for species viability or reduced fire hazard and insect risk, although there is increasing interest in fire-hazard and insect-risk reduction in the WUI.

Discussed in cumulative effects sections are the contributions to species viability and fire hazard and insect risk from adjacent National Park land and state-owned lands. These lands may be specifically managed for species viability and fire-hazard reduction.

County zoning regulations for residential and commercial development represent planning level decisions that authorize and result in subsequent projects that contribute to cumulative effects. Therefore, the analysis considered the general types (e.g., construction), location (e.g., WUI), and intensity (e.g., density) of actions allowed by county zoning regulations rather than the site-specific impacts of individual projects. Private land within the WUI is being developed and numerous residential and commercial development projects are presently underway or planned for the foreseeable future on private lands within the Black Hills region.

Other programmatic or planning level decisions in the region include future development of a Forest transportation plan and private/public cooperative fuels-management projects.

A limited number of previously analyzed and authorized public activities on the Forest are ongoing and are expected to continue for an undetermined number of years even after the ROD for the Phase II Amendment is signed. The effects of these previously approved projects, combined with the incremental effects of reasonably foreseeable (and subsequently analyzed) site-specific projects under the Phase II Amendment, will contribute to cumulative effects in the study area. A schedule of proposed actions within the Forest appears on the Forest website (www.fs.fed.us/r2/blackhills/projects/nepa/sopa/index.shtml).

Implementation of each alternative would likely contribute both positive and negative incremental effects. However, the nature and extent of these incremental effects, due to actions performed during implementation of the selected Phase II Amendment alternative, cannot be determined at a programmatic level and will therefore be analyzed in more detail during subsequent cumulative effects analyses for individual projects.

The Phase II Amendment alternatives cumulative effects are summarized in Chapter 2, Table 2-3.

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