Appendix B

THE ANALYSIS PROCESS

Part One
Process Overview

This appendix discusses the analytical phases of the Forest planning process:

- Part 1: Process Overview
- Part 2: Inventory Data and Information Collection
- Parts 3, 4, 5, and 6: Analysis of the Management Situation
- Part 7: Formulation of Alternatives
- Part 8: Financial and Economic Efficiency Analysis

We did not complete these phases sequentially, but rather in an iterative process. We repeated some steps or refined them as we gained new insight about the issues, the resource conditions, and the process. We deal with some of these phases in more deal in other parts of the document.

The Forest Planning Process

A primary responsibility of managers of NFS land is to decide how best to manage public lands to produce the goods and services the public desires. National forests must be managed to provide adequate levels of materials and services for both current and future uses. The purpose of forest planning is to evaluate a range of alternatives and then select the alternative that maximizes the long-term net public benefits in an environmentally sound manner.

The Forest and Rangeland Renewable Resources Planning Act, as amended by the National Forest Management Act of 1976 (NFMA), requires preparation of a forest plan and environmental impact statement. The NFMA regulations, as found in 36 CFR 219, provide the analytical framework within which planning decisions are made.

Forest plans must provide for multiple use and sustained yield of products and services, particularly coordination of outdoor recreation, range, timber, wildlife, and fish. The plans must maximize long-term net public benefits in an environmentally sound manner.

Net public benefits are defined as "...the overall value to the Nation of all outputs and effects (benefits) less all associated inputs and negative effects (costs), whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria, rather than a single measure and index. The maximization of net public benefits to be derived from management of units of the National Forest is consistent with the principles of multiple use and sustained yield" (36 CFR 219.3).

Congress has established three conditions that must exist in every forest management plan:

- Maintain the long-term productivity of the land. This means that we must maintain the Forest in a condition that will not impair its capability to produce future outputs of goods and services.
- Coordinate and integrate planning activities for multiple-use management. This requires that we consider each resource in a roughly equal manner in the planning process. At a minimum, we must not emphasize any resource to the extent that we violate the minimum management requirements of other resources.
- Ensure that each alternative is the most cost-efficient combination of management prescriptions to meet the goals and objectives of that alternative.

In addition, NFMA identified specific requirements that we must analyze and determine as part of the development of Forest Plan alternatives. They include:

- Analyze the maximum physical and biological potentials of significant individual goods and services, together with associated costs and benefits.
- Analyze the potential response to public issues and management concerns.
- Analyze the amount of timber that can be harvested.
- Establish quantitative and qualitative guidance.
- Use a systematic interdisciplinary approach to ensure coordination and integration of planning activities for multiple-use management.

The requirements and constraints spelled out in NFMA and its regulations result in a complex planning process. The process used a number of resource specialists, analytical tools, and quantitative methods to help ensure that we meet the requirements. Analytical tools and techniques, including computer models, were particularly helpful in reducing complexity by carrying out countless calculations and allowing the Forest planning team to identify the quantitative tradeoffs and conflicts between alternatives. The entire analytical process was based on the planning process specified in the NFMA regulations.

Among the tools and information resources not available for those developing the 1991 Forest Plan that have aided the present plan analysis were: Geographic Information Systems, the internet, landscape models, the Ecological Classification System, and a functioning forest plan that was successful.

Appendix B explains the analysis process used in developing the Plan and solving the planning problem. Before beginning this discussion, however, it is important to understand the role of the analysis process and where it fits in the overall planning process.

Overview of the Planning Process

The NFMA process comprises 10 planning steps:

1. Identification of issues, concerns, and opportunities (ICO's)
2. Development of planning criteria
3. Inventory data and information collection
4. Analysis of the management situation
5. Formulation of alternatives
6. Estimation of effects of alternatives
7. Evaluation of alternatives
8. Recommendation of the preferred alternative (proposed action)
9. Plan approval and implementation
10. Monitoring and evaluation

Identification of Issues, Concerns, and Opportunities
Public involvement identified public issues and helped the Hoosier assess the possible need for change in the management of the national forest. In addition, we identified opportunities and management concerns of the Forest Service. The Forest identified issues during the period prior to and the months following the publication of the Notice of Intent in the Federal Register.

Planning team members grouped issues and concerns according to similar content. The interdisciplinary team then evaluated each group of issues and concerns and identified the major issues, concerns, and opportunities that would drive the planning process. Appendix A contains a detailed discussion of the issues and concerns.

Development of Planning Criteria
The planning process and the criteria for subsequent planning steps were developed based on regional and national direction and were revised as needed throughout the planning process. The Forest planning records document these criteria.

Inventory Data and Information Collection
The next step identified the data and information needed for the analysis process. We assessed existing inventories and sometimes identified a need for new inventories. Part Two of this appendix presents a summary of this step.

Analysis of the Management Situation
The analysis of the management situation determined the ability of the Forest to supply goods and services in response to society's demands and the management challenges. This analysis provided a basis for formulating a range of alternatives. To define the limits on this range of alternatives (decision space), we defined and analyzed various "benchmarks."

Part Six of this appendix contains a more detailed discussion of the analysis of the management situation and the benchmarks.

Formulation of Alternatives
We formulated a range of alternatives to respond to the issues and provide efficient resource output production. Parts Six and Seven of this appendix and Chapter 2 of the DEIS present a more detailed discussion of alternatives.

Estimating Effects of Alternatives
We estimated the physical, biological, economic, and social effects of implementing each alternative. Part Five of this appendix includes a discussion of this analysis, and Chapter 3 of the DEIS contains a summary of the effects.

Evaluation of Alternatives
Using the planning criteria, we evaluated the significant physical, biological, economic, and social effects of each management alternative. The evaluation also focused on each alternative's ability to respond to the issues. Chapters 2 and 3 of the DEIS disclose this evaluation.

Recommendation of the Preferred Alternative

The Hoosier Operations and Strategy Team, including the Forest Supervisor, reviewed the interdisciplinary team's evaluation and recommended to the Regional Forester the preferred alternative identified in Chapter 2 of the DEIS and displayed in the Proposed Forest Plan.

Plan Approval and Implementation

The Regional Forester has reviewed the Forest Plan and Environmental Impact Statement and approved the revised Forest Plan (36 CFR 219.10(c)). The Record of Decision approving the Plan will include the items required by NEPA procedures and a summarized comparison of the selected alternative with any alternative that is environmentally preferable to the selected alternative and any alternative that nearly maximizes present net value. The Forest plans to begin implementation and use the management area prescriptions and their guidance to produce the goods and services in the amounts specified in the Plan.

Monitoring and Evaluation

At intervals established in the Plan, implementation will be evaluated on a sample basis to determine how well objectives have been met and how closely management guidance has been applied. Based on this evaluation, the interdisciplinary team will recommend to the Forest Supervisor such changes in management direction, revisions, or amendments to the Forest Plan as are deemed necessary.

Part Two
Inventory Data for Information Collection

Part Two defines the nature of the information collected for the Forest planning process and some of the terminology used. Subsequent parts of this appendix describe how this information was used.

Criteria for Data Collection

The determination of what data to use, how specific and reliable it should be, and how to use it rested on the following criteria.

- The data had to meet NFMA requirements
- The data had to relate directly to issues and concerns identified by the public for the Forest
- The data had to identify opportunities relative to the problems being addressed in the Forest Plan
- The data and information had to be implementable
- The data had to be reasonably reliable
- The data had to be compatible with data to be used for monitoring activities and updating databases after revision of the Forest Plan

Process Descriptions

Table B-1 lists the sources of major data sets used to determine yields. Further discussion of yields is provided by Part Four of this appendix.

Table B.1

SOURCES OF DATA

ITEM	DATA SOURCE	PURPOSE OF USE
Cover Type/Age Class	Combined Data System (CDS)	To estimate acres of land by type to determine yields. Also to identify suited and unsuited lands and wildlife habitat factors
Geographic Information	Primary base series maps at 1:24000 scale	To estimate acres available for various classification
Cost Estimates	Previous forest budget	To estimate fixed costs and estimate variable costs
Economic and Social Analysis Data	IMPLAN data base	To assess economic and social impacts by alternatives
Timber Product Values	Timber sale transaction evidence and Indiana State Forest timber sales	To project timber product values for the SPECTRUM model
Timber Demand Trends	Indiana State Forest and Regional timber demand documents	To project timber demand
Wildlife Indicator Species Information	Selection of indicator species by FS biologists and Midwest experts based on intensive study, including Species Viability Evaluations. Numerous journals and scientific documents were used in selecting indicator species and in estimating effects of alternatives	To determine appropriate plant and animal species to monitor effects of alternatives on populations and habitat
Fish and Wildlife Population Trends	Indiana DNR and Forest records and numerous references from journals, symposia, and other sources	To estimate existing and potential wildlife populations trends and forest wildlife diversity
Endangered Threatened and Sensitive Species	U. S. Fish and Wildlife and IDNR publications; species recovery plans; additional references from journals, symposia, experts and other sources	To establish Forest direction for conservation of ET&S species
Dominant Species and Age Distribution	LANDIS, North Central Research Station - USDA Forest Service, spatially explicit landscape vegetation model	To models vegetation change overtime including natural disturbance
Average Volume Information	Recent sale information from Brownstown and Tell City Districts and Forest Inventory Analysis (FIA) data.	To determine present condition for inventory estimates

Timber Resource Land Suitability

An analysis of forest lands to determine which were suitable for timber management activities was done in three steps (Refer to 36 CFR 219.14.):

1) Tentatively Suited Land Classification - An analysis of all lands to determine which were suitable for timber production.
2) Economic Efficiency Analysis - An analysis of costs and benefits and present net value for a range of management intensities for timber production.
3) Lands Not Appropriate - An analysis of lands not appropriate for timber production because of the overriding need to meet other resource output objectives, or lands where harvest activities were not cost efficient in meeting Forest objectives within the planning horizon.

Allocation and Scheduling Alternatives

The management area prescriptions define the major emphasis of management in the management areas. The prescriptions define sets of practices that are available to use in analysis areas to achieve management area purposes and goals. SPECTRUM prescriptions contain costs and benefits as well as production coefficients. The land suitability analysis process identified what choices were suitable for each analysis area.

With these basic building blocks for analysis, benchmarks and alternatives were developed. We defined a set of objectives for each benchmark and each alternative, and these were translated into SPECTRUM constraints. SPECTRUM then determined the mix of prescriptions on analysis areas (allocation) and the associated schedule of practices with associated inputs (costs) and outputs (benefits) from these prescriptions. Parts Six and Seven of this appendix provide details of benchmark and alternative development, respectively.

Monitoring for Plan Implementation

The Forest Plan contains requirements for monitoring and evaluating the effects of management practices. The Plan establishes intervals to determine how well objectives have been met and how closely management guidance has been applied. The purposes of monitoring are to assess how well the plan meets the intended land management goals and objectives and to provide new data and information for adjusting the Plan.

Developing Programs for Plan Implementation

The resource data collected for the development and analysis of alternatives will be used to formulate program budget proposals and to develop projects. Monitoring will validate the data on which the Plan is based. For instance, the SPECTRUM output and cost estimates, which are linked to the program budget proposals, will be evaluated and adjusted by tracking the project costs and outputs. If we find deficiencies, we can strengthen future programs and projects by collecting new data.

Inputs, outputs, activities, effects, and other information produced through the planning process will use the definitions in the Management Information Handbook (MIH 1309.11). This requirement is necessary to ensure integration of the planning process with the Forest Service management model and existing analytical tools.

Part Three
The Forest Planning Model (SPECTRUM)

SPECTRUM modeling software, developed by the USDA-Forest Service, is designed to help provide decision support for forest plan revision. SPECTRUM enables a user to build linear programming based forest planning models that optimize resource allocation and activity scheduling, over a specified time span, relative to achieving stated management objectives. For example, vegetation management activities can be scheduled to provide sustainable harvest levels, subject to environmental limitations.

SPECTRUM was developed collaboratively by the Inventory and Monitoring Institute, formerly the detached Washington Office Ecosystem Management Analysis Center located in Fort Collins, CO., and the Rocky Mountain Forest and Range Experiment Station. SPECTRUM is based on FORPLAN Version 2 but includes many model formulation enhancements and a Windows 95 user interface application. The primary role of SPECTRUM is in modeling alternative land management strategies or scenarios over time, and it is being used as a tool to support revisions of Forest Plans across the nation. The present effort used Version 2.6 of the SPECTRUM system, released 11/26/01.

SPECTRUM uses mathematical programming and optimization techniques to derive solutions to a given model. The specific commercial optimization software employed is C-Whiz from Ketron Management Science.

Model Design and Application

SPECTRUM models were constructed for each plan alternative with three main analytical objectives in mind. First, determine the level of timber harvest that is sustainable for each alternative and calculate the present net value of this program. Second, develop an optimal vegetation treatment schedule that meets the objectives of the alternative. This schedule then serves as input to LANDIS to evaluate likely landscape scale vegetation change for each alternative over time. And third, explore the potential with each alternative for using prescribed burning and mechanical vegetation treatments to ensure persistence of oak-hickory forest type over time. The model analyzed production of a sustained yield of timber products.

Some of the data and many of the resource relationships present in the SPECTRUM model were taken directly from an existing FORPLAN model built and used in support of the 1991 Forest Plan Amendment. For example, yield tables were reused, while acres, costs, values, and vegetation dynamics were updated based on current data and knowledge.

Using SPECTRUM software, models were formulated for each Hoosier plan alternative and benchmark. Each model applies vegetation management choices to achieve resource objectives while satisfying all constraints imposed. The generalized vegetation model represented in SPECTRUM for the Hoosier shows hardwood stands transitioning over time from the oak-hickory type to maple-beech in the absence of even-aged management or prescribed fire. Simultaneously, pine types are transitioning to maple-beech unless they too are converted via mechanical harvest and fire to oak-hickory. Vegetation dynamics are tracked as acres transition through three cover types and three to five age classes, depending on cover type, based on management or natural succession taking place. An important limitation of this model is that it is not spatially explicit.

A SPECTRUM model consists of seven major data components. These are: (1) a time horizon for analysis; (2) a land stratification scheme for classifying acres; (3) management action choices; (4) activities, outputs, and conditions that comprise the management actions; (5) costs and values for economic analysis; (6) objective functions for deriving solutions; and (7) constraints. Each component will be described in more detail below.

Time Horizon

Each model was run for 150 years, represented as 15 ten-year periods.

Land Stratification

Six layers or land themes are available in SPECTRUM for categorizing land attributes. GIS is used to determine the number of acres in each combination of attributes across the six layers. Each of these combinations with associated acres is referred to as an analysis unit. There are approximately 120-130 analysis units in each Hoosier model. The number varies slightly by alternative based on assigning different numbers of acres to management areas. The layers used to define analysis units and the attributes in each layer are as follows:

- Layer 1 is Land Class with 2 attributes
    1. Forested
    2. Non-Forest
- Layer 2 is Natural Area with 2 attributes
    1. Highland Rim
    2. Shawnee Hills
- Layer 3 is Management Areas with 10 attributes
    1. MA 2.4
    2. MA 2.8 (3.3, 3.1 and 3.5)
    3. MA 5.1
    4. MA 6.2
    5. MA 6.4
    6. MA 7.1
    7. MA 8.1
    8. MA 8.2
    9. MA 8.3
    10. MA 9.2
- Layer 4 is not in use
- Layer 5 is current Cover Type with 9 attributes
    1. Hardwoods
    2. White pine
    3. Shortleaf pine
    4. Redcedar
    5. Barrens
    6. Permanent forest openings
    7. Marsh
    8. Lakes
    9. Other
- Layer 6 is current Age Class with 8 attributes
    1. 0-9 years
    2. 10-39 years
    3. 40-59 years

4. 60-79 years
5. 80+ years for hardwoods
6. 40+ years for white pine
7. 60+ years for shortleaf pine
8. No Age for redcedar and non-forest

Each plan alternative has its own set of analysis units. The number of acres assigned to various management areas (layer 3) varies by alternative to reflect the different land allocation schemes associated with the alternatives.

Management Actions

Management actions are sets of vegetation treatments that can be applied to groups of analysis units. Each management action has timing, or scheduling choices, associated with it. For example, one management action option is to use shelterwood methods in mature hardwood. With this option, the timing choices for treatment allow scheduling anytime between decade 1 and decade 15.

The following management actions are present in each model:

- No Management or minimum custodial level of management
- Prescribed fire in hardwood cover types
- Prescribed fire in pine cover types
- Convert shortleaf pine to hardwood using final harvest (clearcut)
- Convert shortleaf pine to hardwood using shelterwood
- Convert white pine to hardwood using final harvest
- Convert white pine to hardwood using shelterwood
- Final harvest in hardwood
- Shelterwood in hardwood
- Group selection in hardwood
- Single tree selection on a 20 year entry cycle in hardwood
- Single tree selection on a 30 year entry cycle in hardwood

Activities, Outputs, and Conditions

Management actions are comprised of combinations of individual activities that have costs associated with them. For example, the management action of shelterwood harvesting in hardwood stands is comprised of such activities as sale preparation, road reconstruction, sale administration, and pre- and post-harvest prescribed burning. Outputs result from scheduling management actions and generally have associated values. Sawtimber and roundwood are examples of outputs resulting from mechanical harvest treatments. Conditions can be thought of as ecological or environmental outcomes resulting from a management action. The following activities, outputs, and conditions are present in the Hoosier SPECTRUM models.

Activities	**Cost**
Sale preparation	$40.57 - $62.59 per acre
Sale administration	$25.40 - $31.75 per acre
Road reconstruction/maintenance	$17.10 - $23.94 per mbf
Silvicultural exam	$4.32 per acre
Certification	$8.00 per acre
Site preparation	$32.26 - $36.53 per acre
Release and weed	$42.93 - $55.15 per acre
Prescribed burning	$25.00 per acre

Outputs	Value
Pine sawtimber	$13.00 per mbf
Pine roundwood	$12.32 per mbf
Hardwood sawtimber	$370.00 per mbf
Hardwood roundwood	$6.00 per mbf

Conditions
Acres of hardwoods age 0-9 years
Acres of hardwoods age 10-39 years
Acres of hardwoods age 40-59 years
Acres of hardwoods age 60-79 years
Acres of hardwoods age 80+ years
Acres of shortleaf pine age 0-9 years
Acres of shortleaf pine age 10-39 years
Acres of shortleaf pine age 40-59 years
Acres of shortleaf pine age 60+ years
Acres of white pine age 0-9 years
Acres of white pine age 10-39 years
Acres of white pine age 40+ years

Costs and Values

The costs and values associated with individual activities and outputs are displayed above. These figures go into the internal calculation of present net value (discounted total revenue minus discounted total cost), assuming a 4 percent discount rate, for each alternative and benchmark. In the Hoosier SPECTRUM models, only costs and values related to vegetation management are present. The values and costs associated with other resources, such as recreation, are accounted for externally.

Objective Functions

Linear programming involves optimization of an objective function. An objective function is either maximized or minimized over time, subject to satisfying all specified constraints, to derive a model solution. Examples might include minimizing cost or maximizing sustainable harvest for a given alternative.

Seven objective functions were specified in the Hoosier models to explore solution possibilities in alternatives, address issues, and comply with planning regulations:

- Maximize timber harvest for the first decade;
- Maximize timber harvest over 15 decades;
- Maximize present net value (PNV) over 15 decades (4 percent discount rate);
- Maximize pine conversion over decades 1 – 3;
- Maximize acres of early successional stage over 15 decades;
- Maximize acres of oak-hickory forest type over 15 decades; and
- Maximize acres of prescribed burning over 15 decades.

The last three objective functions were used infrequently, primarily to help establish sideboards in alternatives as they were being developed. Although only a single objective function may be optimized at a time using linear programming, it is possible with SPECTRUM to solve models sequentially for a number of objective functions. The solution to a prior objective function becomes a constraint in a subsequent execution of the model. Maximizing PNV was the most

commonly used objective function, and always the final objective function for an alternative, to comply with Forest Service regulations. Some alternatives were also solved using a sequence of up to three objective functions. First, pine conversion was maximized over decades 1 – 3. Next, first decade timber harvest was maximized subject to non-declining flow and achieving at least 99 percent of the maximum pine conversion in decades 1 – 3 established in the previous solution. Finally, PNV was maximized over 15 decades subject to achieving 99 percent of the maximum pine conversion and 99 percent of the maximum first decade harvest established in the second solution.

Constraints

Even though SPECTRUM uses optimization techniques, for a model solution to be feasible, it must comply with all specified constraints in the problem. Constraints are used to represent physical, ecological, financial, or social thresholds that a solution must fall within to be considered reasonable or appropriate to implement. Models of alternatives had to satisfy numerous types of constraints to be considered feasible.

Harvest policy compliance -- In all alternatives and benchmarks, a set of harvest policy constraints are applied to comply with agency regulations. Harvest levels must be non-declining at or below the long-term sustained yield capacity of the forest. Further, timber inventory conditions must be sufficient at the end of the 150-year planning horizon so that harvest levels can be sustained in perpetuity.

Dispersion of Temporarily Created Openings -- Limiting the maximum area that can be treated in a single entry in individual stands can ultimately limit overall levels of vegetation treatment across an entire Forest.

As described in the 1991 Draft EIS and Plan Amendment (USDA FS 1991a), the dispersion objective is based on two assumptions: accessibility and dispersion legal requirement. The accessibility assumption is based on transportation yields by management area as considered in Appendix B of the 1991 DEIS and is hereby incorporated by reference. At most, only one-half of the forest in any management area is accessible in any decade.

The dispersion legal requirement is met by a general rule where the fraction of a stand to be regenerated by even-aged methods in any decade may not exceed 1/(2N+1); when N is the number of decades required to establish a timber stand greater than 20 percent of the height of the surrounding vegetation. On the Hoosier, N is equal to one decade, which results in a fraction of 1/3. With 1/2 of the area being accessible and 1/3 of the area able to be regenerated by even-aged methods in any decade the figure of lands available for harvest in any decade is (1/2 x 1/3 = 1/6). A discussion of dispersion used for reference was an article by Mealey, S. P.; Lipscomb, J. F.; and Johnson, K. N.; 1982; Solving the Habitat Dispersion Problem in Forest Planning: Transaction of the 47th North American Wildlife and Natural Resources Conference, 47: 142-153.

For example, if only 40 acres can be treated at a time in such a way that a temporary forest opening is created, and these openings need to be separated by at least an area equal to the size of the created opening, then dispersion of created temporary openings may become a limiting factor in scheduling management activities on the landscape. NFMA specifies maximum harvest unit sizes. Therefore, dispersion of created openings is modeled in SPECTRUM as analysis unit specific constraints that permit no more than one-sixth (17 percent) of the acres to be treated per decade. The 1/6 factor was derived in the previous plan and used again for this revision. The only modeled management actions that create openings

in the forest are those involving even-age management (final harvest and shelterwood). When created, openings require only one decade to no longer be considered open.

Prescribed Burning Limit -- Alternatives 1, 3, 4, and 5 each have objectives relative to the amount of prescribed burning to be done each decade. The targets are 20,000 acres per decade; 50,000 acres per decade; and 100,000 acres per decade, respectively, for Alternatives 1 (and 5), 3, and 4..

Market Demand for Pine Volume -- Based on the projected demand in the market place for pine volume and local milling capacity, an upper limit of 4.7 MMBF per year for decades 1 – 5 is imposed on pine harvest.

Controls on Management Actions -- For a variety of reasons, specific types of management actions are sometimes limited, or required to occur in a specified proportional mix, for certain alternatives. Alternatives 1 and 5 are constrained in the first decade so that the mix of mechanical treatments scheduled reflects the current mix of activities (final harvest, selection, shelterwood, and pine conversion) called for in the 1991 Forest Plan. Alternatives 3 and 4 are constrained to create a relative mix of even-aged and uneven-aged management consistent with the definition of each alternative.

Rate of Harvest Limits – In Alternatives 1 and 5 the level of harvest was constrained to match the limit listed in the 1991 Forest Plan. Alternative 3 specifies the rate of harvest limits as an objective of the alternative. For Alternative 3, constraints permit no more than 1 percent of the acres available for timber management to be treated each decade.

Selection of Management Prescriptions

To respond to the issues and concerns, the planning team used different management strategies, called management areas. The management areas used in Alternative 5 are described in detail in the Proposed Forest Plan. The other management areas are described in Chapter 2 of the DEIS.

Management areas are composed of goals for the future, desired condition, and associated guidance. The desired condition describes the conditions of the land that need to be created to produce various compatible combinations of goods and services. Guidance provides for management practices that are essential to creating and maintaining the desired land conditions and the flow of goods and services.

The Interdisciplinary (ID) team built upon the management areas in the 1991 Forest Plan, which used the following criteria when the management areas were developed:

- Different strategies would address the major public issues, management concerns, and resource opportunities.
- These strategies must reflect the full range of major commodity and environmental resource uses and values that could be produced from the Forest.
- The strategies address the goals and associated standards from the Regional Guide which the Forest chose to incorporate for this revision.
- The strategies would be appropriate as set by laws, executive orders, regulations, and agency policy as set forth in the Forest Service Manual.
- Recommendations and assumptions developed from the citizen participation process would be incorporated.

- The strategies would be compatible with plans and programs of other Federal agencies and State and local governments.
- The strategies would be ecologically, technically, and economically sound.
- The strategies would meet the resource integration and management requirements in CFR 219.13 through 219.27.

Alternative 1 uses the same management areas as in the 1991 Forest Plan. They are described in detail in the Forest Plan.

Alternative 2 would re-categorize the majority of lands classified in MA 2.4 and 2.8 to MA 9.3, and the lands currently in MA 2.4 that surround the Lost and Little Blue Rivers would be placed in MA 9.2. It would also slightly increase the acreage of MA 7.1.

Alternative 3 would shift most of the acreage presently in MA 2.8 to a new management prescription, MA 3.5. Approximately 13,000 acres presently in MA 2.8 would be shifted to a new management prescription, MA 3.3. It would also slightly increase the acreage of MA 7.1.

Alternative 4 would shift most of the acreage presently in MA 2.8 to a new management prescription, MA 3.1. Approximately 13,000 acres presently in 2.8 would be shifted to a new management prescription, MA 3.3. It would also slightly increase the acreage of MA 7.1.

Alternative 5 uses the same management areas as in the 1991 Forest Plan, except approximately 13,000 acres presently in 2.8 would be shifted to a new management prescription, MA 3.3. It would also slightly increase the acreage of MA 7.1.

By building on the management area work done in 1991, the Planning Team was able to modify the 1991 allocations of land to management areas to fit the objectives of each of the 2004 alternatives.

SPECTRUM Prescriptions

The management areas provided the framework for development of the SPECTRUM prescriptions. These included more detailed specifications of options and direction within the theme of the management area. We developed them to reflect different levels of intensity and different timing choices.

We developed SPECTRUM prescriptions for analysis areas on a per acre basis for recreation, timber, and wildlife. A broad range of prescriptions was developed to respond to the ICO's. To have a broad range of responses, practices not currently being used were considered, such as the single tree methods of financial maturity and diameter limit. Also, the prescriptions were required to meet the minimum management requirements of 36 CFR 219.27.

The Forest used the information provided by the Stage II analysis to reduce the size of the SPECTRUM matrix and make the model more efficient.

Part Four
Economic Efficiency Analysis

The Forest and Rangeland Renewable Resources Planning Act (RPA), as amended by the National Forest Management Act (NFMA), and its regulations provide the basis for integrating economic efficiency analysis in the land management planning process. Efficiency is the relationship between the quantities of inputs and outputs of a production process. The larger the output per unit of input, the greater the efficiency is. The preparation of the proposed Forest Plan required the specification of many production processes or functions. A cost efficiency analysis requires a detailed consideration of both the forest production processes and the values for inputs (costs of activities) and outputs. The next few sections discuss public benefits, parameters, projected consumption, collection and analysis of costs, outputs, and economic analysis in benchmarks and alternatives.

Public Benefits

The Multiple-Use Sustained Yield Act (MUSYA) and the National Forest Management Act (NFMA) require "…coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output" (16 U.S.C. Sec. 4(a)).

To delineate the purposes of forest planning, the regulations state that land and resource management plans (LRMP's):

> ". . . shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes net public benefits in an environmentally sound manner" (36 CFR 219.1(a)).

In connection with public benefits and intangible benefits, the key phrase in this provision is "net public benefits," which are defined in the regulations as:

> ". . . the overall long term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative values (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index" (36 CFR 219.3).

Net public benefits represent the overall value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. A single value or index could not be used to represent net public benefits. The Forest planning process sought to simultaneously analyze and display all benefits, inputs, and effects. Decision makers could then weigh all values to determine the resource mix that comes nearest to providing the greatest long-term net public benefits.

Parameters

Present Net Value

Present Net Value (PNV) is criterion used to determine net public benefits. PNV is the difference between the discounted value of all priced outputs and the discounted cost for management and capital investment during the entire analysis period of 150 years.

The period of analysis is the time over which costs and benefits associated with the Plan are assumed to accrue. Unlike other production processes, such as agricultural products that are grown in 1 year, the production of forest resources usually requires a long time period and hence a need for long-term investment analysis. A period of 150 years was used to allow the simulation of any given management alternative to proceed over one rotation of the Forest's longer-lived tree species. This period of analysis was also long enough to determine when long-term sustained yield could be established to allow for potential forest type conversions and ensure that no viable management scheme was precluded from the study.

The PNV of each alternative represents net benefits from priced outputs only. Forest Plan alternatives will also provide nonpriced benefits to the public. Nonpriced benefits are those for which there is no reasonable basis for estimating a market value. Since it is not possible to assign a dollar value to the nonpriced benefits, they are not included in the PNV calculation. These benefits are still important in the decisionmaker's determination of net public benefits.

We designed alternatives to achieve their goals and objectives in a manner that would provide the greatest value of priced outputs in relation to their cost. Economic efficiency is maximized while meeting all specified constraints and objectives for nonpriced outputs. Net public benefits, therefore, is the sum of PNV plus the full value of nonpriced outputs. The full value can be used because its cost of production is already accounted for in PNV.

Discount Rate

The discount rate represents the cost or value of money as used in determining the present value of future costs and benefits. A four percent rate was used to evaluate benchmarks and alternatives. This rate approximates the return on long-term investments above the rate of inflation.

Base Year Dollars

We express all prices and costs in 2003 dollars. Inflation is not included in the calculation of discount rate, benefits, and costs, due to the difficulty in predicting future inflation rates.

Real Price Changes

We assumed that the value of the outputs produced would not change on a real basis during the planning horizon. This is because supplies of outputs are generally adequate to meet expected demands and because the Forest's ability to produce these outputs does not generally play a pivotal role in satisfying demand.

General market prices have been, and are expected to be, insensitive to the levels of production on the Forest. This situation occurs because the Forest does not control a significant portion of the market; and sizeable quantities of goods, services, and uses are available from other suppliers in the market area. In the case of some nonmarket outputs, the quantity potentially available from the Forest may be sufficient to affect prices. However, a constant price or value

was used because of state-of-the-art limitations in determining a local demand/price relationship for these uses.

Projected Consumption (Demand)

The determination of the demand for resources on the Forest is based on an analysis of the existing resource use, existing demand, long-run projections of demand for resources, and the assumptions used in making these projections. Estimated demands for outputs and uses reflect the public's desire for certain benefits to be provided from the Forest. Therefore, demands for resources are a basis for developing a broad range of reasonable alternatives.

Demand projections were developed using the best available techniques for both market and nonmarket resources. Though it is desirable to assess demand using price-quantity relationships, it was not possible to do this for resources of the Forest.

Collecting and Analyzing Costs

Purpose of Costs

Management prescriptions involve multiple management activities, which in turn require numerous inputs such as manpower, skills, equipment, and supplies. The total cost of any prescription is based on the estimates of cost for the inputs associated with each of the activities. Total costs of prescriptions are reflected in the actual combination of activities that compose the prescription, the intensity with which the activities are undertaken, the standards adhered to, and the effects of site conditions on implementation.

Providing on-the-ground vegetation management and most recreation opportunities incurs costs. The actions that could be proposed include:

- Choice of areas and objectives for these management areas
- Modification of settings (modifying land, vegetation, water bodies, and fish and wildlife habitat)
- Provision of access, structures, and facilities
- Maintenance of sites and areas
- Regulation and direction of visitors
- Interpretation (information and education)
- Conservation of species, soil, water, and scenic quality of the landscape

Since SPECTRUM was the primary analysis tool to ensure that the cost-efficiency requirement was met, we attempted to include all costs needed to implement a prescription. The total cost of a prescription was based on the projects assumed to be implemented. It reflects all phases of the project: inventory, planning, design, implementation, administration, and monitoring.

Cost Development

SPECTRUM estimated costs for the 150-year planning period for all benchmarks and alternatives. Forest personnel developed costs in conjunction with developing standards for management prescriptions and practices. Teams estimated costs for every management activity and specified activities for each prescription. Data sources for costs included the judgments and cost studies of professional resource managers and specialists.

Cost Characteristics and Treatment

Two major cost groupings are (1) modeled costs, and (2) nonmodeled costs. Modeled cost activities are treated in the SPECTRUM model and subdivided into two categories. Some activities have fixed costs and others have variable costs. The variable costs vary by management area or analysis area (or site conditions). Timber management costs used in the planning process are available in the planning record. The planning record also documents other costs.

We discounted costs of activities not modeled in SPECTRUM and added them to the modeled costs to calculate the PNV. We projected that real costs (unit costs) would not increase during the planning period.

Outputs (Benefits)

The analysis carried three basic kinds of benefits. The first category is priced benefits, called market outputs. These are products that are exchanged in the marketplace and thus provide a record of actual dollar transactions—for example, timber and minerals.

The second category of benefits is the priced benefits called nonmarket benefits, those where no relevant markets exist and whose values are determined through analytical techniques (for example, recreation and wildlife). The third category is nonpriced benefits.

Timber Benefits

Timber benefits represent the receipts the Forest Service receives for timber harvested from NFS lands. Timber benefit is realized when the tree is cut. We based values for timber on actual receipts from timber sales. Some of the many factors influencing these values are timber size, species groups, volume per acre, product, insect and disease damage, and current market conditions. The timber outputs considered and valued in the SPECTRUM model included both sawtimber and pulpwood for hardwood and for pine.

Timber values followed the procedures of the 1991 Plan and used the following assumption--shortleaf pine, white pine, and hardwood pulpwood stumpage prices are based on actual volumes sold over a 13-year period (1991-2003).

Since the Hoosier has sold very little hardwood since 1985, the Forest relied on State-wide stumpage prices.

Other Priced Benefits

For reasons similar to those stated under the cost section, the benefits of some activities were handled outside of Spectrum.

Recreation receipts are now approximately $80,000 per year. It is projected that receipts will increase at an average annual rate of two percent.

Payments to counties were estimated, based on the 25 percent rule with a minimum payment of 75 cents per acre.

Nonpriced Benefits

Nonpriced benefits included those outputs, effects, or conditions for which there was no established market price or means of estimating a price from willingness-to-pay studies. These benefits did not overlap with priced benefits but in some cases were closely linked. For

example, improved vehicular access may affect yield coefficients or values either through lessening the cost of woods operations or increasing the attractiveness of an area to many recreationists.

Nonpriced benefits included:

- Separation of incompatible resource uses
- Visual and vegetative variety
- A variety of native plant and animal communities
- Species diversity in communities with at least viable populations of vertebrate species
- Protection of threatened and endangered species and unique communities (natural areas)
- Flexibility to adjust to changing public preferences and needs
- Wildlife openings
- Wetlands and lakes
- Potential old-growth areas
- Areas for solitude and remote enjoyment of the forest
- Natural-appearing forests

These and other nonpriced benefits respond to public needs and preferences identified through public involvement. Some, such as endangered species protection or enhancement, also meet public needs expressed through existing laws and regulations.

Economic Analysis in Benchmarks and Alternatives

The economic efficiency analysis performed for each benchmark and alternative included developing estimates of present net value as well as estimates of discounted benefits by resource and costs by the budgets, returns to the Federal treasury, and estimated returns to local governments. Part Eight, Table B.18 ranks the alternatives by PNV and itemizes the factors that cause the change in each compared to the maximum present net-value benchmark.

Chapter 3 of the DEIS presents economic information on each alternative. It also presents differences in economic benefits and cash flows.

Part Five
Social and Economic Impact Analysis

Documentation of Economic Analysis
Part Five is based on a Report Prepared for Hoosier National Forest by Northwest Economic Associates; 12009 N.E. 99th Street, Suite 1410; Vancouver, WA 98682-2497.

This is a summary of the report by Northwest Economic Associates (NEA). The full report is contained in the record.

The purpose of this report is to document the economic analysis portion of the analysis process. First, the process for the delineation of the study area is described. This is followed by a description of the development of the model for assessing impacts. This discussion includes the development of the model itself and of the development of the data used to estimate economic changes attributed to plan alternatives. Finally, baseline estimates of the effects of current forest outputs, uses, and budgets are presented.

Study Area Definition
The counties that contain NFS land are essential to include in any analysis of economic impacts of forest management alternatives. Based on data related to payments to counties (including Payment in Lieu of Taxes as well as national forest payments made under the Secure Rural Schools and Community Self-Determination Act 2000), the following counties (Table B.2), all in Indiana, contain some NFS land.

Table B.2

COUNTIES WITH A PORTION OF THE HOOSIER
(as of September 2004)

County	NFS Acres
Brown	18,382
Crawford	24,283
Dubois	412
Jackson	23,203
Lawrence	16,140
Martin	9,550
Monroe	18,995
Orange	31,311
Perry	58,661

Source: Hoosier National Forest

After considering forest products, national forest employment, and recreational destinations, NEA concluded that the nine counties in the table above should be the study area.

Methodology for Impact Analysis
To estimate the economic impacts resulting from Forest Plan alternatives in the study region, an input-output (I-O) model was developed for the region (FSH 1909.17, 22) of the nine counties in south central Indiana identified in Table B.2. This model is used to measure the indirect effects

of forest plan alternatives on the regional economy, in terms of additional output, employment, and income. The model is based on IMPLAN ("IMpact analysis for PLANning"), a system of software and data used to perform economic impact analysis.

IMPLAN is a "non-survey" or secondary I-O system, as it does not require primary, survey-based data. It is based on national average technical relationships among industries to which information has been added on regional economic activity. The software allows for national average conditions to be adjusted for unique regional conditions. The IMPLAN model for the study region estimates effects on the local economy of changing forest outputs. Because the businesses in a local economy are linked together, an action which has a direct impact on one or more local industries is likely to have an indirect impact on many other businesses in the region. For example, a decline in the production of cattle will lead to a reduction in spending in the adjacent area as farms reduce production. These additional effects are known as the indirect economic impacts. As household income is affected by the reductions in regional economic activity, additional impacts occur. The additional effects generated by reduced household spending are known as induced economic impacts.

A key element of an input-output model is the measurement of the direct, indirect, and induced linkages in a regional economy. The tool most often used to measure these interrelationships is known as a multiplier. A variety of multipliers are generated by an input-output model and each is associated with a specific industry. A multiplier is a single number that quantifies the total economic effects (for all businesses) which arise from direct changes in the economic activity of a single industry.

Limitations of the Methodology

IMPLAN analysis has some limitations which are attributable to the I-O methodology. One of the most important is that of fixed proportions: for any good or service, all inputs are combined in fixed proportions that do not vary with the level of output. Hence, there is no substitution among production inputs and no economies of scale. Second, each production function incorporates fixed technology. Such an assumption may be questionable in the case of some sectors, such as agriculture, where technological changes occur regularly. This concern is offset in part by the slow, gradual technological changes that are typical in some other sectors. Third, I-O does not model any price effects that might be important to a region. Finally, I-O assumes that resources that become unemployed or employed due to a change in final demand have no alternative employment.

The IMPLAN database contains 528 sectors at the national level. The IMPLAN database is developed from national, state, and county level data sets, with the national level used as a control. A disaggregation procedure, which has proven quite reliable, is used to insure that the state data sets add up to the national totals, and that the county data sets add up to their respective state totals. There are occasional instances where apparent anomalies occur, particularly in counties with very small economies and particularly with very small sectors in these counties.

IMPLAN Model Output

Estimating Final Demand Changes of Forest Plan Alternatives

Once the IMPLAN model is built, procedures for estimating changes in final demand must be developed. The outputs and expenditures to be measured are forest service expenditures, recreation, timber, and other. Forest Service expenditures consist of salary and non-salary expenditures. More detailed procedures are needed for the various types of recreation outputs.

Recreation outputs are measured in Recreation Visitor Days (RVDs). These outputs, as listed in Task 4 are; Hunting Related, Fishing Related, Gathering Forest Products, Camping, Day Use, Trail Related, Motorized Trail Related, and Water Based Activity.

NEA examined recreation visitation data and estimates of recreation visitor expenditure patterns available from a variety of sources. The first difficulty found is that many studies use units of trips that are not comparable with or cannot be converted to Recreational Visitor Days (RVD). As the Forest Service defines RVDs via the use of an activity-specific conversion factor multiplied by the number of calendar days taken by participants for the activity, the "overnight" category cannot be converted into RVDs without knowing precisely how many calendar days are indicated. Second, some studies are not comparable to the region in which the Hoosier is located based on socio-economic and recreational patterns.

On the other hand, other models, and the expenditure profiles derived from them are designed specifically to work with USFS RVD units of measure. These surveys are the most comprehensive surveys of recreation in national forests found in the literature. USFWS survey data and expenditure profiles can be converted to RVD relatively easily, as well. The data is available for non residents and residents for categories of developed, trail, mechanized, winter, and other uses. The USDI FWS data is available for non residents and residents for categories of big game hunting, small game hunting, migratory bird hunting, all other hunting, Great Lakes fishing, other fresh water fishing, and wildlife watching. The data is based upon national data, and the FWS data is based on State data. NEA felt that these data sets, already correlated to IMPLAN sectors, can be logically and cost effectively matched to the recreation outputs.

NEA examined the expenditure patterns in each category for similarity. They sorted the data by IMPLAN sector and expenditure and found that the patterns were very similar with those sectors with the largest expenditures appearing in essentially the same order in all profiles. NEA also compared total expenditure levels for each category, with the greatest differences resulting from the presence of lodging expenditures in the nonresident profiles.

Bridging Public Area Visitor Survey (PARVS) and USDI FWS data With Forest Service Recreation Activities

The RVDs for these outputs must be converted into recreation visits using appropriate duration factor to be compatible with expenditure patterns the Forest Service has developed from PARVS and Fish and Wildlife Service data, based on recreation visits instead of recreation visitor days.

To compute the needed final demand values the recreation visitor day values are converted to recreation visits for the three forest plan categories and the recreation visit values are summed to get total recreation visits for the three categories. This total is then apportioned 9 percent to the non-resident trail use expenditure pattern and 91 percent to the resident trail expenditure pattern. These values are then used in the IMPLAN impact module to generate a final demand vector.

Other Outputs

Sawtimber is measured in thousands of board feet (MBF). It has a final demand value of $342/MBF. The final demand value is the value of the sawtimber as it is exported from the impact area (i.e., stumpage value plus logging and hauling costs). Pulpwood is also measured in thousands of board feet and has a final demand value of $169/MBF.

Estimating Response Coefficients for Forest Outputs

Response coefficients were developed for the following categories and units of measure are described in Table B.3.

Table B.3

RESPONSE COEFFICIENTS FOR FOREST PLAN OUTPUTS AND ACTIVITIES

Category	Unit of Measure
Fishing	100,000 Recreation Visits
Developed Camping	100,000 Recreation Visits
Dispersed Camping Trail & Water	100,000 Recreation Visits
Day Use, Gathering Forest Products	100,000 Recreation Visits
Hunting	100,000 Recreation Visits
Forest Service Budget	$1,000,000
Sawtimber	100 MBF
Pulpwood	100 MBF

Source: Northwest Economic Associates

The next step in developing the analytical model is to translate forest outputs measured in recreation visits, million board feet, and budget dollars into values for input into the I-O model.

FEAST Review

The Forest Service has developed a tool to provide an interface between the output of an IMPLAN model and the preparation of economic tables for an EIS. It is called the "Forest Economic Analysis Spreadsheet Tool" (FEAST). It is designed to help planning specialists estimate the economic impacts of alternative forest outputs where the specialists typically develop their output estimates in units such as thousand board feet, recreation visitor days, and animal unit months. Response coefficients are developed to bridge between the specialist units of measure and IMPLAN values.

NEA felt that the spreadsheet approach they had used in the past for preparing input data for IMPLAN and managing IMPLAN output data for analysis and document preparation was sufficiently efficient. As they had to build a spreadsheet to convert RVDs to RVs and bridge recreation activities to PARVS expenditure patterns, it was straightforward to extend this spreadsheet to incorporate the response coefficients to estimate the output, jobs, and income impacts of the alternatives.

Alternative Spreadsheet

The results of the spreadsheet for estimating impacts are shown in Tables B.4 through B.8 below. To illustrate how this spreadsheet works, NEA used the baseline 2002 output and budget estimates to show how much economic activity was supported in the impact area by Forest operations in 2002. NEA took the output and budget values and treated them as a change in final demand.

Table B.4 shows bridges from the activity column to the project column (project is an IMPLAN term in this instance) by grouping some of the activities into projects. Table B.6 estimates budget impacts and Table B.7 estimates timber impacts. These sections use procedures much the same as for recreation, but with different units of measure. Table B.8 summarizes the impact values and shows the amount of output, the number of jobs, and the amount of income supported.

Table B.4

CONVERTING RVDS TO VISITS

Activity	Duration Factor (hours)	RVDs	Recreation Visits
Camping Developed	26.1	114,746	52,757
Camping Dispersed	26.1	25,243	11,606
Day Use/ Picnicking	6.37	59,091	111,317
Fishing	9.19	31,514	41,10
Hunting	13.04	124,977	115,010
Water Based	9.19	12,929	16,882
Trail Use	6.37	12,308	23,186
Gathering Forest Products	6.37	15,963	30,072

Source: Hoosier National Forest

Table B.5

CHANGE IN RESPONSE COEFFICIENT
(100,000 Recreation Visits)

Project	Rec Visits per 100,000	Output	Jobs	Income
Camping Developed	0.53	$917,295	15	$282,894
Camping Dispersed, Trail & Water	0.52	$833,085	14	$256,659
Fishing	0.41	$760,474	9	$174,289
Day Use, Gather Forest Products	1.41	$3,595,067	57	$1,080,468
Hunting	1.15	$1,257,922	14	$283,574
TOTAL Recreation		$7,363,844	109	$2,077,884

Source: Hoosier National Forest and Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates

Table B.6

ESTIMATING BUDGET IMPACTS

	Value	Change in Budget $ per million	Response Coefficient (million $)			Impact		
			Output	Jobs	Income	Output	Jobs	Income
FS Total Budget (2003)	$6,597,822	$6.60	$1,449,737	20.6	$1,001,738	$9,565,107	136	$6,609,289

Source: Hoosier National Forest and Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates

Table B.7

ESTIMATING FOREST IMPACTS

	Quantity	Price	Value	Change in MBF[1] per 100 MBF	Response Coefficient (100 MBF)			Impact		
					Output	Jobs	Income	Output	Jobs	Income
Sawtimber (MBF)	61.76	342	$21,122	0.62	43,870	0.4	$9,657	$27,094	0.25	$5,964
Pulpwood (MBF)	41.44	10	$414	0.41	21,679	0.2	$4,772	$8,984	0.08	$1,978
TOTAL Timber								$36,078	0.33	$7,942

[1]thousand of board feet

Source: Hoosier National Forest and Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates

Table B.8

SUMMARY: ALTERNATIVE BASELINE 2002

	Output	Jobs	Income
Recreation	$7,363,844	109.37	$2,077,884
Forest Service Expenditures	$9,565,107	135.92	$6,609,289
Timber	$36,078	0.33	$7,942
Total	$16,965,028	245.62	$8,695,115

Source: Hoosier National Forest and Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates

Baseline Forest Economic Data

In the process of developing an IMPLAN model for an impact area, substantial amounts of descriptive data about the economy of the impact area is developed. Table B-9 presents a summary of the most commonly used economic measures. The manufacturing sector produces the most output and income in the impact area and the second highest number of jobs. The Services sector is second in output and income and leads in employment, with trade being third in these measures.

Table B.9

MOST COMMONLY USED ECONOMIC MEASURES

Industry	Income *($millions)*
Agriculture, Forestry, & Fishing	$108.067
Mining	$75.672
Construction	$512.911
Manufacturing	$2,225.914
Transportation, Communication, & Public Utilities	$423.349
Trade (Retail & Wholesale)	$1,015.264
Finance, Insurance, & Real Estate	$959.579
Services	$1,223.157
Government	$1,455.978
Other	-$1.055
Totals	**$7,998.836**

Source: Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates.

Sector 522 State and Local Government – Education includes Indiana University as well as other state and local schools, this sector supports the most jobs and income supported.

Economic Effects

Recreation

Alternative 1 is the baseline or no change alternative. It is used to measure changes proposed in the action alternatives.

In general, differences in recreational opportunities among the alternatives are negligible. Table B.10 shows the amount of output, jobs, and income supported in the study area by the proposed recreation levels.

Table B.10

OUTPUT, JOBS, AND INCOME SUPPORTED BY RECREATION,
HOOSIER NATIONAL FOREST STUDY AREA, 2000

Alternative	Output ($millions)	Employment (jobs)	Income ($millions)
1	$14.080	185	$3.618
2	$14.050	184	$3.608
3	$14.354	189	$3.702
4	$14.080	185	$3.618
5	$14.080	185	$3.618

Source: Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates.

All of the differences in values between the alternatives in Table B.10 are due to the variation in trail related recreation activity. Compared to Alternatives 1 and 5, Alternative 2 would support about $30,000 less in output, one less job, and $10,000 less in personal income. These are very small changes and likely well within the margin of error in the estimates of recreation activity and economic effects.

Alternative 3 would support about $275,000 more output, four more jobs, and about $85,000 more in income than Alternatives 1 and 5. Alternative 4 provides the same level of output, jobs, and income as Alternatives 1 and 5.

Timber

The capacity of the forest to produce wood products is based on the ability of the land to produce wood fiber in perpetuity, or its sustained yield capacity. In the recent past, actual harvests have been below the sustained yield capacity of the forest.

For this analysis, Alternative 1, the baseline for analysis, represents the sustained yield capacity of the 1991 Forest Plan. This sustained yield capacity is compared to the sustained yield capacity under the other alternatives. The output, jobs, and income values shown in Table B.11 are those that would be supported by harvest at the sustained yield levels and are not projections of what will be supported by actual harvests.

Table B.11

OUTPUT, JOBS, AND INCOME SUPPORTED BY TIMBER,

Alternative	Output ($millions)	Employment (jobs)	Income ($millions)
1	$20.534	188	$4.520
2	$0	0	$0
3	$21.159	193	$4.658
4	$30.020	275	$6.608
5	$20.534	188	$4.520

Source: Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates.

Alternative 2 provides no timber output and thus, compared to Alternatives 1 and 5, would support about $20.5 million less in output, 188 fewer jobs, and $4.5 million less in income. Alternative 3 provides for an increase in timber output over Alternatives 1 and 5. It would support an increase of $625,000 in output, 5 more jobs, and almost $140,000 in income. Alternative 4 provides for an additional increase in timber output. It would support an increase in output of almost $9.5 million, 87 more jobs, and over $2 million in income over Alternatives 1 and 5.

Forest Service Budget

Forest Service expenditures and payroll are an important source of income to communities in the study area. Purchases made locally for forest management and the income spent locally by employees support further economic activity in the study area. Table B.12 displays this economic activity.

Table B.12

OUTPUT, JOBS, AND INCOME SUPPORTED BY FS BUDGET
-- HOOSIER NATIONAL FOREST STUDY AREA, 2000

Alternative	Output ($millions)	Employment (jobs)	Income ($millions)
1	$12.540	178	$8.665
2	$8.771	125	$6.061
3	$13.452	191	$9.295
4	$14.918	212	$10.308
5	$12.540	178	$8.665

Source: Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates.

Total Effects of Forest Plan Alternatives

The total effects of the alternatives are presented in Table B.13, which shows the changes in output, jobs, and income under each of the alternatives as compared to Alternative 1. Alternative 2 provides the most change from Alternative 1, with output decreasing by 48 percent, jobs by 56 percent, and income by 58 percent. Most of this change is due to a lack of timber harvesting. Alternative 4 provides the greatest increase over Alternative 1, again primarily to increased timber harvest. Alternative 3 is very similar to Alternative 1 in its economic effects. Alternative 5 provides the same economic effects as Alternative 1.

Table B.13

OUTPUT, JOBS, AND INCOME SUPPORTED BY FOREST PLAN ALTERNATIVES -- HOOSIER NATIONAL FOREST STUDY AREA, 2000

Alternative	Output ($ millions)	Employment (jobs)	Income ($ millions)
1	$47.154	551	$16.802
Change from Alternative 1			
2	-48 percent	-56 percent	-58 percent
3	+4 percent	+4 percent	+5 percent
4	+25 percent	+22 percent	+22 percent
5	No change	No change	No change

Source: Minnesota IMPLAN Group, IMPLAN model with modifications by Northwest Economic Associates.

For definitions used and detailed IMPLAN base data, see NEA's report in the project record.

Part Six
Analysis before Development of Alternatives

Part Six explains the development and modeling of minimum management requirements and the benchmark analysis.

The Forest planning process adopted evaluation criteria to guide the formulation of the model and to assist in measuring the tradeoffs related to the issues. Evaluation criteria included the minimum management requirements, National Forest Management Act of 1976, National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Part 1500), National Forest System Land and Resource Management Planning regulations (36 CFR Part 219), and Forest Service Land and Resource Management Planning Handbooks.

The minimum management requirements are requirements of law and regulation that must be met while implementing management prescriptions for resource use. Management requirements are specified in 36 CFR 219.27 and the National Forest Management Act of 1976.

For instance, the requirement that clearcutting can only be used where it is optimal is a requirement of the Act. Management requirements are primarily achieved through application of the guidance contained in the Forest Plan.

We developed benchmarks to approximate maximum economic and biological resource production opportunities. Benchmarks are useful in evaluating the compatibilities and conflicts between individual resource objectives. Benchmarks help define the range within which alternatives can be developed. The requirements in 36 CFR 219.12 require benchmark analysis to provide a basis for developing a broad range of alternatives. Therefore, the development of benchmarks preceded the development of alternatives, but the two were closely coordinated during the planning process, and at times the process became iterative.

Development of Minimum Management Requirements

Prior to the development of benchmarks, the Hoosier determined the minimum management requirements (MMR'S) to be met in accomplishing the specifications of 36 CFR 219.27. An interdisciplinary team was used to establish the minimum requirements. The interdisciplinary team and resource staff specialists relied on available research and historical experiences on the Hoosier to set the minimum resource requirements.

The ID team worked with the operations research analyst to determine how the minimum requirements could best be incorporated in the SPECTRUM analysis and how to ensure that duplication of minimum requirements did not occur. Based on this effort, the ID Team decided that some requirements could most effectively be achieved through guidance specified for each SPECTRUM prescription. This would best meet other MMRs through constraints, project planning, spatial arrangements, or the monitoring of Forest Plan implementation. The following discussion elaborates on each method used to meet the MMRs.

Guidance

We combined management practices and other activities to produce multiple-use integrated prescriptions, for which guidance was developed to assure the minimum management requirements would be met. The costs of management practices in the SPECTRUM prescriptions reflected the manpower, equipment, and other inputs needed to meet the requirements. The costs of achieving the MMRs reflect the influence of different site characteristics (analysis areas). When more than one option was possible, the appropriate guidance that was the most cost effective was selected to meet the minimum requirements.

The Plan’s Forest-wide guidance contains a multitude of various resource protection requirements. These resource protection measures may also be considered mitigation measures. Because they apply generally to the Forest, they are not site-specific. The Forest Plan’s management area guidance contains additional resource protection measures. These also are not site specific because many of the management areas are thousands of acres in size.

Constraints

Although most of the MMRs are assured through guidance provided in the Plan, some requirements could most effectively be achieved by using constraints in SPECTRUM. In particular, SPECTRUM constraints were effective in meeting minimum management requirements that dictated specific activity timing or allocation needs. We were careful to ensure that the constraints did not duplicate or overlap any MMRs met through another method.

Solutions from SPECTRUM

The allocation and schedule developed with the SPECTRUM model ensures that certain MMRs are met. Section 219.27(c)(1) regulations require that "no timber harvesting shall occur on lands classified as not suited for timber production pursuant to 219.14 except for salvage sales, sales necessary to protect other multiple-use values or activities that meet other objectives on such lands if the forest plan establishes that such actions are appropriate." In part, lands are determined not to be suitable if they are not cost efficient in meeting the Forest objectives over the planning horizon. The lands that are not cost efficient are determined based on the prescriptions chosen by SPECTRUM, given the goals and objectives of the benchmarks.

Project Planning

In some cases, compliance with MMRs is dependent on site-specific situations and information. Although some general guidance has been developed to ensure these requirements are met, minimum requirements will be addressed in more detail through project plans and the application of site-specific guidance. For example, Section 219.27(a)(3) of the regulations requires protection by "utilizing principles of integrated pest management." This requirement is generally addressed through guidance, but since the precise application of integrated pest management principles is dependent on uncertain and site-specific factors, the MMR's will be addressed in more detail through project plans.

Spatial Arrangement of Prescriptions

Minimum management requirements are also achieved through the spatial arrangements of prescriptions and the allocation of specific management prescriptions to management areas.

Monitoring

The ultimate determination of whether the MMRs are achieved will depend on systematic and frequent monitoring of the Forest Plan. Some requirements can only be met through monitoring. It is not possible to set guidance or constraints or use other methods to assure their achievement. For example, Section 219.27(c)(5) regulations state that harvest levels based on intensified management practices shall be decreased no later than the end of each planning period, if such practices cannot be completed substantially as planned. It is obvious that this requirement could not be met without careful monitoring of planned and actual intensified management accomplishments.

We will also use monitoring to ensure compliance with the guidance section of the Plan. We list monitoring In Table B.14 only when it is the primary method of achievement.

Table B.14 displays a summary of the key work required in each management requirement specified in 36 CFR 219.27 and notes how the analysis process ensures compliance.

Table B.14

MINIMUM MANAGEMENT REQUIREMENTS

CFR Reference	Key Work Summary	Brief Statement of Compliance
219.27 Resource Protection	(1) conserve soil and water	Forest Plan and Appendix I; project development and planning
	(2) Minimize hazards from flood, fire, and erosion	Forest Plan and Appendix I; project development planning
	(3) Control pests	Forest Plan and Appendix F; project development and planning
	(4) Protect streams, streambanks, lakes, and wetlands	Forest Plan and Appendix I ; project development and planning; SPECTRUM
	(5) Provide for and maintain diversity	Forest Plan and Appendix B; Common constraints
	(6) Maintain viable fish and wildlife populations	Forest Plan; Common constraints
	(7) Assess prescriptions for potential impacts	Project development and planning
	(8) Protect critical habitat for threatened and endangered species	Project development and Forest Plan
	(9) Designate ROW corridors	Forest Plan
	(10) Road design appropriate for planned uses	Forest Plan and Appendix G - Project development and planning
	(11) Re-establish vegetative cover within ten years of road construction	Forest Plan and Appendix G Project development and planning
	(12) Maintain air quality	Guidance; Project development and planning
219.27(b Vegetation Manipulation	(1) Prescription best suited to multiple-use goals	Prescription development SPECTRUM analysis- Project development and planning
	(2) Assure land adequately restocked	Forest Plan and Appendix B Project development and planning, monitoring
	(3) Prescriptions not chosen primarily due to dollar return or greatest timber output	SPECTRUM analysis
	(4) Consider effects on residual trees and adjacent stands	SPECTRUM analysis; Plan guidance Project development and planning; Spatial feasibility
	(5) Avoid permanent impairment of site and conserve soil and water	Forest Plan and Appendix B, G, and I; Project development and planning
	(6) Prescriptions have desired	Forest Plan and Appendix E, F,

CFR Reference	Key Work Summary	Brief Statement of Compliance
	effect on non-timber resources	G, H, I; Project development and planning
	(7) Be practical in terms of transportation, harvest requirements and costs	Forest Plan; Prescription development; Project development and planning
219.27(c) Silvicultural practices	(1) No harvest on non-suited land except salvage or to meet non-timber objectives	Forest Plan Structural constraints for non-suited areas; Project development and planning
	(2) Timber sale schedule gives allowable sale quantity for each period	Monitoring Non-declining yield constraint
	(3) Cut only if restocking assured in five years	Forest Plan Project development and planning
	(4) Cultural treatments for multiple-use or to promote crop tree growth	Forest Plan and Appendix B - Analysis outside of SPECTRUM Project development and planning SPECTRUM analysis
	(5) Decrease harvest levels if intensified management practices cannot be completed	Monitoring
	(6) Even-aged cutting protect other resource values	Forest Plan and Appendix B, E, and I; Project development and planning
	(7) Use timber harvest to prevent pest damage	Forest Plan and Appendix F Project development and planning
219.27(d) Even-aged manage-ment	(1) located openings to desired multiple-use objectives	Forest Plan; Monitoring; Project development and planning
	(2) Clearcut size limits	Forest Plan; Project development and planning SPECTRUM; Monitoring
219.27(e)	Riparian areas	Forest Plan and Appendix I; Project development and planning, monitoring
219.27(f)	Soil and water	Forest Plan and Appendix I; Project development and planning
219.27(g)	Diversity	Forest Plan; Project development and planning

BENCHMARK ANALYSIS

Benchmark analysis provides baseline data necessary to formulate and analyze alternatives. The benchmark process estimates the Forest's physical, biological, and technical capabilities to produce goods and services. The development of benchmarks is not limited by policy or budget, discretionary objectives, or program and staffing requirements. To carry out the requirements of 26 CFR 219.12(e)(l), the Forest was required to analyze the following benchmarks.

- Minimum level management
- Maximum present net value based on established market price
- Maximum present net value including assigned values
- Current level management
- Maximum resource levels

The maximum resource level benchmark is to be used where appropriate to estimate the maximum capability of the unit to provide significant resource emphasis levels. We chose to divide this into two benchmarks: Maximum Amenity and Maximum Timber.

The ID team determined what benchmarks were needed to respond to the ICO's. The ID team reviewed the requirements of the planning regulations of 36 CFR 219.12(e)(1); Section 1922.12 of the Forest Service Manual (FSM); and the suggested guidance in Land and Resource Management Planning Handbook (FSH) 1909.12, Chapter 3, Section 3.41b and 3.42.

In developing the benchmarks to be analyzed, we reviewed our list of major indicators of response to the ICO's, as identified by the planning team. These major indicators are:

- Roads (miles, locations and maintenance level)
- Allowable Sale Quantity (MMBF)
- Vegetation Treatment (prescription and acres)
- Suitable Areas for Management (acres in each management area)
- Species Composition (acres and percent)
- Age Class Distribution
- Invasive and Nonnative Plants (acres treated)
- Present Net Value ($, both market and non-market values)
- Recreation Visitor Days (by user groups)
- Acres of Available Habitat (species viability evaluation of plants and animals)
- Forest Openings Maintained (acres)

Since the publication of the NOI in the Federal Register, the major indicators of response have evolved. Several indicators have been dropped or changed. The indicator of young forest acres evolved into age class distribution to better represent our interest in the ages of the entire forest and not just the youngest age class.

To respond to ICO's, we determined that two benchmarks were necessary to respond to maximum resource levels: maximum amenity benchmark and maximum timber benchmark.

The maximum amenity benchmark allocated most of the Forest to a Management Goal 6 which would maximize natural-appearing forest with no timber harvest but would maintain forest openings for forest sensitive species.

The maximum timber benchmark maximized allowable sale quantity, young forests, and suitable timber acres.

Before discussing the individual benchmarks, we discuss the structural objectives, common objectives, and other objectives incorporated in the SPECTRUM model.

Structural Objectives for the SPECTRUM Model

We made a number of analyses and decisions prior to running the SPECTRUM model on the dataset. Many of these pre-SPECTRUM analyses and decisions were reflected in the basic SPECTRUM dataset formulation. Others required structural objectives in the model to assure that the pre-SPECTRUM decisions were fully incorporated in the analysis. We did not establish the structural objectives to meet the MMRs of 36 CFR 219.17 but rather to model prior decisions. The structural objectives also set limits and ensured that the model was operational and feasible. Structural objectives did not vary between alternatives or benchmarks. These objectives were:

- Land Accounting Objectives for Allocation Zones
- Land Accounting Link between Allocation Zones and Analysis Areas
- Group Selection Implementation Objectives
- Single Tree Accessibility Objectives
- Coordinated Allocation Choice Structural Objectives

Coordinated Allocation Choice Structural Objectives:

The forest land in Management Areas 5.1, 8.1 and 8.3 is withdrawn from timber production for all alternatives and the max timber and PNV benchmark outputs. The 5.1 area consists of the 12,953 acre Charles C. Deam Wilderness. Management Area 8.1 is used for the Research Natural Area, Pioneer Mothers Memorial Forest, an 88-acre virgin hardwood forest, and is outside the model. Management Area 8.3 is used for the Paoli Experimental Forest, a 632-acre area located southwest of Paoli, Indiana and was placed outside the model for all benchmarks.

The allocation of MA 5.1, 8.1, 8.2, and 8.3 is constant across all alternatives, but MA 6.2, 6.4, and 7.1 are available for timber production in maximum timber and maximum PNV benchmarks. The availability of MA 7.1 developed areas and 9.2 is controlled by SPECTRUM absolute constraints. The modeling of these management areas is different from the others due to this complexity.

Management Area 7.1 developed recreation sites were limited to the existing sites: Hardin Ridge, German Ridge, Tipsaw Lake, Celina Lake, Springs Valley, Indiana Lake, Saddle Lake, Buzzard Roost, and Blackwell Horse Camp. These sites provide opportunity for high-density, developed forest recreational experiences. This management area occurs in all benchmarks and alternatives. In some benchmarks, the entire management area is available for timber management. These benchmarks are: the maximum PNV assigned, maximum PNV market, and maximum timber.

Management Area 9.2 is a holding category until designation is assigned. It has acreage allocated to it in Alternatives 2, 3, and 4. Alternatives 1 and 5 retain it as a category that could be used but has no acreage assigned to it. In some benchmarks, the entire management area is available for timber management. These benchmarks are: the maximum PNV assigned, maximum PNV market, and maximum timber. The timber intensities are not available in any alternative.

Common Objectives

Prior to the development of benchmarks, the Forest identified the legal requirements, Forest Service policies, and other considerations that must be met to ensure that each benchmark and alternative was feasible. Common objectives were set to ensure that these requirements were met. The set of common objectives did not vary in the benchmark and alternative analysis. The list of legal requirements, Forest Service policies, and other considerations that must be met included:

- Meet the MMRs of 36 CFR 219.27.
- Ensure a non-declining and long-term sustained yield of timber.
- Ensure that the Forest has enough timber inventory at the end of the planning horizon to provide a perpetual harvest of timber at the long-term sustained yield level.

Table B.15 shows the SPECTRUM objectives used to ensure the legal requirements were met.

We based the dispersion objective on two assumptions: accessibility and the dispersion legal requirement.

TABLE B.15

OBJECTIVES COMMON TO ALL BENCHMARKS AND ALTERNATIVES TO ENSURE THE LEGAL REQUIREMENTS ARE MET

Objective	Purpose	Time Period (years)	Objective Rationale
Non-declining yield	219.16(a)(1)	10 -150	The planned timber sale for any future decade must be equal to or greater than the sale in the preceding decade.
Link with long-term sustained yield capacity (LTSYC)	219.16(a)(2)	10 -150	The Forest must be able to maintain a sustained yield. Harvest in the last decade cannot exceed LTSYC.
Perpetual Timber Harvest	219.16	150	To ensure that there is a somewhat regulated flow of timber in the future.
Dispersion	219.27(d)	60	To ensure standards are modeled. Limit even-age hardwood harvest to 1/6 of acres allocated to even-age intensities per analysis area

The dispersion legal requirement is met by a general rule where the fraction of a stand to be regenerated by even-aged methods in any decade may not exceed 1/(2N+1); when N is the number of decades required to establish a timber stand that is greater than 20 percent of the height of the surrounding vegetation. For this Forest, N is equal to one decade which results in a fraction of 1/3 that is [1/((2*(1))+ 1)]. The combination of 1/2 of the analysis area being accessible and 1/3 of the of the analysis that can be regenerated by even-aged methods in any decade results in only 1/6 of the lands available for harvest in any decade (1/2 x 1/3 =1/6). A discussion of dispersion used for reference was an article by Mesley, S. P.; Lipscomb, J. F.; and Johnson, K. N.; 1982; Solving the Habitat Dispersion Problem in Forest Planning; transaction of the 47th North American Wildlife and Natural Resources Conference, 47:142-153.

Displayed Benchmarks

The following section discusses each benchmark that was identified for the Forest. We discuss each benchmark in terms of the purpose. We also identify the specifications used to accomplish the goals and objectives, as well as assumptions and model structures that were applied.

Benchmark: Minimum Level Management

Purpose

This benchmark represents the minimum level of management needed to maintain and protect resources of the Hoosier. Minimum level is that level of management necessary to meet the background outputs and fixed costs associated with maintaining the Forest in Federal ownership. Because it is only an accounting analysis, the phase-in period that would be necessary if the minimum level were actually implemented is ignored. The SPECTRUM outputs from this Benchmark analysis were used in the analysis of Alternative 2.

Specifications

a. The objective function is to minimize cost for the planning horizon.
b. The management objectives are:
    (1) Protect the life, health, and safety of incidental users,
    (2) Prevent environmental damage to the land or resources of adjoining lands of other ownerships or downstream users,
    (3) Conserve soil and water resources,
    (4) Prevent significant or permanent impairment of the productivity of the land, and
    (5) Administer unavoidable non-Forest Service special uses and mineral leases, licenses, permits, contracts, and operating plans.
c. Incidental outputs are permissible, but there is to be no management that would produce timber, range, and developed recreation outputs.
d. Vegetation is to follow natural succession.
e. Maintenance is only for those facilities needed to support the basic ownership activities. All other facilities are allowed to deteriorate. The fire organization is reduced.
f. Dispersed recreation use that cannot be discouraged or controlled is to occur.
g. Cultural resource management is at a minimum level and is primarily for identification and protection of the resources in conjunction with any proposed ground-disturbing activities.

Table B.16 displays the estimate of the minimum level benchmark costs. A comparison can also be made with the fixed costs of other benchmarks. Minerals, Lands, and Cooperative Law Enforcement continue at the same level as in most other alternatives because most of this activity is related to administering unavoidable non-Forest Service leases, licenses, permits, and contracts to prevent damage to the land or resources. Landline expenses are necessary to prevent environmental damage to the land or resource from trespass problems with the intermingled land ownership pattern of the Forest. Facilities maintenance and fire management are reduced by 50 percent. The Forest incurs recreation expenses to support a one-half time person in cultural resource management. One person each in soil/water, wildlife, and engineering is needed to prevent environmental damage to the land or resources while administering unavoidable non-Forest Service uses. We estimated that eight people are needed in general administration to respond to public issues and manage the Forest.

Benchmark: Current Management

Purpose

The purpose of this benchmark was to provide for management using the current plan, adjusted to incorporate changes necessary to meet current management direction. The benchmark estimates the capability of the planning area to provide for a wide range of goods, services, and other uses from the present land allocation. This benchmark meets all requirements specified in the regulations (36 CFR, Part 219).

Of the benchmarks considered in this revision, this benchmark is the closest approximation of what current management of the Hoosier would be under the amended 1985 Forest Plan.

For this benchmark, timber management is allowed on approximately 41 percent of the Forest. Increases in potential old growth acreages also occur. Uneven-aged harvest methods such as single tree and group selection predominate under this direction.

Under this alternative, the PNV is $22.7 million.

In this benchmark, oil, gas, and other mineral activities, with special restrictions, are compatible uses in some management areas.

Mogan Ridge is managed as open to vehicle traffic on a seasonal basis.

The land acquisition program for this benchmark would emphasize areas along rivers and streams, additions to the wilderness system, and acquisition of special and research natural areas.

The Lost and Little Blue Rivers are not determined to be eligible for potential inclusion in the Wild and Scenic River System at this time, but both rivers and their values are protected for potential future consideration for inclusion in the system.

Benchmark: Maximize Present Net Value--Market and Assigned Values

Purpose

The purpose of establishing this benchmark is to estimate the mix of resources and a schedule of outputs and costs that would maximize the present net value of those outputs assigned a monetary value. Dollar values are based on actual market prices or simulated market prices (willingness to pay) for timber, minerals, and developed recreation. Minimum specific management requirements and nondeclining yield requirements also apply to this benchmark.

Model Structures

To derive this benchmark, the following parameters were used.

Objective function - Maximize PNV for 150 years.

Other Objectives

- Common objectives
- Structural objectives
- Limits on timber harvests

Total hardwood volume limits were set at 24 MMBF for the first 10 years. This level was not limiting.

Under the Maximum PNV benchmark the Maximum is $72.8 million and produces 164.9 MMBF. The maximum timber output produces 183.4 MMBF.

Benchmark: Maximize Present Net Value--Market Values only

Purpose

The purpose of establishing this benchmark is to estimate the mix of resources, as well as to determine a schedule of outputs and costs, that would maximize the present net value of those outputs that have an established market price. Dollar values are based on actual market prices for timber, minerals, and developed recreation. The market prices for developed recreation are based on receipts. Current campground receipts total only about $80,000. Minimum specific management requirements and nondeclining yield requirements also apply to this benchmark.

Part Eight
Financial and Economic Efficiency Analysis

Financial efficiency is defined as the degree to which dollars invested in each alternative produce revenues to the agency. Economic efficiency is defined as the degree to which dollars invested in each alternative produce benefits to society. Present Net Value (PNV) is used as an indicator of financial and economic efficiency.

The Region 9 forests used a Microsoft Office Excel electronic spreadsheet to calculate PNV for each alternative over a 100-year period. A dollar today is worth more to society than the same dollar would be in 10 years, let alone 100 years. Discount rates help express this decline in the value of money over time, with higher discount rates or a longer time resulting in greater depreciation in values. A four percent real discount rate, as prescribed by Forest Service Handbook (FSH) 1909.17, was used for calculating PNV. Cumulative present values for program benefits and costs for one hundred years, as well as present net values, were the product of this spreadsheet.

Inflation is not factored into the analysis because of the difficulty in predicting inflation rates over 100 years. We have made the assumption that inflation affects benefits and costs equally over time and have expressed both in 2002 dollar values.

The financial values for hardwood sawtimber were obtained from Indiana timber price reports for stands of average quality. Hardwood roundwood values along with pine values were derived from average transaction prices on recent sales on the Forest. Recreation and wildlife pricing and valuation were developed at the national level for the Resources Planning Act program. These values were inflated to 2002 dollars based on the gross domestic product inflation calculator (NASA 2004). The values represent society's willingness to pay for a recreation visitor day (RVD) over and above the actual costs of participation. All values are in 2002 constant dollars.

Table B.17

ECONOMIC BENEFITS AND FINANCIAL REVENUE VALUES USED FOR EACH RESOURCE

Resource	Benefit or Value
Timber ($/MBF)	
Pine - sawtimber	$13.00
Pine - roundwood	$12.32
Hardwood - sawtimber	$370.00
Hardwood - roundwood	$6.00
Recreation ($/Recreation Visitor Day):	
Camping, Picnicking, Swimming	$18.64
Mechanized Travel, Viewing Scenery	$14.00
Hiking, Horseback Riding, and Water Travel	$21.63
Resorts	$23.32
Wilderness (Backpacking)	$27.84
Other Recreation	$81.67
Wildlife ($/Recreation Visitor Day)	
Hunting	$59.89
Fishing	$101.31
Wildlife Watching	$57.97

Timber values based on Indiana timber price reports and Forest harvest values; recreation and wildlife values based on non-market values in the USDA Forest Service “Resource Pricing and Valuation Procedures for the Recommended 1990 RPA Program.”

Table B.18

PRESENT VALUE OF COSTS AND BENEFITS, AND PRESENT NET VALUE
(thousand dollars)

	Alt 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Present Net Value	1,383,313	1,353,486	1,402,473	1,390,732	1,383,313
Present Value Benefits by Program:					
Recreation Fee Demo, Recreation Special Uses, Non concessionaire Campgrounds	2,688	2,688	2,688	2,688	2,688
Timber	29,477	0	19,969	36,896	29,477
Recreation	755,420	755,070	784,088	755,420	755,420
Wildlife	751,442	751,442	751,442	751,442	751,442
PV of Benefits	1,539,027	1,509,200	1,558,187	1,546,446	1,539,027
Present Value Costs (total)	155,714	155,714	155,714	155,714	155,714

Table B.19

ECONOMIC AND FINANCIAL EFFICIENCY BY ALTERNATIVE
(thousand dollars)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Financial Efficiency	$-117,995	$-147,473	$-127,332	$-113,361	$-117,995
Economic Efficiency	$1,388,867	$1,359,038	$1,408,019	$1,393,501	$1,388,867