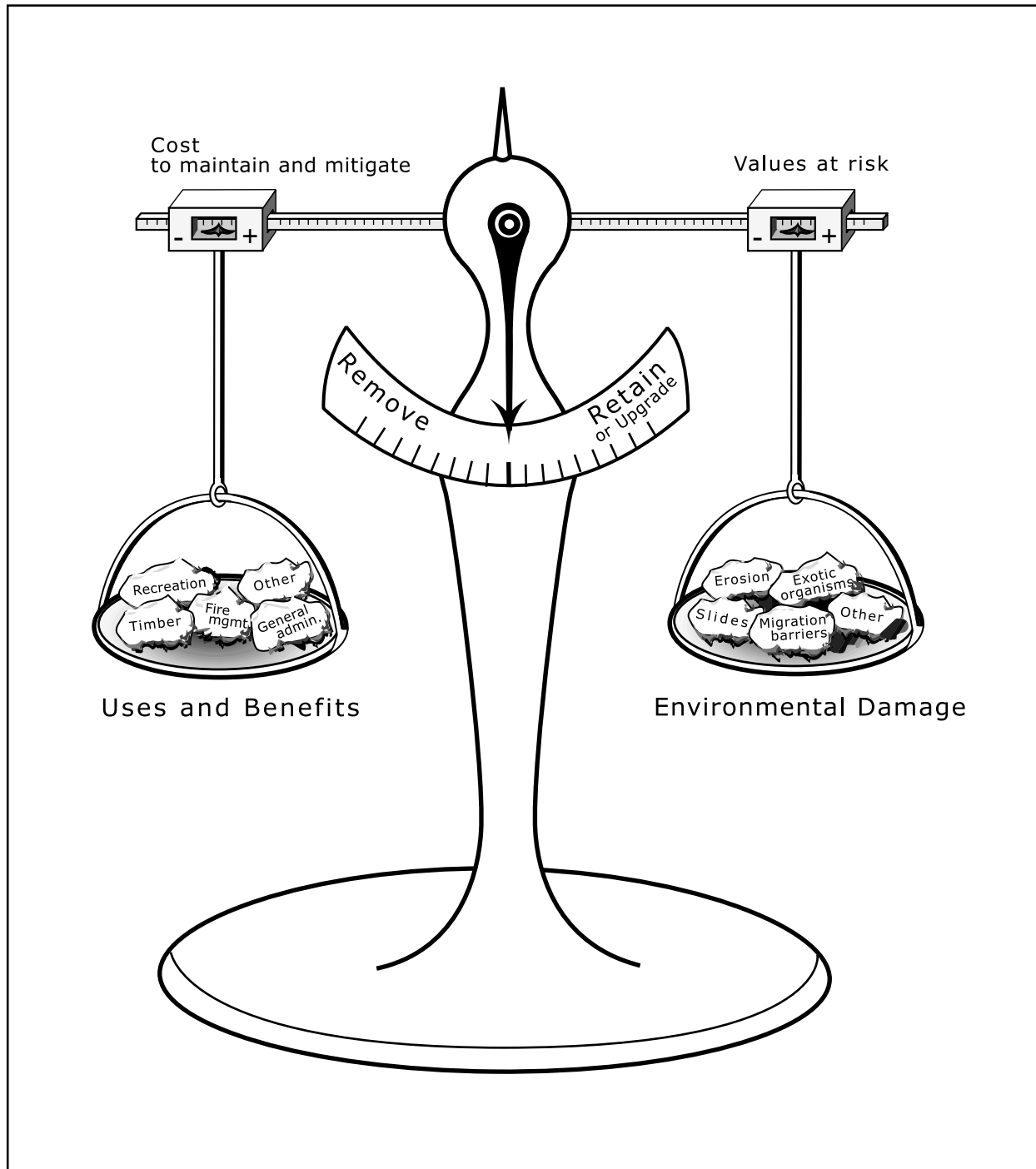




Roads Analysis:

Informing Decisions About Managing the
National Forest Transportation System



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Abstract: Roads analysis is an integrated ecological, social, and economic science-based approach to transportation planning that addresses existing and future road management options. A completed science-based roads analysis will inform management decisions about the benefits and risks of constructing new roads in unroaded areas; relocating, stabilizing, changing the standards of, or decommissioning unneeded roads; access issues; and increasing, reducing, or discontinuing road maintenance.

Keywords: roads, access, travel, transportation, watershed analysis, ecosystem analysis, national forests, watershed, erosion, wildlife

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Roads Analysis:

Informing Decisions About Managing the
National Forest Transportation System

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Summary

The Need for Roads Analysis

An optimum road system supports land management objectives; for the Forest Service, those objectives have markedly changed in recent years. How roads are managed must be reassessed in light of those changes. Expanding road networks have created many opportunities for new uses and activities in national forests, but they have also dramatically altered the character of the landscape. The Forest Service must find an appropriate balance between the benefits of access to the national forests and the costs of road-associated effects to ecosystem values. Providing road systems that are safe to the public, responsive to public needs, environmentally sound, affordable, and efficient to manage is among the agency's top priorities. Completing an assessment of road systems for all national forests is a key step to meeting this objective.

Characteristics of the Process

Roads analysis is an integrated ecological, social, and economic approach to transportation planning, addressing both existing and future roads—including those planned in unroaded areas. Roads analysis is intended to be based on science. Analysts should locate, correctly interpret, and use relevant existing scientific literature in the analysis, disclose any assumptions made during the analysis, and reveal the limitations of the information on which the analysis is based. Finally, the analysis report should be subjected to critical technical review.

The analysis is designed to be scaleable, flexible, and driven by road-related issues important to the public and to managers. It uses a multiscale approach to ensure that these issues are examined in context. And it provides a set of analytical questions to be used in fitting analysis techniques to individual situations. Roads analysis is intended to complement and integrate existing laws, policy, guidance, and practice into the analysis and management of roads on the national forests. Roads analysis as described here is primarily a stand-alone procedure, but the conceptual framework and resources for analysis may be readily integrated into any analytical process in which the roads are examined.

The detail of the analyses must be appropriate to the intensity of the issues addressed. Where ecosystem analyses or assessments are completed, roads analysis will use that information rather than duplicating these efforts. Roads analysis may be integrated as a

component of watershed analyses, landscape assessments, and other analyses supporting existing decision processes.

Roads analysis neither makes decisions nor allocates lands for specific purposes. Line officers, with public participation, make decisions. Technical analysts conduct analyses that inform the decisionmaking role about effects, consequences, options, priorities, and so on. Roads analysis provides information for decisionmaking by examining important ecological, social, and economic issues. Roads analysis helps implement forest plans by identifying management opportunities that can lead to site-specific projects. It can also identify needed changes in forest plans to be addressed in amendments or revisions.

By completing roads analysis, national forests will generate maps and narratives that display and describe management opportunities for changing current road systems to better address future needs, budgets, and environmental concerns. A report from each analysis will provide details of potential changes and other information relevant to managing national forest programs and projects.

The Six Steps

Roads analysis comprises six steps aimed at producing needed information and maps. Line-officer participation is essential to the process. Although the analysis consists of six sequential steps, the process may require feedback and iteration among steps over time as the analysis matures. The amount of time and effort spent on each step will differ, based on specific situations and available information. The process provides a set of possible road-related issues and analysis questions, the answers to which can inform the choices made about future road systems. Line officers and interdisciplinary teams can determine the relevance of each question, incorporating public participation as deemed necessary by line officers.

Step 1 — Setting up the analysis. The analysis must be designed to produce an overview of the road system. Line officers will establish appropriate interdisciplinary teams and identify the proper analytic scales. The interdisciplinary team will develop a process plan for conducting the analysis. The output from this step will include assignment of interdisciplinary team members, a list of information needs, and a plan for the analysis.

Step 2 — Describing the situation. The interdisciplinary team will describe the existing road system in relation to current forest plan direction. Products from this step include a map of the existing road system, descriptions of access needs, and information about physical, biological, social, cultural, economic, and political conditions associated with the road system.

Step 3 — Identifying issues. The interdisciplinary team, in conjunction with line officers and the public, will identify important road-related issues and the information needed to address these concerns. The interdisciplinary team will also determine data needs associated with analyzing the road system in the context of the important issues, for both existing and future roads. The output from this step includes a summary of key road-related issues, a list of screening questions to evaluate them, a description of status of relevant available data, and what additional data will be needed to conduct the analysis.

Step 4 — Assessing benefits, problems, and risks. After identifying the important issues and associated analytical questions, the interdisciplinary team will systematically examine the major uses and effects of the road system including the environmental, social, and economic effects of the existing road system, and the values and sensitivities associated with unroaded areas. The output from this step is a synthesis of the benefits, problems, and risks of the current road system and the risks and benefits of building roads into unroaded areas.

Step 5 — Describing opportunities and setting priorities. The interdisciplinary team and line officers will identify management opportunities, establish priorities, and formulate technical recommendations that respond to the issues and effects. The output from this step includes a map and descriptive ranking of management options and technical recommendations.

Step 6 — Reporting. The interdisciplinary team will produce a report and maps that portray management opportunities and supporting information important for making decisions about the future characteristics of the road system. This information sets the context for developing proposed actions to improve the road system and for future amendments and revisions of forest plans.

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The Roads Analysis

Roads have become a focus of controversy on national forests. An expanding forest road network in the last half-century has resulted in a system of more than 383,000 miles of roads (Coghlan and Sowa 1998) and created extensive opportunities for new national forest uses and activities. The road network facilitates managing the national forests, provides recreational opportunities, and contributes to the rural transportation infrastructure of surrounding private lands. Although visitors depend on roads to enjoy national forests, parts of the expansive road system threaten the very naturalness many people are seeking (Fan and Bengston 1997). The effects of road building, when coupled with activities such as logging and mining, have dramatically altered the landscape in many areas. The social and environmental effects of such alterations have been extensively studied (USDA Forest Service, in press). Taking a hard look at this legacy makes good sense.

An optimum road system is a function of land stewardship needs and management objectives. These objectives have changed substantially in the past decade, so reassessing road systems in light of these changes is timely. The challenge is to develop a Forest Service analysis process that provides information that helps managers find a balance between the benefits of access and the road-associated effects on naturalness; on other values and resources, such as clean water, fish, and wildlife; and on maintaining choices for future generations. The proper balance will result in a more efficient road system with less risk to the environment and public safety than currently exists.

Acting now to resolve issues related to national forest road systems—sensibly, comprehensively, judiciously, and with a view for sound stewardship of natural resources—is in the best tradition of public service.

Finding a balance that addresses both the need for public access and the risks associated with roads is essential. Developing a premise for building new roads that can garner public support is also essential. Assessing the needs for the road system for all national forests is a forthright response to an awareness that roads, along with their benefits to people, present demonstrated risks to the environment.

The Objectives of Roads Analysis

The objective of roads analysis in the Forest Service is to provide line officers with critical information to develop road systems that are safe and responsive to public needs and desires, are affordable and efficiently managed, have minimal negative ecological effects on the land, and are in balance with available funding for needed management actions.

How Roads Analysis Will Achieve These Objectives

Roads analysis is intended to be science based. That is, analysts should locate, correctly interpret, and use relevant existing scientific literature in the analysis. They should disclose any assumptions made during the analysis, and reveal the limitations of the information on which the analysis is based. Finally, the analysis report should be subjected to critical technical review.

Roads analysis will assess the extent and current condition of the road system on a national forest or group of national forests in the context of other public and private road systems and land ownership patterns. Comparing this current condition to a desired condition will identify the need for change. Roads analysis will provide the information to develop the agency's strategic intent for road management; that is, what will happen to balance the need for public access with the need to minimize risks.

Roads analysis will provide decision support to field personnel managing forest roads and help managers address questions on road access related to ecosystem health and sustainability, commodity extraction, recreation, social and cultural values, and administrative uses.

A completed analysis will inform future management decisions on the merits and risks of building new roads in previously unroaded areas; relocating, upgrading, or decommissioning existing roads; managing traffic; and enhancing, reducing, or discontinuing road maintenance. Decommissioning options could include thoroughly obliterating roads and restoring the environment, treatments to remove all hydrologic and erosional hazards, converting roads to trails, and simply closing roads without further action. The analysis can inform future decisions at bioregional, provincial, subbasin, watershed, or project scales.

The analysis will be based on:

- Use of the best available scientific information about ecological effects of roads on terrestrial and aquatic ecosystems at appropriate scales;
- Economics of constructing, reconstructing, maintaining, and decommissioning roads;
- Social and economic costs and benefits of roads; and
- Contribution of existing and proposed roads to management objectives.

The analysis will include methods for identifying opportunities for increasing benefits of road systems and reducing existing problems and risks. It will provide a framework for examining important issues and developing relevant information before managers enter into a formal decision process [National Forest Management Act (NFMA) and National Environmental Policy Act (NEPA)] that will change the characteristics and uses of national forest road networks. The analysis will neither make land management decisions nor allocate land for specific purposes because both require NFMA- and NEPA-based Forest and project planning.

Although concluding the analysis with a documented product is important, additional iterations of analysis will be needed as conditions change—rates of funding, inventory and monitoring results, severe disturbance events, or new regulatory requirements, for example.

Technical and Policy Roles Within the Interdisciplinary Team

Interdisciplinary teams conducting roads analysis will be commissioned and supervised by line officers, and staffed with appropriate technical experts. This structure provides effective integration of technical and policy roles in the conduct of the analysis.

Technical experts provide line officers with facts, processes, and technology, such as:

- Existing conditions on the national forest;
- Processes by which roads exert physical, biological, social, and economic effects;
- The nature, magnitude, and probability of those effects;
- Technology that might be used for modifying effects, and;
- The relative cost-effectiveness of alternative actions that management might prescribe.

Line officers, after considering technical information, laws, policies, and the needs of the public, make value judgments, such as:

- Which conditions, effects, technologies, and management actions are desirable or undesirable;
- How to establish priorities;
- What conditions or effects create unacceptable risk;
- What are appropriate objectives and criteria;
- When and how to include public participation in decision processes; and
- Allocation of agency resources.

Responsibilities of Line Officers

Analysis of existing and potential future road systems is neither a simple linear sequence of technical steps nor a self-contained set of analytical tasks. At various points in the process, line officers will need to make policy choices, the people affected need to participate, and those involved in policy and technical functions need to collaborate.

Line officers need to identify and specify the existing context of relevant policy already established by the agency. Policy examples include the land-use allocation specified in an approved forest plan; Forest Service road policy specified in an approved forest plan; and Congressional, Departmental, or Forest Service directives. The analysis itself might reveal a need to revise the policy context, but such revision is not part of the roads analysis. Rather, information produced by the analysis can help responsible officers choose whether to consider amending or revising a forest plan.

Line officers (Regional Foresters, Forest Supervisors, or District Rangers) must also choose the appropriate geographic scale or scales and how detailed the analysis will be. Scale refers to the geographic or spatial scope of the analysis or decision. Road management, including maintaining the absence of roads in unroaded areas, not only supports a variety of uses and activities at many different scales but also connects with a wide variety of resources and potential effects. Selecting the appropriate scale for assessing roads opportunities depends on the issues being analyzed and how their effects are manifested; the extent and nature of linkages with other ecological, social, and economic systems; the nature of variables under the control of the decision process; the information availability and value in relation to the range of potential consequences; and budget and personnel constraints. Starting at broader scales

has the advantage of identifying problems or risks that may only be detected at broad scales (for example, cumulative effects); avoiding attacks on relatively inconsequential problems; identifying pivotal actions through a better understanding of the connections among resources and roads; offering the opportunity to reframe the administrative authority to make needed changes (for example, putting two national forests together or pursuing interagency strategies); and avoiding collecting unnecessary information for relatively unimportant problems or areas.

Choosing the depth of the analysis depends on the skills and resources available and the associated risk. The choice of how to modify the road system might be obvious after field inspection and consulting with technical staff and representatives of the people affected. Technical analysis might consist of no more than a judgment by technical staff on the relevant questions. At other times, the scale of the problem, the potential severity of effects, or both might be sufficient to justify using state-of-the-art analytical tools or even conducting original research.

Technical description and analysis of the existing situation helps managers identify the issues, define the problem, and set situation-specific management priorities. Technical assessment of an existing situation also allows line officers to choose the relevant variables or factors to include in further analysis. Each roads analysis needs to focus only on relevant effects and uses.

One of the most important line officer responsibilities is to decide whether the problems described or predicted by the technical assessment warrant action. That decision requires clear specification of criteria and standards by which to choose between acceptable and unacceptable effects. Specifying those criteria and standards is also a management responsibility. Choosing between acceptable and unacceptable effects, as well as developing criteria and standards by which to make the choice, may also require public participation and technical consultation, but it is ultimately a management choice.

A critical management choice is whether to fully accommodate the demand for road use generated by many and various purposes like recreation, timber harvest, and forest management, or to limit use. Regulating use, modifying the road system, or both to achieve ecosystem sustainability goals requires establishing criteria and standards for all relevant and significant ecosystem, social, and economic effects, including needs generated by the public and the agency for forest access and other purposes. The choice between acceptable and unacceptable effects must consider cumulative as well as local or partial effects. Numerous small and relatively unimportant effects can add to

significant cumulative effects. Complex interactions among the affected ecological, social, and economic systems can have far-reaching consequences.

Given the statement of needs for access or other road functions discovered by technical analysis and public involvement, line officers must ultimately determine, through the NEPA process, how much accommodation of the transportation demand is acceptable. The determination will usually require participation by affected public groups and individuals. Accommodation of demand might be constrained or determined, however, by environmental effects. A hierarchical policy context might specify that certain environmental criteria and standards must be satisfied before any road uses can be considered. If so, those environmental criteria and standards might constrain the amount of accommodation that can be achieved, or vice versa. The technical analysis might find that a given road segment or subnetwork serves no purpose at all.

Interdisciplinary teams must recognize that analysis of public resources is a partnership between technical staff advisory functions (factual analysis of effects, changes, consequences, processes, and so on) and policy decision functions (values, priorities, risks, benefits, costs, losses, and so on).

Roads Analysis in Relation to Existing Planning, Analyses, and Decisions

Roads analysis, focusing on existing and future transportation systems, can contribute to implementing and revising forest plans. The analysis proceeds using the existing forest plan but may provide information about inconsistencies between road management objectives and existing forest plans. It can also assure that a road system is consistent with direction set forth in the forest plan. The analysis is intended to complement and integrate previous and ongoing analytical efforts, including access and travel management plans, transportation plans, watershed analyses, NEPA analyses, and all other relevant planning and analysis products. Roads analysis is not a decision process, nor does it constitute a Federal action. Management opportunities identified through the analysis will complement previous decisions that establish management objectives and the need for transportation facilities. The assessment depends on information and analysis from past decisions, and it provides information relevant to future decisions. When a manager concludes from the analysis that action is needed, adjustments can be initiated in the context of current Forest and project planning.

Roads analysis will not duplicate work already completed through other assessments or analyses. It will serve to guide future project-scale analyses by identifying conditions, changes, and effects relevant to implementing forest plans. Where possible, current and relevant existing data and analyses will be used directly or with minimal modification. For example, a hydrologic condition assessment (McCammon et al. 1998) may contain information about erosion hazards in a particular area. To the extent this same information is needed in developing strategies for existing and future transportation systems, it will be incorporated into the roads analysis.

The Forest Service uses a two-stage approach to decisions guided by two principal laws—NFMA and NEPA. Roads analysis is not intended to duplicate any work already being completed through forest plan or project analyses. It can provide information to be considered in those analyses, however.

The relation of roads analysis to other assessments currently being used and to the two-stage decision process is shown in figures 1 and 2. The relation to other assessments is intended to represent the situation on many national forests where assessments are being completed to address various issues. Sometimes the assessments are completed separately from each other and sometimes they are integrated. In fact, roads analysis will often be a component of watershed analysis, landscape assessments, and other analyses supporting existing decision processes.

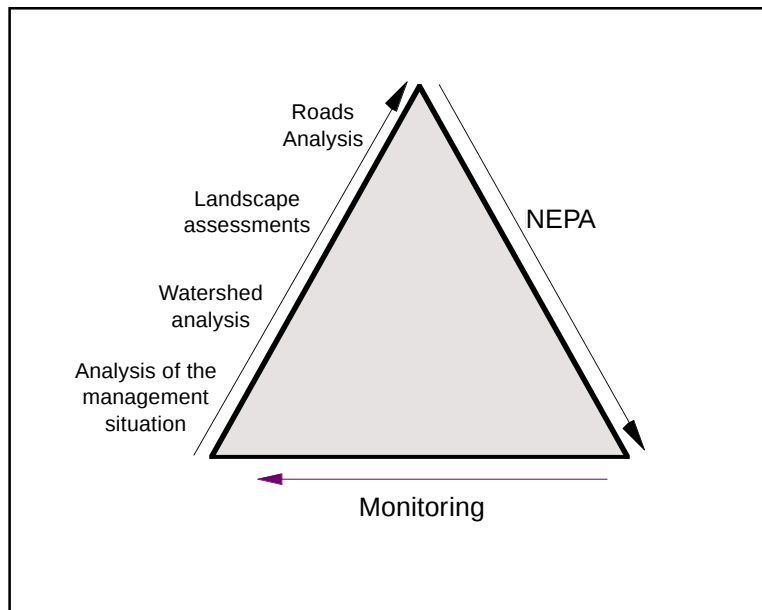


Figure 1. Roads analysis fits with planning and analytical activities on the 'left-side' of the NFMA—NEPA—Monitoring planning triangle.

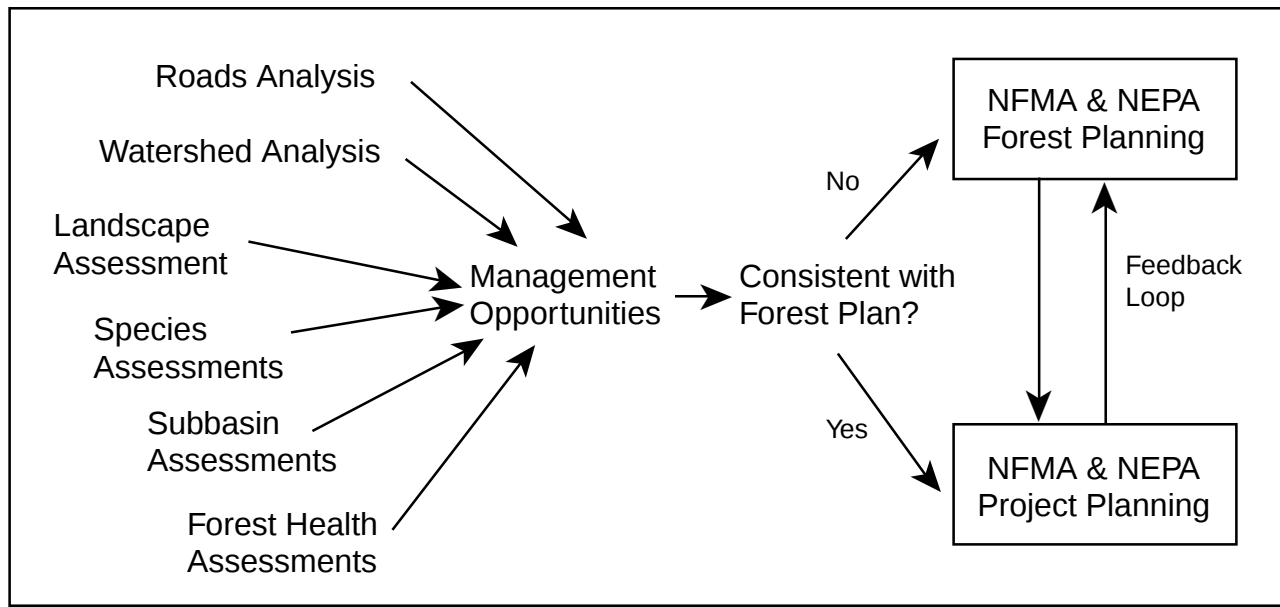


Figure 2. How roads analysis is related to the two-stage planning process and other ecosystem assessments.

Roads analysis may produce information relevant to planning issues. Sometimes, this information needs to be examined as potential “new information” to planning that could lead to a forest plan amendment or revision. Roads analysis also identifies management opportunities that could be used to implement a forest plan. Those opportunities consistent with a Plan can be formulated into proposed actions and studied through the project NEPA process. Those that are not consistent with a Plan could only proceed to project NEPA if the plan was amended or revised.

Forest plans provide guidance on multiple-use goals and objectives, management prescriptions, and monitoring and evaluation. Allocations of specific land areas to various management activities—such as recreation, timber harvest, wildlife management, livestock grazing, and watershed protection—establish the basis and need for a transportation system. In addition to land allocations, forest plan standards and guides help to provide for compatibility of transportation facilities with specific ecological conditions. Information from roads analysis can help managers to set priorities and, if needed, revise forest plans and their standards and guides.

For projects, NEPA provides a process to help make decisions about how to carry out management activities that implement forest plans. Roads analysis can provide important information to project planning. As an example, roads analysis might identify and set priorities for opportunities to decommission roads no longer needed to meet management objectives. Once priorities are

established for adjusting a road system, a variety of funding sources and related actions can be used to propose specific treatments, analyze them through NEPA, and get them done. By identifying a set of management opportunities and priorities before formulating proposed actions, managers can assure that limited funds are spent efficiently on the highest priorities.

Analyses completed as part of roads analysis can be referenced in the project NEPA analysis to help managers address cumulative effects and to reduce the NEPA workload. Roads analysis can lead to or be completed concurrently with a forest plan amendment or revision, providing important information for use in amending or revising the Plan. Analysis can lead to priorities for implementing existing decisions about roads, and set priorities for acquiring the needed inventory and further analysis.

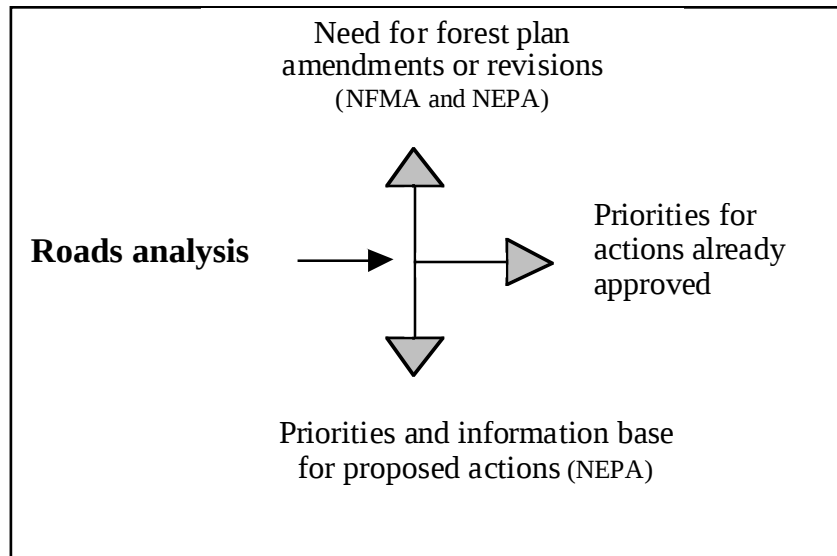


Figure 3. Possible outcomes of roads analysis.

Three possible types of choices that could be informed by roads analysis are shown in figure 3. Analysis might indicate that a forest plan amendment or revision is needed; it might inform the setting of work priorities for already authorized activities such as closing of temporary roads or additional road inventory; and it might suggest priorities among projects and proposed actions to be taken into the NEPA process.

How Roads Analysis Is Related to Management Decisions

Those conducting roads analysis must clearly distinguish between three types of decisions that are either associated directly with the analysis, or are informed by the analysis. The three types of decisions are:

Decisions made by line officers that pertain to the conduct of the analysis; for example,

- The proper scale or scales to use in the analysis,
- Selection of the road-related issues that drive the analysis, or
- Specification of criteria and standards by which to choose between acceptable and unacceptable effects.

These types of decisions are made by line officers in collaboration with the technical specialists on the interdisciplinary team before the analysis can be conducted and completed. They are essential elements leading to the products of the analysis.

Prior land management NEPA decisions that set direction and context for the analysis; for example,

- Forest plan land allocations, or
- Other Federal actions approved through the NEPA process that could affect the context or conduct of the analysis—that is, land management decisions that pre-date the roads analysis.

Roads analysis will not change or modify any existing NEPA decisions, but information generated by the analysis might cause line officers to reconsider, and perhaps at some future date revise previous NEPA decisions.

Future land management decisions that will be informed by the roads analysis but are made through the NEPA process after the analysis; for example,

- The decision to close a national forest road or road segment, or
- A decision to build new roads in roaded or unroaded terrain.

Information generated by the analysis and opportunities for future actions that will bring national forest roads into improved balance with management objectives may lead line officers to initiate a formal NEPA process on one or more of the potential actions. The roads analysis informs these types of land management decisions but does not make or require them.

Terms Used in Analyzing and Managing Roads

The specific analysis and management of roads, access, travelers, and transportation have been variously referred to in the Forest Service, with different but often overlapping purposes ascribed to each term and body of guidance and direction. Roads analyses that are planning functions (left side of the triangle in figure 1) have been called “transportation planning” (reference FSH 7700), “travel management,” or “access and travel management planning.” NEPA analysis and implementation of existing decisions (on the right side of the triangle) have been called “road management” or “access and travel management.” The roads analysis described here includes all analysis of roads on the left side of the planning triangle.

Definitions

Road. A vehicle travel-way more than 50 inches wide. As used in this section, a road may be **classified** or **unclassified**.

Classified road. A road constructed or maintained for long-term highway vehicle use. Classified roads may be public, private, or forest development.

Public road. A road open to public travel under the jurisdiction of and maintained by a public authority such as states, counties, and local communities.

Private road. A road under private ownership authorized by an easement to a private party, or a road that provides access pursuant to a reserved or private right.

Forest development road. A road wholly or partially within or adjacent to a national forest boundary and necessary for protecting, administering, and using national forest lands, which the Forest Service has authorized and over which the agency maintains jurisdiction.

Unclassified road. A road that is not constructed, maintained, or intended for long-term highway vehicle use, such as roads built for temporary access and other remnants of short-term-use roads associated with fire suppression; timber harvest; and oil, gas, or mineral activities; as well as travel-ways resulting from off-road vehicle use.

Unroaded areas. Areas that do not contain classified roads.

Road Classifications in Current Use

Functional Class	Traffic Service Level	Maintenance Level
Arterial: Provides service to large land areas. Connects with other arterials or public highways. Collector: Serves smaller land areas than arterials. Connects arterials to local roads or terminal facilities. Local: Single purpose road. Connects terminal facilities with collectors or arterials.	A: Free flowing, mixed traffic; stable, smooth surface; provides safe service to all traffic. B: Congested during heavy traffic, slower speeds and periodic dust; accommodates any legal-size load or vehicle. C: Interrupted traffic flow, limited passing facilities, may not accommodate some vehicles. Low design speeds. Unstable surface under certain traffic or weather. D: Traffic flow is slow and may be blocked by management activities. Two-way traffic is difficult, backing may be required. Rough and irregular surface. Accommodates high clearance vehicles. Single purpose facility.	Level 1 Closed more than 1 year. Level 2 High-clearance vehicles. Level 3 Passenger vehicles—surface not smooth. Level 4 Passenger vehicles—smooth surface. Level 5 Passenger vehicles—dust free; possibly paved.

Road Management Objectives are to:

- Establish the specific intended purpose of a road based on management needs as determined through land and resource management planning;
- Contain operation and maintenance criteria for existing roads; and
- Contain design criteria and operation and maintenance criteria for new roads.

The Products of the Roads Analysis

The products of the analysis will be

- A report for line officers and the public that documents the information and analyses used to identify opportunities and set priorities for future national forest road systems.
- A map displaying the known road system for the entire administrative unit, and the risks and opportunities for each road or road segment.
- Other maps and tables necessary to display specific priorities and changes in the road system.

Adaptive Management

Uncertainty of the outcomes is a component of all management actions. Understanding that uncertainty and improving how national forests are managed requires a systematic procedure for learning from experience. Individuals learn and procedures evolve, but progress is much faster when learning is considered a valued objective of management actions—the premise underlying the concept of adaptive management. The roads analysis procedure suggests processes, road-related issues, and analysis questions to address. Implementing roads analysis and associated actions needs to include a systematic process for predicting, monitoring, evaluating, and learning from the outcomes of this procedure.

Currently, the primary approach to this learning objective is through forest plan monitoring, but the newness of roads analysis and its potential to affect day-to-day national forest activities requires an adaptive management component to enhance learning from and then adjusting the roads analysis procedure.

A national interdisciplinary team should be established to implement this adaptive management component. This group will identify what will be measured, how, and when; and determine what magnitudes of those variables will have meaning in evaluating management actions, the analysis, and policy decisions. Possible components to be addressed include the attributes of the ecosystem (including its social components) that need to be monitored to evaluate the effects of road systems; the values of those measurements that will indicate if the predicted outcomes are acceptably close; the changes to procedures suggested to support subsequent decisions; the timeframe necessary to conduct roads analysis at various scales; and the budget

requirements of roads analysis. Whether monitoring demonstrates success or failure of outcome predictions, what is learned from monitoring will illuminate analysis and decisionmaking in the future.

The group can be guided by the following questions to learn from implementing roads analysis and to adapt the procedure:

- Are road problems and management opportunities for responding to them better understood?
- Has the agency's organization for responding to road-related issues been improved?
- Have clear and measurable outcomes been predicted for various opportunities?
- What are the monitored outcomes relative to policy objectives and intended results?
- Have opportunities for improving outcomes or changing the process been identified?

The Roads Analysis Procedure

Roads analysis will help to identify changes to national forest transportation systems that may be needed to meet current or future management objectives. The six steps of roads analysis are shown in figure 4. The analysis will be customized to local situations—landscape and site conditions coupled with public issues, forest plan land allocations, and management constraints. The analysis products demonstrate how well existing and planned roads or road systems meet their intended purposes and the degree to which they can affect ecological, social, and economic conditions.

Broad landscape-scale analysis will inform managers and interested parties of the strategic intent of the Forest Service road network and demonstrate the compatibility of road systems with ecological, social, and economic objectives. Broad-scale analysis will provide a context for finer scale analysis units, such as for watersheds; will set priorities for more detailed analysis and program planning; and will identify issues requiring further work. At the watershed scale, the analysis is tiered to the broad scale, is more detailed, and will display opportunities to adjust road systems to efficiently and effectively achieve transportation objectives in ways that protect ecological integrity and public safety. Detailed analysis at the watershed scale over the entire national forest may not be necessary. Rather, detailed analysis can be focused initially on those watersheds identified by the broader analysis, where adjusting the road system is most important based on public issues and ecological needs, and where site conditions dictate higher priorities.

The process provides a set of possible road-related issues and analysis questions, the answers to which can inform the choices made about future road systems. Line officers and interdisciplinary teams assigned to complete the analyses can review this list and determine the relevance of each question. For those that are relevant, additional suggestions on information needs and possible research findings that might apply are included.

Roads analysis is designed to provide information that allows integration of ecological, social, and economic concerns into future decisions about roaded and unroaded areas. It is meant to inform thinking about roads options at all planning scales. The process is meant to complement, rather than replace or preempt, other planning and decision processes. It is not specific to a geographic scale or a particular set of issues. The interdisciplinary team determines these aspects of the analysis as they work through its questions and instructions. The interdisciplinary team and line officer select the geographic and time scales after careful thought and interdisciplinary

discussion. A specific requirement of the analysis is to describe how the information developed and opportunities identified affect or are affected by adjacent units (for example, adjacent national forests, counties, private ownerships) and other agencies and jurisdictions (for example, the Bureau of Land Management, the Bureau of Reclamation, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, State and county governments). Further, the analysis will describe how the information developed and opportunities identified affect or are affected by the scale above and the scale below the selected analysis scale.

Roads analysis is a framework for periodic reevaluation of road systems and road management strategies. Interdisciplinary teams may choose to revisit the analysis as new information becomes available; as management needs, ecological conditions, or social issues change; as major disturbances occur; as inventory, monitoring, or research results are revealed; or as regulatory requirements are changed. The interdisciplinary teams should compare actual outcomes against interpretations and effects estimates made in earlier iterations.

The process has six steps:

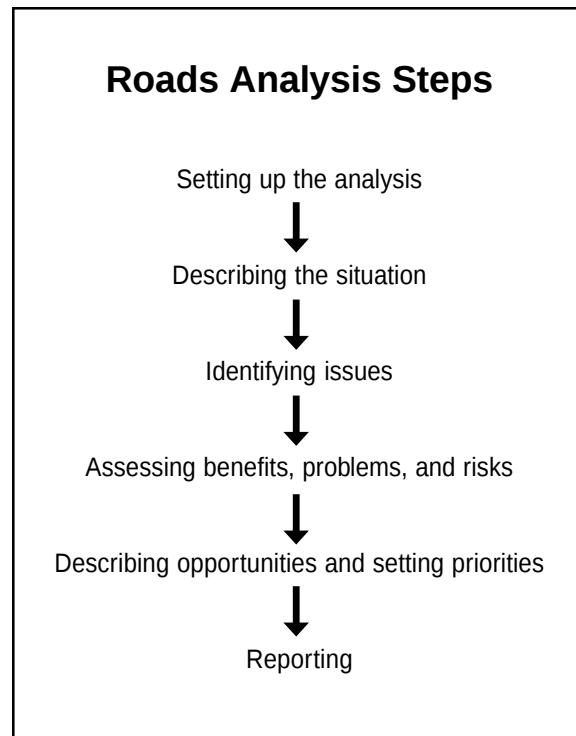


Figure 4. Roads analysis steps. Note: Although the analysis consists of six sequential steps, the process may require feedback and iteration among steps over time as the analysis matures.

Step 1. Setting up the Analysis

Purpose

Establish the level and type of decisionmaking that the analysis will inform: for example, projects, forest planning, plan implementation, or program of work.

Identify the geographic scale or scales for the analysis.

Develop a process plan for conducting the analysis.

Clarify the roles of technical specialists and line officers in the team.

Products

- ✓ **Statement of the objectives of the analysis**
- ✓ **List of interdisciplinary team members and participants**
- ✓ **List of information needs**
- ✓ **Plan for the analysis**

Questions

Who should participate in the analysis?

An analysis of the effects of and future need for roads is an important interdisciplinary problem for national forest staffs to address. The roads analysis will be conducted by interdisciplinary teams that include specialists from each relevant field because roads and access are fundamentally linked to all aspects of ecosystem management. Interdisciplinary teams will be assembled to address the specified scales. Identifying and consulting other public and private collaborators who can contribute to the analysis process or review the final report may be necessary.

How intensely will the road management system be analyzed?

The type of analysis selected to complete roads analysis will differ depending on the unique physical and social attributes of a particular national forest area, the issues to be addressed, and available skills and resources. The time needed for the analysis will also differ widely, depending on the management situation, age and currency of the forest plan, availability of relevant analysis products, complexity of the social and environmental issues, and the status of needed inventory and

monitoring data about roads and their effects. Although most Roads Analyses are likely to be complex, interdisciplinary teams should use an approach that is as simple as possible to complete a cost-effective assessment to produce high-quality information balanced with the nature and magnitude of risks and opportunities.

What are the appropriate geographic scales for the analysis?

The choice of scale is an important consideration. It is based on the issues to be addressed and potential changes to existing management direction. Several possible scales of analysis are appropriate to support future decisions; they range from a national scale down to a project or site-specific scale. Many biophysical issues have easily definable scales such as the range of a particular species or the hydrologic conditions of a watershed or river basin. Each issue may define the scale or scales where the resulting effects are measured.

Broad-scale analysis is essential to establish context, provide guidance, define analysis units at finer scales, allocate budgets and expertise, establish schedules and accountability, and address issues that cross national forest boundaries. Analysis of broad scales may also evaluate ecologically unique portions of the landscape, such as unroaded areas; areas with particularly high value, such as biological refugia and domestic water supplies; or high hazards, such as toxic waste transportation routes or landslide-prone terrain. Important social and economic considerations, such as public demand for recreation access will tend to require broad-scales of analysis.

For example, the following roads analysis components might be most relevant and feasible to do at specific scales:

Basin or multiple national forest scales

- Patterns of public use of national forest roads and their economic benefits
- Primary beneficial uses of water, such as fish stocks, municipal water supplies, and recreation
- General locations of susceptible plant and animal populations of particular concern
- Expected changes in regional demographics, and how they could affect the demand for access or for unroaded areas
- The distribution and nature of access rights, obligations, and agreements

Subbasin, national forest, or ranger district scales

- Priorities and scheduling for acquiring detailed condition and risk information; for example, priority watersheds for fine-scale inventory and analysis needed to plan and set priorities for project work
- Sociological analysis of needs and desires for access to the national forests
- Expected financial constraints and the implications for the capacity to maintain the road system in the long-term
- The type and duration of access needed for Forest Service administration of lands

Watershed scale

- Assessment of problems and risks for all roads in a watershed
- Specific opportunities to change the system
- Areas of special sensitivity, resource values, or both
- Suggested priority locations for site-scale evaluation and project-NEPA

What is the appropriate time scale for the analysis?

The line officer and the interdisciplinary team should agree about how long the predictions of effects will be valid. The time scales relevant for implementing management direction and those relevant for the effects of potential changes to the existing road system should also be considered. For example, considering the response of the road system to rare or unusual events such as floods and fire is important. Consideration of time scales over which important demographic and economic changes occur may be crucial in the analysis as well.

What information is available? What relevant analyses have already been done, and what data bases are available?

Existing data, assessments, and plans will be used whenever possible unless current information is inadequate for a credible result. Information needed for roads analysis will differ according to the issues and concerns for each analysis area. Information will need to be discovered, amalgamated, and prepared in a format that can be shared.

What additional information and analyses will be needed?

That important information is not available is often obvious. Some of this information may be acquired during the analysis; some may be too

difficult or costly to obtain. Some may never be available, and the analysis must proceed without it.

The interdisciplinary team should explicitly acknowledge that the information may be incomplete or imperfect and describe what uncertainties remain. A careful reckoning of needed but unavailable data will be included, describing what information and data will and will not be considered prerequisite both for proceeding with the analysis and informing decisions. Uncertainties will be used to guide future data acquisition and analyses and should be considered in subsequent management decisions.

What policies, laws, and guidance from regional or multi-forest assessments are relevant?

Recommendations from regional assessments for ecosystem-based analysis at the subbasin and watershed scales will be considered. Ongoing or planned assessments, such as forest plans and Resources Planning Act (RPA) assessments, will be used as an opportunity to develop common information and expertise and provide information on the effects of alternative road system configurations.

Legally mandated processes may need to be coordinated with roads analysis, such as NFMA, NEPA, Administrative Procedures Act, Federal Advisory Committee Act, Endangered Species Act, Clean Water Act, State-adopted Best Management Practices, Clean Air Act, National Historic Preservation Act, and others.

Also look at Federal, State, and local requirements. Most States have their own endangered species laws, NEPA-like assessments, implementation programs for the Clean Water Act and Clean Air Act, wetlands protection programs, and other considerations.

Describe what arrangements are required to integrate these processes with the roads analysis, how and when during the process they will be integrated, and who must participate because of these policies.

Look for factors that affect process such as lead times required for agency liaisons, expertise needed for key judgments, length and timing of comment periods, complexity of consultations, approval steps, and officials who must be kept informed.

What is your plan for conducting the analysis?

First identify the goals and objectives of the analysis and tasks to achieve the objectives. Identify when and by whom the tasks associated with the

analysis will be done, what deadlines must be met, and what are the responsibilities of individual interdisciplinary team members, as well as of the whole team. Note which parts of the analysis individual specialists will do and which parts the interdisciplinary team does. Identify what organizations and individuals will participate, and what roles each will play.

List the tasks and outline a simple timeline answering the basic questions of who, what, when, where, and how, and any other important elements. These questions include how often the interdisciplinary team will meet, at what points the analysis team and the deciding officer will confer on key choices, and how many cycles through the process might be needed. The plan will also include how the interdisciplinary team will set priorities among the component tasks under constrained budgets, and how much time, effort, and money the organization can afford in analyzing its roads program.

Who should review your roads analysis?

Most roads analyses will be complex, addressing multiple issues and scales; therefore, subjecting the analysis to technical review will have many benefits. Internal and external technical review will add rigor and credibility to the final report. Subjecting a sample of draft reports to an evaluation of how science was used in the analysis (Everest et al. 1997) is also desirable. The report will benefit from a comprehensive review by appropriate experts from other Forest Service units and other agencies. Regional review teams could be formed that would provide a standard for roads analysis and ensure consistency between analyses.

Step 2. Describing the Situation

Purpose

Describe the existing road system in relation to current forest plan direction.

Products

- ✓ **Map or other descriptions of the existing road and access system defined by the current forest plan or transportation plan.**
- ✓ **Basic data needed to address roads analysis issues and questions.**

Questions

What is the existing road system?

Broadly describe the road system and the area—physically, biologically, socially, culturally, economically, and politically. A large-scale map is a useful template to identify existing forest plan direction, access, and road information.

Use a common definition and a hierarchy of roads for all scales (see page 46). Include all roads considered to affect wildlife, water, recreation, or other resources.

Questions to consider in roaded areas include

What is the location of all roads?

What is the underlying geographic and geologic template?

What are the ages and development histories of the roads?

What are the road surface types and existing maintenance levels?

What are the existing Road Management Objectives?

What are the road-use patterns over time, now and expected in the future?

What are the primary destinations of the road system users?

What is the road density (open and closed to traffic) at various geographic scales?

What is the degree of connectivity between the road system and the stream system, in terms of road-stream proximity, and road-stream crossings?

What are the area's social and cultural values?

What are the local, regional, and national social and economic benefits derived from the existing roads?

Questions to consider in unroaded areas include:

Where are all of the unroaded areas?

What plants and animals live in them?

What ecological characteristics of the area are common and what characteristics are unique?

What are the area's social and cultural values?

What social and economic benefits could be derived from building roads in the area? From not building roads?

Step 3. Identifying Issues

Purpose

The interdisciplinary team, in conjunction with line officers and information obtained from the public, identifies the most important road-related issues in the analysis area and the information needed to address these concerns. This step may include the following elements:

Identify the key questions and issues affecting road-related management.

The issues include environmental, social, and economic components. Public participation can be useful in defining these issues, though it is not required at this step.

Describe the origin of the issues.

Include a description of how the issues arose, and how they have been addressed in the past.

Products

- ✓ **Summary of key road-related issues, including their origin and basis. The issues will be presented by general category (environmental, sociocultural, and economic).**
- ✓ **Description of the status of current data, including sources, availability, and methods of obtaining information.**

The most important products are agreed-upon lists of issues that will drive the analysis and determine what information is needed to resolve

them. Reaching consensus on which issues take priority may be difficult, so this step is a place where policy guidance is very helpful. An important product may be identifying topics about which relatively little is known.

Questions

Answers to the following questions can help to identify the most important road-related issues in the analysis area.

What are the primary public issues and concerns related to roads and access?

What are the primary management concerns (internal issues) related to roads and access?

What are the primary legal constraints on roads and roads management?

What additional information will be needed to better understand and define the key issues?

What resources and skills are available to complete an effective analysis?

Step 4. Assessing Benefits, Problems, and Risks

Purpose

The interdisciplinary team systematically examines the major uses and effects of the road system, at the chosen scale and intensity identified in Step 1, to generate the information baseline against which the existing and future road systems can be compared. The main element of this step is to assess the various benefits, problems, and risks of the current road system and whether the objectives of Forest Service policy reform and forest plans are being met.

Products

- ✓ **A synthesis of the benefits, problems, and risks of the current road system.**
- ✓ **An assessment of the risks and benefits of entering any unroaded areas.**
- ✓ **An assessment of the ability of the road system to meet objectives.**

New data may have to be gathered to provide needed information. The synthesis focuses on the issues identified as priorities in step 3.

Questions

Below are examples of the types of questions that might be used in roads analysis to assess benefits, problems, and risks. Benefits are the potential uses and socioeconomic gains provided by roads and related access.

Problems are conditions for certain environmental, social, and economic attributes that managers deem to be unacceptable. Risks are likely future losses in environmental, social, and economic attributes if the road system remains unchanged. The questions below should be used as a checklist to scan the range of possible benefits, problems, and risks and to screen them for those relevant to roads in the area under consideration.

Answering all of the questions will usually not be necessary. The relevant questions can then be used to guide more in-depth assessment and link to the science base for each of the identified benefits, problems, and risks.

After each question is a code [for example, AQ (1)] for cross-reference to Appendix 1, which takes each example question and describes some scale considerations, information needs, analytical tools, and recommended references that might assist the interdisciplinary team.

These questions and associated information are not intended to be prescriptive, but they are here to assist interdisciplinary teams in developing questions and approaches appropriate to each analysis area. Which questions are appropriate for a particular analysis area and which warrant deep or cursory treatment will depend on the particular area and the issues being addressed. Some question may need to be addressed at several scales.

Addressing these and other road-related questions may benefit from the use of indicators: that is, maps, GIS queries, statistical summaries, or other information displays that contribute to understanding the benefits, needs, risks, and effects of roads. Even the best indicators will not answer questions directly but may assist in discerning and quantifying important interactions. Appendix 2 provides some examples of indicators and risk assessment techniques that can be helpful in this step. Appendix 3 describes a package of software tools developed to facilitate the generation of indicators.

Ecosystem Functions and Processes (EF)

What ecological attributes, particularly those unique to the region, would be affected by roading of currently unroaded areas? EF (1)

To what degree do the presence, type, and location of roads increase the introduction and spread of exotic plant and animal species, insects, diseases, and parasites? What are the potential effects of such introductions to plant and animal species and ecosystem function in the area? EF (2)

To what degree do the presence, type, and location of roads contribute to the control of insects, diseases, and parasites? EF (3)

How does the road system affect ecological disturbance regimes in the area? EF (4)

What are the adverse effects of noise caused by developing, using, and maintaining roads? EF (5)

Aquatic, Riparian Zone, and Water Quality (AQ)

Watershed and upper catchment processes

How and where does the road system modify the surface and subsurface hydrology of the area? AQ (1)

How and where does the road system generate surface erosion? AQ (2)

How and where does the road system affect mass wasting? AQ (3)

How and where do road-stream crossings influence local stream channels and water quality? AQ (4)

How and where does the road system create potential for pollutants, such as chemical spills, oils, de-icing salts, or herbicides to enter surface waters? AQ (5)

How and where is the road system 'hydrologically connected' to the stream system? How do the connections affect water quality and quantity (such as delivery of sediments, thermal increases, elevated peak flows)? AQ (6)

Affected values and lower catchment processes and influences

What downstream beneficial uses of water exist in the area? What changes in uses and demand are expected over time? How are they affected or put at risk by road-derived pollutants? AQ (7)

How and where does the road system affect wetlands? AQ (8)

How does the road system alter physical channel dynamics, including isolation of floodplains; constraints on channel migration; and the movement of large wood, fine organic matter, and sediment? AQ (9)

How and where does the road system restrict the migration and movement of aquatic organisms? What aquatic species are affected and to what extent? AQ (10)

How does the road system affect shading, litterfall, and riparian plant communities? AQ (11)

How and where does the road system contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species? AQ (12)

How and where does the road system facilitate the introduction of non-native aquatic species? AQ (13)

To what extent does the road system overlap with areas of exceptionally high aquatic diversity or productivity, or areas containing rare or unique aquatic species or species of interest? AQ (14)

Terrestrial Wildlife (TW)

What are the direct effects of the road system on terrestrial species habitat? TW (1)

How does the road system facilitate human activities that affect habitat? TW (2)

How does the road system affect legal and illegal human activities (including trapping, hunting, poaching, harassment, road kill, or illegal kill levels)? What are the effects on wildlife species? TW (3)

How does the road system directly affect unique communities or special features in the area? TW (4)

Economics (EC)

How does the road system affect the agency's direct costs and revenues? What, if any, changes in the road system will increase net revenue to the agency by reducing cost, increasing revenue, or both? EC (1)

How does the road system affect priced and non-priced consequences included in economic efficiency analysis used to assess net benefits to society? EC (2)

How does the road system affect the distribution of benefits and costs among affected people? EC (3)

Commodity Production

Timber management (TM)

How does road spacing and location affect logging system feasibility? TM (1)

How does the road system affect managing the suitable timber base and other lands? TM (2)

How does the road system affect access to timber stands needing silvicultural treatment? TM (3)

Minerals management (MM)

How does the road system affect access to locatable, leasable, and salable minerals? MM (1)

Range management (RM)

How does the road system affect access to range allotments? RM (1)

Water production (WP)

How does the road system affect access, constructing, maintaining, monitoring, and operating water diversions, impoundments, and distribution canals or pipes? WP (1)

How does road development and use affect the water quality in municipal watersheds? WP (2)

How does the road system affect access to hydroelectric power generation? WP (3)

Special forest products (SP)

How does the road system affect access for collecting special forest products? SP (1)

Special-Use Permits (SU)

How does the road system affect managing special-use permit sites (concessionaires, communications sites, utility corridors, and so on)? SU (1)

General Public Transportation (GT)

How does the road system connect to public roads and provide primary access to communities? GT (1):

How does the road system connect large blocks of land in other ownership to public roads (ad hoc communities, subdivisions, inholdings, and so on)? GT (2)

How does the road system affect managing roads with shared ownership or with limited jurisdiction? (RS 2477, cost-share, prescriptive rights, FLPMA easements, FRTA easements, DOT easements)? GT (3)

How does the road system address the safety of road users? GT (4)

Administrative Uses (AU)

How does the road system affect access needed for research, inventory, and monitoring? AU (1)

How does the road system affect investigative or enforcement activities? AU (2)

Protection (PT)

How does the road system affect fuels management? PT (1)

How does the road system affect the capacity of the Forest Service and cooperators to suppress wildfires? PT (2)

How does the road system affect risk to firefighters and to public safety? PT (3)

How does the road system contribute to airborne dust emissions resulting in reduced visibility and human health concerns? PT (4)

Recreation

Unroaded recreation (UR)

Is there now or will there be in the future excess supply or excess demand for unroaded recreation opportunities? UR (1)

Is developing new roads into unroaded areas, decommissioning of existing roads, or changing the maintenance of existing roads causing substantial changes in the quantity, quality, or type of unroaded recreation opportunities? UR (2)

What are the effects of noise and other disturbances caused by developing, using, and maintaining roads on the quantity, quality, and type of unroaded recreation opportunities? UR (3)

Who participates in unroaded recreation in the areas affected by constructing, maintaining, and decommissioning roads? UR (4)

What are these participants' attachments to the area, how strong are their feelings, and are alternative opportunities and locations available? UR (5)

Road-related recreation (RR)

Is there now or will there be in the future excess supply or excess demand for roaded recreation opportunities? RR (1)

Is developing new roads into unroaded areas, decommissioning existing roads, or changing maintenance of existing roads causing significant changes in the quantity, quality, or type of roaded recreation opportunities? RR (2)

What are the adverse effects of noise and other disturbances caused by constructing, using, and maintaining roads on the quantity, quality, or type of roaded recreation opportunities? RR (3)

Who participates in roaded recreation in the areas affected by road constructing, maintaining, or decommissioning? RR (4)

What are these participants' attachments to the area, how strong are their feelings, and are alternative opportunities and locations available? RR (5)

Passive-Use Value (PV)

Do areas planned for road entry, closure, or decommissioning have unique physical or biological characteristics, such as unique natural features and threatened or endangered species? PV (1)

Do areas planned for road construction, closure, or decommissioning have unique cultural, traditional, symbolic, sacred, spiritual, or religious significance? PV (2)

What, if any, groups of people (ethnic groups, subcultures, and so on) hold cultural, symbolic, spiritual, sacred, traditional, or religious values for unroaded areas planned for road entry or road closure? PV (3)

Will road construction, closure, or decommissioning significantly affect passive-use value? PV (4)

Social Issues (SI)

What are people's perceived needs and values for roads? How does road management affect people's dependence on, need for, and desire for roads? SI (1)

What are people's perceived needs and values for access? How does road management affect people's dependence on, need for, and desire for access? SI (2)

How does the road system affect access to paleontological, archaeological, and historical sites? SI (3)

How does the road system affect cultural and traditional uses (such as plant gathering, and access to traditional and cultural sites) and American Indian treaty rights? SI (4)

How are roads that are historic sites affected by road management? SI (5)

How is community social and economic health affected by road management (for example, lifestyles, businesses, tourism industry, infrastructure maintenance)? SI (6)

What is the perceived social and economic dependency of a community on an unroaded area versus the value of that unroaded area for its intrinsic existence and symbolic values? SI (7)

How does road management affect wilderness attributes, including natural integrity, natural appearance, opportunities for solitude, and opportunities for primitive recreation? SI (8)

What are the traditional uses of animal and plant species within the area of analysis? SI (9)

How does road management affect people's sense of place? SI (10)

Civil Rights and Environmental Justice (CR)

How does the road system, or its management, affect certain groups of people (minority, ethnic, cultural, racial, disabled, and low-income groups)? CR (1)

Step 5. Describing Opportunities and Setting Priorities

Purpose

The interdisciplinary team and line officers identify management opportunities, establish priorities, and formulate technical recommendations for the existing and future road system that respond to the issues and concerns, benefits, problems, and risks identified in preceding steps, using public participation wherever appropriate. The objective is to compare the current road system with what is desirable or acceptable, and describe options for modifying the road system that would achieve desirable or acceptable conditions.

Products

- ✓ **Map and descriptive ranking of the problems and risks posed by the current road system.**
- ✓ **Assessment of the potential problems and opportunities of building roads in a currently unroaded area.**
- ✓ **Map and list of opportunities, by priority, for addressing important problems and risks.**
- ✓ **A prioritized list of specific actions, projects, or forest plan adjustments requiring NEPA analysis.**

Questions

Does the existing system of roads create an unacceptable risk to ecosystem sustainability?

Problems associated with existing roads will be summarized from the analysis in step 4. The interdisciplinary team will collaborate with managers to determine which effects are unacceptable based on legal, social, or policy criteria; unacceptable effects become a primary focus of road system options.

Can the maintenance requirements of the existing system be met with current and projected budgets?

One of the primary drivers of road reform is to bring the road system into balance with projected budgets. If maintenance needs exceed the funds projected to be available, the opportunities to reduce the mileage in the system, reduce maintenance, increase the cost-efficiency of maintenance, or have someone else perform the maintenance (that is, users), must be considered.

Are some existing roads not needed to meet projected access needs?

Some roads currently part of the system may not be necessary to meet the access needs projected in current or revised forest plans, most likely where land allocations have changed substantially since the road system was developed, or where roads developed along routes of traditional use. Where excess roads exist, they will be considered for decommissioning or, where effects are acceptable, to be hydrologically self-maintaining to allow some use by forest visitors to continue.

If new access is proposed, what are the expected benefits and risks?

Existing forest plan direction may identify the need for road construction in some of these areas to facilitate planned resource uses. Does this analysis indicate problems, risks, and opportunities that could lead to reconsideration of existing decisions?

What opportunities exist to change the road system to reduce the problems and risks or to be more consistent with forest plan direction and strategic intent of the roads system?

Changing some road systems will be considered as a form of active ecosystem restoration rather than simply correcting existing problems. For example, seasonal or year-round road closures across a large area could create new refugia for species that require large habitat areas with minimal human disturbance. Alternatively, new road access might be used to attract forest visitors to less sensitive areas and reduce visitor pressure on the more sensitive areas. Recreation priorities could also be served through such strategies. For example, new primitive or semiprimitive recreational opportunities could be created by using large-area road closures.

Are additional roads or improved roads needed to improve access for forest use or protection, or to improve the efficiency of forest use or administration?

Access needs identified in existing or revised forest plans, or in steps 3 and 4 of this analysis, may not be fully met by the existing transportation system. New or reconstructed roads may be needed to meet access needs for national forest management, range management, recreation, forest protection, or monitoring.

What changes to the road system could be used to respond to the priorities identified? Opportunities will be identified to respond to the whole set of priorities. Those opportunities could include, but are not limited to:

- ☐ Changes in road maintenance level or schedule;
- ☐ Upgrading or downgrading of road characteristics to match current objectives and uses;
- ☐ Relocation of roads in high problem or risk locations;
- ☐ Individual road closures or area-wide road closures;
- ☐ Traffic management;
- ☐ Road decommissioning; or
- ☐ New road construction or reconstruction.

Where possible, individual opportunities should be aggregated into an integrated set of recommendations for changing the road system and its management.

Opportunities identified in this analysis can be fed into planning, budgeting, and scheduling of forest programs of work, project-scale analysis, and land management planning.

Step 6. Reporting

Purpose

The interdisciplinary team reports the key findings of the analysis. Reports may take several different forms for different audiences.

Products

Note: These products are drawn from the previous five steps.

- ✓ **Reports including maps, analyses, and text documentation of the roads analysis.**
- ✓ **Maps that show the data and information used in the analysis, and the opportunities identified during the analysis.**

Questions

Who is the audience for the report of the roads analysis?

Primary audiences for the report are stakeholders and members of the general public, line officers on the national forest and in the region, and technical specialists who are pursuing similar analyses in other geographic areas. The primary report will be prepared for line officers, but it may be offered in other formats to best communicate with other audiences.

How was the roads analysis report reviewed, and how were the comments used?

Roads analysis is intended to be science based. A principal tenet of scientific rigor and credibility is that the methods and conclusions be subjected to critical internal and external technical review, and that the final product adequately addresses concerns raised by those reviews.

What will the content of the primary report be?

The following information should be included in most reports, but adjustments may be made to accommodate the scale, intensity, and complexity of the analysis:

Describing the existing situation

- ☐ Geographic area included in the analysis, and brief rationale for selecting the area; maps and text
- ☐ Land ownership in the analysis area; maps and table
- ☐ Basic ecological unit inventory of the area; map
- ☐ Unroaded areas; map
- ☐ Roads inventory for the area; maps, tables, and text
- ☐ Roads maintenance and management regimes; maps and text
- ☐ Key public groups and individuals served by the road system; text
- ☐ Management prescriptions under the existing forest plan; map
- ☐ Forest, Regional, and national roads policies; text
- ☐ Summary of key legal obligations relative to the road system; text
- ☐ Summary of concerns identified by managers and technical specialists; text
- ☐ Summary of concerns raised by stakeholders and the general public; text
- ☐ Summary of legal considerations related to the road system; text
(Note: This summary needs to be broader than the one for the direct legal obligations under the “existing situation” above.)
- ☐ Synthesis of the issues that became the focus of the analysis

Assessing benefits, problems, and risks

- ☐ Inventories and other information that were used as input to the analysis; maps, tables, figures, and text. (All sources of the information, and its limitations and reliability will be described.)
- ☐ Current and future environmental, economic, and social problems and risks posed by the road system; maps, tables, figures, and text

Describing opportunities and setting priorities

- ☐ Summary of the opportunities to address the environmental, economic, and social problems and risks, projected budget concerns, ability to satisfy current and future access needs, and road mileage in excess of access needs, based on the existing road system; maps, tables, figures, and text
- ☐ Summary of priority management activities that could be accomplished through changes in the road system; maps, text
- ☐ Summary of projected new roads identified in current forest plan direction; maps, text

Roads analysis report appendixes

- ☐ Glossary
- ☐ References
- ☐ Maps
- ☐ Detailed analytical reports

Recordkeeping

Initiate an analysis file that will eventually include documentation of the entire six-step process and serve as the basis for the analysis report (step 6). At step 1, document the analysis plan that outlines how the six steps will be conducted and includes specific information about:

- Interdisciplinary team assignments and interagency participation;
- How and when the public will be involved and how key issues will be identified;
- A discussion of the inventory information used to conduct the analysis and any associated data gaps;
- The appropriate scale or scales for the analysis, the anticipated analytical output at each scale, and a map of the land area covered by the analysis;
- The intensity of the analysis relative to each scale;
- A projected timeline for completing the six steps, and
- Planned technical review of the analysis products.

In addition, any agreements by the interdisciplinary team associated with analysis rigor or the methods that will be used to conduct the analysis will also be documented in the analysis file.

At each subsequent step in the analysis process, document the analytical methods used.

Maintain a file of review comments and the manner in which those comments were addressed in the analysis and report.

References

- Coghlán, G.; Sowa, R. 1998. National forest road system and use (draft). Engineering Staff, USDA Forest Service.
www.fs.fed.us/news/roads/roadsummary.pdf
- Everest, F. H.; Swanston, D. N.; Shaw, C. G. III; Smith, W. P.; Julin, K. R.; Allen, S. D. 1997. Evaluation of the use of scientific information in developing the 1997 Forest Plan for the Tongass National Forest. Gen. Tech. Rep. PNW GTR-415. Portland, OR: USDA Forest Service, Pacific Northwest Research Station, 69 p. (Shaw, Charles G. III, tech. coord.; Conservation and resource assessments for the Tongass land management plan revision).
- Fan, D; Bengston, D. 1997. Attitudes towards roads on the national forests: An analysis of the news media.
www.ncfes.umn.edu/epubs/pdf/roads.pdf
- McCammon, B.P.; Rector, J.R.; Gebhardt, K. 1998. A framework for analyzing the hydrologic condition of watersheds. Denver, CO: USDA Forest Service and USDI Bureau of Land Management. 40 p.
www.stream.fs.fed.us
- USDA Forest Service. (In press). Forest Service roads: A synthesis of scientific information. www.fs.fed.us/news/roads/science.pdf
- USDA Forest Service. 1992. Transportation planning handbook. Forest Service Handbook 7709.55. Washington, DC: USDA Forest Service.
fsweb.wo.fs.fed.us/directives/fsh/7709.55