

## Chapter 4 Monitoring and Evaluation

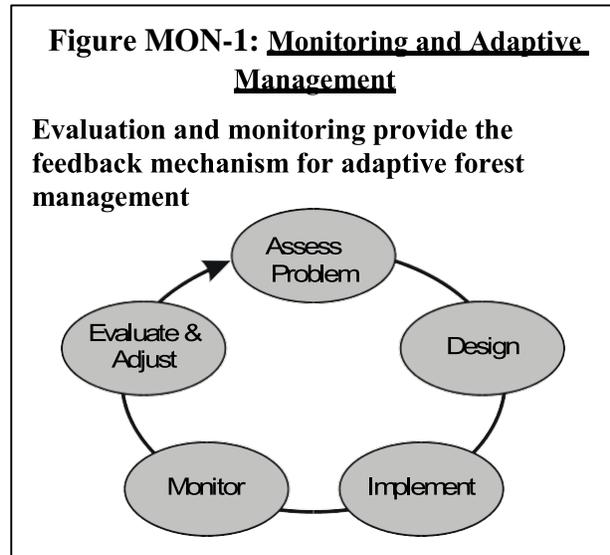
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**INTRODUCTION**

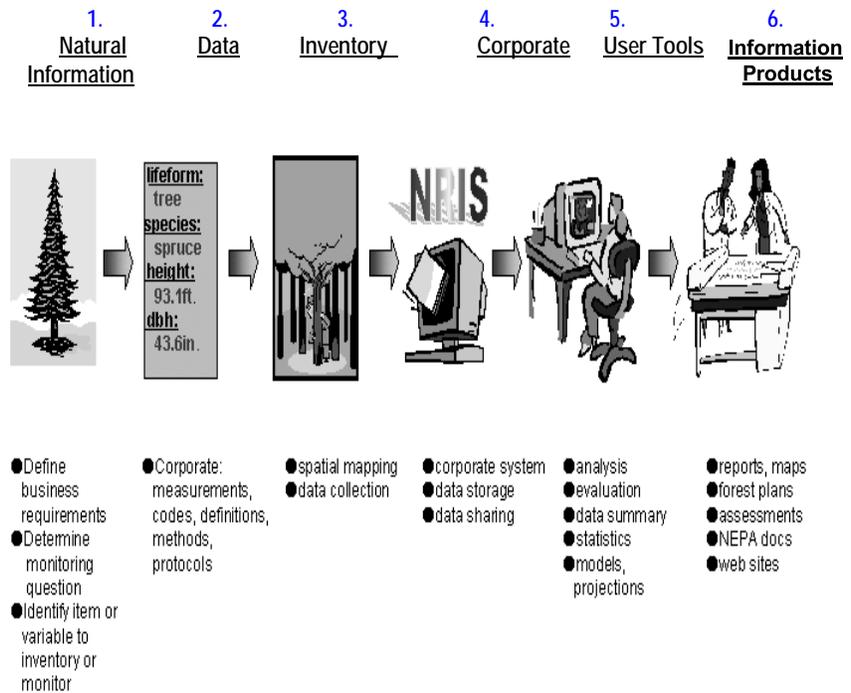
Monitoring and evaluation (M and E) are separate, sequential activities required by NFMA regulations. Monitoring involves collecting data by observation or measurement. Evaluation involves analyzing and interpreting monitoring data. The information gained from M and E is used to determine how well the desired conditions, goals, objectives, and outcomes of the Forest Plan have been met. Monitoring and evaluation keep the Forest Plan up-to-date and responsive to changing conditions and issues, which provides the feedback mechanism for adaptive management (Figure MON-1). The results are used to identify if and when changes are needed to either the Forest Plan itself or the way it is implemented.

Monitoring and evaluation involve more than just collecting and interpreting data. Data must be converted to useful information and stored in a form that is accessible to others. A plan for managing monitoring information over time is critical to a successful program and should be developed early in the planning process (Figure MON-2).

Data will be designed and collected according to appropriate data standards and entered into corporate databases such as Automated Lands Program (ALP), Natural Resource Inventory System (NRIS), or other corporate spatial and/or tabular data structures. The information can then be accessed and analyzed to produce information products such as monitoring reports (Steps 5 and 6). These would become available for internal and external use.



**Figure MON-2: Elements of Information Management**



## Legal and Regulatory Requirements

The Forest Plan addresses the following monitoring as required in the 2012 regulations, found CFR 36 Part 219.12 Monitoring. These requirements are summarized in the *Forest Plan monitoring program* and *broad-scale monitoring strategies* sections below.

### Forest Plan monitoring program:

- The responsible official shall develop a monitoring program for the Plan area and include it in the Plan. Monitoring information should enable the responsible official to determine if a change in Plan components or other Plan content that guide management of resources on the Plan area may be needed.
- The Plan monitoring program sets out the Plan monitoring questions and associated indicators designed to inform the management of resources on the Plan area. Questions and indicators should be based on one or more desired conditions, objectives, or other Plan components in the Plan, but not every Plan component needs to have a corresponding monitoring question.
- The Plan monitoring program should be coordinated and integrated with relevant broader-scale monitoring strategies to ensure that monitoring is complementary and efficient, and that information is gathered at scales appropriate to the monitoring questions.
- The responsible official has the discretion to set the scope and scale of the plan monitoring program after considering the information needs identified through the planning process as most critical for informed management of resources on the plan area and the financial and technical capabilities of the Agency.
- Each Plan monitoring program must contain one or more monitoring questions and associated indicators addressing each of the following:
  - The status of select watershed conditions.
  - The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
  - The status of focal species to assess the ecological conditions required under § 219.9.
  - The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
  - The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
  - Measurable changes on the Plan area related to climate change and other stressors that may be affecting the Plan area.
  - Progress toward meeting the desired conditions and objectives in the Plan, including for providing multiple use opportunities.
  - The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).
- A range of monitoring techniques may be used to carry out the monitoring requirements.
- This section does not apply to projects or activities. Project and activity monitoring may be used to gather information for the Plan monitoring program, and information gathered through Plan monitoring may be used to inform development of projects or activities. But, the monitoring requirements of this section are not a prerequisite for making a decision to carry out a project or activity.

### Broader-scale monitoring strategies

- The Regional Forester shall develop a broader-scale monitoring strategy for Plan monitoring questions that can best be answered at a geographic scale broader than a single Forest.
- When developing a monitoring strategy, the Regional Forester shall coordinate with the relevant responsible officials, Forest Service State and Private Forestry and Research and Development, partners, and the public.
- Each Regional Forester shall ensure that the broader-scale monitoring strategy is within the financial and technical capabilities of the Region and complements other ongoing monitoring efforts.
- Projects and activities may be carried out under Plans developed, amended, or revised under this part before the Regional Forester has developed a broader-scale monitoring strategy.

The timing and process for developing the Plan monitoring program and broader-scale strategies are described below:

- The responsible official shall develop the Plan monitoring program as part of the planning process for the development of a new Plan or Plan revision.
  - Where a Plan's monitoring program has been developed under the provisions of a prior planning regulation and the unit has not initiated Plan revision under this part, the responsible official shall modify the Plan monitoring program within 4 years of the effective date of this part, or as soon as practicable, to meet the requirements of this section.
- The Regional Forester shall develop a broader-scale monitoring strategy as soon as practicable.
- To the extent practicable, appropriate, and relevant to the monitoring questions in the Plan monitoring program, Plan monitoring programs and broader-scale strategies must be designed to take into account:
  - Existing national and regional inventory, monitoring, and research programs of the Agency, including from the NFS, State and Private Forestry, and Research and Development, and of other governmental and non-governmental entities.
  - Opportunities to design and carry out multi-party monitoring with other Forest Service units, Federal, State or local government agencies, scientists, partners, and members of the public.
  - Opportunities to design and carry out monitoring with federally recognized Indian Tribes and Alaska Native Corporations.
- The responsible official shall conduct a biennial evaluation of new information gathered through the Plan monitoring program and relevant information from the broader-scale strategy, and shall issue a written report of the evaluation and make it available to the public.
  - The first monitoring evaluation for a Plan or Plan revision developed in accordance with this subpart must be completed no later than 2 years from the effective date of Plan decision.
  - Where the monitoring program developed under the provisions of a prior planning regulation has been modified to meet the new Planning Rule requirements, the first monitoring evaluation must be completed no later than 2 years from the date the change takes effect.
- The monitoring evaluation report must indicate whether or not a change to the Plan, management activities, or the monitoring program, or a new assessment, may be warranted based on the new information. The monitoring evaluation report must be used to inform adaptive management of the Plan area.
- The monitoring evaluation report may be incorporated into other planning documents if the responsible official has initiated a Plan revision or relevant amendment.
- The monitoring evaluation report is not a decision document representing final Agency action, and is not subject to the objection provisions of the broad-scale monitoring strategies, subpart B in the 2012 Planning Rule.

## Monitoring Guidelines and Components

### Monitoring Framework

Many approaches to Forest Plan monitoring are currently being used throughout the agency. However, each monitoring chapter must: 1) meet the legal requirements of the planning regulations, 2) be consistent with corporate data standards and protocols, and 3) be developed by an interdisciplinary team that addresses the ecological, social and economic dimensions of forest management in an integrated manner.

To meet these objectives, the Superior National Forest's monitoring program includes:

- 1) Forest Plan (Chapter 4) Direction that provides broad, strategic guidance.
- 2) A biennial Monitoring and Evaluation Report that provides a forum to review current year findings and identify specific modifications if necessary.

### Monitoring Prioritization

Within any agency or institution, necessary or desirable work demands often exceed available funding. Forest Plan monitoring is no exception. To ensure efficient use of limited time, money and personnel, following is a list of potential criteria that may be used in the screening process:

- Is monitoring of a particular question or resource mandated by regulation or court order?
- Is there a high degree of uncertainty associated with management assumptions? (management significance)
- Is there a high degree of disparity between existing and desired conditions?
- Are proposed management activities likely to affect resources of concern? (ecological significance)
- How do monitoring items fit into national and regional priorities?
- How well do monitoring items fit with public comments?
- What are the consequences of not knowing resource conditions?
- Will monitoring respond to a key issue?

Monitoring priorities will be established each year utilizing the above criteria, information gained during the past year, and budgets.

## Information Management

There will be a tremendous amount of monitoring information collected over time. If this information is not stored so it can easily be retrieved, shared with the public and other stakeholders, or used by agency managers to foster better decisions, it is of limited value. Information management will consist of:

- (1) Management of the collection and storage of data;
- (2) Evaluation and interpretation of data and;
- (3) Sharing of information internally and externally.

### Manage the Collection and Storage of Data

The interdisciplinary team review will work with Forest Service employees and cooperators to see that data is collected using standard methods and is entered into the appropriate databases.

### Evaluation and Interpretation of Data

Evaluation is the process of transforming data into information. It is a process of synthesis that brings together value, judgment and reason with monitoring information to answer selected monitoring questions. Successful adaptive management depends on this information in moving the Forest toward desired conditions.

The Forest interdisciplinary team will review the biennial monitoring and evaluation results. Based on their findings they will recommend to the Forest Leadership Team necessary changes (if any) to the Forest Plan, or Forest Service Manual or Handbook.

Monitoring information and findings gathered through monitoring will be summarized and shared in various reports (most notably the biennial Monitoring and Evaluation Report) and publications distributed internally and externally with cooperating agencies and organizations, interest groups, policy makers, and the general public.

### Biennial Monitoring and Evaluation Report

The biennial Monitoring and Evaluation report (M and E report) provides an opportunity to track progress towards the implementation of revised forest Plan decisions and the effectiveness of specific management

practices. The focus of the evaluation is to provide short and long term guidance to ongoing management. The M and E report should include components such as:

- (1) Forest accomplishments toward desired conditions and outputs of goods and services.
- (2) Forest Plan amendment status.
- (3) Status of other agency/institution cooperative monitoring.
- (4) Summary of available information on Management Indicator Species (MIS) or comparable species.
- (5) Summary of large scale or significant projects or programs (i.e. storm recovery).
- (6) Update of research needs.
- (7) Public participation/disclosure Plan.

### Public Involvement

The Forest Service mission “Caring for the Land and Serving the People” will not be realized without public trust in our decision making process. Even though agency decisions will not consistently please everyone, using an open process for making decisions should foster public understanding of the rationale for individual decisions. The same principle applies to monitoring. Moreover, since our approach incorporates an adaptive strategy, frequent public feedback is necessary to facilitate monitoring activity prioritization, protocols, evaluation, and ultimately better informed decisions. Subsequently a strategy for involving the public and other agencies in Forest monitoring, planning, execution, and evaluation will be attempted each year. Partnerships with interest groups, volunteer groups, other federal, state and local agencies, and universities will be part of that strategy. Monitoring information trips for the public will be encouraged to review monitoring findings and methods and address subsequent management implications. Other avenues of public involvement such as news releases, the internet, brochures, and public reports will also be used.

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**MONITORING MATRIX**


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The contents in Table MON-3 are outlined in the monitoring matrix (Table MON-4). The focal point for each monitoring item will be the Monitoring Question. Each Monitoring Question is derived from one or more Monitoring Rationale (Legal Requirements, Desired Conditions or objectives etc.). Not all indicators will be monitored each year. Biennially, the rationale that best answer the monitoring question for each resource area will be identified.

As previously mentioned, public involvement with Forest Plan monitoring (beyond comments received on the Draft Forest Plan) will be sought.

Modifying direction for the BWCAW was not part of the Plan revision process. Therefore, the monitoring items below appear as they did in the 1993 BWCAW Management Plan.

<b>Table MON-3. Definitions of Components in the Monitoring Matrix</b>	
<b>COMPONENT</b>	<b>DEFINITION</b>
Resource Area	A quantitative or qualitative parameter that can be assessed.
Monitoring Question	Specific monitoring question(s) developed to ensure that monitoring and evaluation provides information essential to measuring the effectiveness of the Forest Plan. These questions relate to the different purposes and rationales for monitoring. There may be more than one monitoring question per resource area.
Monitoring Indicator	A measure or measurement of an aspect of ecosystem sustainability criterion. A quantitative or qualitative variable that can be measured or described and, when observed periodically, shows trends. Indicators are quantifiable performance measures of outcomes or objectives for attaining criteria designed to assess progress toward desired
Monitoring Driver	Monitoring drivers identifies the reason or why we are monitoring a particular monitoring item. Following is a list of monitoring drivers: (1) Legal and regulatory requirements and Forest Service Manual direction and (2) Forest Plan desired conditions, goals, objectives standards and guidelines (S and G's). (3) Validation of assumptions and predictions, (4) Court rulings. Legal and regulatory drivers are described whereas desired conditions, goals, objective, and S and G's are referenced. Refer to chapters 2 and 3 for full description of these drivers.
Measurement Frequency	Describes how often monitoring information is collected.
Evaluation and Reporting Frequency	Describes how often monitoring information is evaluated and reported.
Precision and Reliability	Two categories of precision and reliability are appropriate at the forest Plan scale: Class A: Methods appropriate for modeling or quantitative measurement. Results have a high degree of repeatability, reliability, accuracy and precision. Class B: Methods based on project records, personal communications, ocular estimates, pace transects informal visitor surveys and similar types of assessments. The degree of repeatability, reliability, accuracy and precision are not as high as Class A methods, but they still provide valuable information.

**Table MON-4. Chapter 4 Monitoring Matrix**

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
All	How close are projected outputs and services to actual?	<a href="#">Various--See "Forest Plan Achievement Indicators"</a>	(36 CFR 219.12(a)(5)). Progress toward meeting the desired conditions and objectives in the Plan, including for providing multiple use opportunities.	Annual	Biennial	A
Insects & Disease	Are insects and diseases populations compatible with objectives for restoring or maintaining healthy forest conditions?	1. Location and number of acres of insect and disease outbreaks. Number of insect trap/controls deployed. 2. Location and number of acres where treatments to avoid, eliminate, minimize or treat insect and disease are implemented.	(36 CFR 219.12(a)(5)). The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems. D-ID-3, O-ID-1, D-VG-5, D-VG-8, O-VG-10-12	Annual	Biennial	A/B
Insects, Diseases and Disturbance Processes	To what extent is Forest management managing undesirable occurrences of fire, insect and disease outbreaks?	1. Number of fires by cause. 2. Acres of fire burnt. 3. Number of fires with full suppression as a management strategy. 4. Acres of SNF inventoried for insect and disease. 5. Acres of SNF insect and disease populations treated. 6. Existing populations contained 7. New infestations reduced or eliminated.	(36 CFR 219.12(a)(5)). The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems. D-ID-1-2, O-ID-1.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Recreation Motor Vehicles	To what extent is the Forest providing RMV opportunities; what are the effects of RMV's on the physical and social environment; and how effective are forest management practices in managing RMV use?	<ol style="list-style-type: none"> <li>1. Miles of road and trail open for RMV use and change from 2004.</li> <li>2. Miles of additional ATV and snowmobile trail constructed since 2004.</li> <li>3. Annual production of Motor Vehicle Use Map.</li> <li>4. Implementation of Travel Management decision, including miles of road opened to motorized use and miles and number of roads decommissioned.</li> <li>5. Monitoring the 90 miles of additional OHV trail and 130 miles of new snowmobile trail since 2004.</li> <li>6. Effectiveness of select closures.</li> </ol>	(36 CFR 219.12(a)(5)). The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives. D-RMV-1, 2. O-RMV-1.	1-5 years	1-5 years	A, B
Social & Economic Stability	To what extent do output levels and location of timber harvest and mix of saw timber and pulpwood compare to those levels projected?	Million board feet of timber harvested and sold, and acres of timber harvested compared to the trends and trajectories for each measure.	(36 CFR 219.12(a)(5)). Progress toward meeting the desired conditions and objectives in the Plan, including for providing multiple use opportunities; D-TM-1, O- TM-1.	Annual	Biennial	A, B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Soils	Are the effects of Forest management, including prescriptions, resulting in significant changes to productivity of the land?	Proportion of monitored sites detrimentally disturbed (rutted, compacted, eroded, displaced, burned, etc.) as a result of management activity.	(36 CFR 219.12(a)(5)). The status of select watershed conditions; The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land; (16 U.S.C. 1604(g)(3)(C)); D- WS-3, D-WS-12, O-WS-9, O-WS-10.	1-5 years	1-5 years	A/B
Timber	Are harvested lands adequately restocked after five years?	1. Percentage of post-harvest units that have been surveyed for NFMA compliance with stocking levels at five years. 2. Percentage of post-harvest units that have achieved NFMA compliance with stocking levels at five years as specified by Forest Plan S-TM-4.	(36 CFR 219.12(a)(5)). The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).	Annual	Biennial	A
Timber	To what extent is timber management occurring on lands suitable for such production?	1. Percentage of unsuitable timber lands evaluated to determine if they have become suited for timber production. 2. Percentage of unsuitable timber lands determined to be suitable that have been reclassified as suitable for timber production. 3. Percentage of timber harvest that is conducted on lands suitable for timber production.	(36 CFR 219.12(a)(5)). The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).	10 years	10 Years	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Timber	How much even-aged management (especially clear cutting) should be used, and in what forest types should it be used?	Proportion of clear-cuts, thinning, removal cuts, seed cuts and sanitation cuts compared to 63% total acreage threshold.	(36 CFR 219.12(a)(5)). Progress toward meeting the desired conditions and objectives in the Plan, including for providing multiple use opportunities; The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).	Years 5 and 10	Years 5 and 10	B
Wildlife: Management Indicator Species	What are the population trends of management indicator species?	1. Northern Goshawk: Annual historic nest site monitoring (participate in MN DNR lead effort) and annual project inventory for new sites. 2. Gray Wolf: Distribution and abundance of wolves in MN (participate in MN DNR lead effort), and USGS long-term wolf study and pack monitoring (wolves per square mile).	(36 CFR 219.12(a)(5)). The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems; The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species; O-WL-1, O-WL-16, O-WL-17, O-WL- 31, and O-WL-32.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Air Quality	To what extent is Forest management contributing or responding to air quality effects on ecosystems, human health or human enjoyment?	1. Fine particulates in air. 2. Mercury levels in watersheds where burns occur.	D-AQ-1, D-AQ-2, D-WS-4, D-WS-5, D-REC-3, D-SC-1 and O- AQ-1.	1-5 years	1-5 Years	A/B
Air Quality	Are air quality related values of the Boundary Waters Canoe Area Wilderness being maintained?	1. Air Chemistry: ozone, total fine particulate, speciated fine particulate, NADP-AMON (ammonia), visibility 2. Water Chemistry: Color, Phosphorus (Ortho), Solids (Total Suspended), Nitrogen (Total Kjeldahl), Total Phosphorous, Nitrogen (Nitrate + Nitrite), Chlorophyll a, Pheophytin, pH, ANC, Conductivity, Cl, NO3N, DIP, SO4, Al, Ca, Fe, K, Mg, Mn, Na, Si, Sr, TOC 3. Precipitation Chemistry: NADP-MDN (mercury), NADP-NTN (Ca,Mg,K,Na,NH4,NO3,Cl,SO4, pH, Conductivity)	D-AQ-1, D-AQ-2, D-WS-4, D-WS-5, D-REC-3, D-SC-1 and O- AQ-1.	1-5 years	1-5 Years	A/B
Cooperation	To what extent does the Forest emphasize agency, tribal, and public involvement and inter-governmental coordination with federal, state, county governments and agencies?	1. Number of formal agreements by type. 2. Dollar value of cash, goods and services included in formal agreements. 3. Hours of volunteer service at an appraised value. 4. Dollar value of donations.	D-CM-1. D-SE-4, D-REC-6.	5 Years	5 Years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Fire	What level of wildland fire on the landscape is appropriate and desirable and, to what extent is unwanted wildland fire on the landscape suppressed?	1. Number of fires by cause. 2. Acres of fire burnt. 3. Number of fires occurring within wilderness with other than full suppression as a management strategy. 4. Number of fires with full suppression as a management strategy.	D-ID-6	1-5 years	1-5 years	A/B
Fire	How, where, and to what extent will prescribed fire be used to maintain desired fuel levels, and/or mimic natural processes, and/or maintain/ improve vegetation conditions, and/or restore natural processes and functions to ecosystems?	1. Number of acres treated with prescribed fire. 2. Number of acres by type of prescribed fire (underburn, broadcast burn, pile burn, etc.). 3. Number of acres of prescribed burning by objective (wildlife, fuels reduction, restoration, etc.).	D-ID-4-5, O-ID-2-4	1-5 years	1-5 years	A/B
Heritage Resources	1) Are avoidance or mitigation measures effective and being followed as recommended in project designs? 2) Are heritage resources being affected in non-project areas?	1) Post-project monitoring of mitigation effectiveness (effectiveness monitoring). 2) Annual condition monitoring of priority heritage assets.	O-HR-1 and O-HR-2.	5 Years	5 Years	A

<b>Resource Area</b>	<b>Monitoring Question(s)</b>	<b>Monitoring Indicator</b>	<b>Drivers</b>	<b>Measurement Frequency</b>	<b>Evaluation / Reporting Frequency</b>	<b>Precision and Reliability</b>
Land Adjustment	How successful is the Forest's land adjustment program in support and enhancement of Forest Plan desired conditions and objectives and contributing to efficient and effective stewardship?	Percent of land adjustments accomplished that meet the objectives and guidelines set forth in the Forest Plan.	D-LA-1, O-LA-1, O-LA-2, and O- LA-3	2 years	2-5 years	A
Landscape Ecosystems	To what extent is the Forest meeting vegetation composition and age class objectives for each of the Landscape Ecosystems?	Percent of acres in each LE and age class compared to 2003 values and decade 1 and 2 objectives.	Composition and Age Class objectives by LE	5 Years	5 Years	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Minerals	Are mineral exploration, development and production avoidance or mitigation measures effective and being followed as recommended in project designs?	<ol style="list-style-type: none"> <li>1. Visual inspection of all equipment mobilized to the Forest for cleanliness/NNIS.</li> <li>2. Acres of disturbance.</li> <li>3. Length of temporary access roads.</li> <li>4. Volume and rate of water withdrawn in conjunction with stream flow and lake elevations.</li> <li>5. Sound pressure levels at established boundaries.</li> <li>6. Presence/absence of NNIS</li> <li>7. Presence/absence of rutting and soil compaction.</li> <li>8. Presence/absence of fill in wetlands.</li> <li>9. Sump failure/success.</li> <li>10. Chloride concentrations in drilling fluid.</li> <li>11. Presence/absence of ATV/vehicle traffic on decommissioned roads.</li> <li>12. Presence/absence of temporary/permanent seal on core holes.</li> </ol>	D-MN-1 and D-MN-2	1-5 years	1-5 years	A/B
Public Health and Hazardous Materials	Does water in Forest-provided drinking water sources and swimming beaches meet standards of quality protective of human health and aesthetics?	<ol style="list-style-type: none"> <li>1. Monthly testing of wells.</li> <li>2. Periodic testing of swim beaches.</li> </ol>	O-PH-1.	5 Years	5 Years	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Public Health and Hazardous Materials	Does hazardous material storage on NF meet standards of quality protective of human health?	<ol style="list-style-type: none"> <li>1. Progress of transitioning to the Global Harmonization program.</li> <li>2. Availability of safety data sheets for chemicals used on the forest.</li> <li>3. Annual HazCom program evaluations.</li> <li>4. Disposal of unneeded chemicals.</li> <li>5. Safe storage of hazardous waste until it can be disposed of.</li> </ol>	O-PH-2.	5 Years	5 Years	A
Public Health and Hazardous Materials	Are Forest facilities and recreation sites safe for employee and public use and enjoyment?	Forest facilities are inspected annually to ensure compliance to OSHA and Forest Service regulations.	O-PH-4.	5 Years	5 Years	A
Recreation	To what extent is the Forest providing a range of motorized and non-motorized recreation opportunities that incorporate diverse public interests yet achieve applicable MA and LE objectives?	<ol style="list-style-type: none"> <li>1. Miles of motorized and non-motorized trails.</li> <li>2. Change in acres of ROS classification within each MA.</li> </ol>	(36 CFR 219.12(a)(5)). Progress toward meeting the desired conditions and objectives in the Plan, including for providing multiple use opportunities; D-REC-1, 7, 9, 10, 11, 12, 13. O-REC-1. D-RTL-1,3. O-RTL-1. D- RWA-1, O-RWA-1.	1-5 years	1-5 years	A/B
Recreation	To what extent are Forest management activities within the Recreation Opportunity Spectrum Objectives (ROS)?	<ol style="list-style-type: none"> <li>1. Change in acres of ROS classification resulting from management actions.</li> <li>2. Comparison of Forest Plan condition to current condition.</li> </ol>	D-REC-2. O-REC-2, 3.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Recreation	To what extent do Forest recreation facilities and opportunities meet accessibility, health, safety, cost, and maintenance requirements and achieve resource and social objectives?	1. Use annual accomplishment reports to measure new and updated facilities, water system reports, trail bridge surveys, identified site hazards, and other health and safety related initiatives. 2. List of specific projects accomplished and funding spent to implement. 3. Number of specific facility related projects accomplished annually.	D-REC-3, 4, 8. O-REC-4. D-RTL-2.	1-5 years	1-5 years	A
Scenic Resources	Are forest management activities providing scenic quality as defined by the Scenic Integrity Objectives (SIO)?	Number of management projects that do and don't specifically address management activities in high SIO areas.	D-SC-1, 2, 3. O-SC-1.	1-5 years	1-5 years	B
Special Uses	Does Forest management of forest product, recreation/wilderness, and other special use permits meet Forest Plan and agency direction?	Number and percentage of special use permits managed to standard annually.	D-REC-5. O-SU-1, 2, 3, 4, 5. D- TS-5.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Transportation System	To what extent is the Forest, in coordination with other public road agencies, providing safe, cost effective, minimum necessary road systems for administrative and public use?	1. Miles of road maintained by Maintenance Level (1-5). 2. Amount of funding spent on road maintenance. 3. Amount of funding obtained for specific projects. 4. Number of county/state projects supported by the Forest.	D-TS-1, 2, 3, 4. O-TS-1, 2, 6, 7, 8.	1-5 years	1-5 years	A
Tribal Rights and Interests	Is Forest management helping to sustain American Indians' way of life, cultural integrity, social cohesion, and economic well-being?	The issues discussed at meetings between the Bands and the Forest (review of meeting minutes).	D-TR-1. O-TR-1. O-TR-3.	Throughout the year	Biennial	B
Tribal Rights and Interests	Are government to government relationships functional?	Percentage of large-scale vegetation projects in which government to government consultation occurred pre-scoping and pre-NEPA.	D-TR-2. O-TR-2. O-TR-4.	Throughout the year	Biennial	B
Tribal Rights and Interests	Is the Forest facilitating the right of the Tribes to hunt, fish, and gather as retained via treaty?	The issues discussed at meetings between the Bands and the Forest (review of meeting minutes).	D-TR-3.	Throughout the year	Biennial	B
Vegetation	To what extent is the Forest providing a full range of vegetative communities that address diverse public interests and needs while contributing to ecosystem sustainability and biological diversity?	Current % of acres by tree species by LE compared to tree species diversity objectives by LE as noted in forest Plan	(36 CFR 219.12(a)(5)). The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems; D-VG-1, -2, -3, -4	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Vegetation Composition & Structure	To what extent are Forest management, natural disturbances, and subsequent recovery processes changing vegetation composition and structure? To what extent are conditions moving toward short-term (1-20 years) and long-term (100 years) objectives at Landscape Ecosystem, Management Area, and other appropriate landscape scales?	Comparison current age class groups acreage with acres by age class in forest Plan.	D-VG-1-6. O-VG-1-16.	1-5 years	1-5 years	A/B
Vegetation Ecological Processes	To what extent is Forest management maintaining or restoring conditions that result from or emulate natural ecological processes of fire, wind, flooding, and insects and disease outbreaks?	Comparison between actual conditions and LE objectives (Composition, Age Class, Tree Species Diversity, and MIH).	D-VG-8, O-VG-6-11, 36 CFR 219.12(k)[5](iii).	5 Years	5 Years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Vegetation Spatial Patterns	To what extent are Forest management, natural disturbances, and subsequent recovery restoring vegetation spatial landscape patterns and moving conditions toward both short-term (1-20 years) and long-term (100 years) objectives at Landscape Ecosystem, Spatial Zone (SNF), Management Area, and other appropriate landscape scales?	1. Forest type and age percentage by LE. 2. Percent of LE with vegetation management decisions. 3. Number of patches and acres by patch type and size category, and by patch zone. 4. Number of acres of each type of harvest by Management Area and stand ages at time of harvest. These measures are compared against: 1. Decade 1 objectives for each forest type and age class percentage by LE. 2. Comparison between current LE objective achievement and percent of LE treated. 3. Decade 1 objectives for each patch type and size category by patch zone. 4. Proposed management practices for Decade 1 as outlined in Table APP-D3 of Forest Plan.	D-VG-1-5, O-VG-17-25.	5 Years	5 Years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Watershed Health & Riparian-	To what extent is Forest management affecting water quality, quantity, flow timing and the physical features of aquatic, riparian, or wetland ecosystems?	<ol style="list-style-type: none"> <li>1. Fluvial geomorphic characteristics including longitudinal slope, cross-section, bed substrate.</li> <li>2. Biological characteristics including macroinvertebrate and fish populations.</li> <li>3. Water quality parameters including cations, anions, turbidity, pH, dissolved oxygen, temperature, organic carbon, suspended solids concentration, and some nutrients.</li> </ol>	(36 CFR 219.12(a)(5)). The status of select watershed conditions; All WS Desired Conditions and Objectives with the possible exception of D-WS-14, plus O-RWA-1 D-PH-3, D-PH-4, O-PH- 3, O-TS-4 and O-TS-5.	1-5 years	1-5 years	A/B
Wildlife	To what extent is Forest management providing ecological conditions to maintain viable populations of native and desired non-native species?	Comparison of various species population trends (data from internal monitoring and partners) with trends in MIH.	D-WL-3b, O-WL-1, O-WL-2, CFR 219.19 (6).	1-5 years	1-5 years	A/B
Wildlife: Non-native Invasive Species	To what extent is Forest management contributing or responding to populations of terrestrial or aquatic non- native species that threaten native ecosystems?	<ol style="list-style-type: none"> <li>1. Number of direct surveys.</li> <li>2. Number of outreach and education efforts.</li> <li>3. Number of eradication efforts.</li> <li>4. Acres of non-native invasive plants treated.</li> </ol>	D-WL-9. O-WL-37 and 38.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Wildlife: Sensitive Species	To what extent is Forest management contributing to the conservation of sensitive species and moving toward short term (10-20 years) and long-term (100 years) objectives for their habitat conditions?	Comparison of trends of MIH important to RFSS with Forest Plan objectives for those MIHs.	D-WL-1-9, O-WL-1-3, O-WL-18- 31.	1-5 years	1-5 years	A/B
Management Indicator Species	To what extent is Forest management moving toward short term (10-20 years) and long-term (100 years) objectives for habitat conditions for management indicator species and species associated with management indicator habitats?	1. Comparison of trends of MIH important to MIS (which are also RFSS) with Forest Plan objectives for those MIHs. 2. White pine forest type acres and percent by LE compared to decade objective for white pine % by LE.	(36 CFR 219.12(a)(5)). The status of focal species to assess the ecological conditions required under § 219.9; D-WL-1-9, O-WL-1-3, O-WL- 16,17, 31, 32, 34, 35, 36, and LE MIH objectives 1-9.	1-5 years	1-5 years	A/B
Wildlife: Threatened and Endangered Species	To what extent is Forest management contributing to the conservation of threatened and endangered species and moving toward short term (10-20 years) and long-term (100 years) objectives for their habitat conditions and population trends?	Comparison of trends of MIH important to TES with Forest Plan objectives for those MIHs.	D-WL-1-8, O-WL-4-17.	1-5 years	1-5 years	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Drivers	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Wildlife: Threatened and Endangered Species	To what extent are road and trails closures effective in prohibiting unauthorized motor vehicle use?	Qualitative visual assessment of effectiveness of recent road closures.	G-WL-7, G-RMV-4, O-TS-3, O-TS-7, S-TS-3, S-TS-7, and G-TS- 12 , G-TS-16	1-5 years	1-5 years	A/B
Wildlife: Threatened and Endangered Species	To what extent is the Forest maintaining no net increase in groomed or designated over-the-snow trail routes unless the designation effectively consolidates use and improves lynx habitat through a net reduction of compacted snow areas?	Number of miles added to the designated over-the-snow trail system.	S-WL-2	1-4 years	1-4 years	A/B
Identify Research Needs	Determine research implementation progress and opportunities. Revise needs and priorities of research.	1. Number and subject of research permits issued on the Forest. 2. Topics and management questions identified by Forest Interdisciplinary Team.	Research needs identified in Plan	Annual	Biennial	B
Climate Change	How are timing and duration of winter weather conditions changing across the Plan area on an annual basis? How is this affecting the Plan area?	1. Accumulated Winter Season Severity Index (AWSSI) calculated for Plan area based on daily measurements of maximum temperature, minimum temperature, snowfall and snow depth. 2. Comparison of AWSSI rating to number of timber operability days.	(36 CFR 219.12(a)(5)) Measurable changes on the Plan area related to climate change and other stressors that may be affecting the Plan area.	Annual	Biennial	A

<b>Resource Area</b>	<b>Monitoring Question(s)</b>	<b>Monitoring Indicator</b>	<b>Drivers</b>	<b>Measurement Frequency</b>	<b>Evaluation / Reporting Frequency</b>	<b>Precision and Reliability</b>
Climate Change	How are drought duration, severity, geographic extent and timing changing across the planning area on an annual basis? How is this affecting the Plan area?	1. U.S. Drought Monitor rating for Forest Plan area. 2. Comparison of rating with stocking survey and pest/disease monitoring information.	(36 CFR 219.12(a)(5)) Measurable changes on the Plan area related to climate change and other stressors that may be affecting the Plan area.	Annual	Biennial	A

## 1993 BWCA WILDERNESS MANAGEMENT PLAN MONITORING ITEMS

Resource Area	Monitoring Question(s)	Monitoring Indicator	Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
SOCIAL 1964 Wilderness Act	Visitor use -Use Levels -Travel Patterns -Use levels by time of year -Average party size -Origin of party	Annual assessment of use levels, use by time of year, average party size and origin of party via the quota permit reservation system (NRRS and Active Network Contract) and self-issue permit statistics to best implement paddle and motor quotas. Annual assessment of travel patterns via the same reservation system and self-issue permits, as well as visitor surveys, encounter monitoring, campsite occupancy monitoring, and Wilderness Character Mapping to assess limits of acceptable change standards.	(36 CFR 219.12(a)(5)). The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.	Annual	Biennial	A
	Compliance with rules, regulations reserving/issuing permits -Cancellations -Party leader names -Alternates -Entrance date -Entrance point -Mode of travel	Annual assessment of wilderness rules/regulation compliance rates via the reservation (NRRS and Active Network Contract) and permit systems, FS permit issuance, Cooperator Program permit issuance (local businesses that issue permits for the FS), Wilderness Character Mapping, and annual law enforcement reports on BWCAW incidents, warnings, and violation notices.	Integrity of permit and reservation system	Annual	Biennial	A/B

Resource Area	Monitoring Question(s)	Monitoring Indicator	Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
	No show rate for overnight and day use motor permits.	% No show. Annual assessment on all permit reservation "no-shows". This report includes outfitter guide/cooperator-made reservations as well as visitor-made reservations. NOTE: Motor quota no-shows are no longer put back into the quota system as "overbookings" for the next year due to information from these annual reviews. Instead, the Forest encourages visitors, outfitter guides and cooperators to promptly cancel their reservations so the quota can automatically rejoin the unused quota and be made available within 24 hours.	Permit check - percent (%) no show built into system.	Annual	Biennial	A/B
	Social encounters - Levels of crowding	Annual assessment of crowding (travel patterns) via the reservation system (NRRS and Active Network Contract) and self-issue permits, as well as visitor surveys, encounter monitoring, campsite occupancy monitoring, and Wilderness Character Mapping to assess limits of acceptable change and group encounter/crowding.	Use levels Wilderness experience	Annual	Biennial	A/B
ECOSYSTEM Bald Eagle Recovery Act & Endangered Species Act	Eagle population levels and reproduction trends	Number of birds Annual Project level or above project level surveys sampling approximately 10-25% of known territories each year.	Bald Eagle	Annual	Biennial	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Endangered Species Act	Wolf density and population levels	Wolves/sq. mile Distribution and abundance of wolves in MN (participate in MN DNR lead effort), and USGS long-term wolf study and pack monitoring (wolves per square mile).	(36 CFR 219.12(a)(5)). The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.	Annual	Biennial	A
Threatened & Endangered Plants	Population trends - prevent habitat loss	Number of rare plant occurrences in DNR Biotics database.	Plant communities; Campsites, Trail maintenance and construction	As needed	Biennial	A
Fisheries	Cooperate with State on inventories and assessments	Number of lakes/streams assessed (including PCA/DNR/Tribes).	Fish	Ongoing	Biennial	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
Air & Water Quality Resources	Effectiveness of State and federal laws related to air and water pollution	1. Air Chemistry: ozone, total fine particulate, speciated fine particulate, NADP-AMON(ammonia), visibility 2. Water Chemistry: Color, Phosphorus (Ortho), Solids (Total Suspended), Nitrogen (Total Kjeldahl), Total Phosphorous, Nitrogen (Nitrate + Nitrite), Chlorophyll a, Pheophytin, pH, ANC, Conductivity, Cl, NO3N, DIP, SO4, Al, Ca, Fe, K, Mg, Mn, Na, Si, Sr, TOC. 3. Precipitation Chemistry: NADP-MDN (mercury), NADP-NTN (Ca,Mg,K,Na,NH4,NO3,Cl,SO4, pH, Conductivity).	Concentration of pollutants in air and precipitation	Precipitation: weekly Air:continuous-2 weeks Water: Annual	Biennial	A
	Acid deposition impacts to lakes	Water Chemistry: Color, Phosphorus (Ortho), Solids (Total Suspended), Nitrogen (Total Kjeldahl), Total Phosphorous, Nitrogen (Nitrate + Nitrite), Chlorophyll a, Pheophytin, pH, ANC, Conductivity, Cl, NO3N, DIP, SO4, Al, Ca, Fe, K, Mg, Mn, Na, Si, Sr, TOC.	Loss of acid neutralizing capacity	Annual	Biennial	A
	Mercury concentration in fish	ppm Hg Mercury concentration in fish	Basis for recommending limits for human consumption	Annual	Biennial	A

Resource Area	Monitoring Question(s)	Monitoring Indicator	Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)	Measurement Frequency	Evaluation / Reporting Frequency	Precision and Reliability
	Passive monitoring for ozone, sulphur dioxide and fluoride	1. Atmospheric ozone levels. 2. Presence/absence of lichen species sensitive to air pollution.	Air pollution effects to vegetation	ozone: continuous lichen: varies depending on other indicators	Biennial	A/B
	Mercury concentrations in select animals, including loons and eagles	1. ppm Hg (concentration in fish). 2. ppm Hg (concentration in loon blood and feathers).	Mercury bioaccumulation	fish: annual loons: varies depending on other indicators	Biennial	A
	Nutrient impacts on lakes	Nutrient levels in lake water.	Human induced eutrophication	Representative lakes, variable intervals	Biennial	A/B
Forest Plan (NFMA)	Implementation of the Forest Plan as it pertains to the Wilderness	Wilderness annually managed to standard includes Limits of Acceptable Change Standards for both social and physical conditions, and maintenance standards for campsites, trails, portages, and structures.	ID Team; Campsites and trails; Prescribed natural fires	Annual	Biennial	A
Forest Plan/LAC Standards	Campsite, trail and lakeshore condition	1. LAC worksheets completed on 20% of BWCAW campsites annually (dependent on staffing) which inform managers on compliance with FP standards and guidelines evaluating vegetation loss and erosion levels. 2. Campsites and trails outside of wilderness receive annual maintenance.	Inventory and monitor changes	Annual	Biennial	A/B
National Historic Preservation Act	Loss of site integrity thru disturbance of physical characteristics	Condition monitoring and site specific evaluations for national register eligibility.	Visitor use, new construction, management activity, natural deterioration	Ongoing	Biennial	A

<b>Resource Area</b>	<b>Monitoring Question(s)</b>	<b>Monitoring Indicator</b>	<b>Driver (Applicable CFR's FP Desired Conditions, and FP Objectives)</b>	<b>Measurement Frequency</b>	<b>Evaluation / Reporting Frequency</b>	<b>Precision and Reliability</b>
	Monitoring of unevaluated sites assessed as Priority #1	Opportunistic monitoring pending formal evaluation for national register eligibility.	Visitor use, management activities, natural deterioration	Every 5 years	Every 5 years	A
	Assessment of identified sites	National Register evaluations pursuant to priority list identified in 5 year Plan.	Visitor use, management activities, natural deterioration	Every 5 years	Every 5 years	A