# Monitoring and Evaluation Guidebook
# for the
# Tongass Land and Resource Management Plan

June 2000

Tongass National Forest
USDA Forest Service

Collaborators

Monitoring procedures presented in this guidebook were developed by an Interagency Monitoring and Evaluation Group that consisted of representatives from the following agencies:

- Alaska Department of Environmental Conservation
- Alaska Department of Fish and Game
- Alaska Department of Natural Resources
- Alaska Division of Governmental Coordination
- Environmental Protection Agency
- United States Department of Agriculture, Forest Service, Alaska Region, Inventory and Monitoring Institute, Pacific Northwest Research Station
- United States Department of the Army, Corps of Engineers
- United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- United States Department of the Interior, Fish and Wildlife Service, Southeast Alaska Ecological Services

In addition to developing the monitoring procedures this group plans to cooperate in monitoring and evaluating the implementation of the Tongass Land and Resource Management Plan.

## Introduction

Monitoring and evaluation is a quality control process for implementation of the Tongass land and resource management plan (Forest Plan). It is an essential feedback mechanism within an adaptive management framework to keep the Forest Plan responsive to changing conditions and emerging information. Monitoring is gathering information and observing results of management activities. Evaluation is a process for interpreting this information and determining whether changes in management direction are needed.

Chapter 6 of the Forest Plan outlines a general approach for monitoring and evaluation. Forty- two monitoring questions are listed, with estimated annual costs, evaluation criteria, general sampling methods, and applicable statutory regulations. This monitoring guidebook provides specific direction on how each monitoring question is addressed.

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| ***Air Quality*** | | | |
| Is air quality meeting State and Federal ambient air quality standards? (V) | John Sherrod | Carol Seitz Warmuth | |
| ***Biodiversity*** | | | |
| Are contiguous blocks of old growth habitat being maintained in a forest-wide system of old growth reserves to support viable and well distributed populations of old growth associated species and subspecies? | Larry Meshew | Gene DeGayner | Kim Hastings<br>Jim Schramek |
| Are the effects on biodiversity consistent with those estimated in the Forest Plan? | Larry Meshew | Gene DeGayner | Kim Hastings<br>Jim Schramek |
| Are management practices consistent with current knowledge regarding sensitive species conservation (federally listed threatened or endangered species, Alaska Region sensitive species, and State species of special concern)? | Larry Meshew | Gene DeGayner | |
| Are destructive insect and disease organisms increasing to potentially damaging levels following management activities? | Forrest Cole | Jim Russell | |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| ***Fish Habitat*** | | | |
| Are population trends for Management Indicator Species (MIS) and their relationship to habitat changes consistent with expectations? | Larry Meshew | Dick Aho | Ron Medel |
| Are fish & riparian standards and guidelines being implemented? | Larry Meshew | Carol SeitzWarmuth<br>Dan Kelliher<br>Steve Paustian | Dick Aho |
| Are fish & riparian standards and guidelines effective in maintaining or improving fish habitat? | Larry Meshew | Dick Aho | Steve Paustian<br>Dan Kelliher<br>Julianne Thompson |
| ***Heritage Resources*** | | | |
| Are heritage resources standards and guidelines being implemented? | Patti Grantham | John Autrey | Karen Iwamoto<br>Mark McCallum |
| Are heritage resources standards and guidelines effective in protecting heritage/cultural resources as expected in the Forest Plan? | Patti Grantham | John Autrey | Karen Iwamoto<br>Mark McCallum |
| ***Karst and Caves*** | | | |
| Are karst and cave standards and guidelines being implemented? | Patti Grantham | Jim Baichtal | |
| Are karst and cave standards and guidelines effective in protecting the integrity of significant caves and the karst landscape? | Patti Grantham | Jim Baichtal | |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| ***Land Management Planning*** | | | |
| Is the management of National Forest System lands consistent with management objectives of adjacent lands and their management plans? | John Sherrod | Karryl Johnson | |
| ***Local and Regional Economies*** | | | |
| Are the effects on employment and income similar to those estimated in the Forest Plan? | John Sherrod | Julie Schaefers | Kathleen Morse |
| Has the Forest Service worked with local communities to identify and pursue Rural Community Assistance opportunities? | John Sherrod | Paul McIntosh | Nichole Clowery |
| ***Minerals and Geology*** | | | |
| Are the effects of mining activities on surface resources consistent with Forest Plan expectations, as allowed in approved Plans of Operations? | Patti Grantham | Jim Baichtal | |
| ***Recreation and Tourism*** | | | |
| Are areas of the Forest being managed in accordance with the prescribed Recreation Opportunity Spectrum (ROS) class in Forest-wide Standards & Guidelines? | Patti Grantham | Bill Tremblay | Marti Marshall |
| Is Off Road Vehicle (ORV) use causing, or will it cause, considerable adverse effects on soil, water, vegetation, fish and wildlife, visitors or cultural and historic resources of the Forest | Patti Grantham | Bill Tremblay | Marti Marshall |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| ***Research*** | | | |
| Have identified high-priority information needs been fulfilled? | John Sherrod | Terry Shaw | |
| ***Scenery*** | | | |
| Are the standards and guidelines effective in attaining the adopted Visual Quality Objectives established in the Plan? | Patti Grantham | John Short | Barth Hamberg |
| ***Soil and Water*** | | | |
| Are the standards and guidelines for soil disturbance being implemented? | Larry Meshew | Everett Kissinger | |
| Are the standards and guidelines effective in meeting Alaska Regional Soil Quality Standards? | Larry Meshew | Everett Kissinger | |
| Are Best Management Practices being implemented? | Larry Meshew | Everett Kissinger | |
| Are Best Management Practices effective in meeting water quality standards? | Larry Meshew | Everett Kissinger<br>Steve Paustian | |
| ***Subsistence*** | | | |
| Are the effects of management activities on subsistence users in rural Southeast Alaska communities consistent with those estimated in the Forest Plan? | Larry Meshew | Dave Johnson | |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| ***Timber*** | | | |
| Are timber harvest activities adhering to applicable timber management standards and guidelines? | Forest Cole | Jim Russell | |
| Are harvested forest lands restocked within five years following harvest? | Forest Cole | Jim Russell | Duane Fisher |
| Is the Allowable Sale Quantity (ASQ) consistent with resource information and programmed harvest | Forest Cole | Jim Russell | |
| Are the Non-Interchangeable Components (NIC) of the allowable sale quantity consistent with actual harvest? | Forest Cole | Charley Streuli | Duane Fisher<br>Jim Schramek |
| Is the proportional mix of volume in NIC I and NIC II as estimated in the Forest Plan accurate? | Forest Cole | Charley Streuli | Terry Shaw |
| Should maximum size limits for harvested areas be continued? | Forest Cole | Charley Streuli | Duane Fisher<br>Jim Schramek |
| ***Transportation*** | | | |
| Are the standards and guidelines used for forest development roads and Log Transfer Facilities effective in limiting the environmental effects to anticipated levels? | Larry Dunham | Jack Oien<br>Jim Rhodes | |
| ***Wetlands*** | | | |
| Are wetlands standards and guidelines being implemented? | Larry Meshew | Patti Krosse | |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| Are wetlands standards and guidelines effective in minimizing the impacts to wetlands and their associated functions and values? | Larry Meshew | Patti Krosse | |
| ***Wild and Scenic Rivers*** | | | |
| Are Wild, Scenic, and Recreational River standards and guidelines being implemented? | Patti Grantham | Marti Marshall | Bill Tremblay |
| Are Wild, Scenic, and Recreational River standards effective in maintaining or enhancing the free flowing conditions and outstandingly remarkable values at the classification level for which the river was found suitable for designation as part of the National Wild and Scenic River System? | Patti Grantham | Marti Marshall | Bill Tremblay |
| ***Wilderness Areas*** | | | |
| Are standards and guidelines for the management of wilderness being implemented? | Patti Grantham | Marti Marshall | Bill Trembley |
| Are standards and guidelines for the management of wilderness effective in maintaining the wilderness resource? | Patti Grantham | Marti Marshall | Bill Tremblay |
| ***Wildlife*** | | | |
| Are population trends for Management Indicator Species (MIS) and their relationship to habitat changes consistent with expectations | Larry Meshew | Gene DeGayner | |

| MONITORING QUESTION | LEAD STAFF | LEAD SPECIALIST | OTHER MEMBERS |
|---|---|---|---|
| Are the population levels and associated distribution of mammalian endemic species on islands and portions of the mainland consistent with the estimates in the Forest Plan? | Larry Meshew | Gene DeGayner | Terry Shaw |

### *Costs and Outputs*

| | | | |
|---|---|---|---|
| What outputs were produced in the previous year? | Debbie Riggs | Michele Canik | |
| Are the costs associated with carrying out the planned management prescriptions (including those of producing outputs) consistent with those costs estimated in Plan? | Debbie Riggs | Michele Canik | |

***AIR QUALITY***

**Goal:** Maintain the current air resource condition to protect the Forest's ecosystems from on and off Forest air emissions sources.

**Objective**: Attain national and state ambient air quality standards Forest-wide.

**Background**: The air quality is addressed Forest-wide, but the actual monitoring takes place at one or more monitoring sites within local airsheds where there are known or suspected air quality problems. Refer to ``Juneau Air Quality Monitoring Project, Mendenhall Valley data Summary, January 1985- December 1995'' published by the Alaska Department of Environmental Conservation, January 31, 1996.

**Air Quality Question: Is air quality meeting State and Federal ambient air quality standards?**

**Estimated Cost:** $1,000 annually.

**Data Collection:** List air quality data summaries from current monitoring sites; including several sites in Juneau's Mendenhall Valley (for particulate matter, measured as PM-10 and PM-2.5) and past sites in Ketchikan and Sitka (for PM-10 and SO 2). Include future sites potentially in Ketchikan and Sitka (for PM-2.5).

**Evaluation Criteria:** Changes in meeting State and Federal ambient air quality standards.

The range of acceptable results is generally defined as attainment of ambient air quality standards based on the most recent monitoring data (i.e. not based solely on attainment or non-attainment designation status). However, the evaluation of non-attainment areas should also consider other factors including, but not limited to:

- The magnitude, frequency, and duration of any exceedances of the standards.
- The potential effects of the exceedances on Forest users and Forest resources.
- The extent to which Tongass national forest management actions contribute to the exceedances.

**Precision and Reliability:** Per ADEC and EPA regulations, guidance, and site specific monitoring plans. Units of measure vary by pollutant, but generally are expressed as unit mass per unit volume per unit time.

**Results:**

- Tabulate ambient air quality summaries from current monitoring sites; including several sites in Juneau's Mendenhall Valley (for particulate matter, measured as PM-10 and PM-2.5) and past sites in Ketchikan and Sitka (for PM-10 and SO 2).
- List any non-attainment areas, estimate the Tongass National Forest acreage affected.
- Briefly summarize the most recent ADEC data trends.

**Analysis:**

- Evaluate the ambient air qualities and determine if the air quality on the Tongass National Forest is meeting the ambient air quality standards.
- Discuss the most recent ADEC ambient air quality trends relative to the Tongass National Forest ambient air quality.
- Report results in the annual monitoring reports as well as in the first year, fifth year, tenth year and fifteenth year monitoring and evaluation reports.

***BIODIVERSITY***

**Goal**: Maintain healthy forest ecosystems; maintain a mix of habitats at different spatial scales (i.e., site, watershed, island, province, and forest) capable of supporting the full range of naturally occurring flora, fauna, and ecological processes native to Southeast Alaska.

**Objective**: Maintain a Forest-wide system of old-growth-forest habitat (includes reserves, non-development land use designations, and beach, estuary and riparian corridors) to sustain old-growth-associated species and resources. Ensure that the reserve system meets the minimum size, spacing and composition criteria described in Appendix K of the Forest Plan. Provide sufficient habitat to preclude the need for listing species under the Endangered Species Act due to habitat conditions on National Forest lands.

**Background:** Two coarse-filter approaches are used here to monitor Forest biodiversity. The first focuses on the spatial distribution and composition of old-growth reserves and the cumulative harvest of old-growth timber by Biogeographical Province. It is assumed that the GIS database will be measured using a current layer. The second examines emerging information concerning sensitive species conservation on the Forest.

**Biodiversity Question 1: Are contiguous blocks of old-growth habitat being maintained in a forest-wide system of old-growth reserves to support viable and well-distributed populations of old-growth-associated species and subspecies?**

**Estimated Cost:** $3,000 annually

**Data Collection:** Collect the following data on an annual basis

*Large Reserves:*

- Use GIS to measure the contiguous size in acres of each large reserve.
- Use GIS to measure the distance in miles of each large reserve and its nearest neighboring large reserve.
- Use GIS to measure the total area in acres of productive old-growth timber by Volume Class within each large reserve using TIMTYP & CLU (common land unit) land base to define the low volume, medium volume and high volume strata (see Julin & Caouette, 1997.)
- Count the number of large reserves within the range of brown bears that do not include at least one Class I anadromous fish streams.

*Medium Reserves:*

- Use GIS to measure the contiguous size in acres of each medium reserve.
- Measure the distance in miles of each medium reserve and its nearest neighboring medium or large reserve.
- Measure the total area in acres of productive old-growth timber by Volume Class within each large reserve.

*Small Reserves:*

- Exclude VCUs containing less than 800 acres of productive-old-growth timber from this analysis.
- Combine VCUs split by decimal extensions (e.g., 597.1 and 597.2).
- Measure contiguous areas of productive-old-growth timber within each VCU.
- Calculate the number of acres of productive-old-growth timber by Volume Class equal to 8 percent of each VCU.

**Evaluation Criteria**: Changes in the system of large, medium, and small habitat reserves identified and mapped in the Forest Plan as part of a forest-wide old-growth habitat reserve strategy.

The reserve system established by the Forest Plan consists of 38 large reserves, 112 medium reserves, and approximately 237 small reserves. While the locations and boundaries of large and medium reserves are expected to remain largely unchanged for the life of the Forest Plan, criteria for small reserves are more flexible and allow for changes. The basic criterion is that each Value Comparison Unit (VCU) should contain the

equivalent of at least one small reserve. Because of the one-reserve-per-VCU guideline, monitoring whether the reserve system meets size, spacing, and composition criteria is slightly more complicated than simply checking each reserve. Medium and large reserves are handled this way, but the appropriate way to monitor the status of the small reserve system is to examine each VCU to ensure that it contains at least one small reserve (or its equivalent in non-development land use designations).

**Precision and Reliability:**

**Results:**

*Large Reserves*
Utilizing GIS analysis:

- List large reserves that are less than 40,000 acres.
- List large reserves that are more than 20 miles from their nearest-neighboring large reserve.
- List large reserves that have less than 20,000 acres of productive-old-growth timber.
- List large reserves that have less than 10,000 acres of high-volume timber.
- List large reserves that are within the range of brown bear that do not have at least one Class I anadromous fish stream.
- Tabulate the productive old-growth composition by Volume Strata (low, medium, high)

*Medium Reserves*
Utilizing GIS analysis:

- List medium reserves that are less than 10,000 acres.
- List medium reserves that are more than 8 miles from their nearest medium or large reserve.
- List medium reserves with less than 5,000 acres of productive-old-growth timber. List medium reserves with less than 2,500 acres of high-volume timber.
- Tabulate the productive old-growth composition of Volume Strata.

*Small Reserves*
Utilizing GIS analysis:

- List VCUs with less than 8 percent productive-old-growth timber.
- List very large VCUs 15,000 acres with a productive-old-growth-timber reserve of less than 800 acres.
- Tabulate the productive old-growth composition of Volume Strata (low, medium,high).

**Analysis:** Explain any deviations from size, spacing, and composition requirements (reserves listed above) for the entire reserve system. The expectation is that the reserve system will meet these requirements; however deviations are both acceptable and were, in some cases, a part of the original Forest Plan reserve system.

The following questions should be addressed if the reserve requirements are not met:

- Did the same reserve/VCU meet the requirements last year?
- Is the change due to management action (reference NEPA documentation), natural causes, encumbrance or inventory updates?
- Will reserve system be altered in response to these changes?
- Were requirements not met in areas where endemic mammals occur?
- In addition, any changes to the reserve system during the previous fiscal year should be documented in the annual report, along with a copy of the updated LUD map. Describe trends in composition in resource system since the Forest Plan was implemented. If the previous year is report recommended changes to the reserve system, the following year's report should document whether those changes were made.

**Biodiversity Question 2: Are the effects on biodiversity consistent with those estimated in the Forest Plan?**

**Estimated Cost:** $3,000 annually

**Data Collection:** Using GIS measure the cumulative harvest of old growth forest by biographical province.

**Evaluation Criteria:** Cumulative harvest of old growth should be less than or equal to planned harvest.

**Precision and Reliability:** All variables examined and the resulting evaluation, should provide medium to high precision and medium to high reliability. High precision is due to sampling of a database that includes data that is carefully maintained. Reliability is tempered by sources of error and bias that include reserve and LUD mapping errors, limitations of resource inventories, and delay in detecting and incorporating resource changes due to natural causes. Though these sources of error and bias reduce reliability, most should be improved or eliminated during the life of the Forest Plan.

**Results:** Tabulate the cumulative harvest of old-growth forest by biographical province by low, medium, high volume strata for each biographical province.

**Analysis:**

- Compare levels of cumulative timber harvest with planned harvest (see Table 3-5, FEIS) by biographical province.
- Comment on instances where actual harvest has or may exceed the 10-year planned harvest projections.

*[ Refer to Table 3-5 from TLMP FEIS, shown below]*

**Table 3-5 Productive old-growth forest planned for harvest by Biogeographic Province by alternative**

| Productive old-growth forest planned for harvest by Biogeographic Province by alternative | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alternatives and Percent Cumulative Harvest After Decades 1 and 10 | | | | | | | | | | | | | | | | | | | | | |
| Unit | Current [2] (1995) | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 9 | | 10 | | 11 | |
| | | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 |
| 1 | 6 | 6 | 6 | 6 | 13 | 6 | 7 | 6 | 8 | 6 | 8 | 6 | 12 | 6 | 13 | 6 | 23 | 6 | 13 | 6 | 7 |
| 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 3 | 10 | 10 | 10 | 12 | 33 | 12 | 24 | 11 | 29 | 11 | 29 | 12 | 30 | 13 | 37 | 13 | 36 | 12 | 28 | 1 | 21 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| 5 | 11 | 11 | 11 | 14 | 32 | 12 | 20 | 11 | 28 | 11 | 28 | 12 | 32 | 14 | 38 | 14 | 39 | 13 | 24 | 12 | 22 |
| 6 | 7 | 7 | 7 | 9 | 16 | 7 | 10 | 7 | 16 | 7 | 18 | 8 | 15 | 8 | 15 | 8 | 16 | 8 | 11 | 7 | 10 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 3 | 3 | 3 | 4 | 12 | 3 | 5 | 3 | 9 | 3 | 9 | 4 | 11 | 4 | 12 | 4 | 11 | 3 | 6 | 3 | 7 |
| 9 | <1 | <1 | <1 | 4 | 16 | 1 | 10 | 1 | 8 | <1 | 8 | 4 | 15 | 5 | 24 | 4 | 19 | 1 | 14 | 2 | 8 |
| 10 | 9 | 9 | 9 | 12 | 40 | 10 | 35 | 10 | 38 | 10 | 36 | 14 | 37 | 12 | 48 | 12 | 41 | 11 | 36 | 11 | 8 |
| 11 | 8 | 8 | 8 | 11 | 34 | 12 | 29 | 10 | 31 | 10 | 31 | 11 | 32 | 11 | 41 | 12 | 37 | 12 | 33 | 11 | 23 |
| 12 | 2 | 2 | 2 | 5 | 11 | 5 | 9 | 4 | 10 | 4 | 10 | 4 | 11 | 7 | 19 | 6 | 13 | 5 | 10 | 5 | 12 |
| 13 | 13 | 13 | 13 | 16 | 35 | 14 | 29 | 14 | 31 | 14 | 32 | 14 | 33 | 19 | 49 | 16 | 37 | 14 | 32 | 14 | 28 |
| 14 | 24 | 24 | 24 | 27 | 49 | 25 | 40 | 24 | 45 | 24 | 41 | 25 | 41 | 27 | 56 | 27 | 54 | 25 | 42 | 25 | 37 |
| 15 | 6 | 6 | 6 | 9 | 25 | 9 | 19 | 7 | 24 | 7 | 23 | 9 | 24 | 12 | 36 | 9 | 28 | 9 | 21 | 7 | 16 |
| 16 | 11 | 11 | 11 | 14 | 24 | 12 | 18 | 12 | 22 | 12 | 22 | 12 | 22 | 14 | 31 | 15 | 33 | 12 | 19 | 12 | 18 |
| 17 | 1 | 1 | 1 | 2 | 9 | 1 | 4 | 1 | 6 | 1 | 4 | 2 | 6 | 8 | 47 | 9 | 53 | 2 | 4 | 1 | 3 |
| 18 | 1 | 1 | 1 | 6 | 27 | 5 | 16 | 4 | 23 | 4 | 23 | 7 | 26 | 7 | 39 | 7 | 36 | 6 | 19 | 4 | 16 |
| 19 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 2 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 3 | 3 | 3 | 5 | 9 | 4 | 7 | 3 | 8 | 3 | 7 | 4 | 8 | 5 | 10 | 5 | 9 | 4 | 8 | 4 | 8 |

[1] All figures represent the cumulative harvest of productive old-growth forest to the end of the period specified (present cumulative harvest, and at the end of one decade and ten decades of alternative Forest Plan implementation), espressed as a percent of 1954 productive old-growth. (Estimated acreges of old-growth harvest are contained in the Planning Record.)

[2] From Table 3-4.

Relate changes in the old-growth forest to changes in biodiversity.

**Biodiversity Question 3: Are management practices consistent with current knowledge regarding sensitive species conservation (federally listed threatened or endangered species, Alaska Region sensitive species, and State species of special concern)?**

**Estimated Cost:** $30,000

**Data Collection:** See Soil and Water Question 3 for methods

- Consult with other Agencies (US Fish and Wildlife Service and the Alaska Department of Fish & Game) regarding the sensitive species and whether additional species should be considered (note want to know if regulatory process has changed) to the Region 10 sensitive species list. These species include all other species in southeast Alaska with threatened or endangered status (U.S. Fish and Wildlife Service designation), sensitive species status (U.S. Forest Service designation), and Species of Special Concern status (Alaska Department of Fish and Game designation).
- Identify new scientific literature concerning sensitive temperate rain forest taxa on the Tongass.

**Evaluation Criteria:** Habitat changes and population trends for threatened, endangered, and sensitive taxa.

**Precision and Reliability:** The precision and reliability are dependent upon the precision and reliability of the data collection methods used by the Forest Service and other agencies in monitoring sensitive species.

**Results:** Annually, the Regional Threatened and Endangered Species Coordinator will prepare a report including:

- For each sensitive species currently on the Region 10 sensitive species list and present in the Tongass:
- List sources of new information investigated in the last year. (e.g., contacts with other agencies, literature search, conference attendance, field data gathered by USFS)
- Describe new information obtained. Reference any biological assessments completed.
- Identify if any new information conflicts with current Forest Service management practices.
- Determine if other agencies (i.e. USFWS, ADF&G, NMFS) been made aware of the new information. Summarize the outcomes of section 7 consultations.
- Summarize comments from other Federal or State resource agencies about how USFS management practices effect sensitive species.

2. Identify if other agencies have been consulted about whether to add new Tongass species to the Region 10 sensitive species list.

**Analysis:**

- Evaluate data collected in studies to determine the need for changes in the standards and guidelines of the Tongass land management plan.
- Summarize results of Biological Evaluations and associated effectiveness monitoring conducted at the project level, and results of any consultations with ADF&G and U.S. FWS under the MOU with those agencies.

**Biodiversity Question 4 Insects and Disease Organisms: Are destructive insects and disease organisms increasing to potentially damaging levels following management activities?**

**Background:** Focus Monitoring on historical monitoring

Estimated Cost: $4,000 annually

**Data Collection:** Review information from the annual Alaska Region report: ``Forest Insect and Disease Conditions in Alaska.''

**Evaluation Criteria:** Identify and quantify areas where insects or disease are occurring.

**Precision and Reliability:** The precision and reliability is dependent upon the precision and reliability of the data collection methods used to determine insect and disease levels.

**Results:** Summarize the annual Forest Insect and Disease Conditions in Alaska report.

**Analysis:** Address implications of the Forest Insect and Disease Conditions in Alaska report concerning destructive insects and disease following management activities.

***FISH HABITAT***

**Goal**: Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.

**Objective:** Use baseline fish habitat objectives as identified in the Fish Forest-wide Standards & Guidelines to evaluate the relative health or condition of riparian and aquatic habitat. Design and implement an average of 16 fish habitat improvement projects annually across the Forest.

**Background:** Fish and the aquatic resources on the Tongass National Forest provide major subsistence, commercial, sport fisheries, and traditional and cultural values. Abundant rainfall, streams with glacial origins and watersheds with high stream densities provide an unusual number and diversity of freshwater fish habitats. These abundant aquatic systems of the Tongass provide spawning and rearing habits for the majority of fish produced in Southeast Alaska. Maintenance of this habit, and associated high quality water, is a focal point of public, State and Federal natural agencies, as well as user groups, Native organizations and individuals.

**Fish Habitat Question 1: Are population trends for Management Indicator Species (MIS) and their relationship to habitat changes consistent with expectations?**

Summary of subgroup progress - Dick Aho (fish MIS subgroup lead) & subgroup is working on completion of a MIS strategy for fish; will be combined with wildlife MIS strategy; refer to the report, "A Reassessment of Management Indicator Species for the Tongass National Forest" for more information on MIS strategy. Anticipate monitoring resident Dolly Varden & Cutthroat will be initiated in 1999 with work on site selection completed. Monitoring protocols for coho salmon and pink salmon will be completed in 1999.

Tentative MIS fish species are listed below with the respective people working on the protocols development:
Dolly Varden & Cutthroat:: Dick Aho, USFS
Coho Salmon: Rocky Holmes, ADF&G
Pink Salmon: Sue Walker, FWS

**Estimated Cost:** to be determined when protocols are developed

**Data Collection**: In recognition of the concern that the use of harvest statistics is unreliable for estimating population trends fish model committees will be convened in May 1998 with a revised MIS list and new models are proposed to be completed in fiscal year 1999. Data will be collected to support the new MIS strategy as listed below:

- Revise the MIS
- Develop Models
- Design Data Layers Supporting the Models
- Model Validation
- Model Revision

**Evaluation Criteria:** Habitat changes and population trends for management indicator species.

**Precision and Reliability:** Precision and reliability will be dependent upon the precision and reliability associated with the data collection methods and models described in the specific monitoring protocols for the species.

**Results:** Discussion and illustration of the new MIS strategy. Report results of the model development, validation, and revision.

**Analysis:** Evaluation of the application of the new MIS strategy.

**Resident Dolly Varden and Cutthroat Trout**
**(November 12, 1998, revised)**

**Background:** Protocol determines population trends for resident Dolly Varden and Cutthroat Trout. Monitoring Dolly Varden char and Cutthroat trout is recommended as a package as they often reside together in our streams and can both be sampled by similar methods. Occasionally, only Dolly Varden or Cutthroat trout will be found in a stream.

**Data Collection:** The two species will be monitored by repeated annual population estimates in permanently marked reaches of stream. Either mark-and-recapture or removal method estimates are recommended depending upon the preference of the district biologists. Once a method has been selected, it should be continued for the life of the monitoring program.

Successful mark-and-recapture estimates have been made in small streams by marking and releasing fish captured in baited minnow traps on the first sampling day. On the following day, the stream is resampled with electrofishing gear to determine the proportion of marked fish in the population. Two capture methods (minnow trapping and electrofishing) eliminate the bias inherent to any single capture method.

The Forest Sciences Laboratory has developed a protocol for multiple-catch removal population estimates using minnow traps. This method is reported to be more effective in larger channels than mark-and-recapture methods.

It is recommended that relatively small channels be chosen for monitoring as it is difficult to capture a high percentage of the fish in large channels. This often leads to large confidence intervals around the estimated population number.

Stream sections selected for population monitoring should be above impassible waterfalls. This approach will avoid the problems of attempting to differentiate between residents and anadromous juveniles. Several people have suggested the complex life histories of anadromous Dolly Varden and cutthroat trout could make interpretation of population estimates difficult and should be avoided.

Population estimates should be made during June or July each year. Fish will be active and steam flows should be relatively low allowing easy sampling . Monitoring should be avoided during high flows following storm events.

Design

Population estimates in short sections of stream should be made on each Tongass Ranger District with a timber harvest program. It is anticipated that will include the Ketchikan, North Prince of Wales, Craig, Wrangell, Petersburg, Juneau, Sitka, and Hoonah districts. Three streams will be monitored on each district. The streams will include, one each, with:

1) no previous or planned timber harvest,
2) no previous timber harvest and planned harvest according to the present standards and guidelines, and
3) pre-Tongass Land Management Plan Revision timber harvest and planned harvest under the current standards and guidelines.

According to this design, 24 streams widely distributed across the Tongass will be monitored. They will be stratified into three relevant categories. The no harvest streams will serve as controls. The streams with planned logging under the current standards and guidelines but no previous logging will test the effectiveness of the current standards and guidelines, and the streams with both old and new logging will test for interaction between the two treatments.

Where possible, monitoring for Dolly Varden and cutthroat trout should occur in the same watershed as the monitoring for trends in populations of the other fish MIS and the channel condition assessments. Multiple monitoring programs in the same stream may increase the probability of understanding the results of the individual monitoring efforts.

**Fish Habitat Question 2: Are fish and riparian standards and guidelines being implemented?**

**Background:** Most of the fish and riparian standards and guidelines are implemented as Best Management Practices (BMPs) described in FSH 2509.22 (as amended in 1996). Monitoring will be conducted according to a Tongass-wide BMP implementation monitoring strategy described under Soil and Water Question 3 (Are Best Management Practices being implemented?). BMPs most applicable to fish and riparian resources include:

- BMP 12.6 Riparian Area Designation and Protection
- BMP 12.6a Buffer Design and Layout (TTRA and other buffers)
- BMP 13.16 Stream Channel Protection
- BMP 14.6 Timing Restrictions for Construction Activities
- BMP 14.17 Bridge and Culvert Design and Installation (fish passage, etc.)

**Estimated Cost**: See Soil and Water Question 3, Implementation Monitoring

**Data Collection:** See Soil and Water Question 3 and refer to the Tongass Implementation Monitoring Strategy for specific detail on data collection.

**Evaluation Criteria:** The evaluation criteria will be specific to the BMP. Refer to the Tongass Implementation Monitoring Strategy.

**Precision and Reliability:** The precision and reliability will vary with the BMP monitored. Where actual measurements or quantifiable observations are made (for example, TTRA buffers or compliance with timing restrictions), both precision and reliability will be high. Where a more qualitative observation is required (for example, providing for reasonable assurance of windfirmness of riparian management areas), precision and reliability may be low. See Soil and Water Question 3, Implementation Monitoring.

**Results:** See Soil and Water Question 3 and refer to the Tongass Implementation Monitoring Strategy.

**Analysis:** See Soil and Water Question 3 and refer to the Tongass Implementation Monitoring Strategy for specific detail.

**Fish Habitat Question 3: Are fish and riparian standards and guidelines effective in maintaining or improving fish habitat?**

**Background:** Priority effectiveness issues for Tongass National Forest fish, riparian, soil, water, and wetlands standards and guidelines were compiled in 1994 and re-assessed in 1998. Monitoring activities will focus on high priority issues and utilize existing or near-final protocols. For fish and riparian resources these include:

- *stream buffer stability*
- *stream buffer effectiveness*
- *fish passage*
- *channel condition assessment*

**Estimated Cost:** $60,000 annually

***Stream Buffer Stability***

**Introduction**

The purpose is to evaluate timber harvest management prescriptions intended to maintain the integrity of streamside buffers.

The riparian vegetation inherent in stream buffers is recognized as an important controlling factor for bank erosion and stream temperatures. The Large Woody Debris (LWD) that riparian zones provide often define stream channel process and habitat conditions. The riparian zone is also important in controlling the amount of sediment and nutrients reaching the stream from upslope sources.

Fish and Riparian Standards and Guidelines of the Tongass Land Management Plan (TLMP) state:1) maintain natural and beneficial quantities of LWD over the short and long-term, 2) maintain stream banks and stream channel processes, 3) provide for the beneficial uses of riparian areas by maintaining water quality, 4) maintain optimum salmonid stream temperatures, 5) maintain the natural range and frequency of aquatic habitat conditions.

It is understood that by retaining riparian vegetation, in a condition found within the range of natural variability, many of the above mentioned fish and riparian standards and guidelines of TLMP can be achieved.

Blowdown is a natural and important phenomenon of Southeast Alaska. It recycles forest stands and maintains and renews the forest ecosystem. Although, timber harvest often exacerbates the rate of blowdown in adjacent forest stands, including streamside buffers, beyond that found within the range of natural variability. TLMP directs us to evaluate the effect of management (including windthrow) of adjacent areas on riparian habitats. TLMP further directs us to establish Riparian Management Areas (RMA's) for each project where ground disturbance will occur and to manage an appropriate distance beyond this no-harvest zone to provide for a reasonable assurance of windfirmness of the RMA.

Forest Plan riparian standards and guidelines state as an objective that riparian areas will be "maintained in mostly natural conditions, for fish, other aquatic life, old-growth and riparian associated plant and wildlife species, water related recreation and to provide for ecosystem processes, including important aquatic and land interactions".

The objective of this protocol is to monitor change in the riparian vegetation of the RMA due to blowdown. The amount of change in the riparian vegetation will be used to assess if RMA's are being maintained in mostly natural conditions.

**Data Collection:**

Design

All stream buffers of Class I, II and III streams, throughout the Tongass National Forest, which are associated with timber sales that are consistent with the revised TLMP will be monitored. Stream buffer condition will be assessed by monitoring the change in canopy cover area of the stream buffer from a period immediately following harvest to future incremental sampling periods. Canopy cover of the stream buffer during each sampling period will be documented and measured with the use of low altitude digital still aerial photographs. Riparian zones located in the vicinity of the harvest unit will also be photographed and analyzed as a control.

Methods

Fisheries and Geographic Information Systems personnel from the Stikine Area will be responsible for obtaining, processing and evaluating the initial digital still aerial photographs of stream buffers associated with harvest units within the Tongass National Forest which have been harvested prior and during 1999.

Selection of Stream Buffers to be Monitored:
Personnel from each Unit on the Tongass will provide Stikine personnel with their Unit's pool of stream buffers to be monitored (see Table 1 Stream Buffer Data Card). All stream buffers of Class I, II, and III streams, which are associated with timber sales that are consistent with the revised TLMP, will be monitored. Monitoring all available stream buffers will prevent selection bias and allow for stratification of data after collection.

To provide consistency, a buffer for the purpose of this monitoring is defined as follows: All RMA's and associated areas managed to assure a reasonable assurance of windfirmness (RAW zone) of the RMA of Class I, II and III which are specifically mentioned in the As-Planned or As-Layed-Out Unit cards. Also included will be areas not specifically mentioned in the Unit Cards which are between Class I, II or III streams and harvest units, which also meet a width criteria. The width which an area must not exceed to be considered a stream buffer, if it is not specifically mentioned in the Unit Cards, is dependent on the Process Group and Stream Class of the channel it is adjacent to. These maximum widths by Process Group and Stream Class can be derived from Table 2 by adding the RMA width to the RAW zone width.

Photographic Image Acquisition:

A De Haviland Beaver mounted with a Kodak DCS420 digital camera (28 mm lens) and two video cameras will capture the images. One of the video cameras will be a forward looking while the other will be directly downward looking. The video cameras will be used primarily for real time navigation and for assistance in post processing orientation. A Rockwell PLGR-196 Global Positioning System unit will record x, y, and z location coordinates.

Flight Specifications:

Elevation: 2,500 feet above the terrain of the stream buffer.
Altitude: Dependent on terrain elevation
Ground Speed: 90mph (132.0'/second)

Digital Still Image Specifications (at designated flight specifications):

Pixel size: 0.8 feet x 0.8 feet
Area per image: 22.82 acres per image
Dimensions of image: 1223' x 813'
Overlap 65% (for stereoscopic viewing)
Gain per image: 284.4'
Images per mile: 18.57
Intervalometer: (image cycle time) 2.2 seconds

Frequency and Time of Photographic Image Acquisition:

Digital still aerial photographs of buffers will be acquired prior to October 1 of the year in which the unit was harvested and in the $2^{nd}$, $3^{rd}$, $5^{th}$, $10^{th}$ and $15^{th}$ year following harvest. All units harvested prior to 1999 and are consistent with the revised TLMP, will also be photographed in 1999)

Image Post Processing:

Digital still photographic images will be processed on TNTmips image processing software. Images will be digitized and polygons drawn which define the following zones: 1) the stream channel zone, 2) the RMA zone, 3) the area managed to assure a reasonable assurance of windfirmness (RAW zone) of the RMA, 4) all canopy gaps contained in these zones. The area (acres) of each polygon will be calculated by the image processing software. The area of the canopy gap polygons within each zone will be summed to obtain total area of canopy opening

**Analysis:**

The condition of stream buffers will be assessed by measuring the change in area of canopy opening of the RMA from immediately following harvest activities to periods of 1, 2, 3, 4, 5, 10 and 15 years following harvest. Initial analysis will include validating the null hypothesis Ho: there is no difference between the mean change in area of canopy opening of the RMA's adjacent to harvest units and that of similar riparian areas not adjacent to harvest units. If the null hypothesis is tenable then our current prescriptions established to maintain the RMA in mostly natural conditions will be considered successful. If the null hypothesis is rejected than additional analysis will be preformed to establish the correlation between the dependent variable (% change in area of canopy opening) and

the independent variables, management prescription, and blowdown hazard class (Kramer M.E.1997) and time since harvest.

Reporting

The stream buffer stability data will be compiled annually and reported in the TLMP and Alaska Department of Environmental Conservation annual monitoring reports. Data will be primarily in graphical and tabular format.

**Literature Cited**

Kramer M.E. 1997. Abiotic Controls on Windthrow and Forest Dynamics in a Coastal Temperate Rainforest, Kuiu Island, Southeast Alaska.M.S. Thesis, Montana State University, Bozman, MT. 45pp.

***Stream Buffer Effectiveness***

**Data Collection:**

This monitoring is a continuation of Part II of the 319 Buffer Monitoring Project initiated in 1993. The objective is to collect information effectiveness of stream buffers in maintaining riparian functions and fish habitat capability. The monitoring parameters include quantitative measures of stream habitat units, stream channel morphology and stability, large woody debris, and riparian canopy gaps. Data collection procedures are detailed in the document *Kelliher, D. "Buffer Effectiveness Monitoring Protocol 1999",* which is available from the Chatham Area Office of the Tongass.

To date, 25 permanent reference reaches have been established in stream buffers located throughout the Tongass N.F. These reference reaches include six Stream Process Groups. Monitoring sites have been established on Chichagof, Baranof, Kuiu, Kupreanof, Prince of Wales Island and the main-land, representing most geo-climatic subsection in the Tongass. Base line data was collected at all sites prior to or immediately following harvest of the riparian timber stand adjacent to the buffer. A total of five sites have been re-surveyed subsequent to harvesting activities.

Established reference buffer sites will re-measured periodically (a minimum of once every 5 years). Between 5 and 10 additional buffer effectiveness monitoring sites will be established for selected Process Groups and Subsections along sale units under current TLMP Riparian Standards and Guides in future years. Emphasis will be in the Moderate Mixed and Floodplain channel type process groups, which are more sensitive to impacts and events within watersheds. Emphasis will also be to select sites within watersheds having a Channel Condition Assessment site (CCA), or to establish a CCA site within watersheds with Buffer Effectiveness sites.

Follow Buffer Effectiveness Monitoring Protocol 1999. A copy is included in the Appendix.

**Evaluation Criteria:**

Forest Plan Riparian Standards and Guidelines objectives include "maintain or restore the natural range and frequency of aquatic habitat conditions; maintain or restore stream banks and stream channel processes; and maintain or restore natural and beneficial quantities of large woody debris". Buffer effectiveness evaluation criteria include fish habitat objectives for pool area (or frequency), channel width-depth ratio and quantity of large woody debris. Additional indices to evaluate stream channel and habitat condition and trend will include streambed substrate and bed-shear ratios, riparian canopy cover, channel cross-sectional area and residual pool depth.

**Precision and Reliability:**

The quantitative parameters being used as evaluation criteria are precise indexes of stream and habitat conditions. These parameters are considered to have good reliability in predicting relative fish habitat capability in Alaska. Natural, spatial, and temporal variability in channel conditions, however, will require careful interpretation of data.

**Analysis:**

Effects of riparian timber harvest on LWD recruitment in streams is the primary question that monitoring of Buffer Effectiveness is intended to address. Analysis will focus on trends in stream channel and habitat condition between the pre-harvest measurement, undisturbed control sites and post-harvest response both short-term and long-term. Changes in stream channel condition indices will be compared to the natural range of variability for Fish Habitat Objectives, and to the indices resulting from CCA site data, to provide insight into the overall health of managed watersheds in the Tongass.

**Results**:

Stream buffer effectiveness data will be compiled annually and reported in the TLMP and ADEC BMP monitoring reports. Data compilation will be primarily in tabular format. Statistics showing trend data, and comparisons between Process Groups and Subsections population means and variances may be displayed in graphical format.

## ***Fish Passage at Road Crossings***

### Background

The goal of this monitoring effort is to evaluate potential fish migration barriers at the intersection of road and stream networks. The objectives of this protocol:

1. Provide specific direction on methods to consistently inventory, characterize, and evaluate existing structures present in fish-bearing streams.

2. Outline a monitoring framework that focuses field time and resources on the highest priority stream crossings.

3. Identify specific structural and hydraulic conditions that are assumed adequate to mitigate fish passage at road crossings.

New roads constructed under the current standards and guidelines will be routinely monitored following this protocol. Additionally, this protocol will be used to evaluate fish passage through forest roads constructed before implementation of the Revised Forest Plan. Monitoring of the older roads will likely occur simultaneously with Forest Plan monitoring.

It is recommended that the entire length of all newly constructed roads be monitored within one year of construction. If for some reason all new roads cannot be monitored within the first year, a priority should be given to roads in watersheds that have been selected for monitoring of fish management indicator species. All forms of fish habitat monitoring should include, or focus in, watersheds chosen for monitoring population trends of the indicator species. Subsequent monitoring should occur on a periodic basis in conjunction with Road Condition Surveys.

This monitoring effort and associated protocols only address the achievement of fish passage under current conditions. They do not address design criteria, maintenance needs, or constitute a risk assessment. This monitoring effort will, however, assist in evaluation of the success of design, maintenance and other management actions. Additional protocols must be developed in these areas to ensure full implementation of TLMP (1997) Standards and Guidelines.

### Data Collection

This monitoring strategy is based on a framework that requires consistent identification, characterization, and evaluation of fish passage structures (Figure 1). The foundation for this framework is derived from a combination of published literature and the working knowledge of State and Federal resource specialists.

Identification

The first priority is to locate and define the population of existing structures on Class I and Class II channels with upstream fish habitat. The Road Condition Surveys (RCS) currently being conducted in the Region are ideally suited to this task. For roads yet to be surveyed, engineering records and NEPA documents are alternate sources of information. The minimum meta-data requirements (spatial and temporal) to consistently track this population are listed in Table 1. Needed additions to the RCS protocol are also noted. The protocol will be revised accordingly and submitted to the Interagency Monitoring and Evaluation Group (IMEG) for approval prior to the 1999 field season.

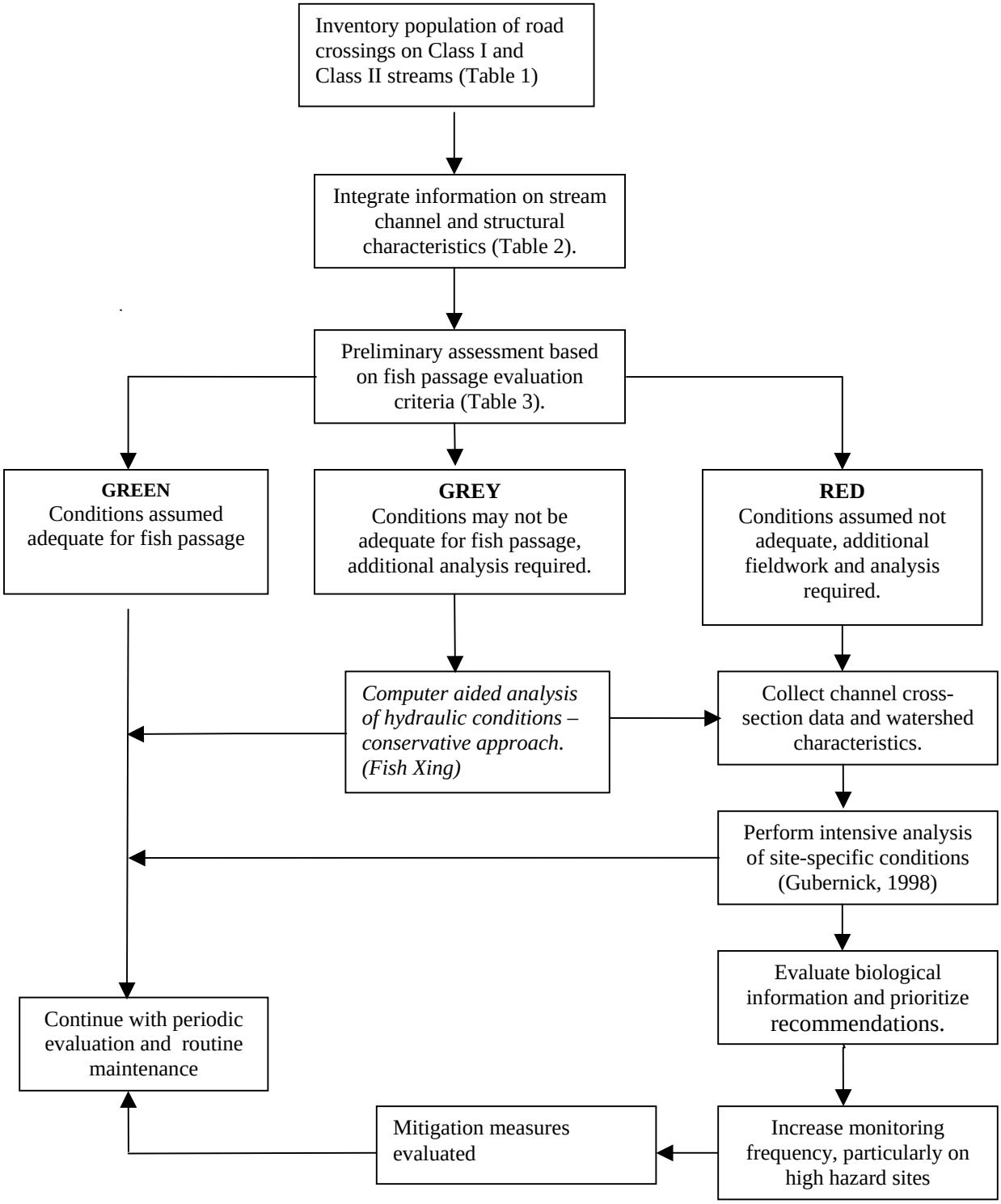


**Figure 1. Monitoring framework for fish passage at road crossings**

**Table 1. Meta-data standards for fish passage structures. Fields currently in the Road Condition Survey Protocol are denoted with a "Y" in the RCS column.**

| ***Data Field*** | **Description** | ***RCS*** |
|---|---|---|
| Road System | Name of local transportation network | Y |
| Route ID | System road GIS route ID (or road number) | Y |
| Milepost | Distance along route | Y |
| Unique ID | Unique identifier (road number & milepost combined) | Y |
| Stream LLID | Stream route ID | N |
| ADF&G Number | Stream number from State Anadromous Waters Catalog | N |
| Stream Class | Forest Plan stream classification | Y |
| Species Present | Documented or observed list of fish species | Y |
| Survey Date | Date of most recent inspection | Y |

## Characterization

After the population has been defined, stream channel and structural characteristics can be attributed in the database and distilled for analysis. Road Condition Surveys are once again the ideal vehicle for obtaining the required information. Data collected during a RCS on a culvert or bridge site includes attributes that describe site condition, hydraulic capacity, and the distribution of fish species.

The data fields listed in Table 2 represent the minimum requirements for conducting a preliminary evaluation of fish passage at road crossings. As previously noted, required modifications to the RCS protocol will be submitted to IMEG prior to the 1999 field season. These modifications will also adjust the accuracy and precision of several measurements needed for modeling purposes. For example, elevation measurements used for culvert slope calculations will need to be taken with a hand level and stadia rod rather than with a clinometer.

The most significant change to the RCS is the inclusion of a longitudinal profile for the affected stream reach. The surveyed reach should extend at least two culvert spans upstream and downstream of the structure. The elevations must be taken from a common datum point and in accordance with USGS survey protocols (Harrelson et al., 1994). Many of the elevations would replace existing depth measurements (e.g. perch height, substrate depth, outlet pool depth, etc.) currently collected by the RCS. Although the profile is labor intensive, the data is essential for modeling fish passage capability.

Another important change in the RCS is a shift to recording channel bedwidth rather than bankfull width. Channel bedwidth is independent of water level, and equates to the distance between the bottom-of-the-left-bank and the bottom-of-the-right-bank (vegetative trim-line to vegetative trim-line). Channel bedwidth is preferred over bankfull width because it easier to consistently identify in the field. A more detailed description and indicators of channel bedwidth can be found in the revised Aquatic Management Handbook.

The bottom-of-the-bank used to determine channel bedwidth is essentially the same as the “ordinary high water mark” used by ADF&G and ADOT. The term "ordinary high water mark" is defined as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

**Table 2. Minimum data requirements for preliminary assessment. Fields in the Road Condition Survey Protocol are denoted with a "Y" in the RCS column.**

| *RCS* | **Data Field** |
|---|---|
| Y | Culvert rise |
| Y | Culvert span |
| Y | Culvert length |
| Y | Culvert shape |
| N | Corrugation size |
| Y | Inlet configuration |
| Y | Installation type |
| Y | Blockage (restriction of culvert barrel) |
| N | Presence of camber |
| N | Structural damage (lip distortion) |
| Y | Pipe flotation |
| N | Bed elevation upstream (two culvert diameters) |
| N | Bed elevation upstream (one culvert diameter) |
| Y | Bed elevation at inlet |
| Y | Invert elevation at inlet |
| Y | Water surface elevation at inlet |
| N | Road surface elevation |
| Y | Invert elevation at outlet |
| Y | Bed elevation at outlet |
| Y | Water surface elevation at outlet |
| Y | Outlet pool surface elevation |
| Y | Outlet pool max depth |
| Y | Outlet pool tailcrest depth |
| N | Bed elevation downstream (two culvert diameters) |
| Y | Substrate coverage |
| Y | Substrate classification |
| Y | Velocity |
| N | Channel geometry |
| Y | Upstream bankfull width |
| N | Upstream bedwidth |
| Y | Downstream bankfull width |
| N | Downstream bedwidth |
| Y | Fish Species |
| Y | Fish Sampling Methods |

Note: Reference Region 10 Road Condition Data Dictionary for definitions, field methods, and precision.

**Evaluation Criteria**

The Tongass Land and Resource Management Plan (TLMP 1997) Standards and Guidelines require that the Forest Service maintain, improve, and restore the opportunities for fish migration in Class I and II streams. Furthermore, on Class I streams, juvenile coho (*Oncorhynchus kisutch*) have been specifically identified as the design species and life stage. "When a culvert is selected for stream crossing, design, install and maintain the culvert to prevent the creation of water velocity or height barriers at the outlet of the pipe, and allow upstream passage of juvenile coho" (TLMP 1997).

On Class II streams, the intent of the Forest Plan is to provide passage of resident fish in all streams, but occasionally it is not feasible to protect short sections of habitat. For Flood Plain (FP) and Moderate Gradient-Mixed Control (MM) channels the design species is Dolly Varden char, rainbow trout, and/or cutthroat trout juveniles greater than a year old. Adult Dolly Varden char, rainbow trout, and/or cutthroat trout are the design species for the remaining stream channel process groups.

The Forest Service is also subject to Section 33 Code of Federal Regulations 323.3(b) (Clean Water Act, 1987) that states; "the design, construction and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body." In addition, the Forest Service recognizes applicable provisions in the Coastal Zone Management Act and the Supplemental Memorandum of Understanding with the Alaska Department of Fish and Game.

Results

Once the structures have been inventoried, attributes listed in Table 2 will be used to conduct a preliminary assessment (RCS database queries). This assessment is directly linked to evaluation criteria that have been designed to classify structures into one of the following three categories (Table 3):

- Green: Conditions are assumed adequate for fish passage.
- Grey: Conditions may be adequate for fish passage, additional analysis required.
- Red: Conditions are not adequate, additional fieldwork and analysis required.

The validity of this preliminary assessment is dependent on the assumptions used to draft the evaluation criteria (Table 3). These criteria need to be field tested and re-evaluated on an annual basis to verify that we are successfully identifying migration barriers at road crossings.

**Analysis**

With the aid of computer software applications (FishXing), the next step is to analyze the population of "gray" culverts, ultimately routing them to either the "green" or "red" side of the framework (Figure 1). To accomplish this task, a conservative modeling approach will be applied. Fundamental knowledge of basin hydrology and/or channel hydraulics is required to adequately perform the following seven-step analysis process. Each step in the process is designed to generate the specific values required to model fish passage capability (Table 4).

**Table 3. Fish passage evaluation criteria.**

| | ***Structure*** | ***Green[1]*** | ***Grey[2]*** | ***Red[3]*** |
|---|---|---|---|---|
| *1* | Bottomless pipe arch or countersunk pipe arch, substrate 100% coverage and invert depth greater than 20% of culvert rise. | Installed at channel grade (+/- 1%), culvert span to bedwidth ratio of 0.9 to 1.0, no blockage. | Installed at channel grade (+/- 1%), culvert span to bedwidth ratio of 0.5 to 0.9, less than or equal to 10% blockage. | Not installed at channel grade (+/- 1%), culvert span to bedwidth ratio less than 0.5, greater than 10% blockage. |
| *2* | Countersunk pipe arches (1x3 corrugation and larger). Substrate less than 100% coverage or invert depth less than 20% of culvert rise. | Grade less than 0.5%, no perch, no blockage, culvert span to bedwidth ratio greater than 0.75. | Grade between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bedwidth ratio of 0.5 to 0.75. | Grade greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bedwidth ratio less than 0.5. |
| *3* | Circular CMP 48 inch span and smaller, spiral corrugations, regardless of substrate coverage. | Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bedwidth ratio greater than 0.75 | Culvert gradient 0.5 to 1.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bedwidth ratio of 0.5 to 0.75. | Culvert gradient greater than 1.0%, perch greater than 4 inches, blockage greater than 10%, span to bedwidth ratio less than 0.5. |
| *4* | Circular CMPs with annular corrugations larger than 1x3 and 1x3 spiral corrugations (>48" span), substrate less than 100% coverage or invert depth less than 20% culvert rise. | Grade less than 0.5%, no perch, no blockage, culvert span to bedwidth ratio greater than 0.75. | Grade between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bedwidth ratio of 0.5 to 0.75. | Grade greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bedwidth ratio less than 0.5. |
| *5* | Circular CMPs with 1x3 or smaller annular corrugations (all spans) and 1x3 spiral corrugations (>48" span), 100% substrate coverage and substrate depth greater than 20% of culvert rise. | Grade less than 1%, no perch, no blockage, culvert span to bedwidth ratio greater than 0.75 | Grade 1.0 to 3.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bedwidth ratio of 0.5 to 0.75. | Culvert gradient greater than 3.0%, perch greater than 4 inches, blockage greater than 10%, culvert span to bedwidth ratio less than 0.5. |
| *6* | Circular CMPs with 2x6 annular corrugations (all spans), 100% substrate coverage and substrate depth greater than 20% of culvert rise. | Grade less than 2.0%, no perch, no blockage, culvert span to bedwidth ratio greater than 0.75 | Grade 2.0 to 4.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bedwidth ratio of 0.5 to 0.75. | Grade greater than 4.0%, greater than 4 inch perch, greater than 10% blockage, culvert span to bedwidth ratio less than 0.5. |
| *7* | Baffled or multiple structure installations | | All | |
| *8* | Log stringer or modular bridge | No encroachment on bedwidth. | Encroachment on bedwidth (either streambank). | Structural collapse. |

| Table 4. Analytical steps and required outputs for conservative modeling approach. | | |
|---|---|---|
| | ***Analytical Step*** | ***Required Output*** |
| 1 | ***Target Fish*** | Species, life stage, swimming speed, and periodicity |
| 2 | ***Basin Hydrology*** | $Q_2$ (discharge corresponding to 2-year return interval) |
| 3 | ***Design Flow*** | $Q_2$ 2-day duration flow |
| 4 | ***Manning's Coefficient*** | Manning's "n" value |
| 5 | ***Tailwater Estimation*** | Critical depth at design flow |
| 6 | ***Velocity Correction*** | Boundary layer velocity |
| 7 | ***Model Evaluation*** | Length of culvert zones |

**1. Target Fish**

The target species and life stages requiring passage will be determined by the District Biologist based upon RCS data, historic records and ADF&G documentation. Table 5 displays prolonged and burst swimming speeds for species and life stages endemic to the Tongass National Forest. The periodicity of seasonal migration also needs to be determined. In the absence of site-specific information, Table 6 has been cooperatively developed by ADF&G and the Forest Service to provide general guidance.

**2. Basin Hydrology**

The principle challenge associated with hydrologic engineering in Southeast Alaska is the general lack of basic hydroclimatological data. However, if sufficient gauging records do exist for a given watershed, the Log Pearson Type III analysis as defined in Water Resources Council Bulletin 17B, 1981, "Guidelines for Determining Flood Flow Frequencies" should be used to calculate the discharge corresponding to a two year return interval ($Q_2$).

Estimation of $Q_2$ without historic gauge data is a two-fold process. First, basin characteristics must be determined with the aid of USGS 1:63,360 series quads, GIS, and aerial photography. These morphometrics are then used in regression equations derived by Jones & Fahl (1994) in the Magnitude and Frequency of Floods in Alaska and Conterminous Basins of Canada:

$$Q_2 = 0.0120 * A^{0.806} * P^{0.819} * (ST+1)^{-0.357} * (J+32)^{1.499}$$

A = Drainage area ($mi^2$)
P = Mean annual precipitation
ST = Area of lakes and ponds in percent
J = Mean minimum January Temperature

The mean annual precipitation and mean minimum January temperature are both obtained from maps provided in the Jones and Fahl (1994) report.

**Table 5. Swimming performance of Alaskan fish species (from Hunter et al., 1986; original field data source noted).**
***Notes: L = total length of the fish in meters (not fork length); t = duration of swimming effort in seconds; substitute Artic char for Dolly Varden char***

| Species | Length Range (mm) | Water Temp. (C) | Burst (m/s) | Sustained (m/s) | Source Data |
|---|---|---|---|---|---|
| Juvenile Salmon | n/a | n/a | 0.638*(L*0.0254)-0.0172 | | Barber and Downs (1996) |
| Coho Salmon | 40 to 178 | 8 to 12 | | 3.02 * L0.52 * t-0.1 | Glova and McInerney (1977); Davis et al. (1963); Flagg et al. (1983); and Howard (1975) |
| Coho Salmon | 40 to 133 | 13 to 15 | | 5.67 * L0.7 * t-0.1 | Glova and McInerney (1977); Davis et al. (1963); Flagg et al. (1983); and Howard (1975) |
| Coho Salmon | 40 to 120 | 18 to 20 | | 5.87 * L0.7 * t-0.1 | Glova and McInerney (1977); Davis et al. (1963); Beamish (1978); and Dahlberg et al. (1968) |
| Coho Salmon | 356 to 510 | 10 to 19 | 13.3 * L0.52 * t-0.65 | | Weaver (1963) and Beamish (1978) |
| Pink Salmon | 494 to 607 | 20 | | 4.08 * L0.55 * t-0.08 | Brett (1982) |
| Sockeye Salmon | n/a | 2 | | 3.31 * L0.6294 * t-0.1 | Brett and Glass (1973) |
| Sockeye Salmon | n/a | 5 | | 3.63 * L0.6243 * t-0.1 | Brett and Glass (1973) |
| Sockeye Salmon | n/a | 10 | | 4.46 * L0.6294 * t-0.1 | Brett and Glass (1973) |
| Sockeye Salmon | n/a | 15 to 18 | | 5.21 * L0.06345 * t-0.09 | Brett and Glass (1973) and Brett (1982) |
| Sockeye Salmon | n/a | 18 to 20 | | 4.99 * L0.6293 * t^0.09 | Brett and Glass (1973) and Brett (1982) |
| Sockeye Salmon | 77 to 539 | 15 | | 4.42 * L0.5 * t-0.1 | Brett (1965a) |
| Sockeye Salmon | 126 to 611 | 10 to 15 | | 5.47 * L0.89 * t-0.07 | Brett (1964, 1967, and 1982) |
| Chinook Salmon | 508 to 965 | 19 | 11.49 * L0.32 * t-0.5 | | Weaver (1963) |
| Cutthroat Trout | n/a | n/a | 6 ft/sec | 2.5 ft/sec | Bell (1991) |
| Rainbow Trout | 103 to 280 | n/a | 7.16 * L0.77 * t-0.46 | | Bainbridge (1960) |
| Rainbow Trout | 103 to 813 | 7 to 19 | 12.8 * L1.07 * t-0.48 | | Bainbridge (1960); Weaver (1963); and Beamish (1978) |
| Rainbow Trout | 610 to 813 | 7 to 19 | 12.3 * L0.52 * t-0.51 | | Weaver (1963) and Beamish (1978) |
| Rainbow Trout | 30 to 300 | n/a | 15.88 * L0.81 * t-0.5 | | Webb (1977) |
| Rainbow Trout | 60 to 200 | 10 | | 3.28 * L0.37 * t-0.1 | Fry and Cox (1970) |
| Arctic Char | 70 to 420 | 9 to 10 | Apply juvenile salmon | 3.74*L^0.606*t^-0.13 | Welch (1979) and Beamish (1980) |
| Arctic Char | 70 to 420 | 9 to 10 | Apply juvenile salmon | 2.69*L^0.606*t^-0.08 | Welch (1979) and Beamish (1980) |

**Table 6. General periodicity chart for Southeast Alaska.**

| **Pink Salmon** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | DDDD | DDDD | DDDD | | | | | | | |
| Adult Passage | | | | | | | UU | UUUU | UUUU | | | |
| Spawning | | | | | | | | XXXX | XXXX | X | | |
| Incubation | XXXX | XXXX | XXXX | XXXX | XXXX | | | XXXX | XXXX | XXXX | XXXX | XXXX |
| Rearing | | | | | | | | | | | | |

| **Chum Salmon** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | DDDD | DDDD | DDDD | | | | | | | |
| Adult Passage | | | | | | | UUUU | UUUU | UUUU | UUUU | UUUU | |
| Spawning | | | | | | | XX | XXXX | XXXX | XXXX | XXXX | |
| Incubation | XXXX | XXXX | XXXX | XXXX | | | XX | XXXX | XXXX | XXXX | XXXX | XXXX |
| Rearing | | | | | | | | | | | | |

| **Sockeye Salmon** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | DDDD | DDDD | DDDD | DDDD | | | | | | |
| Adult Passage | | | | | | | UUUU | UUUU | UUUU | UUUU | | |
| Spawning | | | | | | | | XX | XXXX | XXXX | | |
| Incubation | XXXX | XXXX | XXXX | XXXX | | | | XX | XXXX | XXXX | XXXX | XXXX |
| Rearing | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX |

| **Coho Salmon** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | | DDDD | DDDD | DDDD | | BB | BBBB | BBBB | | |
| Adult Passage | | | | | | | | UUUU | UUUU | UUUU | UUUU | |
| Spawning | | | | | | | | XXXX | XXXX | XXXX | XXXX | XXXX |
| Incubation | XXXX | XXXX | XXXX | XXXX | XXXX | | | XXXX | XXXX | XXXX | XXXX | XXXX |
| Rearing | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX |

| **Steelhead** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | DDDD | DDDD | DDDD | DDDD | | BBBB | BBBB | BBBB | | |
| Adult Passage | | | BBBB | BBBB | BBBB | DDDD | | UUUU | UUUU | UUUU | UUUU | |
| Spawning | | | XXXX | XXXX | XXXX | | | | | | | |
| Incubation | | | XXXX | XXXX | XXXX | XXXX | XX | | | | | |
| Rearing | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX |

| **Cutthroat Trout** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | | | | | | BBBB | BBBB | BBBB | BBBB | |
| Adult Passage | | | | BBBB | BBBB | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spawning | | | | XXXX | XXX X | | | | | | | |
| Incubation | | | | XXXX | XXX X | XXXX | XXXX | | | | | |
| Rearing | XXXX | XXXX | XXXX | XXXX | XXX X | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX |

| **Dolly Varden** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Passage | | | | | | | | BBBB | BBBB | BBBB | BBBB | |
| Adult Passage | | | | | | | | | BBBB | BBBB | | |
| Spawning | | | | | | | | | XXXX | XXXX | X | |
| Incubation | XXXX | XXXX | XXXX | XXXX | XXX X | | | | XXXX | XXXX | XXXX | XXXX |
| Rearing | XXXX | XXXX | XXXX | XXXX | XXX X | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX | XXXX |

*Note:* **U=Upstream Movement; D=Downstream Movement; B=Both Upstream & Downstream Movement**
Use periods designated either Upstream or Both for calculation of fish passage high design flow
Incubation life phase includes time of egg deposition to fry emergence
Periodicity for cutthroat trout and Dolly Varden char apply to both resident and anadromous species
Assumptions for Dolly Varden, steelhead and coho juvenile passage from Staney Creek (Forest Science Lab)

Calculation Estimate Method

When sufficient data is not available and regression equations are not applicable, the flow that corresponds to the bedwidth should be substituted for $Q_2$. This value can be obtained through analysis of channel cross-section data and application of Mannings equation:

$$Q = 1.49/n*A*R^{2/3}*S^{1/2}$$

Q = Discharge (cfs)
R = Hydraulic radius (ft)
S = Channel slope (ft/ft)
n = Dimensionless Mannings resistance coefficient
A = Cross-sectional channel area ($ft^2$)

These values can be obtained through analysis of channel cross section data and should be used as a last resort for this conservative modeling approach. In all cases, design discharge estimates should be crosschecked against other observed field conditions (e.g., discharge indications) in undisturbed sections of the stream.

**3. Design Flow**

The fish passage design high flow corresponds to the mean annual flood with a two-day duration for the specified time of year that the target fish is migrating upstream. The $Q_2$ two-day duration flow is equal to the discharge twenty-four hours after the peak (Figure 2). Analysis of Southeast Alaska hydrographs indicates that the $Q_2$ two-day duration flow is approximately 40% of the $Q_2$ value derived from the Jones and Fahl regression equations. Until further analysis is completed, the interim equation for determining the design flow is as follows:

$$Q_2 \text{ two-day} = .4 * Q_2$$

**4. Mannings Coefficient**

Estimation of Mannings coefficient within the barrel of the culvert is a function of substrate distribution, corrugation size and culvert material. A listing of Manning coefficients is located in the Handbook of Steel Drainage & Highway Construction Products (1994). General hydrology reference books also contain roughness coefficients for a range of substrate sizes (WinXspro users manual (1997), Handbook of Applied Hydrology (1964), USGS Water Supply Paper 1849 (1967)). Substrate size and culvert attributes listed in the RCS may be used to determine the appropriate coefficient which is required in the preliminary assessment. A roughness coefficient may also be back calculated with Mannings equation if velocity, water depth, and precise slope measurements were recorded during the RCS.

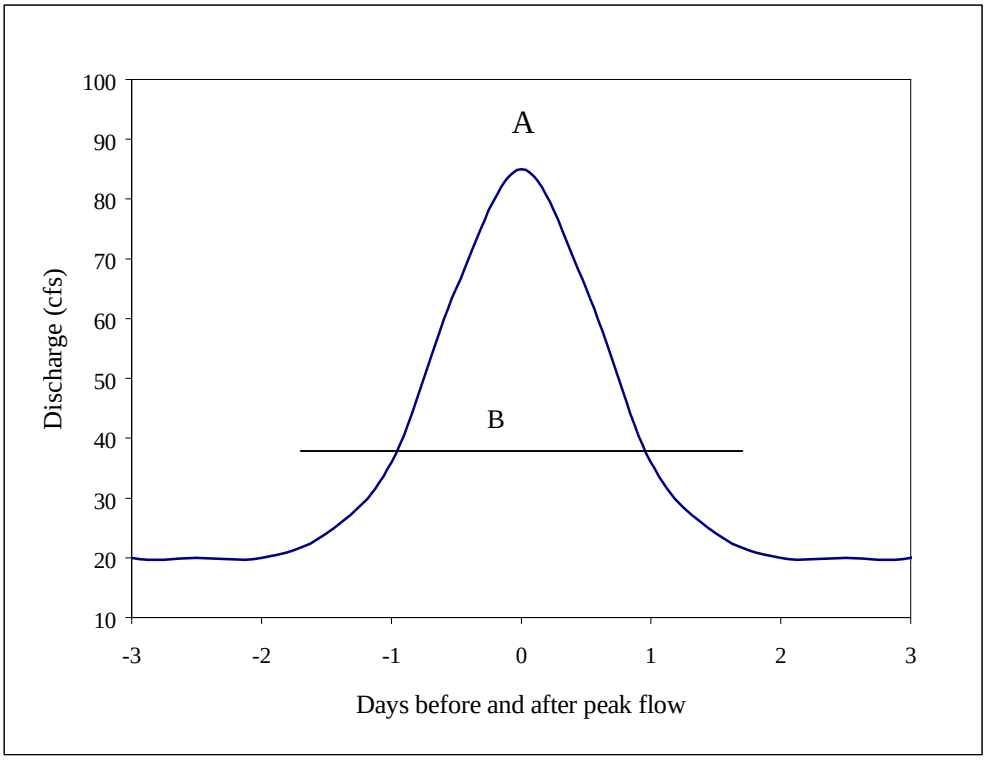


**Figure 2.** Median hydrograph depicting (A) $Q_2$ peak and (B) $Q_2$ 2-day duration.

**5. Tailwater Estimation**

Without channel cross-sections, the best estimate for tailwater elevation is the critical depth within the pipe at design flow. If the culvert outlet is perched, tailwater elevation is the elevation of the invert at the outlet of the culvert. Critical depth for bare circular pipes can be obtained directly from nomographs published in the Handbook of Steel Drainage & Highway Construction Products (1994) and the Hydraulic Design of Highway Culverts FHWA-IP-85-15 (1985). If the installation is a circular or arch culvert with substrate coverage, critical depth for a given flow in a culvert is calculated by trial and error solution where:

$Q_{2d2}^2 * B / g * A^3 = 1$
$Q_{2d2}$ = Design discharge
B = Water surface width
A = Cross sectional flow area
g = Acceleration of gravity 32.2 ft/sec

A standardized spreadsheet or computer program (Haestad Methods™) will need to be adopted for ease of computation. Once a number of iterations have been run and critical depth determined, the conservative estimate will help model flow conditions at the outlet of the culvert.

**6. Boundary Layer Velocity Reductions**

Once the culvert attributes have been entered into the FishXing program, the mean velocity is calculated. However, this average velocity ($V_{ave}$) is not representative of the velocities in the culvert where fish (juveniles in particular) generally migrate. Research (Behlke et al. 1991) has shown that fish swim in the zones of lowest velocity along the boundary layer. These zones are typically near the water surface, against the culvert walls or along the substrate depending upon its roughness. Inlet and outlet velocities apply for a length equal to one culvert diameter. The interim reduction factors needed to convert mean velocity to boundary layer velocity are as follows:

Culverts with 2x6 corrugations or installations with 100% substrate coverage:

Inlet & outlet velocity = $0.8*V_{ave.}$
Barrel velocity = $0.4*V_{ave.}$

Culverts with 1x3 corrugations or installations without 100% substrate coverage:

Velocity = $0.8*V_{ave.}$

7. Model Evaluation

This evaluation is strictly based on velocity criteria and does not account for other known forces (Virtual mass, gradient forces etc.) at work within the culvert. This velocity-based method is primarily intended to serve as an interim measure until the FishXing program is updated in the Fall of 1999 to account for the additional forces that influence fish passage through culverts.

The analysis assumes allowable time duration for a burst speed of 5 seconds 60 minutes for prolonged speeds. Allowable distance will be analyzed according to the following equation:

$L_c = T(V_f - V_{fw})$
$L_c$ = Allowable distance (barrel, inlet or outlet lengths)
$V_f$ = Fish burst or prolonged speed
$V_{fw}$ = Water velocity in the boundary layer

Using the boundary velocities for each region within the culvert, the equations are solved for the allowable distance a fish can swim at a given duration. The calculated distances will then be compared to the lengths of the inlet, barrel, and outlet zones.

Fish passage is assumed if the total allowable distance exceeds the length of the culvert. Routine maintenance surveys will continue to periodically monitor site conditions. If the length for a portion of the pipe namely inlet and outlet zones are less than the actual length then the culvert is placed in the “red-zone.” Once as structure has fallen into the “red-zone” a site visit and more intensive, interdisciplinary investigation will be required. The “red-zone” protocol currently being refined by Bob Gubernick on the Stikine Area provides guidance for the structural, hydraulic, and biological evaluation of those culverts assumed not adequate for fish passage.

## Glossary

**Bankfull discharge** is the discharge corresponding to the stage at which the floodplain of a particular stream reach begins to be flooded. The discharge generally equals a flood with a return frequency of approximately 1.5-years.

**Bed roughness** is a measure of the irregularity of streambed materials as they contribute to resistance to flow. Commonly measured in terms of Mannings roughness coefficient.

**Bedwidth** is the distance from the bottom of the left bank to the bottom of the right bank. The distinction between bed and bank are determined by examining channel geometry and the presence/absence of vegetation.

**Channel** is a natural or artificial waterway of perceptible extent, which periodically or continuously contains moving water. It has a definite bank and bed that serves to confine the water.

**Class I streams** have anadromous or adfluvial fish habitat; or high quality resident fish waters; or habitat above fish migration barriers known to be reasonable enhancement opportunities for fish.

**Class II streams** have resident fish populations and generally steep (6-15%) gradient (can also include streams from 0-6% gradient) where no anadromous fish occur, and otherwise not meeting Class I criteria. These populations have limited fisheries values and generally occur upstream of migration barriers or have other habitat features that preclude anadromous fish use.

**Invert** is the bottom inside surface of a culvert.

**Mannings n** is an empirical coefficient for computing stream bottom roughness used in determining water velocity in stream discharge calculations.

**Mean annual flood discharge** is the arithmetic mean of all the annual floods at a given site and should not be confused with the flood having a recurrence interval of one year. The mean annual flood has a recurrence interval of 2-years for normal or log-normal distributions and 2.33-years according to the theory of extreme values as applied to floods by Gumbel (1945).

**Migration** is the deliberate movement of fish from one habitat to another. Includes the downstream movement of young anadromous fish from streams to sea; the upstream movement of adult anadromous fish from sea to freshwater spawning streams; the movement (upstream and downstream) of juvenile anadromous fish to rearing and over-winter habitats; and the movement (upstream and downstream) of resident fish to spawning, rearing and over-wintering habitats.

**Ordinary high water mark** is defined as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

**Pools** are portions of the stream with reduced current velocity, often with water deeper than the surrounding areas, and which is frequently usable by fish for resting and cover.

**Swimming speeds** of fish vary from essentially zero to over six meters per second, depending upon species, size, and activity. Three categories of performance are generally recognized:

**Sustained (prolonged) speed** is the speed that a fish can maintain for a prolonged period, but which ultimately results in fatigue. Metabolic activity in this mode is mixed anaerobic and aerobic and utilizes some white muscle tissue and possibly red muscle tissues.

**Burst (darting) speed** is the speed a fish can maintain for a very short period, generally 5 to 10 seconds, without gross variation in performance. Burst speed is employed for feeding, escape, and negotiating difficult hydraulic situations, and represents maximum swimming speed. Metabolic activity in this mode is strictly anaerobic and utilizes all of the white muscle tissues.

**Thalweg** is the line connecting the lowest or deepest points along a streambed.

**Velocity** is the time rate of motion; the distance traveled divided by the time required to travel that distance.

**Mean culvert cross-sectional velocity ($V_{Q/A}$)** is the discharge divided by the cross-sectional area of the flow.

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***Channel Condition Assessment***

**Data Collection:**

The TLMP follow-on study, '*Development of Protocols for Effectiveness Monitoring of Aquatic Habitat Conditions on the Tongass National Forest: a TLMP Information Need*' is testing and revising protocols used for measuring stream channel condition as an effectiveness monitoring tool. This is a cooperative project involving personnel from the PNW Research Station and District, Area, and Regional personnel from the Tongass National Forest. The foundation for this work is reported in the publication, *Woodsmith, R.D. and Buffington, J.M. 1996. 'Multivariate geomorphic analysis of forest streams: implications for assessment of land use impacts on channel condition', Earth Surface Processes and Landforms, 21:377-393*. This initial research identifies objective, consistent, and repeatable measurements for assessment of the physical condition of stream channels, and concludes that the condition of undisturbed channels is markedly different from that of channels highly disturbed by land use. In addition to monitoring, this information is useful for identifying restoration needs, evaluating restoration effectiveness, establishing habitat objectives, and assessing channel sensitivity. Data collection procedures include instrument surveys of channel morphology, measurement of stream bed grain size, surveys of pools and large woody debris, and remote measurement of watershed size, riparian stand condition, and land use intensity. These procedures are detailed in the draft report, *Kuntzsch, D., Smith, D.P., Dilger, M., and Woodsmith, R.D., 'Channel Condition Assessment Protocol'*, which is available from the Juneau Forestry Sciences Laboratory.

A cumulative effects approach is taken in that study sites are limited to low gradient channels with some floodplain development. These depositional stream reaches respond to many of the potential effects of land management throughout the watershed. However, this channel condition assessment procedure is not designed to measure changes in water chemistry, temperature, turbidity, or dissolved or suspended sediment load. During 1997, the first year of this five-year study, over forty stream reaches were sampled, including sites on each Area of the Tongass National Forest.

In order to develop an integrated approach to effectiveness monitoring, the TLMP follow-on study includes measurement of salmonid species density and distribution and size distribution employing depletion estimate techniques at selected study sites (*Bryant, M. D., unpublished ms.)*. This sampling is based on procedures reported in the publication*, Bryant, M. D., Wright, B.E., and Davies, B.J. 1992. 'Application of a Hierarchical habitat unit classification system: stream habitat and salmonid distribution in Ward Creek, southeast Alaska', Research Note PNW-RN-508, Portland, OR., U.S.D.A., Forest Service, Pacific Northwest Research Station, 18 pp*. The biologic component of this study will provide a link between the physical measurements, habitat complexity, and the response of salmonid populations.

**Evaluation Criteria:**

Forest plan standards and guidelines include the objectives, "maintain or restore the natural range and frequency of aquatic habitat conditions ...and stream channel processes". Effectiveness monitoring evaluation criteria should include the following variables: pool frequency, large woody debris loading, the ratio of mean residual pool depth to mean bankfull depth, and the ratio of the measured surface grain size to that predicted for bankfull flow. Other variables that are being assessed, and should be considered, include channel width to depth ratio, relative roughness, riparian stand condition, intensity of land use, and watershed size. All evaluation should be done in a whole-watershed context, in the sense that study streams should be evaluated as part of a basin where aquatic habitat inventories include portions of the entire basin and basic watershed analysis components are conducted to assess the effects of geology, local climate, glacial deposits, etc. This framework will allow for the interpretation of measured change or lack of change in the context of processes and conditions occurring throughout the watershed.

**Precision and Reliability:**

Several sources of variability are being evaluated as part of this study. These sources include naturally-occurring variability in channel condition parameters over time and space, variability between individual data collectors and crews, and the limits of measurement precision. An accurate assessment of these sources of variability is essential to the meaningful interpretation of monitoring results and the distinction of apparent from real change in channel condition parameters.

**Results:**

Interim progress and results of the five-year TLMP follow-on study are being reported in the 'Forest Plan Research News' and in meetings with District and Area personnel interested in results for specific sites. Automation of data analysis was a major aspect of the first year of this study and will facilitate rapid interpretation of field data in the future.

**Analysis:**

Data will be analyzed by testing for successful discrimination among study sites on the basis of intensity of land management. This will be done qualitatively by visual interpretation of scatter plots and quantitatively using multivariate statistical techniques. Relationships between habitat measures and fish densities will be tested statistically to determine salmonid response to the type and range of habitat variables. If intensity of land use is reflected in real differences in channel condition parameters, then these parameters can be used to monitor effectiveness of forest plan standards and guidelines.

***HERITAGE RESOURCES***

**Goal**: Identify, evaluate, preserve, protect, and enhance heritage resources.

**Objective:** Protect heritage resources (as described in the Heritage Resources Forest-wide Standards and Guidelines).

**Background:** The Forest Plan provides guidance on maintenance of a heritage resource management program that identifies, evaluates, preserves, and protects significant heritage resources. This guidance applies Forest-wide and on a project-specific basis pursuant to the National Historic Preservation Act (NHPA), as amended, as well as other relevant acts and implementing regulations (for example, the Archaeological Resources Protection Act and the Native American Graves Protection and Repatriation Act). Section 106 of the NHPA requires that the Forest Service take into account the effect an "undertaking" (project, activity or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency) may have on heritage resources eligible for or listed on the National Register of Historic Places (National Register). When it is deemed necessary to complete a heritage resource survey for an undertaking, previously identified heritage resources within the project area are monitored for condition status. Section 110 of the NHPA requires a federal agency to inventory, protect, use and interpret all heritage resources eligible for or listed on the National Register.

The Alaska Region has a Programmatic Agreement (PA) with the Advisory Council on Historic Preservation and the Alaska State Historic Preservation Officer. The PA formalizes our compliance with Section 106 of the NHPA and implements monitoring standards. These standards call for monitoring of project areas either during or after project implementation to judge the effectiveness of current models that predict the heritage resource sensitivity of any given area of the forest.

The Forest Plan heritage resources standards and guidelines address (1) project clearance/inventory, (2) project implementation, (3) mitigation, and (4) enhancement. Detailed monitoring directions can be found in the Heritage Resource Monitoring Guidebook. These directions include details on a filtering process to select sites and forms to utilize for field investigations.

**Heritage Resources Question 1: Are heritage resources standards and guidelines being implemented?**

**Estimated Cost**: $30,000 annually

**Data Collection:** Refer to the heritage resource Guidebook for details on the filtering process, data collection and data collection forms.

1. Project Inventory/Clearance
    - At the end of each fiscal year, compile a list of all Section 106 undertakings and Section 110 activities completed during that year.

    - Determine whether consultation with the Alaska State Historic Preservation Officer was accomplished, according to the programmatic agreement, prior to the release of the draft Environmental Impact Statement or the Environmental Assessment for public review, or before signing a decision memo.

2. Project Implementation

- Determine whether inventory and evaluation was accomplished under the supervision of a qualified heritage resource specialist.

- Determine whether each undertaking or project included a statement of the operating conditions required to protect heritage resources in the project area. Determine if these included the pertinent clause notifying the operator of his or her responsibility to protect marked sites when working in the project area and the operator's liability for damage.

- Determine whether sites were discovered during project implementation.

3. Mitigation
   - Determine whether mitigation measures were effective in protecting heritage sites.

   - Identify whether disinterment of human remains and associated grave goods, sacred objects and objects of cultural patrimony followed the Native American Graves Protection and Repatriation Act.

4. Enhancement
   - Determine whether significant and suitable heritage resource sites were managed to realize their recreational and educational values to the public.

   - Document whether heritage resource properties and their records were protected to prevent degradation or unauthorized use under authority of the Archaeological Resources Protection Act of 1979 and the regulations in 36 CFR 296.

**Evaluation Criteria:** Compliance with Heritage Resource standards and guidelines. The expectation is for 100% compliance at all sites, except as documented during the NEPA and NHPA process.

**Precision and Reliability:** Most variables will be examined by qualified heritage resource professionals providing high precision and reliability. Some variables may be evaluated by other professionals who will be trained to recognize those specific conditions, also providing high precision and reliability.

**Results:** Tabulate information obtained through data collection above by Section 106 undertaking and Section 110 activities.

**Analysis:**
- Summarize compliance with standards and guidelines for all undertakings and projects. Present the total number of undertakings and projects, and percent compliance for each standard and guideline examined.
- Discuss intentional or unintentional deviation from any heritage resource standard or guideline, including what corrective action, if any, is planned.

**Heritage Resources Question 2: Are heritage resources standards and guidelines effective in protecting heritage resources as expected in the Forest Plan?**

**Estimated Cost:** $90,000 annually.

**Data Collection:**

1. Project Inventory/Clearance: Conduct a files search and field review of all Section 106 undertakings completed during the fiscal year.

2. Project Implementation: Conduct field inspections on selected sites at least once a year, and document the conditions of any site, any changes from the previous inspection and, if possible, the cause of the change. Select sites based on an assessment of several factors, including their resource values and their susceptibility to disturbance from natural forces, vandalism or management activity.

3. Mitigation; Observe in the field the effects of specified protection and mitigation measures implemented.

4. Enhancement:: Where heritage resources were enhanced through interpretation and education determine whether these measures were effective in communicating salient features of the site and in being compatible with the nature, quality and integrity of the subject resource.

**Evaluation Criteria:** Demonstrated effectiveness of activities implemented.

**Precision and Reliability:** Most variables will be examined by qualified heritage resource professionals providing high precision and reliability. Some variables may be evaluated by other professionals who will be trained to recognize those specific conditions, also providing high precision and reliability.

**Results:** Tabulate results obtained through data collection.

**Analysis:**

- Describe the effectiveness of protecting heritage resources for all projects and sites examined.
- Describe the effectiveness of the standards and guidelines in protecting heritage resources including what corrective action, if any, is planned.

**KARST AND CAVES**

**Goal**: Maintain and protect significant cave and karst ecosystems Forest-wide.

**Objectives**: Allow for the continuation of natural karst processes. Maintain the productivity of the karst landscape while providing for other land uses where appropriate.

**Background:** The Tongass National Forest contains the largest concentration of dissolution caves known in the State of Alaska. The Forest also contains world-class surface or epikarst features particularly in the alpine and sub-alpine zones. The caves and epikarst features result from the chemical weathering of limestone and marble bedrock. The karst and cave features and associated resources are a recently discovered and recognized attribute of the lands within Southeast Alaska. The have been found to be of national and international significance for a wide variety of reasons, including their intensity and diversity of development, the biological, mineralogical, cultural, paleontological components, and recreational values.

**Karst and Caves Question 1:** Are karst and cave standards and guidelines being implemented?

**Estimated Cost:** $30,000 annually

**Data Collection**: Utilize the data collection form for the karst data collection that is included in the appendix. Select unit based upon stratified random sample weighted on sensitivity on karst vulnerability.

- For each project, review the planning record for Karst related issues.
- In the planning record review, determine whether a karst vulnerability assessment process was completed.
- Annually conduct field investigations selected harvest units and associated roads developed under the new Forest Plan to determine if Karst standards and guidelines have been implemented
- Determine if partial suspension was achieved in areas of moderate vulnerability karst within the harvest unit. Characterize the soil disturbance if present.
- Determine whether high vulnerability karst areas were excluded from management activities.
- Determine whether timber harvest, road construction, and/or quarry development occurred within 100' edge of a sinkhole, collapse channel, doline field, losing stream, or other collapse karst feature.
- Note if dye tracing was used to determine whether losing streams contributed to class I or II streams or domestic water supply through a karst hydrologic system.
- Note whether buffers designed to protect karst systems and their features appear to be wind firm.
- Determine whether development occurred on lands that overlie a known ``significant'' cave.
- Determine whether development occurred on lands that were close enough to the entrance of a cave to be capable of altering the microclimate of the cave's entrance, cave features within the cave or both .
- Determine if roads crossed high vulnerability areas only where no other option existed and karst resource values were not compromised. If so was the mitigation prescribed adequate to protect the karst and cave resources.
- Determine whether roads were constructed over sinkholes and other collapse features and losing streams
- Determine whether roads and other development diverted water to or from karst features

- Determine whether measures were taken to reduce erosion and sediment transport from road surface and cutslopes were effective.
- Determine whether quarries were not developed on top karst without adequate site survey and design.
- Determine if high vulnerability karst areas have been digitized into GIS and removed from the timber base.

**Evaluation Criteria:** Compliance of land disturbing projects with Karst and Cave Forest-wide Standards and Guidelines.

**Precision and Reliability:** Relatively high reliability; data collection is based upon field investigations by local experts, trained resource specialists and qualified volunteers.

**Results:**

- List projects on karst terrain or that directly effect karst terrain.
- Tabulate observations concerning suspension, road construction, or quarry development relative to standard & guide compliance.
- Document karst vulnerability assessment process used and any dye studies completed.

**Analysis:**

- For each project summarize compliance results.
- Summarize results of karst vulnerability assessments for each project.

**Karst and Caves Question 2: Are karst and cave standards and guidelines effective in protecting the integrity of significant caves and the karst resource?**

**Estimated Cost:** $50,000 annually

**Data Collection:**

- Select two significant caves per year to monitor near where development has occurred. To be useful, pre-management activity information and inventory must have been collected. This includes surface and subsurface inventories and stream chemistry analysis.

- Enter the caves to determine if any of the management activities have caused damage to the cave resources including their geologic, hydrologic, wildlife, fisheries, historical, cultural, and paleontological resources have not been damaged by the timber harvest or road construction activities.

- Inspect the caves and adjacent land to determine if the karst system's and the cave's integrity has been maintained. Determine the status of the karst hydrology in the caves and note soils loss, forest regeneration, sedimentation, and debris transport if evident.

- Measure the pH, conductivity, dissolved oxygen, and turbidity of the losing or rising streams associated with the caves. Compare this information with the pre-management data collected for the sites. Try to duplicate the seasonal timing and flows of the pre-management sampling. Attach this hydrologic data to the GIS database both as a lookup table and an annotated point.

**Evaluation Criteria:** Maintenance of caves and karst resource values.

**Precision and Reliability:** Relatively high reliability; data collection is based upon field investigations by local experts, trained resource specialists and qualified volunteers.

**Results:**

- Identify locations of significant caves and karst features examined.
- Note development activities near each cave and any associated mitigation measures.
- Tabulate observations and measurements related to inspection of the cave resources.

**Analysis:**

- Prepare a written narrative assessment for the caves regarding the status of its attendant resources.
- Describe results and trends of the cave and karst resource assessment.
- Discuss any difficulties in applying the Standard and Guidelines.

**LAND MANAGEMENT PLANNING**

No goals, objectives, desired future condition, or standards and guidelines for Land Management Planning have been identified. The Forest Service policy and direction for improvement of government-to-government relationships, and collaborative, community-based, resource stewardship establishes a goal of compatibility of Forest Service management activities with the goals and objectives of adjacent lands. In addition, 36 CFR {219.7(f)} requires that a program of monitoring and evaluation shall be conducted that includes the effects of National Forest management on lands, resources, and communities adjacent to or near the National Forest being planned. The effects upon National Forest land by activities on nearby lands managed by other Federal or other government agencies or under the jurisdiction of local governments will also be monitored and evaluated.

**Land Management Planning Question 1: Is the management of National Forest System lands consistent with management objectives of adjacent lands and their management plans?**

**Estimated Cost:** $3,000 annually

**Data Collection:**

- Annually note any inconsistencies between all current fiscal year National Forest management projects and management objectives of adjacent publicly owned lands based on information from a number of sources, including project level environmental documents, input from state, local, and other federal agencies, as well as professional judgment.

- Review of project-level plans for activities or actions to be located adjacent to lands not in the National Forest System. Data sources will be the project planning records, NEPA analysis, planning documents and land management plans for the adjacent lands, and project-specific input from applicable land owners, and local, state and other Federal agencies. In addition, coordination with the adjacent land manager and input by the adjacent land manager will be reviewed. Qualitatively determine consistency or compatibility with the management objectives of adjacent lands.

**Evaluation Criteria:** Implementation of projects under TLMP compared with land management objectives of adjacent publicly owned lands.

**Precision and Reliability:** The precision and reliability is dependent upon the precision and reliability of the GIS data base lands information. This precision and reliability will vary with the update status of information about the management of lands adjacent to National Forest land.

**Results:**

- Describe projects monitored, including location, type of project, and management objectives on adjacent non-NFS lands.
- Report whether or not the Forest Service activity is compatible with the planned objectives and uses of the adjacent lands, and the degree of the effect.
- List incompatibilities and note if they occur on more than an incidental basis.

**Analysis:**

- Compare results of the current year's monitoring with previous years' monitoring results and trends.
- The analysis of monitoring information acquired will be qualitative, and will consist of weighing of the Forest Service activity against the management objectives of adjacent publicly owned lands, and the degree of any inconsistencies or incompatibilities.

Tabulate results showing if the Forest Service activity is fully consistent with, partly consistent with, or fully inconsistent with these management objectives, and any effects that any inconsistencies may have on the management of the adjacent non-NFS lands.

- If the project is determined incompatible, describe the extent of the incompatible, the effect of the incompatibility, and what mitigation, if any, is recommended.

**LOCAL AND REGIONAL ECONOMIES**

**Goal**: Provide a diversity of opportunities for resource uses that contribute to the local and regional economies of Southeast Alaska.

**Objective**: Work with local communities to identify rural community assistance opportunities and provide technical assistance in their implementation. Support a wide range of natural-resource employment opportunities within Southeast Alaska's communities.

**Background:** The Tongass National Forest comprises about 90 percent of Southeast Alaska's land base. The 33 communities within Southeast Alaska use and depend on Forest resources for their economies, quality of life, traditions and cultures, and recreation activities. Forest management decisions can have significant impacts, positive and negative, on these communities.

**Local and Regional Economies Monitoring Question 1: Are the effects on employment and income similar to those estimated in the Forest Plan?**

**Estimated Cost:** $3,000

**Data Collection:**

- Annually summarize estimates of the natural resource employment and income estimates from the Alaska Department of Labor employment and earnings publications and U.S. Bureau of Economic Analysis income and employment data.
- Compare to the Forest Plan the annual estimates of the natural resource employment and income.

**Evaluation Criteria:** Effects of Forest Plan implementation on employment and income by resource sector.

**Precision and Reliability**: The precision and reliability is dependant upon the precision and reliability of the natural resource employment and income estimates and data from the Alaska Department of Labor and the U.S. Bureau of Economic Analysis.

**Results:** Tabulate Forest Plan estimated and the Alaska Department of Labor and U.S. Bureau of Economic Analysis income and employment data.

**Analysis:** Describe and explain the differences between the Forest Plan estimates and actual income and employment data.

**Local and Regional Economies Question 2: Has the Forest Service worked with local communities to identify and pursue Rural Community Assistance opportunities?**

**Estimated Cost:** $5,000

**Data Collection:** Annually document the Rural Community Assistance activities.

**Evaluation Criteria:** Evidence of a Rural Community Assistance program.

**Precision and Reliability:** The precision and reliability is relatively high and based upon the precision and reliability of the documentation of Rural Community Assistance activities.

**Results:** Summarize the FS role in Rural Community Assistance activities.

**Analysis:** Evaluate effects of the Rural Community Assistance in assisting communities.

**MINERALS AND GEOLOGY**

**Goals**: Provide for environmentally sound mineral exploration, development, and reclamation in areas open to mineral entry and in areas with valid existing rights that are otherwise closed to mineral entry. Seek withdrawal of specific locations where mineral development may not meet Land Use Designation objectives. Encourage the prospecting, exploration, development, mining, and processing of locatable minerals in areas with the highest potential for minerals development. Insure that minerals are developed in an environmentally sensitive manner, and other high-valued resources are considered when minerals developments occur.

**Objective**: Implement the Minerals and Geology Forest-wide Standards and Guidelines.

**Background:** A wide variety of mineral types and mineral resources occur within the boundaries of the Tongass National Forest. Examples of some of these mineral resources are gold, silver, molybdenum, and uranium, and nationally designated "strategic" and "critical" minerals such as lead, zinc, copper, tungsten and platinum group metals. The Forest Service recognizes that minerals are fundamental to the Nation's well being and, as policy, encourages the exploration and development of the mineral resources that it manages. The Secretary of Agriculture has provided regulations (36 CFR 228) to ensure surface resource protection, while encouraging the orderly development of mineral resources on National Forest System lands.

**Minerals and Geology Question #1:** Are the effects of mining activities on surface resources consistent with Forest Plan expectations, as allowed in approved Plans of Operations?

**Estimated Cost:** $2,000 annually.

**Data Collection:** Select a minimum of one site on each district for analysis based on random selection that is stratified by the amount of activity on each site; sites with more activity are weighted more in the selection process. Review the summary list of activity on site clean up of abandoned sites.

- Annually summarize monitoring efforts, results, and findings conducted under project-specific Plans of Operation.
- Review the summary list of activity on site clean up of abandoned sites.
- Review results of previous monitoring activities, both for the specific mining project and for similar projects elsewhere should be reviewed. These, in addition to research and administrative studies, can provide both baseline information and anticipated results and effects.
- Review the project NEPA analysis and plan(s) of operations for applicable site-specific mitigating measures
- Review the project NEPA analysis and plan(s) of operations for anticipated results.
- Collect project-level monitoring results for active minerals operations, or for operations under a shutdown where monitoring is continued. This includes all activities, including those in approved POOs, or done for other agencies (i.e. Environmental Protection Agency, Alaska Department of Environmental Conservation) as part of a permit or under a memorandum of understanding/agreement.

**Evaluation Criteria:** Evaluation will be based on the evaluation criteria of mining operations with effects not anticipated in the plan of operations: MG12IIIB. If an unanticipated effect is identified, answer the question if so, what? If the evaluation indicates that the effect may result in unacceptable consequences or be widespread (involving multiple mineral operations), work with the Forest Minerals Specialist or Geologist to determine the corrective action and follow the Regulations and manual direction to correct actions creating unacceptable effects.

**Precision and Reliability:** The precision and reliability is dependent upon the precision and reliability of the documentation on mining activities and monitoring activities. The monitoring activities involve some subjective judgement by mineral specialists.

**Results:** Describe the minerals operations monitored, including a project description and monitoring efforts, results and findings.

- Summarize findings of review of abandoned site clean-up activities.
- Determine if all applicable standards and guidelines were incorporated into operating plans.
- Determine if applicable S&Gs were incorporated into project planning. If the Standards and Guides were not incorporated, determine why not.
- Determine if Standards and Guidelines identified in project planning were implemented on the ground.
- Determine if applicable S&Gs were not implemented and why not.
- List and describe any unpredicted effects.

**Analysis:**

- Analysis of monitoring data acquired is largely qualitative, and consists of analyzing the summarized data from project-level monitoring efforts.
- Analysis involves the review of assembled monitoring data for each minerals activity to determine if there are effects not anticipated in the project NEPA document or the approved plan of operations. This includes a review of monitoring results against applicable standards and guidelines, as well as any included mitigating measures.
- Recommended actions may range from remedial action to revision of the Land and Resource Management Plan, including development of additional standards and guidelines. If the effect involves resources that may be affected similarly elsewhere (other than minerals operations) addition investigation, including validation monitoring may be required.
- Describe any recommended actions to correct or avoid reoccurrence.

***RECREATION AND TOURISM***

**Goal**: Provide a range of recreational opportunities consistent with public demand, emphasizing locally popular recreation places and those important to the tourism industry.

**Objectives**: Manage the Forest's recreation settings in accordance with the Recreation Opportunity Spectrum (ROS) standards and guidelines for each Land Use Designation. Construct or reconstruct at least an average of 7 miles of hiking trails per year. Construct or reconstruct enough developed recreation sites to annually increase or improve the developed site capacity for an average of 190 people at one time.

**Background:** Southeast Alaska, of which the Tongass National Forest makes up about 80 percent, possesses a remarkable and unique combination of features. These include inland waterways with over 11,000 miles of shoreline, mountains, fiords, glaciers, and large or unusual populations of fish and wildlife populations that provide a wide range of excellent outdoor recreation experiences. Many of these opportunities cannot be duplicated elsewhere in North America, or most other places in the world. Southeast Alaska imparts a feeling of vastness, wilderness, and solitude. These feelings are enhanced by the small resident population, and relative absence of development compared to most other National Forests.

**Recreation and Tourism Question 1: Are areas of the Forest being managed in accordance with the prescribed Recreation Opportunity Spectrum (ROS) class in Forest-wide Standards and Guidelines?**

**Estimated Cost:** $20,000 annually

**Data Collection:**

- Review previous monitoring reports, project plans, special use permits, and field review notes for surveys or interviews, indicating trends or changes in ROS classes per land use designation that may require more intensive monitoring, or require change in ROS class or other action.
- Select the sites to monitor based upon a stratified approach based on ROS class. Focus monitoring in those locales with the highest number of uses and users.
- Observe whether ROS standards and guides have been implemented at the selected sites.
- Conduct ``visual surveys'' of use areas for indications of ROS class standards and guidelines, both for numbers of encounters and for activities such as facilities development, and trail construction and maintenance.
- Identify indications of conflicting uses that may result from S&G implementation.

**Evaluation Criteria:** Compliance with standards & guidelines specific to numbers of encounters allowed in each ROS class. The numerical thresholds are those levels established in the Recreation Opportunity Spectrum class.

**Precision and Reliability**: The precision and reliability is dependent upon the monitoring activities and will be effected by the subjective judgement of the recreational specialists.

**Results:**

- Tabulate instances where ROS changed or may require changing.
- List the number of special use by activity and corresponding backlog of applications.
- For each recreation place examined in the field list:
- Corresponding prescribed and observed ROS class, number of encounters, type of facility development, trail development and associated maintenance level.
- Indications of conflicting use resulting from Standard & Guideline implementation.

- Conformance with permit requirements
- Visitors comments on quality of their recreation experience.
- Tabulate information on permit compliance from the user reports and maintenance forms.
- Semi-annually run a GIS query of the information tracked annually on ROS by LUD. List cumulative changes in ROS class.

**Analysis:**

- Identify opportunities for changing ROS class designation and correlate with specific land use designations.
- Characterize observed recreation places. Note compliance with applicable standards & guidelines, conformance with permit requirements, visitor comments on quality of their recreational experience.
- Explain difficulties implementing Standards & Guides.
- Determine if the actual use of a given recreation place, use area, or other designation is within the limits set in the Recreation Opportunity Spectrum class or other analysis (carrying capacity analyses, W.I.S., Wilderness Plan or other analysis). Determine if any changes are within the limits of acceptable change under the analysis.
- Semi-annually conduct a cumulative analysis on the information collected through GIS query describing the ROS by LUD.

**Recreation and Tourism Question 2: Is Off Road Vehicle (ORV) use causing, or will it cause considerable adverse effects on soil, water, vegetation, fish and wildlife, visitors or cultural and historic resources of the Forest?**

**Estimated Cost:** $10,000 annually.

**Data Collection:**

- Survey ORV use through gathering information from the districts, information on road closures and use from engineering, and citations from law enforcement. Annually select a representative sample of ORV high-use areas distributed across the Forest. When possible, observe high use areas for extended periods of time to determine actual use.

- Review previous years' monitoring reports, law enforcement reports, comments from the public (complaints or otherwise), existing ORV management plans, project-level plans where appropriate, and studies published by other agencies or organizations.

- Talk with field employees, other administrative units, research and education organizations, off-road vehicle organizations, and outdoor recreation organizations to get assistance in the collection of information concerning the sample areas selected.

    - Conduct visual surveys of sample use areas for indications of:
    - inappropriate use of ORVs in areas where authorized,
    - unanticipated or unpredicted damage where ORV use is authorized,
    - unauthorized ORV use,
    - conflicting uses that may result from ORV use.

**Evaluation Criteria:** Compliance with all applicable standards and guidelines. The threshold is the point at which ORV use is unsuitable, or causes unacceptable damage. The threshold of unsuitable is reached when the use of ORVs is considered inappropriate in a given area. This may be caused by use of ORVs in areas where such use is proscribed by law or regulation, by changes in allocation (legislatively or administratively), or by changes in management goals

through area-specific analysis. The threshold for areas where uses of ORVs are unsuitable is any use other than that specifically allowed by law. For example, the use of ORVs in wilderness is unsuitable outside the uses allowed in ANILCA Section 1110, which permits the use of over-the-snow vehicles during periods of adequate snow cover for traditional activities. All other use is unsuitable and has crossed the threshold for acceptable use. A second example would be use of ORVs in an area closed to such use under 36 CFR §261.53 or §261.56; any use of ORVs is considered unsuitable.

The threshold for ``unacceptable damage'' is determined by the resource and its sensitivity to adverse activity; this includes effects on soil and water, fish and wildlife, vegetation, cultural and historic properties, or other human users. Qualified persons for a particular resource specialty must set the limits of acceptable damage; the limits may be quantitative or qualitative.

**Precision and Reliability:** The precision and reliability will be dependent upon the monitoring activities. The monitoring activities will require subjective and professional judgement by the recreational specialists on the effects of observed and anticipated effects of ORVs.

**Results:**

- List the sample of high-use ORV areas sampled.
- Summarize issues and observations from reports and conversations concerning sampled areas.
- Tabulate results of visual surveys.

**Analysis:**

- Describe use patterns in relation to applicable standards and guidelines and Forest plan goals and objectives for each land use designation, as well as the resource standards and guidelines for the various resources.
- Evaluate the extent of ORV use and the degree of unacceptable resource damage with respect to the goals, objectives, standards and guidelines and resource values for a given area.

***RESEARCH***

**Goal:** Continue to seek out and promote research opportunities that are consistent with identified information needs.

**Objectives**: Cooperate with PNW in pursuing the high-priority information needs identified in Appendix B [of the Forest Plan] through the intra-agency agreement entitled ``Joint Studies for Improved Future Tongass National Forest Planning'' and other means.

**Background:** Ten high-priority information needs are identified in Appendix B of the Forest Plan. Results from this research will be used to strengthen the scientific information base for the next Forest Plan revision or amendments to the current Forest Plan.

**Research Question**: **Have identified high-priority information needs been fulfilled?**

**Estimated Cost:** $1,000

Data Collection:

- For each study, contact the responsible Alaska Regional Coordinator(s) and PNW Research Station Principal Investigator(s) listed below.
    - Timber productivity and response to harvest of forested wetlands in southeast Alaska.
    - Determine the relationship between socioeconomic conditions in rural communities and resource allocations on the Tongass National Forest.
    - Determine subsistence resource patterns in southeast Alaska.
    - Identify and measure the interactions between aquatic/riparian habitat and perturbations in upland areas and the response of anadromous and resident salmonids.
    - Determine the geographic and habitat distribution of endemic mammals on the Tongass National Forest.
    - Evaluate the future timber productivity of young-growth stands on the Tongass National Forest.
    - Evaluate alternatives to clearcut harvest on the Tongass National Forest
    - Determine Alaska timber prices and market arbitrage in the Pacific Northwest.
    - Determine prices and costs in Alaska timber production and product supply.
    - Study lumber recovery of second growth timber from southeast Alaska.
- Obtain an annual progress report describing work completed in the previous fiscal year, and work planned for the following year, including any substantial changes to the study design.
- Document the overall study cost on annual and cumulative bases.

**Evaluation Criteria:** Progress and completion of studies.

**Precision and Reliability:** The precision and reliability will be relatively high since it is dependent upon summary of research work completed relative to needs.

**Results:**

- List the status of each study in terms of percent completion and projected completion date.
- Tabulate preliminary findings.
- Tabulate costs.

**Analysis:** For each study describe the following:

- Schedule of completion.
- Expenditures to date and anticipated future budgetary needs.
- Key preliminary or final results and their implications for management of the Tongass.

***SCENERY***

**Goal**: Provide Forest visitors with visually appealing scenery with emphasis on areas seen along the Alaska Marine highway, State highways, major forest roads, and from popular recreation places; recognize that in other areas where landscapes are altered by management activities, the activity may visually dominate the characteristic landscape.

**Objectives**: Manage the scenery of the Forest in order to achieve the following visual quality objectives: Retention 4.8 million acres + ?? million acres Retention in Wilderness; Partial Retention 3.2 million acres; Modification 0.4 million acres; Maximum Modification 2.8 million acres.

**Background:** Each land use designation in the Forest Plan has a corresponding visual quality objective that defines maximum levels of visual impact desirable from human-induced alterations to the natural landscape character. Associated with each objective is a set of recommended guidelines that includes unit size ranges and type of harvest treatment (e.g., clearcut, group selection, single-tree selection) for different visual absorption capability settings (e.g., landscapes with steep slopes; minimal terrain and vegetative diversity to landscapes with gentle slopes; high terrain and vegetative diversity). Also part of the FORPLAN modeling process includes a set of guidelines that define roughly how much of a viewshed (or logical part of a viewshed segment) can be in a ``disturbed'' condition and still meet the visual quality objective. This monitoring effort is intended to assess whether these guidelines, as applied actually results in meeting established visual objectives.

**Scenery Question: Are the standards and guidelines effective in attaining the adopted visual quality objectives established in the Plan?**

**Estimated Cost:** $12,400 annually

**Data Collection:**

- For each 5-year period, select 10 viewsheds across the Forest associated with the visual priority travel routes and use areas listed in Appendix F of the Forest Plan. Chosen viewsheds should (1) contain harvest units cut under the current Forest Plan, and (2) include areas representing the different characteristic landscapes (e.g., if possible include relatively high elevation rugged terrain with significant alpine openings along with the lower elevation, broad or rolling landscapes with more or less uniform forest cover); different visual absorption capacity settings; and different visual quality objectives.

- In each viewshed select the major viewpoints from (a minimum of 3 in travel routes) which harvest activity is clearly evident.

- Obtain photographs from each viewpoint that provide a representation of the entire activity seen from that viewpoint. It is preferable to use a 50-mm focal-length lens. This focal length most closely approximates what is seen by the naked eye. Photographs should be taken in optimum lighting conditions for seeing the activity.

  Each photograph must be accompanied by the following:
  - Date of photograph.
  - Date of cuts or activity.
  - Key which ties the photograph to a map.
  - Visual quality objective (VQO) for area visible in photograph.
  - Visual absorption capability (VAC) of area in the photograph.
  - Vegetation type seen in the photograph (spruce, mixed hemlock/ spruce, etc.).

  - Size of each opening or of treatment area if not clearcut (source would be GIS, unit card, or both.
  - Distance to between openings or treatment areas.
  - Type of treatment applied and other descriptive features of the area after treatment such as size of groups and density of groups in a group selection harvest; density of trees retained for single tree removal; stem diameter and spacing guidelines used in overstory removal cutting. Record this information for the current and past activities and other activities such as roads, landings, and recreation facilities that appear in the photograph.
  - Landscape position (i.e., is the opening on a lower slope, valley bottom, mid-slope, or upper slope near the ridge.
  - Topography (e.g., steep uniform slopes, highly dissected, diverse steep terrain, or gently sloping and rolling terrain).

- Measure the total viewshed size using GIS.
- Plot a map that includes at least all 100-foot contours (preferably 40-foot contours if available), boundary of viewshed, delineation of priority travel routes and use areas, delineation of refined and updated visual absorption capacity ratings, treatment area location areas by type, location of viewpoints, and numbers that key photographs from these viewpoints.

**Evaluation Criteria:** Whether the combination of unit size, type of harvest treatment, dispersal of openings, and overall percentage of viewshed ``disturbed'' results in the visual objective being met for the viewshed under review.

**Precision and Reliability:** Relatively high, the judgements are drawn from field investigations and based upon criteria established in the scenery management system.

**Results:**

- Identify viewports, location and aspect for current and future monitoring.
- Show a photographic record of scenic quality as seen from identified viewports. This record will provide a baseline for measurement of the impacts of future activities in the area and a baseline for measurement of the rate of recovery of scenic quality.
- Determine the effectiveness of the standards and guidelines for management of scenic quality.

**Analysis:** For each 5 year reporting period:

- Identify the range of sizes of created openings in each viewshed.
- Calculate the percentage of each viewshed occupied by created openings.
- Calculate average distance between openings.
- Describe whether management activities have maintained intended visual quality objectives. If the answer to this question is no, discuss what factors contribute to not meeting VQOs (e.g. size of openings or treatment, type of treatment, dispersal, location of activities in landscape, or overall level of disturbance.
- Describe whether standards and guidelines related to harvest unit sizes and harvest type and treatment are successful in attaining desired visual objectives.
- Assess whether different visual quality objective-visual absorption capacity settings in the FORPLAN model use the correct cumulative visual disturbance thresholds. In viewsheds that have had more than one entry over several years to several decades, analyze to extent possible what entry cycles might be suitable in these different

settings. Note that the entry cycle factor is used in only a very generalized way in the FORPLAN model.

- Where appropriate, assess effectiveness of various harvest unit, facility, road or other activity design techniques in achieving adopted visual quality objective (e.g., shaping techniques, hiding of backlines behind ridges, placement of units).

- Assess separately effectiveness of specific harvest prescriptions other than clearcutting in meeting visual quality objectives. Note such specifics as percent of treatment area harvested, size of groups harvested, size of groups retained, number of trees taken (or retained), and overall size of treatment area. The Forest Plan states in general terms where single-tree selection or group selection methods might be appropriate, but it does not provide specific guidelines concerning these treatments.

***SOIL AND WATER***

**Goals:** Maintain soil productivity and minimize soil erosion from land disturbing activities. Minimize sediment transported to streams from land disturbing activities. Maintain and restore the biological, physical, and chemical integrity of Tongass National Forest waters.

**Objectives:** Attain Alaska Region (R-10) Soil Quality Standards. Attain State of Alaska Water Quality Standards Forest-wide.

**Background:** Implementation of Soil and Water standards and guidelines is necessary to maintain soil productivity and water quality.

Implementation monitoring evaluates whether or not a BMP was required and implemented. Effectiveness monitoring includes evaluating the effectiveness of individual BMPs and where practicable, comparing the physical, biologic, and chemical parameters of water against the State of Alaska Water Quality Standards.

Implementation monitoring will be conducted according to a Tongass-wide BMP implementation-monitoring strategy described under the Soil and Water Question 3. BMP's monitored that are most applicable to the soils resources include:

BMP 13.5 Identification & Avoidance of Unstable Areas
BMP 12.17 Revegetation of disturbed Areas
BMP 13.9 Yarding Systems to Protect Soil/ Water Resources
BMP 13.10 Landing Location & Design
BMP 13.11/14 Erosion Control Measures
BMP 14.5 Erosion Control Plan Non-Point Source Discharge Plan
BMP 14.7 Measures to Minimize Mass failures
BMP 14.8/ 12.7 Measures to Minimize Surface Erosion
BMP 14.9 Drainage Control structures to Minimize Erosion & Sedimentation
BMP 14.12 Control of Excavation & Sidecast
BMP 14.14/14.17 Bridge/ Culvert Design, Installation & Removal
BMP 14.18 Control Rock Pit Sediment
BMP 14.20/14.22 Road Maintenance/ Access Management

**Soil and Water Question 1: Are the standards and guidelines for soil disturbance being implemented?**

Implementation monitoring of soil conservation practices are documented in the annual BMP implementation monitoring report. Refer to Soil and Water Question #3 protocol.

**Soil and Water Question 2: Are Standards and Guidelines effective in meeting Region-10 Soil Quality Standards?**

**Background:** The soil and water standards and guidelines are implemented as Best Management Practices (BMPs) described in FSH 2509.22. Region-10 Soil Quality Standards are documented in FSM 2554. Methods for effectiveness monitoring of Soil Quality Standards are referenced in the FSM 2554. Soil conservation practices are practices used to ensure that ground disturbing activities will meet the R-10 Soil Quality Standards. Typical soil conservation practices include log suspension requirements in timber harvest units and the use of full-bench and end-haul road construction techniques on landslide prone terrain. Implementation monitoring evaluates whether or not soil conservation practice(s) were required and implemented. Effectiveness monitoring determines whether or not the soil conservation practice used kept the ground disturbing activity within the R-10 Soil Quality Standard.

Soil effectiveness monitoring has two parts:

1. Determining the amount and degree of soil disturbance related to management activities
2. Inventory landslides related to management activities.

Data collection for both of these projects has been completed as project monitoring on the Ketchikan Area. This data will be analyzed and reports written in FY 99. Further data collection will depend on the results of the analysis.

**Part 1 Soil Disturbance**

**Estimated Cost:** $20,000

**Data Collection:** Data collection has followed the procedures outlined in "Guidelines for Sampling Some Physical Conditions of Surface Soils" R-6-RWM-146-1983, USDA-FS, Pacific Northwest Region, 34p. Sampling was modified for Alaska conditions with procedures similar to those outlined by Landwehr, 1993 unpublished white paper. Most Soil Quality Standards can be monitored though the completion of randomly located line transects within 2 years of timber harvest.

- Review data set of roughly 31 miles of random and non-random transects collected over a 7 year period for the completion of the 89-94 Ketchikan Pulp Company Final Environmental Impact Statement Soil and Water Monitoring.

- Review the data set for statistical soundness against statistical methods including the statistical analysis method described in ``Guidelines for Sampling some Physical Conditions of Surface Soils'' R6-RWM-146-1983, USDA-FS, Pacific Northwest Region, 34p.

**Evaluation Criteria:** Statistical summaries of transect data are evaluated against the Soil Quality Standards.

**Precision and Reliability:** The precision and reliability can be very high. FSM 2554 suggests precision to the 90 percent confidence level, however plots of the existing data show a one-sided, somewhat non-normal distribution. A 90 percent confidence level is difficult to achieve. The actual precision and reliability of the data can be calculated and reported. Non-parametric statistics can be used to further display the data.

**Results:**

- Tabulate and summarize the transect data from the 89-94 Ketchikan Pulp Company Final Environmental Impact Statement Soil and Water Monitoring.
- Summarize the findings on the statistical soundness of the transect data set.
- Tabulate and summarize the transects completed units with the partial suspension cable systems.
- Compare the R-10 Soil Quality Standards for disturbance relative to the findings of transects completed.

**Analysis:**

- Discuss the results of the transect data relative to the recorded disturbance associated with controlled shovel yarding, partial log suspension, and full log suspension.
- Determine if the transect data set is statically sound.
- Discuss the findings from transects relative to application of the standards and guides and whether the standards and guides are effective in meeting the Alaska Regional Soil Quality Standards.

**Part 2. Landslide Inventory .**

**Data Collection:** Through GIS identify areas of high concern based upon high mass movement soils (MMI=3 or 4) and steep areas (>72%) and select a subset of a minimum of 1 area to monitor. Surveys are conducted annually during project implementation and again 3 years after project completion. The VCU or Watershed selected for monitoring should have landslide potential addressed in the EA or EIS and soil conservation practices implemented.

- Conduct a field investigation of landslides associated with road construction activities or unit harvest as soon as practical after they occur and collect data elements describing the following attributes as listed in the appendix:
  - Define slide type
  - Identify slip plane
  - Define potential for continued mass movement
  - Identify potential for sediment transport that will contribute to water quality problems

- Document the date of the slide and management factors associated with the slide through discussions with the Sale Administrator, Engineering Representative, Contracting Officer's Representative, or Contractor.
- Define slide location through ground based or aerial surveys.
- Investigate site and construction diaries and harvest reports for indicators of potential causes for the landslide. Identify:
  - Geomorphology: hollow topography, landforms
  - Water indicators: wet-site indicator plants at the headwall
  - Soil Disturbance indicators: soil disturbance, stumps pulled at headwall
  - Construction/ Logging activity: road construction, blasting, yarding
  - Construction/ Logging phase: equipment in slide
  - Impacts: Violation of State Water Quality Standards (document report to ADEC)

- Collect information on the precipitation for the previous week and details on any associated storm event.

**Evaluation Criteria:** Slides included in this inventory can be any size. Slides must have an identifiable slip plane; cutbank failures in glacial till are excluded unless the failure is cutback to an identifiable slip plane at the till/ soil or till/ bedrock interface.

**Precision and Reliability:** The inventory is a 100 percent sample of landslides associated with a single project on Prince of Wales Island . Landslide frequency studies have indicated a higher rate of mass movement in older second growth than in old-growth conditions. The effects of timber harvest on slope stability can be long-term and extend beyond the three-years-after-harvest as monitored in this project.

**Results:**

- Tabulate the data describing each landslide .
- Summarize the background data pertinent to the cause of the landslide.
- Mark the location of the landslide on a map & in the GIS database.
- Define the mapped soil series and MMI for the headwall of the site.

**Analysis:**

- Summarize the integrated landslide table by causal agents, activity causing slides, impact on water quality.
- Identify trends in landslide frequency and magnitude relative to geomorphology, parent material, rainfall, timing of the slide event compared to construction and logging activities, and other site conditions.

- Identify the range in the observed soil series and MMI at the headwall with respect to the mapped units.

**Soil and Water Question 3: Are the Best Management Practices being implemented?**

**Background:** The State of Alaska Water Quality Standards set standards for chemical, physical and biologic parameters of waters on National Forest System Lands. The Forest Service in Region-10 uses Best Management Practices and site specific prescriptions to meet State of Alaska Water Quality Standards when implementing ground disturbing activities on National Forest System lands. Typical BMPs include buffer zone design and layout for stream course protection, revegetation of disturbed areas, and timing of instream activities. Implementation monitoring evaluates whether or not a BMP was required and implemented.

This BMP implementation monitoring protocol integrates selected implementation monitoring questions that address direct and indirect effects to aquatic resources.

In addition to soil & water question 3, the following questions are addressed, in part, through this implementation monitoring protocol:

- **Fish Habitat Question 2:** Are fish and riparian standards and guidelines being implemented?
- **Soil and Water Question 1:** Are the standards and guidelines for soil disturbance being implemented?
- **Timber Management Question 1:** Are timber harvest activities adhering to applicable timber management standards and guidelines?
- **Wetlands Question 1:** Are wetlands standards and guidelines being implemented?

**Estimated Cost:** $230,000

**Data Collection:** The soil and water standards and guidelines are implemented as Best Management Practices (BMPs) described in FSH2509.22. Monitoring will be conducted according to a Tongass-wide BMP Implementation Monitoring Strategy described in the two tier approach below.

A two-tiered approach to monitoring will be applied to address these implementation-monitoring questions. First, all harvest units, temporary roads, and specified roads (new construction and reconstruction) will be monitored by timber sale administrators and engineering representatives for implementation of Forest Plan standards and guidelines and BMPs upon their completion. Second, a subsample of projects (³10%) will be monitored for implementation and effectiveness by an interdisciplinary team. Specific details on the monitoring protocol for each of the implementation monitoring items can be found in the Tongass Monitoring Strategy.

For all harvest units, temporary roads, and specified roads developed using current standards and guidelines sale administrators and engineering representatives complete the following and record data on the form provided. Refer to the Appendix for a copy of the implementation monitoring form.

- Review records (e.g., unit folders- soil resource reports, soil conservation practice and logging suspension prescriptions, NEPA documents, sale area maps, unit cards, road cards, construction inspection daily diaries, and timber sale inspection reports) to identify:
  - Very steep slopes (>72%) and whether the analysis approving timber harvest on steep slopes was documented.
  - Prescribed buffer areas (riparian, beach, estuary). Record the approximate size of buffers identified as requiring protection measures.

- Prescribed channel protection measures (e.g., directional felling, split yarding, and debris removal). Record total length of stream protection measures prescribed by type.
- Estimated areal extent within units requiring suspension.
- Whether an erosion control plan was prepared. Record areal extent of measures proposed.
- The areal extent of wetlands and mitigation measures prescribed (e.g., suspension, exclusion of sensitive wetlands, shovel yarding, road relocation).
- Fisheries timing prescriptions for stream crossings and road segments. Record onset and duration of timing prescriptions.
- The lengths of temporary road requiring erosion control measures.
- Whether erosion control measures were implemented and a non-point source discharge plan was in place before roads and units were accepted.
- Whether oil control measures and spill prevention control and countermeasure plans were in place before roads and units were accepted.
- Whether a oil or gas spill occurred during project implementation.
- Whether potentially unstable slopes were identified and recommendations were made to limit mass movement.
- Whether measures to restrict blasting or full bench road prisms were designed and built or end haul segments were designed and implemented.
- Prescribed erosion control measures including seeding, water bars, ditches, erosion netting-fabric, terraces, benching, and riprap.
- Evaluation of rock durability and mechanisms used to limit rock degradation (e.g., variable tire pressure, road maintenance).
- Prescribed drainage control structures and road erosion control features (e.g., inlet aprons).
- Measures prescribed to minimize sedimentation from excavated and sidecast materials.
- Measures prescribed to minimize adverse impacts on water quality and stream courses.
- Whether hydrologic analysis showed runoff rates, volumes, flood conditions, flow velocities, and sedimentation.
- Measures at rock pits to minimize adverse impacts on adjacent resources.
- Prescribed methods for organic material disposal.
- Road access management objective and prescribed measures.

- In the field inspect:
  - Units to identify any very steep slopes. Note if measures to avoid the area or mitigation to limit mass movement were implemented.
  - Units to verify that all riparian areas were identified.
  - Whether prescribed buffers were maintained.
  - Units and roads to determine whether erosion control measures were applied in areas where displaced soil could effectively channel water.
  - Units to determine whether prescribed channel protection measures were implemented. Record total length of stream protection measures by type.
  - Units to estimate the actual size of areas where suspension requirements were met.
  - Landings to assess whether landings were constructed in ways that minimized soil erosion and water quality degradation and confirm whether logging slash and sediment was kept out of streams.
  - Units and roads to estimate the areal extent of erosion control measures implemented.
  - Units and roads to estimate the actual size of wetlands in units and the areal extent of wetland mitigation measures applied.
  - Road segment stream crossings and road segments to determine whether timing prescriptions were met.
  - Temporary roads where erosion control measures were applied.

- Units to and roads to determine specified erosion control measures were implemented.
- Log transfer facilities and observe whether settling ponds were properly constructed and measures to minimize sediment transport were implemented.
- Roads, landings, and log transfer facilities, fueling facilities, and fuel tanks to observe whether good housekeeping techniques were implemented to minimize hydrocarbon contamination.
- Fill slopes adjacent to streams, clearing widths, and borrow disposal sites were constructed to minimize mass movement potential.
- Roads cut slopes and observe where they were seeded to prevent erosion.
- Erosion control measures implemented including seeding, water bars, ditches, erosion netting-fabric, terraces, benching, and riprap were implemented.
- Roads for implementation of drainage control structures.
- Culverts to determine whether their spacing and sizing dissipated flows.
- Ditches and cross drains to identify whether they were installed to limit erosion and sediment transport.
- Roads to identify erosion control features applied (e.g., trash racks, drop inlets, inlet aprons, and armored outlets).
- Roads to determine whether measures to minimize sedimentation from excavated and sidecast material were implemented.
- Bridges and culverts to identify whether their design minimized restriction of the channel and prevented scour of the fill slopes and drainage.
- Rock pits to identify whether prescribed measures to mitigate adverse impacts other resources were implemented.
- Road corridors to determine whether organic debris was disposed of using the prescribed method.
- Roads to evaluate whether prescribed road access measures were implemented.

**Evaluation Criteria: Compliance with the Forest Plan Standards & Guides and BMPs. Whether the unit harvest as well as the road and facility construction shows subsequent effects that support the applicable objectives for fish habitat, soil & water, wetlands, timber, and transportation.**

**Precision and Reliability:** Generally the precision and reliability is very high. The implementation of the Best Management Practices (BMPs) is documented during the monitoring conducted by the Sale Administrators, Engineering Representatives, and Contracting Officer's Representatives. Implementation Monitoring is conducted at 100 % of the sites and implementation-monitoring forms documenting this activity are filed at the time each unit and road is finalled or closed. Ground traverses and inspections have 100 % reliability and show a precision of +/- 1 foot, +/- 5 % slope gradient, and +/- 10% acre.

**Results:**

- Tabulate the data collected to list attributes of the unit and road specific to the streams, slopes, oil pollution prevention, sediment transport, and wetlands.
- Document the number instances of fully successful implementations of the BMPs or Standards & Guides.
- Document the number of instances of departures from full implementation of BMPs or Standard & Guides.
- Summarize the situations and circumstances where departures from full implementation of the BMPs or Standards & Guides occurred.

**Analysis:**

- Prepare a table showing the summarized results of the attribute ratings.
- Compare the number of fully successful implementations of the BMPs or Standards and Guides to the departures from full implementation.

- Discuss any difficulties implementing the BMPs or applying the Standards and Guides.

**Soil and Water Question 4: Are Best Management Practices effective in meeting water quality standards?**

**Background:** Effectiveness in meeting water quality standards has several components, which are discussed in various other protocols as listed below:

- Stability and effectiveness of stream buffers: Fish Habitat, Channel condition Assessment, 319 Protocols
- Road drainage structure operations and maintenance: Fish Habitat, Fish Passage
- Stream buffer strip stability and consequences of blowdown: Fish Habitat, 319 Protocols
- Effectiveness of class III stream prescriptions in minimizing sediment delivery to fish streams: Fish Habitat, Channel Condition Assessment, 319 Protocols
- Effectiveness of yarding methods in minimizing soil disturbance and achieving soil quality standards: Soil and Water, Soil Disturbance Protocols
- Frequency and effects of landslides in old growth, young growth, and clearcut sites: Soil & Water, Landslide Protocols

**Estimated Cost:** See specific protocols listed above.

**Data Collection:** See the following protocols for data collection components since the data will be collected in completing implementation of these protocols:

- Fish Habitat: Fish passage, 319 protocol, channel condition assessment
- Soil & Water: Mass movement/ Landslides, Soil Disturbance
- Transportation
- Aquatic Resources: Erosion, sediment transport

**Evaluation Criteria:** Alaska State Water Quality Standards, 18AAC70 and protected beneficial uses.

**Results:**

- Evaluate data collected on other protocols; specifically Fish Habitat: Fish Passage, Soil & Water: Mass movement/ Landslides and Transportation. Compare this data relative to the BMP's for water quality.
- Define if BMP's were implemented.
- Determine if the water quality was impacted.

**Analysis:**

- Ascertain which BMP's were implemented (or not implemented) in situations where water quality was impacted.
- Summarize where water quality was impacted and chart the duration and magnitude of exceedance of the water quality standards.

***SUBSISTENCE***

**Goal**: Provide for the continuation of subsistence uses and resources by all rural Alaskan residents.

**Objectives**: Evaluate and consider the needs of subsistence users in making project land management decisions.

**Subsistence Question**: **Are the effects of management activities on subsistence users in rural Southeast Alaska communities consistent with those estimated in the Forest Plan?**

**Estimated Cost:** $20,000/year.

**Data Collection:**

1. Record summaries to report the effects of the Forest Plan on subsistence users by community. Information should include testimony from subsistence hearings, project evaluations and testimony from hearings conducted under ANILCA Section 810, comments from federally recognized tribes, and comments from council meetings. Communications with community leaders and elders including formal and informal meetings, as well as efforts to capture traditional environmental knowledge should be documented. Document comments on subsistence from AK Federation of Natives, AK Native Brotherhood Grand Camp, and Tlingit Haida Central Counsel. Summarize information obtained from the subsistence study specified in the Information Needs Appendix of the Forest Plan, specifically including comments from individuals responding on NEPA efforts.

2. Review existing data including :(1) results of 1988 Tongass Resource Use Cooperative Study (TRUCS) and updated TRUCS (1996 data available for 10 SE communities; (2) updated survey results to be available for all SE communities by year 2000); (3) narrative in project-level EISs' on effects of proposed management activities on subsistence use and resources; transcripts from ANILCA 810 hearings; (4) Alaska Department of Fish and Game harvest trend data; (5) *official minutes from Southeast Regional Advisory Council meetings (two meetings/year)* (6) meeting notes from Forest Service key contact meetings with *federally recognized* tribal leaders and community leaders on affects of proposed management activities on subsistence use and resources.

3. Collect species-specific harvest data for Southeast Alaska communities. This would include: (1) field observation and interviews in study communities completed for other activities and monitoring efforts and; (2) compilation and analysis of harvest reports and surveys. Products for use in analyzing the effects of forest management activities on communities would include Subsistence Use Area maps as well as reports produced annually.

4. Review SERAC Annual Reports. Under Sec. 805(a)(D), the SERAC is required to prepare an annual report to the Secretary which shall contain: ``(i) an identification of current and anticipated subsistence uses of fish and wildlife populations within the region; (ii) an evaluation of current and anticipated subsistence needs for fish and wildlife populations within the region; (iii) a recommended strategy for the management of fish and wildlife populations within the region to accommodate such subsistence uses and needs; and (iv) recommendations concerning policies, standards and guidelines, and regulations to implement the strategy."

5. Annually monitor ANILCA 810 sections of environmental impact statements and evaluate proposed net effects of management activities on subsistence use and resources. Collect ADF&G harvest trend data. Review SERAC annual reports and track regulatory changes. Document key contact meetings with tribal and community leaders.

**Evaluation Criteria:** Changes in traditional resource use patterns, traditional environmental knowledge, and subsistence needs and uses.

**Precision and Reliability:** Precision and reliability will depend on the different types of data and methodologies being used. Different aspects of the data collection will have different precision and reliability: some of the data will be documentation and other data will be effected by judgements in interpretation during summary processes.

**Results:**

1. Once every five years, summarize and evaluate the effects of the Forest Plan on subsistence users by community. Summaries should include testimony from subsistence hearings, project evaluations and testimony from hearings conducted under ANILCA Section 810, comments from federally recognized tribes, comments from council meetings. Summarize comments on subsistence from AK Federation of Natives, AK Native Brotherhood Grand Camp, and Tlingit Haida Central Counsel. Communications with community leaders and elders including formal and informal meetings, as well as efforts to capture traditional environmental knowledge should be evaluated. Summarize information obtained from the subsistence study specified in the Information Needs Appendix of the Forest Plan, specifically including comments from individuals responding on NEPA efforts.

2. Summarize data including :(1) results of 1988 Tongass Resource Use Cooperative Study (TRUCS) and updated TRUCS (1996 data available for 10 SE communities; (2) updated survey results to be available for all SE communities by year 2000); (3) narrative in project-level EISs' on effects of proposed management activities on subsistence use and resources; transcripts from ANILCA 810 hearings; (4) Alaska Department of Fish and Game harvest trend data; (5) *official minutes from Southeast Regional Advisory Council meetings (two meetings/year)* (6) meeting notes from Forest Service key contact meetings with *federally recognized* tribal leaders and community leaders on affects of proposed management activities on subsistence use and resources.

3. Summarize Board of Game and Federal Subsistence Board regulatory changes, reports from ADF&G Subsistence & Wildlife. Summarize species-specific harvest data for Southeast Alaska communities. This would include: (1) field observation and interviews in study communities completed for other activities and monitoring efforts and; (2) compilation and analysis of harvest reports and surveys. Products for use in analyzing the effects of forest management activities on communities would include Subsistence Use Area maps as well as reports produced annually.

4. Summarize SERAC Annual Reports. Under Sec. 805(a)(D), the SERAC is required to prepare an annual report to the Secretary which shall contain: ``(i) an identification of current and anticipated subsistence uses of fish and wildlife populations within the region; (ii) an evaluation of current and anticipated subsistence needs for fish and wildlife populations within the region; (iii) a recommended strategy for the management of fish and wildlife populations within the region to accommodate such subsistence uses and needs; and (iv) recommendations concerning policies, standards and guidelines, and regulations to implement the strategy."

5. Summarize any noted effects from ANILCA 810 sections of environmental impact statements and evaluate proposed net effects of management activities on subsistence use and resources. Evaluate ADF&G harvest trend data. Summarize SERAC annual reports and tracked regulatory changes. Summarize subsistence issues discussed at key contact meetings with tribal and community leaders.

**Analysis:**

1. Once every five years summarize and evaluate the effects of the Forest Plan on subsistence users by community.

2. The information provided through community surveys and other sources will provide the base information on which the Southeast Regional Advisory Council will develop their report. The recommendations and strategies provided by the Council will then be used in developing further monitoring activities or modifications to existing monitoring activities.

3. Analysis of Testimony from Subsistence Hearings and Project Evaluations: Monitor ANILCA 810 sections of EISs and evaluate proposed net effects of management activities on subsistence use and resources. A social scientist will review and analyze all project hearing transcripts and project evaluations. A summary report will be compiled.

4. Key Contact Meetings with Tribal and Community Leaders: Analyze key contact meetings with tribal and community leaders

***TIMBER MANAGEMENT***

**Goal**: Manage the timber resource for production of saw timber and other wood products from suitable timber lands made available for timber harvest, on an even-flow, long-term sustained yield basis and in an economically efficient manner.

**Objectives**:

1) Pre-commercial thin an average of 2,130 acres annually of previously harvested suitable timber land;
2) Evaluate non-clearcutting silvicultural systems;
3) Conduct a systematic inventory of all vegetation for southeast Alaska by completing the installation and measurement of the permanent plot inventory grid;
4) Seek to provide a timber supply sufficient to meet the annual market demand for Tongass National Forest timber, and the market demand for the planning cycle, up to a ceiling of this Plan's allowable sale quantity, which is 653 million cubic feet or 2.67 billion board feet per decade.

**Background:**

Size of Clearcuts. The standard upper limit for individual created openings in the hemlock-Sitka spruce type of coastal Alaska is 100 acres (36 CFR §219.27[d][2]). Larger openings are allowed at the discretion of the Forest Supervisor (150-acre maximum) and the Regional Forester (200-acre maximum) when warranted (Forestwide Standards & Guidelines, Timber Sale Preparation, Size of Clearcuts).

Slope Guidelines. At the project planning level, the Forest Supervisor or District Ranger may approve timber harvest on slopes of 72% or more on a case-by-case basis, based on the results of an onsite analysis of slope and class IV channel stability and an assessment of potential impacts of accelerated erosion on downslope and downstream fish habitat, other beneficial uses of water, and other resources.

Management of beach and estuary fringe. The beach and estuary fringes are classified as unsuitable for programmed timber harvest. Unprogrammed timber harvest is allowed as part of a salvage sale, for specialty wood products, for customary and traditional uses, and for landings, roads, or timber harvest (along the landward edge of the fringe) necessary to access timber in adjacent programmed areas where there are no feasible alternatives in project design.

Falldown Factors. Forest planners recognized limitations in their ability to accurately estimate timber output levels based on existing inventories and unforeseen circumstances encountered during project implementation. ``Falldown'' occurs when the number of acres actually harvested is less than the number of acres planned for harvest. To anticipate fall down, Forest planners applied Modeled Implementation Reduction Factors (MIRFs) to reduce the area of land suitable for timber production.

Non-interchangeable Components. Forest planners partitioned the annual allowable sale quantity into two components to promote economic sustainability of the timber resource. This approach distinguishes portions of the timber supply at lower risk of attainment from those portions at higher risk of attainment. Volumes associated with each component will be identified separately in annual harvest plans for the Forest and are not to be substituted for volume from the other component to determine the allowable sale quantity. Forest planners created two non-interchangeable components based on operability: land of normal operability was designated NIC I (220 million board feet per year); all other land was designated NIC II(47 million board feet per year).

Implementation Monitoring detailed in the Soil and Water Question 3 includes specific reference to the unit size, slope guidelines, and beach/ estuary buffers. Many of the timber management

standards and guides are implemented as best Management Practices (BMPs) described in FSH 2509.22. These attributes are monitored during the implementation-monitoring phase in both the 100% monitoring and in the 10% IDT monitoring of all units closed.

**Timber Management Question 1**: **Are timber harvest activities adhering to applicable timber management standards and guidelines?**

**Estimated Cost:** $40,000

**Data Collection:**

- Refer to the Soils Implementation Monitoring Protocol.
- Review the Region's Silvicultural Information System (SIS) database, environmental impact statements (EISs), unit cards, and unit card addenda for areas harvested in the last year to identify where created openings (alone or in combination with other adjoining created openings) exceed the 100-acre limit.
- Identify why exceptions (if any) were allowed. Obtain citations for decision documents where the Forest Supervisor or Regional Forester approved the exceptions.
- See Soils section for details on data collection on slopes 72% gradient and higher and harvest within the 1000 feet beach or estuary buffer.
- Identify unprogrammed timber harvest activities from EISs and unit cards within the 1,000-foot beach or estuary fringe completed in the previous year.

**Evaluation Criteria:** Created openings should be less than 100 acres unless approved by Forest Supervisor (up to 150 acres) or Regional Forester (up to 200 acres). Timber harvest should not be conducted within the 1000 feet beach or estuary buffer.

**Precision and Reliability:** The precision and reliability will be dependent on the precision and reliability of the SIS data base, unit cards, implementation monitoring forms, and Forest records.

**Results:**

- Refer to the Soil and Water Question 3, Implementation Monitoring.
- Tabulated details describing harvest units greater than 100 acres, documenting rational and approval of the activity.
- List any unprogrammed timber harvest (salvage sales, commercial sales and harvest of blow down) within the 1000 feet beach or estuary buffers.

**Analysis:**

- Refer to the Soil and Water Question 3, Implementation Monitoring.
- Explain circumstances where the 100-acre upper limit of created openings has been exceeded.
- Explain circumstances where beach or estuary fringe buffers have been reduced to less than 1000 feet.

**Timber Management Question 2: Are harvested forest lands restocked within five years following harvest?**

**Estimated Cost:** $4,000

**Data Collection:**

- Obtain the Status of Reforestation Five Years After Final Harvest Report prepared annually by the Regional Forest Management staff.
- Quantify the areas that met and failed to meet stocking requirements established by the Region.
- Characterize (e.g., soil series, aspect, community type) of lands where stocking requirements were not achieved.

**Evaluation Criteria:** Stands should be fully stocked 5 years after harvest

**Precision and Reliability:** High precision and reliability, based upon intensive fieldwork. Data is collected by plots (1 plot/ acre) and walk through surveys.

**Results:**

- Tabulate results from the Reforestation report including the total area that failed to meet stalking requirement.
- List characteristics associated with substandard stocking.

**Analysis:** Summarize the reforestation performance industry a description of circumstances where stocking requirements were not achieved.

**Timber Management Question 3**: **Is the allowable sale quantity consistent with resource information and programmed harvest?**

**Estimated Cost:** $20,000

**Data Collection:** Review and analyze assumptions in the Forest Plan at least every five years, unless significant changes in any of the following factors are evident:

- Timber Inventory Results which are completed every 5 years. Use the new timber inventory and the TIMTYP data layer to estimate low, medium, & high volume stands (refer to Julin and Caouette 1997 for methods).
- Timber Dispersion Requirements. Define if visual constraints changed (e.g., clearcut size, adjacency, and disturbance rules).
- Tentatively Suitable Land Base. Determine if there is new information that affects the size of the tentatively suitable land base (e.g., forested wetlands suitability classification).
- Yield Tables. Determine if new information has been developed that significantly alters yield predictions (e.g., coefficients, new data range). Contact the Resource Management and Productivity Group at the Juneau Forestry Sciences Laboratory to obtain updates on timber growth and yield.
- Operability Layer Inventory. Determine if the operability layer updated and has this coverage changed significantly.
- Riparian Buffers. Determine if the buffer width guidelines changed?
- Beach and Estuary Fringe. Address if beach and estuary fringe buffer widths changed.
- Modeled Implementation Reduction Factors. For each new project, upon completion, document falldown for each factor listed in the table below.

| | Administrative Area | | |
|---|---|---|---|
| Falldown Factor | Chatham | Ketchikan | Stikine |
| | ---------- | Percent Reduction | ---------- |
| Land Selections | 2.0 | 2.0 | 2.0 |
| Unmapped TTRA Buffers | 2.5 | 2.5 | 2.5 |
| Non-Commercial Forest (applied to low volume stratum only) | 18.0 | 18.0 | 18.0 |
| Slope and Soil Conditions | 32.0 | 3.1 | 3.1 |
| Cost Efficiency (applied to low-volume stratum, difficult and isolated operability; medium-volume stratum isolated operability) | 100.0 | 100.0 | 100.0 |
| Riparian | 14.2 | 14.3 | 14.3 |
| Karst and Caves | 0.5 | 5.9 | 0.3 |

| | | | |
|---|---|---|---|
| Standards & Guidelines | 1.0 | 1.0 | 1.0 |

**Evaluation Criteria:** The assumptions used to calculate ASQ in the Forest Plan.

**Precision and Reliability:** Based upon the level of precision and reliability of the GIS database and aerial photograph interpretation.

**Results:**

- Tabulate timber inventory results with regard to timber volume.
- List changes in visual constraints.
- List new information that affects the size of the tentatively suitable land base.
- Tabulate new information on yield predictions.
- Tabulate results of timber operability review.
- List changes to buffer width guidelines by channel process group.
- List any changes to any beach and buffer width guidelines.
- Tabulate the observed project fall down factors.

**Analysis:**

- Summarize changes in the assumptions used to calculate ASQ
- Compare falldown estimates used in the Forest Plan with those obtained during project planning and implementation.
- Identify any additional falldown factors that might be considered in the next Forest Plan revision.

**Timber Management Question 4: Are the non-interchangeable components (NICs) of the allowable sale quantity consistent with actual harvest?**

**Estimated Cost:** $3000

**Data Collection:** Record logging system code & operability code designation for each harvest unit

**Evaluation Criteria:** Estimated timber volume for the non-interchangeable component (NIC) I (220 mbf/yr.) & II (47 mbf/yr.) categories

**Precision and Reliability:** The precision and reliability will be dependent upon the precision and reliability of the GIS data base timber data.

**Results:** Through GIS exercise, annually tabulate the volume of harvest by NIC I and NIC II categories.
(NIC I includes standard cable and tractor with normal operability. NCI II includes long span cable, access limited with difficult operability and isolated high-volume strata.)

**Analysis:** Compare the cumulative volume in these categories to the ceilings specified for the first decade in the Forest Plan for each component. NIC I was estimated in the Forest Plan to be 80-82%; NIC II was 18-20%

**Timber Management Question 5: Is the proportional mix of volume in NIC I and NIC II as estimated in the Forest Plan accurate?**

**Estimated Cost:** $2,000

**Data Collection:** Obtain results from logging and operability review

**Evaluation Criteria:**
NIC I 80-82% of the total ASQ
NIC II 18-20% of the total ASQ

**Precision and Reliability:** The precision and reliability will be dependent upon the precision and reliability of the timber data and the GIS database.

**Results:**
- Summarize the NIC administrative study results to determine if changes in the Forest Plan are required.
- Summarize the timber operability review to determine of change in the Forest Plan are required.

**Analysis:** Discuss the implication of the review for calculating the NIC components.

**Timber Management Question 6: Should maximum size limits for harvested areas be continued?**

**Estimated Cost:** $3,000

**Data Collection:** Annually query the Region's Silvicultural Information System for trends in harvest unit size.

**Evaluation Criteria:** Circumstances that warrant increasing the harvest unit size greater than 100 acres.

**Precision and Reliability:** Based upon the reliability and precision of GIS and associated field traverses. The precision and reliability of this data is relatively high for resources except land use suitability, which is under development. The data is collected through field traverses and include GPS location data.

**Results:** Summarize annual trends in harvest unit size by silviculture system using the Region's Silvicultural Information System (SIS). Track separately by land use designation categories.

**Analysis:** Annually evaluate monitoring results for other resources (e.g., scenic) in combination with professional judgment to determine whether or not to recommend a change to the maximum allowable harvest unit size.

**TRANSPORTATION**

**Goal**: Develop and manage roads and utility systems to support resource management; recognize the potential for future development of major transportation and utility systems.

**Objectives**: Provide access for Forest users. In support of Forest resource management activities, design and construct up to an average of 110 miles of roads annually. Manage and maintain roads to protect water, soil, fish, and wildlife resources.

**Background:** Transportation implementation monitoring issues are addressed in the fishery, soil, and water resource protocol. This section should be referenced for information as to what standards and guidelines were implemented so that effectiveness can be tracked.

Stream turbidity during in-stream activity was not rated as a high priority issue but represents a simple low cost observation of a water quality standard responding to routine effectiveness monitoring commitments in the USDA Forest Service Memorandum of Understanding with the Alaska Department of Environmental Conservation (1992).

Monitoring will continue to be conducted for each log transfer facility (LTF) under terms of the LTF permits, in accordance with Alaska Water Quality Standards, and requirements from the Environmental Protection Agency for Storm Water Discharge.

**Transportation Question**: **Are the standards and guidelines used for forest development roads and log transfer facilities effective in limiting the environmental effects to anticipated levels?**

**Estimated Cost:** $80,000 annually

**Data Collection:**

- Annually conduct field inspections on a representative sample of harvest units and their associated roads that were closed and finalled in the current year and Log Transfer Facilities to determine whether the standards and guidelines adequately mitigate adverse impacts on other resources, including soil productivity, water quality, and wildlife and fish habitat. This monitoring may overlap with timber, karst, wetlands, soil & water, and fish monitoring.

- Refer to the Soils section, Implementation monitoring. For each road constructed, collect field data and complete implementation monitoring form noting compliance with Best Management Practices for eagle nest buffers, fisheries prescriptions (specify fish passage requirements and timing guidelines), oil pollution control plan, timing restrictions to minimize erosion, measures to minimize mass failures, measures to minimize surface erosion (seeding), drainage control structures, control of excavation and side cast, bridge and culvert design and installation, control rock pit sediment, and disposal of slash and stumps.

- Monitoring will continue to be conducted for each log transfer facility (LTF) under the terms of that LTFs permit, in accordance with Alaska Water Quality Standards and Environmental Protection Agency Regulations for Storm Water Discharge.

- Closed roads and trails should be inspected once every 3 years.

- Gates and barriers on closed roads should be visually inspected for integrity and evidence of being bypassed.

- Turbidity measurements will be taken at the stream crossings where culverts greater than 48" in diameter are installed above and below the culvert site using visual observations. Turbidity measurements will be taken at a minimum of 40 % of the sites using a portable turbidity meter.

For turbidity water measurements the following equipment will be needed:

- Turbidty Meter equivalent to a Hach Pocket Turbidity Meter or Hach 2100P Portable Turbidity Meter.
- Clean plastic or glass water sample collection bottle.
- Sample testing vial (specialized vial for meter).
- Drying cloth for testing vial.
- Lint/ Oil cloth for testing vial.

The samples will be taken following a standard sampling procedure:

- 3 to 4 samples should be taken from various locations in the stream cross section and the readings averaged. Caution should be taken not to stir up sediment in crossing the stream in collecting samples.
- Stand downstream of the sample site. Sample sites should be selected at a site that represents the average water quality. Sites generally should be selected that are in the center of the flow, roughly mid-depth in the sediment mixing zone.
- Invert the sample collection bottle and lower it to ½ the stream depth.
- Turn the bottle upright with the opening pointing upstream and elevate the bottle out of the water.
- Immediately cap bottle for transport to testing site.
- Transfer water from collection bottle to testing vial insuring that water and sediment stays in solution and testing vial is not scratched.
- Dry testing vial initially with dry cloth then lint/ oil cloth.
- Ensure test vial is not fogged up nor shows condensation.
- Test the water for turbidity either using the visual measurement or the turbidity meter.
- Record the readings on the turbidity monitoring data input table for the site as well as on the Turbidity Monitoring Data Summary Table.
- Record details on any departures from the State Water Quality standards and any corrective actions/ mitigation measures implemented on the Turbidity Corrective Action/ Mitigation Measures Table.

Turbidity will be measured at the following time intervals:

- Immediately before construction begins at the stream crossing location or if not possible immediately prior to construction, as close to construction time as possible
- 48 hours after culvert installation is complete, downstream within 20 feet of the installation
- Upstream of any stream work immediately ***following*** the sampling downstream of the installation site
- If turbidity measurements show elevated levels downstream of the installation relative to upstream, turbidity measurements should continue both upstream and downstream daily until the turbidity levels upstream and downstream are relatively no longer elevated.

  Elevated defined as:

  1. For readings lower than 50 NTUs; elevated levels are turbidity levels >5 NTU difference between the upstream and downstream measurement
  2. For readings higher than 50 NTUs; elevated levels are turbidity levels >10 % increase over upstream levels or a maximum of >25 NTU difference between upstream and downstream measurement

Descriptive notes on the stream bed material (i.e. bedrock, organic soil, glacial till, clean gravel, silt and gravel, silt, sandy loam, gravel and boulders, sand, gravel and boulders), traffic, stream character (i.e. steep sideslope drainage, meandering, braided), stream gradient (% slope gradient measured from the inlet of the culvert roughly 25 feet upstream) flow conditions (high flow, low flow, water turbulence, and estimated flow in cubic feet per second), and precipitation should be kept with the turbidity measurements.

One turbidity data sheet should be completed for each culvert site. The specific date and time construction starts at the culvert site, ends at the culvert site, as well as the time and date of the

turbidity measurements should be recorded. The turbidity data and descriptive site information should be recorded on the Turbidity Monitoring Data Input Table as well as on the Turbidity Monitoring Data Summary Table. A copy of the contract plan sheet showing the culvert location and culvert construction details should be attached to the turbidity monitoring data sheet. Details on any departures from the State Water Quality standards as well as any corrective actions/ mitigation measures should be recorded on the Turbidity Corrective Action/ Mitigation Measures Table. A cross reference note should be listed on the roads implementation monitoring form for this road segment in the comments column under BMP14.14/ 14.17 Bridge/ Culvert Design, Installation & Removal to see the turbidity monitoring data table(s) and reference the road station numbers of the culvert sites where turbidity measurements were completed.

**Evaluation Criteria:** Refer to Soils section, Implementation Monitoring. Compliance with the Standards & Guides for Soil and Water, Clean Water Act, Code of Federal Regulations for Non-Point Source Discharge, and Alaska State Statutes & Regulations for petroleum discharge and water quality.

***Turbidity***

The basis of the turbidity sampling procedure is to determine if a `degradation of water quality' occurred and to determine if the Best Management practices are effective in preventing water quality degradation. The turbidity measurements should be evaluated against the criteria for the Degradation as well as the Alaska Water Quality Standards for both drinking water supply and the standard for propagation for aquatic life. The Alaska Water Quality Standards (18AAC70) require that the most stringent criteria for water quality apply to streams unless a variance to change the designated use is granted. Because the standards are written as an increase above upstream or natural levels, it is important that the downstream observation be compared to the upstream. The upstream level is used as the base, and will vary with different conditions including precipitation.

***Degradation***

Per the State Forest Practices Regulations (11AAC95) and incorporated by reference into the R10 Soil and Water Conservation Handbook; ``degradation of water quality'' does not include changes that are temporary, localized, and reparable decreases in water quality; in this paragraph (a)''reparable'' means an effect on or change to, a use or aquatic system due a decrease in water quality that is reversible by natural processes such that the use or system will return to a state functionally identical to the original; (B)''temporary'' means 48 hours or less with respect to existing uses.''

***Drinking Water Standards***

The Alaska State Water Quality Standards (18AAC70) for turbidity require that, with respect to the most stringent use the turbidity should be evaluated against the criteria for water supply (i) drinking, culinary, and food processing, these standards state that the levels “may not exceed 5 NTU (nephelometric turbidity units) above natural conditions when the turbidity is 50 NTU or less, and may not have more than 10 % increase in turbidity when natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU”.

***Propagation of Aquatic Life Standards***

The Alaska State Water Quality Standards (18AAC70) for turbidity require that, with respect to the beneficial use ``growth and propagation of fish, shellfish, other aquatic life, and wildlife,'' the levels may not exceed 25 NTU (nephelometric turbidity units) above natural conditions; for all lake waters, the levels may not exceed 5 NTU above natural conditions.

***Transportation Criteria***

The Forest Service handbook FSH 7709 lists criteria for road maintenance, which can be used as evaluation criteria to access the road condition. The observed conditions of the roads, rock quarries and LTF's can be evaluated against the design criteria in the plans, typicals and the Forest Service Handbook FSH 7700. Criteria for evaluating the LTFs can be found in the storm water discharge plans, operators pollution prevention plans, EPA guidance documents on fuel storage as well as in the construction plan typicals and site plans.

**Precision and Reliability:** Visual turbidity measurements should be calibrated with a portable turbidity meter. Upon visual calibration a person can define whether the turbidity is 25 NTUs or greater. Turbidity measured with a turbidity meter should show +/- 5% over a range of 0.1 - 400 NTU. Specific precision and accuracy of less than 1 NTU is considered acceptable for this application.

**Results:**

- Tabulate field inspection data on the representative sample of older and newer harvest units and associated roads and log transfer facilities.
- List impacts on other resources including soil productivity, water quality, and fish and wildlife habitat.
- Compile implementation monitoring form data including details on the status of the drainage structures, sediment transport and erosion control.
- Tabulate the turbidity observation and measurements indicating the time and date of measurement, culvert size, brief description of the streambed material, stream character, flow conditions, precipitation at the time of installation and turbidity measurement, as well as any unusual site characteristics such as highly degrading road fill or high silt/ schistose rock road fill.
- List any mitigation measures, corrective action, and remediation measures taken at sites where turbidity measurements were outside the levels defined in the Alaska State Water Quality Standards.
- Tabulate the assessments of the LTF facilities, including clean-up of bark and debris, functionality of runoff controls, storage of petroleum products, ability of refueling facilities to contain petroleum products during transfers and secondary containment facilities, used fuel storage, and sediment settling ponds.

**Analysis:**

- Describe the observed impacts caused by roads and log transfer facilities on soil productivity, water quality, and fish and wildlife habitat.
- Assess the road prisms for drainage ditch conditions, sufficiency of cross drainage, cut and fill slope conditions (stability and erosion) and running surface condition.
- Compare the turbidity measurements relative to the Alaska State Water Quality Standards and determine if the measurements are within the criteria for degradation, drinking water quality and propagation of aquatic life.
- Summarize the turbidity measurements and assess the sites to determine if the construction is contributing to elevated levels.
- Determine if any of the mitigation measures, corrective action, and remediation measures taken at sites where turbidity measurements were outside the levels defined in the Alaska State Water Quality Standards were effective in contributing to bring the water quality into compliance into State standards.
- Assess the rock quarries and gravel sources for erosion control and stability.
- Assess the LTF facilities for run-off, bark accumulations, fuel storage, and functionality of sediment settling ponds.
- Explain how well the Best Management Practices were implemented and if the implementation was effective.

***WETLANDS***

**Goal:** Minimize the destruction, loss or degradation of wetlands and preserve and enhance wetland functions and values.

**Objectives:** Avoid alteration of, or new construction in wetlands whenever there is a practicable, environmentally preferred alternative. Implement Best Management Practices and estuary, riparian, and soil and water standards and guidelines specific to wetlands.

**Background:** Wetland implementation monitoring will follow established protocols for BMP implementation monitoring on a representative sample of harvest units and associated roads for the Tongass NF. Avoidance of wetlands will by monitored Tongass-wide each year, through GIS analysis.

Currently, the Tongass NF does not have an approved method to evaluate impacts of management activities to wetland functions and values. Some studies exist that are aimed at partially answering functional effectiveness questions. Some of these studies are complete and some are on going. No one study can give us the answer to all the functional questions associated with management activities in wetlands.

Wetland effectiveness monitoring for FY1998 and 1999 will be accomplished by reviewing and summarizing results of previous and on-going studies where wetland functions are being evaluated. Future effectiveness monitoring will be based on development of the HydroGeomorphic Model (HGM) for southeast Alaska.

**Wetlands Question 1: Are wetlands standards and guidelines being implemented?**

**Estimated Cost:** $10,000

**Data Collection:**

**A. Avoidance Implementation Monitoring**

1. Calculate total wetlands Tongass-wide in the GIS database (CLU layer) using the following categories:
    a. Estuarine
    b. Lacustrine
    c. Palustrine
        1) Forested
        2) Fens (short and tall sedge fens)
        3) Bogs (moss muskeg)
        4) Subalpine forest/bog (muskeg) mosaic
        5) Bog (muskeg)/forested wetland mosaic
        6) Forested upland/wetland mosaic
    d. Riverine

2. Use most Forest-wide roads inventory to analyze total area affected by roads (use 3 ac/mile).
3. Calculate total area (acres) of wetland impacted by road construction by wetland category (above).
4. Calculate percent of wetlands (Tongass-wide) affected by roads by wetland category.

**Evaluation Criteria:** The CLU database will be the standard for wetland analysis. Wetland categories mentioned above will be queried in GIS, using a new ITEM (called WETLD_CAT) which will be added to the CLU.SMUT look-up table. The Forest-wide inventory for roads will be used to calculate acres of roads.

**Precision and Reliability:** Total acres of wetlands will be measured to the nearest 5 acres. The CLU database and associated wetland categories will be used consistently across Administrative Areas. Wetland information generally does not change over time (unless a wetland is converted to an upland or vice versa, which rarely occurs), therefore the reliability of the database is high. Forest-wide road database will be updated every year.

**Results:**

1. Report total acres of wetlands by wetland category.
2. Report total acres of wetland impacted by road construction.
3. Discuss specifically any acres of wetland fens or estuaries (high value wetlands) impacted by road construction.
4. Report percent of Tongass-wide area by wetland category.
5. Report percent of wetlands impacted by road construction by wetland category.
6. Report Tongass-wide total percent wetlands impacted by road construction .

**Analysis:** to be written

**B. BMP Implementation Monitoring**:
Follow Tongass National Forest Best Management Practices Implementation Monitoring Strategy (June 1998) protocols for wetlands (BMP 12.5 - Wetland Protection Measures). Refer to the Soils Implementation Monitoring Protocol.

**Results**:

1. Summarize BMPs, which were implemented for the monitored sites.
2. Summarize BMP ratings for sites monitored.
3. Discuss how well the BMP was implemented and summarize results.

**Analysis:** to be written

**Wetlands Question 2: Are wetlands standards and guidelines effective in minimizing the impacts to wetlands and their associated functions and values?**

**Estimated Cost:** $50,000

**Data Collection:**

1. Define wetland functions by wetland category.
2. Review completed and on-going research/monitoring on wetlands to determine if they address effectiveness of management activities on wetland functions. These studies include:
    - Timber Productivity and Response to Harvest of Forested Wetlands in Southeast Alaska - FSL - Dave D'Amore.
    - Effects of overlay road construction on ground water hydrology - Study done by Terry Brock and FSL on Wrangell Island (which includes Impacts of Forest Roads on Sloping Peatlands - Glaser, 1996.)
    - Southeast Alaska Wet-Soil Monitoring Project - FSL - Dave D'Amore
    - Road Interception of Ground Water Movement - FSL - KK McGee
    - HydroGeomorphic Model (HGM) (modified Wet II) analysis method to evaluate beneficial functions and values of wetlands affected by management activities.

**Evaluation Criteria:** The evaluation criteria used will be the standard, generalized functional attributes by wetland category. To evaluate if the studies cited can address the effectiveness questions, a team of Soil Scientists, Ecologists, Hydrologist and Fisheries Biologists from the TNF and FSL will review the studies and discuss their findings in a group forum. This group will also discuss usage of the HGM and its applicability to southeast Alaska wetlands.

**Precision and Reliability:** This will be based on the scientific validity of the studies being used to address the effectiveness questions. Each study should have a defined methodology and results should be peer-reviewed before acceptance.

**Results:**

1. Describe generalized wetland functions by wetland category.
2. Describe project activities in wetlands.
3. Describe wetland mitigation measures applied (BMPs, mitigation or restoration).
4. Summarize findings of research/monitoring studies as they apply to different management activities and how they affect wetland functions.
5. Develop a plan of action to use the HGM or other tool for making simple, reliable functional assessments of wetlands before and after activities take place.

**Analysis:** to be written

***WILD AND SCENIC RIVER***

**Goal**: Maintain the outstandingly remarkable values and the free flowing conditions of rivers designated or recommended for designation as components of the National Wild and Scenic Rivers System.

**Objectives**: Manage the 32 rivers (or segments) recommended for designation as Wild, Scenic, or Recreational pending designation by Congress, to maintain the eligibility of the total miles of river for the following recommended classifications:

| | |
|---|---|
| Wild | 364.5 miles |
| Scenic | 87.5 miles |
| Recreational | 89.0 miles |

**Background:** The Wild and Scenic Rivers Act of 1968 established a policy for preserving selected rivers in a free-flowing condition that would balance the development of water, power and other resources on rivers of the United States. Rivers are eligible to be considered for inclusion in the National Wild and Scenic Rivers System if they are essentially free-flowing (without major dams, diversions, or channel modifications) and if they possess at least on "outstandingly remarkable" scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar value. These values should be a unique or exceptional representation for the area that the evaluation of a river's eligibility considers.

**Wild and Scenic River Question 1: Are Wild, Scenic, and Recreational River standards and guidelines being implemented?**

**Estimated Cost:** $3,000 annually

**Data Collection:**

- Annually select three proposed or designated Wild, Scenic, and Recreational River to monitor. Select an area that reflects a higher intensity on those Rivers with the highest use within the river corridor, and those adjacent to or within project areas for other activities, such as timber sales. Choose a wild, scenic, recreational river, rated by recreational staff that shows high use.

- Review project-specific plans and approved Management Plan (if applicable) for special management considerations, carrying capacities and River- or project-specific standards, guidelines and mitigating measures, and authorized projects and activities. Note if all applicable standards and guidelines were incorporated into project plans and special use authorizations.

- Review current year observation records from visitors for evidence of implementation of standards and guidelines, particularly those concerning the quality of the river experience.

- Conduct visual surveys of use areas to determine whether standards and guidelines have been implemented, both for numbers of encounters and for construction and maintenance activities.

- Identify indications of conflicting uses that may result from standards and guidelines implementation.

- When possible, observe activities of outfitter/guides under permit for conformance to permit requirements, especially in numbers of visitors.

- When possible, interview visitors for indications of the quality of their river experience. Visit permitted recreation cabin sites for compliance with permit requirements.

- Monitor each proposed or designated river at least once every five years. For each selected wild, scenic recreational river stratify the area into different levels of use and focus the monitoring on the reaches of highest use or with adjacent other activities (i.e. timber sales).

- Review previous monitoring reports, permit administration records, project NEPA documents, and monitoring and research from other sources for predicted conditions, identification of previous problems, development of trends, and anticipated effects of past activities.

- Interview field employees, research and education organizations, outfitter/guide organizations, and visitor's organizations about conditions and status of river selected.

**Evaluation Criteria:**

- Evaluation will be based on whether or not applicable standards and guidelines were incorporated into project planning documents and special use permits, and if they are being implemented on-the-ground.

- Numerical thresholds are those established by respective standards and guidelines and ROS class for each river classification, and relates to numbers of groups, party size, and numbers of encounters. The thresholds for social encounters and social effects (quality of the river experience) are based on personal and professional experience and knowledge.

**Precision and Reliability:** Precision and reliability will be dependent upon the precision and reliability of the monitoring activities. The precision and reliability will be effected by the subjective judgement of the people interviewed as well as the recreation specialists.

**Results:**

- Describe the River environment monitored, including a description of locations visited and activities monitored.
- List standards and guidelines incorporated into project plans and implemented on the ground.
- Identify any standards and guidelines not incorporated into project planning
- Identify if the appropriate ROS class applied, relative to river classification, based on pre-designation uses?
- List the numbers of encounters for each ROS class observed.

**Analysis:**

- Describe the implementation of the standards and guidelines for these rivers. Describe circumstances where the standards and guides were not implemented. Examine the trends observed relative to implementation of the standards & guides, ROS classes relative to river classifications and numbers of encounters.
- If numbers of encounters exceeded the established limits, why? What actions, if any, are recommended?
- Discuss whether ROS class applied was appropriate.
  Evaluate the encounter numbers prescribed and realized and explain the differences.

**Wild & Scenic River Question 2: Are Wild, Scenic, and Recreational River standards effective in maintaining or enhancing the free flowing conditions and outstandingly remarkable values at the classification level for which the river was found suitable for designation as part of the National Wild and Scenic River System?**

**Estimated Cost:** $3,000 annually

**Data Collection:** For rivers selected for implementation monitoring:

- Document the Standards & Guides implemented.
- Review the administration records to evaluate whether the Standards & Guides were implemented.
- Interview field employees, research and educational organizations, outfitter-guide organizations concerning the effectiveness in the Standards & Guides in a achieving the River objectives.
- Select at least one proposed or designated Wild, Scenic, and Recreation River per Area, in conjunction with and at the same intensity level as, wild and scenic river implementation monitoring above.
- Review previous monitoring reports, permit administration records, project NEPA documents, and monitoring and research from other sources for predicted conditions, identification of past problems, development of trends, and anticipated effects of past activities.
- Review approved project-level plans, special use permits, and (where applicable) approved River management plans, for special management considerations, carrying capacities, River-specific standards, guidelines and mitigating measures, and authorized projects and activities.
- Conduct field surveys of use areas for indications of excessive or inappropriate use, or other indicators that the applicable standards and guidelines are not effective in maintaining the river resource. Indicators include streambank damage, stream sedimentation, destruction of vegetative cover, site hardening, concentrations of visitors, grouping of camping sites, shortcuts in relation to trails, excessive motorized or mechanical use, excessive or readily observable permitted authorized facilities, excessive evidence of human presence and deterioration of facilities such as trail, boat mooring sites, and cabin sites.

**Evaluation Criteria:** The degree to which human activities maintain or enhance the resource values of the river.

Evaluation of the results of monitoring will be based on whether or not the standards and guidelines guiding Forest Service-approved activities have been effective in maintaining the river resource.

If standards and guidelines are being properly implemented but effectiveness monitoring indicates that unacceptable damage to the river resource is occurring, and analysis identifies the reason for failure, take action to correct the downfall. Actions may be to limit numbers of users, physically restrict access, physical restoration of the site, or work with commercial users to use alternate sites. Conversely, if it is found that the standards and guidelines are effective in maintaining or enhancing the river resource, the appropriate action may be to reduce or eliminate monitoring.

**Precision and Reliability:** The precision and reliability will be effected by the professional judgement of the recreational specialist conducting the monitoring activity.

**Results:**

- List the Standards & Guides Implemented.
- Summarize observations of Standers & Guide Implementation.
- Compile interview data concerning the effectiveness of Standards & Guides in achieving the River objectives.
- Summarize field surveys describing indications of unplanned use relative to maintaining the River resource.

**Analysis:**

- Describe the overall effective of the S & G in maintaining the River resources reviewed.
- Explain any challenges or conflicts resulting from implementation of the Standards & Guides. Recommend measures that would be more effective in protecting the river resource.

***WILDERNESS AREAS***

**Goal**: Manage designated Wilderness to maintain an enduring wilderness resource while providing for public access and uses consistent with the Wilderness Act of 1964 and the Alaska National Interest Lands Conservation Act of 1980 (ANILCA).

**Objectives**: In Wilderness, manage for the adopted ROS class. Where ROS has not been adopted, manage for no greater development than semi-primitive motorized (with certain localized exceptions due to the effects of activities outside wilderness and ANILCA exceptions).

**Background:** Congressionally designated Wilderness in the Tongass National Forest comes from two pieces of legislation. Alaska National Interest Lands Conservation Act (ANILCA) of 1980 established 14 Wildernesses totaling 5.5 million acres within the Tongass. Two of the area, Admiralty Island and Misty Fiords, we also designated as National Monuments. Prior to ANILCA three was no designated Wilderness on the Tongass. In 1990, the Tongass Timber Reform Act (TTRA) amended ANILCA and designated five new Wilderness and one Wilderness addition totaling 296,080 acres. This brings the total to 5.7 million acres in 19 Wilderness on the Tongass National Forest.

**Wilderness Question 1: Are standards and guidelines for the management of wilderness being implemented?**

**Estimated Cost:** $30,000 annually

**Data Collection:**

- Recreation Staff nominates wilderness area to monitor.
- Select at least one Wilderness per Area with the highest number of uses and users.
- Document the degree of compliance with applicable standards and guidelines.
- Perform a field monitoring trip on a representative sample of wilderness areas each year to assess compliance with standards and guidelines not related to authorizations and as an overview of permit compliance within that individual wilderness area.
- Review applicable Wilderness Implementation Schedule or approved Wilderness Management Plan, permit administration records, and project NEPA documents for incorporation of applicable standards and guidelines.
- Review past monitoring reports for indication of standards and guidelines implementation in past years.
- Collaborate and coordinate with field employees (such as wilderness rangers), other administrative units, research and education organizations (i.e. Wilderness Resource Institute), outfitter/guide organizations, and wilderness visitors organizations (i.e. Alaska Wilderness Recreation and Tourism Association), to provide assistance in the collection and evaluation of data.
- Review the approved Wilderness Implementation Schedule, approved Wilderness Management Plan (if applicable), and project-specific plans for special management considerations, carrying capacities, Wilderness- or project-specific standards, guidelines and mitigating measures, and authorized projects and activities. Note if all applicable standards and guidelines were incorporated into project plans and special use authorizations.

- Review special use permit files for authorized amount and location of use, and performance history.

- Review current year observation records/comments of wilderness rangers, other official visitors, and recreational visitors for evidence of implementation of standards and guidelines, particularly those concerning the quality of the wilderness experience.

- Review previous monitoring reports for identification of problems, areas of needed improvement, or areas where no additional monitoring may be required.

- Conduct visual surveys of use areas for indications of standards and guidelines implementation, both for numbers of encounters, etc. and for activities such as facilities development, and trail construction and maintenance.

- Identify indications of conflicting uses that may result from standards and guidelines implementation.

- When possible, observe activities of outfitter/guides under permit for conformance to permit requirements, especially in numbers of visitors.

- When possible, observe high use areas for extended periods of time to determine numbers of visitors for compliance with ROS class limits or, if applicable, with established carrying capacities.

- When possible, interview wilderness visitors for indications of the quality of their wilderness experience. Visit permitted recreation cabin sites for compliance with permit requirements.

- When possible, visit sites of administrative activities, such as fish habitat improvements and recreation cabins, for compliance with standards and guidelines for appearance.

**Evaluation Criteria:** Compliance with guidelines establishing levels of social encounters, development, and visitor impacts by Recreation Opportunity Spectrum class.

Threshold: The numerical thresholds are those levels established in the Recreation Opportunity Spectrum class (Forest-wide Standards and Guidelines), or as a carrying capacity either in the W.I.S. or an approved Wilderness Management Plan. The threshold for implementation of other required standards and guidelines is ``Was the standards and guidelines implemented?'' and is answered yes or no.

Evaluation: Evaluation of the results of monitoring will be based on whether or not the actual use of a given wilderness is within the limits set in the Recreation Opportunity Spectrum class, the W.I.S., or Wilderness Management Plan. Visitor use days can be within the threshold, but other standards and guidelines are not being implemented in order to prevent effects such as hardening of sites other than those predicted as acceptable, unacceptable bunching of camp sites, obvious damage or evidence of use, or concentrations of visitors. In addition to the evaluation of the levels of social encounters, development, and visitor impacts specifically identified in the monitoring question Evaluation Criteria, determine whether the Standards and Guidelines relating to wilderness management are being incorporated into project planning or special use permits. Determine, through field observation, if these standards and guidelines were implemented on the ground.

Recommended Actions: If monitoring indicated that standards and guidelines are being incorporated into wilderness planning and implemented on the ground, rely on effectiveness monitoring to indicate whether the standards and guidelines are effectively maintaining an

enduring wilderness resource while providing for public access and use. If monitoring indicates that applicable standards and guidelines are not being incorporated into project planning or implemented in the field, particularly relating to outfitter/guide use, administrative actions should be taken to insure that these standards and guidelines are implemented in the future. Administrative action may include limiting commercial use, stricter special use enforcement, limiting of non-commercial use, or, if conditions warrant it, changing the current ROS class to one less restrictive.

**Precision and Reliability:** The precision and reliability will be dependent upon the data documentation and the professional judgement of the recreational specialist.

**Results:**

- Describe the wilderness environment monitored, including a description of locations visited and activities monitored.
- Review the project plans and determine if the standards and guidelines were incorporated into project plans.
- If applicable standards and guidelines were not incorporated into project planning, determine why not.
- Determine if standards and guidelines identified in project planning were implemented on the ground.
- Determine if applicable standards and guidelines were not implemented, why not?
- Determine if the appropriate ROS class applied, relative to remoteness.
- List the numbers of visitors and numbers of groups encountered.
- Determine if the numbers of encounters were within the numbers established for the ROS class, or in a Wilderness Implementation Schedule or approved Wilderness Management Plan.

**Analysis:**

- Analysis of monitoring information acquired will primarily be qualitative and will be weighed against the principle Land and Resource Management Plan Goals and Objectives of managing designated Wildernesses to maintain an enduring wilderness resource while providing for public access and use. As stated above, the included standards and guidelines are only those felt to be key to the monitoring question. Other standards and guidelines may be required by a project-specific plan, and should be included in any analysis relating to the monitoring question.
- If numbers of encounters exceeded the established limits, why? What actions, if any, are recommended?

**Wilderness Question 2: Are standards and guidelines for the management of wilderness effective in maintaining the wilderness resource?**

**Estimated Cost:** $30,000 annually

**Data Collection:**

- Recreation Staff nominate wilderness areas to monitor.

- Select at least one Wilderness per Area per year with the highest number of uses and users in conjunction with wilderness implementation monitoring .

- Review past monitoring reports, permit administration records, project NEPA documents, and monitoring and research from other sources for predicted conditions, identification of past problems, development of trends, and anticipated effects of past activities.

- Collaborate and coordinate with field employees (such as wilderness rangers), other administrative units, research and education organizations (i.e. Wilderness Resource Institute), outfitter/guide organizations, and wilderness visitors organizations (i.e. Alaska Wilderness Recreation and Tourism Association), to provide assistance in the collection and evaluation of data.

- Review the approved Wilderness Implementation Schedule, and, where applicable, the approved wilderness management plan, for special management considerations, carrying capacities, Wilderness-specific standards, guidelines and mitigating measures, and authorized projects and activities.

- Review special use permits for authorized amount and location of use, and performance history, Review current year observation records of wilderness rangers, other official visitors, and recreational visitors for indications of problem areas, areas of concentrated use, or inappropriate or excessive use.

- Review previous monitoring reports for identification of problems, areas of improvement, or areas where no additional monitoring may be required.

- Conduct visual surveys of use areas for indications of excessive or inappropriate use, or other indicators that the applicable standards and guidelines are not effective in maintaining the wilderness resource. Indicators include streambank or shoreline damage, stream sedimentation, destruction of vegetative cover, site hardening, concentrations of visitors, grouping of camping sites, shortcuts in relation to trails, excessive motorized or mechanical use, excessive or readily observable permitted authorized facilities, excessive evidence of human presence (may not result in site hardening, etc., but still readily evident), and deterioration of facilities such as trail heads trails, boat mooring sites, and cabin sites.

**Evaluation Criteria:** The degree to which human activities maintain the wilderness resource.

Threshold: The threshold for any given standard and guideline will vary by the type of standards and guidelines and location; however, the overall guiding threshold is the standard and guideline effective in maintaining the wilderness resource?. The answer is yes or no. If no, corrective action must take place. The exception will be only those effects that have been identified in an approved NEPA document.

Evaluation of the results of monitoring will be based on whether or not the standards and guidelines guiding Forest Service-approved activities have been effective in maintaining the wilderness resource. Standards and guidelines relating to resource protection (Best Management Practices, visuals, trail construction requirement, etc.) may effectively protect that resource, but not be acceptable in terms of the overall wilderness resource. This evaluation is primarily qualitative rather than quantitative and is subject to personal and profession interpretation.

Recommended Actions: If standards and guidelines are being properly implemented but effectiveness monitoring indicates that unacceptable damage to the wilderness resource is occurring, and analysis identifies the reason for failure, take action to correct the downfall. Actions may be to limit numbers of users, physically restrict access, physical restoration of the site, or work with commercial users to use alternate sites. Conversely, if it is found that the standards and guidelines are effective in maintaining the wilderness resource, the appropriate action may be to reduce or eliminate monitoring.

**Precision and Reliability:** The precision and reliability will be dependent upon the professional judgement of the recreational specialist completing the monitoring activity.

**Results:**

- Describe the wilderness environment monitored, including a description of locations visited and activities monitored. Include a description of those standards and guidelines identified for effectiveness monitoring.

- Describe in a narrative if the standards and guidelines identified in project planning were implemented on the ground.

- Determine if standards and guidelines effective in protecting the wilderness resource?

**Analysis:**

- Analysis of monitoring information acquired will primarily be qualitative and will be weighed against the principle Land and Resource Management Plan Goals and Objectives of managing designated Wildernesses to maintain an enduring wilderness resource while providing for public access and use. The applicable wilderness implementation schedule will describe limits of acceptable change, desired conditions, and anticipated effects by the various wilderness visitors. While the quantifiable data obtained may indicate that use has not reached numerical limits indicated in applicable standards and guidelines, W.I.S., or approved wilderness management plan, professional experience and knowledge may suggest that acceptable use has been met or exceeded, and the standards and guidelines ineffective in maintaining the wilderness resource. If an unacceptable condition is identified, determine the cause, if it is site-specific or widespread, if it is a single-year occurrence or on going, and what the cumulative effects, if any, may be.

- Summarize findings if standards and guidelines were not effective in protecting the wilderness resource. Address what actions, if any, are recommended.

***WILDLIFE***

**Goal:** Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations in the planning area. Also, maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.

**Objectives:** In addition to objectives included in Biodiversity, design and implement non-structural wildlife habitat improvement projects to improve an average of 8,000 acres annually across the Forest. Include a young-growth management program to maintain, prolong, and/or improve understory forage production and to increase future old-growth characteristics in young-growth timber stands for wildlife. Additionally, design and implement an average of 75 structural wildlife habitat improvement projects annually across the Forest.

**Background:** The Tongass National Forest provides habitat for 54 species of mammals (including the recently introduced elk on Etolin Island), 231 species of birds, and five species of amphibians and reptiles. There are an additional 18 species of marine mammals found in Southeast Alaska waters which depend entirely on the ocean environment, and 45 bird and 3 amphibian or reptile species considered casual or accidental visitors to Southeast Alaska. These species provide many opportunities for consumptive and non-consumptive uses, including commercial, sports, and subsistence hunting and photographic and viewing activities. The Forest is rich in its varied and unique species; some of the species found on the Forest in relative abundance (such as bald eagle and brown bear) are threatened or endangered in other parts of the United States.

**Wildlife Question #1: Are population trends for Management Indicator Species and their relationship to habitat changes consistent with expectations?**

**Estimated Cost:** [cost will be determined when the specific protocols for the species are developed]

**Data Collection:** Monitoring protocol still under development; Gene DeGayner is lead in subgroup developing Protocol for wildlife MIS.

Refer to Gene DeGayner's document ``A Reassessment of Management Indictor Species for the Tongass National Forest, 19 February 1999'' that describes the MIS selection process.

**Evaluation Criteria:** [to be written]

**Precision and Reliability:** [to be written]

**Results:** [to be written]

**Analysis:** [to be written]

We discussed this monitoring at length during the last Interagency Monitoring and Evaluation Group meeting (1/7-8/98). In the face of a unified stance by fish and wildlife biologists from several agencies that ADF&G harvest data, in and of itself, was not sufficient to answer the TLMP MIS monitoring questions, IMEG agreed to propose an alternative approach:

Protocols for these monitoring items are not due for the FY 98 field season.
For wildlife MIS on the Tongass, the best monitoring strategy probably involves continually evaluating and improving habitat capability models, including testing the assumptions that underlie them. To this end, IMEG recommends reconvening the Interagency Model Group. Action items will include:

- Reevaluate the existing MIS list (recommend species to add or drop).

- Recommend information needs for evaluating existing models or constructing new ones as appropriate.
- Where possible, and if issues demand it, develop population indices for monitoring individual MIS.
- The results of this process will be deliverables for the FY 98 monitoring report (early 1999), as follows:
- Develop discussion on limitations of CFR language on MIS and the existing TLMP language (in chapter 6).
- Summarize the results of FY 98 work (#2 above).
- From those results, recommend any plan amendments needed, and MIS monitoring approach from FY 99 forward.

**Wildlife Question #2: Are the population levels and associated distribution of mammalian endemic species on islands and portions of the mainland consistent with the estimates in the Forest Plan?**

**Background:** A study is currently being conducted by the Forest Science Laboratory to determine the geographic and habitat distribution of endemic mammals on the Tongass National Forest. Objectives of this study include:

1.) Documenting the geographic extent and habitat distribution within and across islands and the mainland portion of the Tongass National Forest of several recognized mammalian taxa that demonstrate limited historical ranges.
2.) Determining population levels and associated distribution of mammalian endemics on islands and portions of the mainland that have had timber harvest

**Estimated Cost:** $1,000

**Data Collection:**

1. Review the progress on the small mammal study on endemic mammals.
2. Review and results of the study, noting the geographic and habitat distribution as well as any effect from timber harvest.

**Evaluation Criteria:** to be written

**Precision and Reliability:** The precision and reliability is dependent upon the precision and reliability of the wildlife studies and associated databases.

**Results:**

1. Summarize the progress on the small mammal study on endemic mammals.
2. Summarize the results of the study, describe the geographic and habitat distribution of the species and note any significant effect from timber harvest activity on the population of the mammalian endemics.

**Analysis:**

1. Describe the status of the small mammal study on endemic mammals including the work completed and planned in the study. Explain the rational that has lead to modifications in the study plan.
2. Document any trends noted in the geographic and habitat distribution of species relative to timber harvest activity.

3. Recommend changes in the study plan to ensure the study is providing the necessary information to determine if the population observations are consistent with the estimates in the Forest Plan.

***COSTS AND OUTPUTS***

**Costs & Outputs Question 1: What outputs were produced in the previous year?**

**Estimated Cost:** $4,000 annually

**Data Collection:**
- Read management report.
- Review Forest Plan projections.

**Evaluation Criteria:** Achieve levels of desired goods and services as described in the Forest Plan.

**Precision and Reliability:** The precision and reliability will be dependent upon the precision and reliability of the cost and output data and will vary on specific items dependent upon the input data.

**Results:** Tabulate current and planned output levels.

**Analysis:** Compare current and projected output levels and explain differences.

**Costs & Outputs Question #2: Are the costs associated with carrying out the planned management prescriptions (including those of producing outputs) consistent with those costs estimated in the Plan?**

**Estimated Cost:** $3,000 annually

**Data Collection:**
- Review estimated costs in the Forest Plan.
- Obtain actual costs of producing outputs (every 5 years)

**Evaluation Criteria:** Produce outputs at a cost less than or equal to planned costs.

**Precision and Reliability:** The precision and reliability will vary with the specific data input for costs and outputs.

**Results:** Tabulate annual current and planned costs.

**Analysis:** Compare actual with planned costs and explain differences.

# APPENDIX

Implementation Monitoring Form

Karst & Caves Monitoring Form

Mass Movement Data Elements

Buffer Effectiveness Monitoring Protocol 1999

| **Date Monitored:** | **SA Name:** | | |
|---|---|---|---|
| **Unit #:** | **Timber Sale:** | **EIS/EA:** | **District:** |
| Planned (ROD/DN) Acres: | Acres Laid Out: | Final Acres: | |
| **Stream/ Wetland Information (streams immediately adjacent to unit or in unit)** | | | |
| Linear Meters/ Feet Stream Class I : | Acres of Stream Class I Buffer: | | |
| Linear Meters/ Feet Stream Class II: | Acres of Stream Class II Buffer: | | |
| Linear Meters/ Feet Stream Class III; buffered: | Acres of Stream Class III Buffer: | | |
| Linear Meters/ Feet Stream Class III; unbuffered: | | | |
| Linear Meters/ Feet Stream Class IV: | Acres of Stream Class IV Buffer: | | |
| Wetland Acres in Units: | | | |
| **LTF Information** | | | |
| LTF Name: | | | |
| Timber Volume to LTF from unit: | | | |
| Site Compliance Inspection date: | | | |

1 BMP rating (rate after unit closure): Y = BMP fully implemented; D = Departure from full BMP implementation; N = BMP not implementated
2 Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

| Item Monitored | Applies | BMP Rating[1] | Corrective Action | Corrective Action Implemente | Departure Occurred[2] | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 12.5- Wetlands Protection Measures**<br>- prescribed/ implemented<br>-Location relative to wetlands<br>-Minimize vegetative disturbance in wetlands<br>-Suspension requirement met | yes/ no | | yes/ no | | | |
| **BMP 12.6- Riparian Area Designation & Protection/ BMP 12.6a- Buffer Zone Design and Layout**<br>-Protection measures prescribed for riparian areas<br>-Streams<br>-Riparian Beach & Estuary Buffer | yes/ no | | yes/ no | | | |
| **BMP 12.8/ 12.9- Oil Pollution Control Measures**<br>-SPPC Plan in place<br>-Absorbents on site<br>-Proper disposal of filters, containers<br>-Stained Soil<br>-Landing Maintenance<br>-Mechanic area clean of spills | yes/ no | | yes/ no | | | |

| Item Monitored | Applies | BMP Rating*1 | Corrective Action | Corrective Action Implemented | Departures*2 | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 12.17- Revegetation of Disturbed Areas**<br>-Implemented | yes/ no | | yes/ no | | | used for "unexpected" disturbances |
| **BMP 13.5- Identification & Avoidance of Unstable Areas**<br>-Standards and Guides for slope stability implemented (slopes in excess of 72%) | yes/ no | | yes/ no | | | |
| **BMP 13.9- Yarding Systems to Protect Soil/ Water Resources**<br>-Implemented | yes/ no | | yes/ no | | | |
| **BMP 13.10 Landing Location & Design**<br>-Minimize clearing excavation<br>-Prevented slash from entering streams<br>-Outside stream channels, wetlands<br>-Allowed required suspension<br>-Stability of landing location | yes/ no | | yes/ no | | | |

| Item Monitored | Applies | BMP Rating*1 | Corrective Action | Corrective Action Implemented | Departures*2 | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 13.11/13.14/ 14.5- Erosion Control Measures- Units, Temporary Roads**<br>-Erosion Control Measures<br>-Erosion control mechanisms<br>-Temporary drainage structures removed | yes/ no | | yes/ no | | | |
| **BMP 13.16- Stream Channel Protection**<br>-Stream course protection implemented<br>-buffers<br>-partial suspension across channel<br>-directional falling<br>-debris removal | yes/ no | | yes/ no | | | |
| **BMP 14.26/14.27- LTF Surface Erosion Control Plan Storm Water Pollution Prevention Plan**<br>-NPDES Plan in place<br>-Settling ponds installed<br>-Erosion control measures utilized<br>-Site Compliance inspection completed | yes/ no | | yes/ no | | | |

Additional Comments:

# Road Implementation Monitoring Form

| **Date Monitored:** | **ER/ COR Name:** | **Road Construction Contract:** | **Date Monitored** |
|---|---|---|---|
| **Road #:** | **Timber Sale:** | **EIS/EA:** | **District:** |
| **Endhaul/ Blasting Restriction Information** | | | |
| Cubic Yards Endhaul: | Length Endhaul: | Length Blasting Restrictions: | |
| **Stream/ Wetland Information** | | | |
| Stream Classes Road Crosses: | | | |
| # Culverts Class I: | # Bridges Class I: | | |
| # Culverts Class II: | # Bridges Class II: | | |
| # Culverts Class III: | # Bridges Class III: | | |
| # Culverts Class IV: | | | |
| Wetland Acres in Road Corridor: | | | |
| **LTF Information** | | | |
| LTF Location: | | | |
| Site Compliance Inspection date: | | | |

# Road Implementation Monitoring Form

[1] BMP rating (rate after road final): F = BMP fully implemented; D = Departure from full BMP implementation; N = BMP not implemented
[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

| Item Monitored | Applies | BMP Rating[1] | Corrective Action | Corrective Action Implemented | Departure Occurred[2] | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 12.5- Wetlands Protection Measures**<br>- prescribed/ implemented<br>-Minimum number roads in wetlands<br>-Location relative to wetlands<br>-Minimize vegetative disturbance in wetlands<br>-Borrow sources located upland | yes/ no | | yes/ no | | | |
| **BMP 12.7/ 14.5/ 14.8 Measures to Minimize Surface Erosion**<br>-Erosion Control Plan<br>-Measures to limit sediment transport: ditch dams, sediment basins, silt fences<br>-Seeding | yes/ no | | yes/ no | | | |
| **BMP 12.8/ 12.9- Oil Pollution Control Measures**<br>-SPPC Plan in place<br>-Absorbents on site<br>-Proper disposal of filters, containers<br>-Stained Soil<br>-Good Housekeeping | yes/ no | | yes/ no | | | |

# Road Implementation Monitoring Form

| Item Monitored | Applies | BMP Rating[1] | Corrective Action | Corrective Action Implemented | Departure Occurred[2] | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 14.6 – Timing Restrictions for Construction Activities/ Fisheries Prescription**<br>-Timing guidelines met | yes/ no | | yes/ no | | | |
| **BMP 14.7/ 14.12- Measures to Minimize Mass Failures/ Control Excavation & Sidecast**<br>-Blasting restrictions<br>-Endhaul<br>-Measures to limit erosion & mass failure | yes/- no | | yes/ no | | | |
| **BMP 14.9- Drainage Control Structures to Minimize Surface Erosion & Sedimentation**<br>-Culverts functional<br>-Adequate number of culverts & spacing | yes/ no | | yes/ no | | | |

# Road Implementation Monitoring Form

| Item Monitored | Applies | BMP Rating[1] | Corrective Action | Corrective Action Implemented | Departure Occurred[2] | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 14.14/ 14.17- Bridge/ Culvert Design, Installation & Removal**<br>-Minimize sedimentation<br>-Turbidity measurements<br>-Fish Passage<br>-FS & ADF&G concurrence details implemented | yes/-no | | yes/ no | | | |
| **BMP 14.18- Control Rock Pit Sediment**<br>-Location relative to streams, soils with high mass movement potential, unstable slopes<br>-Sediment & drainage control | yes/-no | | yes/ no | | | |
| **BMP 14.20/ 14.22- Road Maintenance/ Access Management**<br>-open/ closed/ seasonal closure/ to be closed after timber harvest activity<br>-Maintenance<br>-Prevent sedimentation & erosion | yes/-no | | yes/ no | | | |

# Road Implementation Monitoring Form

| Item Monitored | Applies | BMP Rating[1] | Corrective Action | Corrective Action Implemented | Departure Occurred[2] | Comments (PRINT!) |
|---|---|---|---|---|---|---|
| **BMP 14.26/14.27- LTF**<br>**Surface Erosion Control Plan**<br>**Storm Water Pollution Prevention Plan**<br>-Plan in place<br>-Settling ponds installed<br>-Good housekeeping techniques observed<br>-Erosion control measures utilized<br>-Site Compliance inspection completed | yes/ no | | yes/ no | | | |

Additional comments:

Office Review of Karst Vulnerability Assessment

Administrative Area _____

Project Name _____

Project Size _____

Project Location _____

Was a karst vulnerability assessment completed?

If assessment was not completed, explain why _____
_____
_____
_____

Karst Field Review For Moderate Vulnerability Lands

VCU #_____ UNIT #_____ Road #_____

Partial suspension was achieved within the harvest unit.

Roads avoided sinkholes and other collapse features and losing streams

Roads did not divert water to or from karst features.

Measures were taken to reduce erosion and sediment transport from road surface and cutslopes.

Quarries were not developed atop karst without adequate site survey and design.

Quarries were properly closed after abandonment.

Comments: _____
_____
_____
_____

## Karst Field Review For High Vulnerability Lands

VCU #_____ UNIT #_____ Road #_____

Timber harvest activities were excluded.

Roads crossed these areas only where no other option existed and karst resource values were not compromised.

No quarry development was allowed.

No timber harvest, road construction, and/or quarry development occurred within 100' of the edge of a sinkhole, collapse channel, doline field, losing stream, or other collapse karst feature unless dye tracing indicated such features did not contribute to Class I or Class II streams or a domestic water supply.

No timber harvest, road construction, and/or quarry development occurred on lands that overlie a known "significant" cave or contribute waters to any known "significant" cave.

No timber harvest, road construction, and/or quarry development occurred on lands that were close enough to the entrance of a "significant" cave to be capable of altering the micro-climate of the cave's entrance and/or cave features within.

Buffers designed to protect karst systems and their features remain windfirm.

Comments: _____
_____
_____
_____

Mass Movement Data Elements

Landslide number
VCU or Watershed
Road Number
Harvest unit Number
Length and Width (Cloth Tape)
Slope Initiation Angle (%)
Area (acres)
Soil series at headwall
Landslide type, these include
  Debris Avalanches
  Debris torrents
  Rockfall
  Earthflows
Bedrock features (if applicable)
  Bedding and dip angle
  faults or joints
Activity causing slide,  these include:
  harvest unit
  road construction
  rock pit development
  Other?
Primary and secondary causal agents, these include
  Soil disturbance in harvest units
   Road sidecast placement
   Blasting of rock pits and road benches
   Cutbank failures (document only if the failure has an identifiable slip plane)
   Rock pit overburden placement
   Unanticipated parent materials
   Fill or landing placement
   End-haul placement
   Unanticipated soil water conditions
   Water concentration from soil disturbance upslope
   Water concentration from road upslope
   Water concentration during a large storm event
   Windthrow on edges of harvest units or road corridors
Parent materials or failure surfaces, these include
   Compact till
   Bedrock
   Marine clay or glacio-lacustrine deposits
   Till/Bedrock interface
   Deep colluvium
   Till overflows (These often occur when compact till is excavated and piled too deep.
     Failure occurs within the pile and till material overflows the soil surface.)
   Colluvium overflows (Same concept as till overflows but with colluvial materials.)
Water quality impacts, These include;
   Stream class and channel type affected
   An estimate of quantities entering watercourses.
   Flow regime of water resource impacted (intermittent, ephemeral, or perennial)
   Mitigation Measures implemented or required.

## Buffer Effectiveness Monitoring Protocol 1999

The purpose is to evaluate the effectiveness of stream side buffers in maintaining riparian and aquatic habitat capability, and water quality. This monitoring project will provide information on how well stream buffers maintain the integrity of riparian timber stands, stream bank stability, and fish habitat capability. This work is designed so that long term effectiveness of stream buffers can be assessed. Measurements can be made periodically over a number of years to assess riparian and aquatic habitat condition.

Buffer Effectiveness sites will be established on Class I Flood Plain and Moderate Gradient Mixed Control channel types (FP3, FP4, FP5, MM1 and MM2).

Parameters to measure are:

Stream habitat units

Large woody debris

Channel cross-sections

Stream reach longitudinal profile

Riparian canopy opening

Stream bank stability

Stream flow at time of survey

Survey Timing and Duration

The first data set measurement should be taken before timber harvest occurs. The survey should be conducted during the low flow time of year (June through August). Ideally each site survey should take one to two days for a two person crew. Some complex channel types such as an FP4 or FP5 may take longer. Five channel cross-sections will be measured at each site

Step 1. Locate Stream Reach Site

The timber unit with a riparian buffer will have been selected through the forest wide selection process. Locate the downstream corner of unit and flag the adjacent stream bank at a point perpendicular to the harvest unit corner, this will mark the beginning point of the stream buffer survey reach. Find the upstream corner of the unit and flag this ending point also.

Step 2. Measure the length of the survey reach and calculate distance between cross-sections

The length of the reach will correspond to the length of the buffer and can be measured with tape measure, hip chain or laser range finder. Measure along the riparian buffer stream bank between the two previously marked end points. If there is a buffer on both banks, the sample reach length will be determined by the longer buffer. Divide the length by 4 to calculate the distance between cross-sections. The first cross-section will be at the downstream end of the stream reach, the fifth cross-sction will be at the upstream end of the stream reach. Place markers at each cross-section. Adjust the location of cross-section to avoid deep pools that may not be wadeable with chest waders or large woody debris accumulations that will make measurements difficult.

Step 3. Monument cross-sections

For steps 3 through 7 refer to Stream Channel Reference Sites: An Illustrated Guide to Field Techniques (Harrelson, 1994) for recommended surveying techniques.

Mark the left and right banks of the cross-section with a survey pin (rebar). Align the pins so that a tape measure stretched between them will be oriented perpendicular to the stream flow. Place pins well back from bankfull points to ensure that they are not lost to bank erosion. Put in a benchmark (lag bolt) on the nearest large tree near each pin or use an additional ground pin as a benchmark. Benchmarks are needed on both banks as the buffer side bank may be subjected to windthrow which would make re-survey of benchmarks difficult. Record the benchmark's elevation, distance and azimuth to the nearest cross-section pin. This will ensure correct replacement of pins if they are lost to a flood event. The most downstream cross-section will be number 1. At cross-section #1, designate the benchmark on the stream bank opposite the buffered bank, as the beginning elevation point. If the exact elevation of the #1 benchmark can be determined use that elevation as the starting elevation for the survey data. If not, use 100.00 feet for the initial monument elevation. Mark benchmark trees with the corresponding cross-section number. If possible, attain GPS latitude and longitude for the benchmarks and cross-section pins. At a minimum attain the GPS data for the #1 cross-section benchmark.

If a cross-section is impacted by a windthrow tree and neither pins nor benchmarks can be re-established, survey in a new cross-section as close to the original as possible. Make note of the alteration in the site records.

Step 4. Survey cross-sections

Survey the cross-sections in sequential order and in one field session. Left and right bank is determined from a downstream (as the water flows) perspective. Essential stations to measure distance and elevation on are:

Left and right bank benchmarks

Left and right bank pins

All slope breaks along the cross-section profile, include:

Bankfull points

Bank bottoms (for channel bed widths)

Edges of water

Thalweg (deepest point of channel bed)

It may be advantageous for purposes of relating subsequent survey data to record distance and elevations at a set increment, while including the essential points. Harrelson et. al. recommends a minimum of 20 points, with more for broad or complex channels. Align tape from left bank to right bank (downstream perspective). Left bank pin will be at distance station 0.

Step 5. Substrate Particle Sampling

At each cross-section sample 100 channel substrate pieces. Measure and record the intermediate axis of each particle. Collect the particle samples according to the procedure described in the Alaska Region Fish and Aquatic Stream Habitat Survey Handbook (USDA, 1999).

Step 6. Photograph cross-section

Take photos along the cross-section tape line from left to right and right to left, and upstream and downstream from the center point of each cross-section. Record photo numbers for each cross-section or photograph a page with the site name, date and cross-section number.

Step 7. Longitudinal Profile

Survey the channel bed longitudinal profile from cross-section #1 to cross-section #5. Measure elevations of channel bed, water surface and bankfull stage at each station. There is no set incremental distance between measurement stations. Measure distances down the center line of

the stream. Shoot individual elevations of channel bottom and water surface at the center point of the stream. Measure the bankfull elevations for both banks at points perpendicular to the center point station. Capture elevations of significant channel features such as pools and riffles and the center line channel bottom for each cross-section. Record distances between cross-sections as it may vary from the calculated distance.

Construct a table and graph displaying distance versus the elevations of the bed, water surface, bankfull points and label the cross-section stations.

Step 8. Bank Stability

Record the length of bank erosion between cross-sections. Measure and record length of erosion for both upper and lower banks on both sides of stream channel. Erosion features are raw banks, bank sloughing, undercut banks and sagging root wads.

Step 9. Riparian canopy survey

Determine riparian vegetation type , forest seral stage and measure canopy openings. Refer to Table 14 in the Alaska Region Fish and Aquatic Stream Habitat Survey Handbook (USDA, 1999) for riparian vegetation and seral stage categories. Use concave densiometers to measure canopy openings. Record canopy openings at each cross-section per instructions for the densiometer. Four readings are needed at each station, in the four cardinal directions. There are 7 required stations for canopy opening measurements at each cross-section:

center of stream

left and right bankfull stations

30m from each bank

60m from each bank

The transect line for the canopy opening measurements should be on a perpendicular azimuth from the cross-section. Use a compass with the proper declination setting and record the azimuth for each side of stream. Record riparian vegetation, seral stage and distance station of change along the transect line.

Step 10. Habitat Unit and Large Woody Debris survey

Refer to the Alaska Region Fish and Aquatic Stream Habitat Survey Handbook (USDA, 1999) for habitat unit and large woody debris (LWD) measurement criteria. Measure all habitat units and LWD between each cross-section. Start the habitat and wood survey at the first cross-section and proceed upstream. Record upstream and downstream habitat widths at the cross-section tape and the cross-section number on the data sheet. For this reason it will be advantageous to restring the tapes to mark the cross-sections.

Use the Region 10 standard habitat survey forms for habitat data recording.

Step 11. Discharge Measurement

Measure stream flow at a rectangular shaped cross-section with a uniform bed without obstructions, such as boulders or woody debris. It does not have to be one of the surveyed cross-sections. Refer to section 10 in the Stream Channel Reference Sites: An Illustrated Guide to Field Techniques (Harrelson, 1994) for measurement techniques.

Step 12. Data

Use the WinXSPRO (USDA, 1998) program to store and analyze the cross-section data.

Initially, substrate and canopy data should be stored in a standardized EXCEL spreadsheet format. Habitat and wood data should be stored per direction of the Alaska Region Fish and Aquatic Stream Habitat Survey Handbook (USDA, 1999). Data will be migrated to Version 1.0 of the National Resource Information System Water Module within the next two years.

References

Harrelson, C. C, C. L. Rawlins and J. P. Potyondy, 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. General Technical Report RM-245. USDA. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO 80526.

USDA, 1999. Fish and Aquatic Stream Habitat Survey, Alaska Region. USDA. Forest Service, Juneau, AK.

West Consultants, Inc., 1998. WinXSPRO, A Channel Cross-Section Analyzer, User's Manual. USDA. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO 80526

# A Reassessment of Management Indicator Species for the Tongass National Forest

## 19 February 1999

## MIS Subcommittee of the Tongass NF Interagency Monitoring and Evaluation Group

**Authors: Gene DeGayner, Cole Crocker-Bedford and Dick Aho**

**Tongass National Forest**

**Contributors to Wildlife Portion**

From US Forest Service (USFS)

Linn Shipley, Kim Hastings, Chris Iverson and Mike Fox

From US Fish and Wildlife Service (USFWS)

Richard Enriquez, John Lindell, and Phil Schempf

From Alaska Department of Fish and Game (ADF&G)

Lana Shea-Flanders and Kim Titus

**Contributors to Fish Portion**

Ron Dunlap (USFS)

Sue Walker (USFWS)

Cindy Hartmann (National Marine Fisheries Service)

and from Alaska Department of Fish and Game

Lana Shea-Flanders, Doug Jones and Leon Shaul

*This document does not represent consensus with all contributors.*

The purposes of this paper are to evaluate the current list of Tongass National Forest (Tongass) Management Indicator Species (MIS) and to recommend improvements in the list to the Tongass Interagency Monitoring and Evaluation Group (IMEG). During this process we have attempted to adopt parts of the effectiveness monitoring approaches used in the Northwest Forest Plan (Mulder et al, in press). Species identified herein as potentially useful for effectiveness and validation monitoring will then have monitoring plans developed by interagency, species-specific task groups. The monitoring protocols will include the feasibility of accurately studying important questions for the species within reasonably conceivable budgets. Ultimately, the analysis in this current paper and the monitoring protocols may be considered in a Forest Plan Amendment, which may modify the MIS list of the Tongass as well as the wildlife and fish sections of the Monitoring and Evaluation Plan (Chapter 6) of the Tongass Land and Resource Management Plan (TLMP).

Management Indicator Species (MIS) are vertebrate or invertebrate species whose population changes are believed to indicate some effects of land management activities (USDA Forest Service 1982). The objective of monitoring MIS is to develop information useful for Forest Plan amendments and revisions. Ideally, each MIS is linked to specific monitoring questions (Noon et al. 1997) that are associated with management practices or Standards and Guidelines (S&Gs), such as road density, sediment, or conversion of gap-phase, old-growth forest to even-age, young-growth (saplings, poles or young timber). Data on MIS will be used to evaluate whether the effects of forest management activities are consistent with those predicted in the Forest Plan.

Early in the implementation of the TLMP Revision of 1997, it became evident that the monitoring plans for the MIS were not sufficiently developed in TLMP. Furthermore, the MIS selections were nine years old. New issues and information from the last ten years, along with the apparent resolution of many previous issues through the new (1997) TLMP, had outdated the MIS list and associated protocols. Thus, there was a need to modify the list of MIS and monitoring plans described in Chapter 6 of TLMP. This document will also help forge a link between the Tongass Monitoring Program for MIS and the information needs and the funding for administrative studies in the Alaska Region of USFS.

**History of MIS Selection for the TLMP Revision of 1997**

- **1985.** An interagency fish and wildlife task group reviewed 451 species and identified 7 fish and 22 wildlife species as potential MIS for the Tongass NF (Regional Publication R10-TP-2).
- **1987.** An interagency task group (USFS, ADF&G, USFWS, and NMFS) ranked the 29 species into four levels of priorities for the TLMP Revision. The biologists used the following 10 screening criteria to rank the species:

  1. Whether populations were then being affected by forest management activities.
  2. Whether a species had high public interest and was considered a public issue.
  3. Whether a species had been designated a national MIS under the Resource Planning Act (RPA).
  4. The economic value of a species, including both consumptive and nonconsumptive values.
  5. The extent of a species' range or distribution on the Forest.
  6. The subsistence value of a species.
  7. Whether or not it was possible to adequately represent the species at a project level in addition to the Forest level.

8. Whether a species habitat requirements significantly overlap with (indicate) other species.
9. The ease with which the species habitats and populations could be monitored.
10. Whether habitats were represented by other MIS.

The black bear, brown bear, American marten, river otter, Sitka black-tailed deer, mountain goat, Vancouver Canada goose, bald eagle, and hairy woodpecker ranked in the highest priority group for the TLMP revision. The gray wolf, moose, blue grouse, red-breasted sapsucker, and brown creeper were in the second priority group. The red squirrel and common merganser were in the third priority group. The fourth priority group included: beaver, long-tailed vole, northern goshawk, osprey, ptarmigan, and orange-crowned warbler.

Wildlife biologists recommended that the 16 species in the three highest priority groups be used for the TLMP Revision.

Fish biologists recommended that four species be carried through as MIS: coho, pink and sockeye salmon, and cutthroat trout. Of the four species, the sockeye salmon was recommend as lowest priority, as the remaining three would represent the majority of the Forest's fish habitat.

- **1988.** The decision by the three Forest Supervisors (until recently the Tongass National Forest was managed as three separate Areas) was to use 17 MIS for the TLMP Revision (Table 3.). Sockeye salmon was not included as a MIS. Cutthroat trout was replaced by Dolly Varden char.
- **1989.** The three Forest Supervisors decided to add one more MIS, the river otter, to the list used for the TLMP Revision.

The primary considerations for the MIS selections of the Forest Supervisor's were (1) the 10 ranking criteria developed in 1987, (2) the ease of modeling habitat capability within the Geographic Information System (GIS), and (3) the politics of Forest planning. The feasibility of monitoring a species' population within a reasonable budget was just one of 12 criteria.

- **1997.** The newly revised TLMP reinstates cutthroat trout as a MIS.
- **1997.** The Interagency Monitoring and Evaluation Group (IMEG) identifies MIS review as a task.
- **June 24-25, 1998.** IMEG suggests a wildlife and fish subcommittee to review MIS lists and monitoring protocols, and to make recommendations to IMEG for improvements. Gene DeGayner (Regional Wildlife Ecologist) and Chris Iverson (Regional Program Leader for Ecology and Threatened, Endangered and Sensitive Species) propose to IMEG a process to review MIS.
- **July 10, 1998.** Tongass NF Supervisor Powell sets out charter for Wildlife and Fish MIS Subgroup.
- **July 14, 1998.** Several members of the Wildlife and Fish MIS Subgroup (DeGayner, Crocker-Bedford, Shipley, Fox, Enriquez, Aho, Dunlap, Shea-Flanders, Hartmann) meet to draft criteria and develop analyses for this paper.
- **August 3, 1998.** DeGayner completes first draft of this paper.
- **August 14, 1998.** Formal comments sent by USFWS on first draft.
- **August 1998.** Fish subgroup meets and selects species and conceptual protocols.

- **September 9, 1998.** DeGayner and Dick Aho (Tongass Lead for Fisheries) complete second draft of this paper.
- **September 10, 1998.** IMEG meeting reviews progress of MIS Subgroup.
- **Fall 1998.** Personnel of ADF&G, USFWS and USFS review September draft of this paper.
- **Late 1998.** DeGayner incorporates most review concerns into the version of 4 January 1999, including adopting some of the approaches used to design the effectiveness monitoring program for the Northwest Forest Plan.
- **Early 1999.** Crocker-Bedford makes small substantive changes and many editorial changes for the version of 8 February 1999.

**Summary of Concerns with TLMP (1997) MIS that were raised during IMEG Meetings**

- What about species that are already being monitored, but are not selected as MIS? These species are currently not addressed in this effort. There is a need to integrate fish and wildlife work conducted by all agencies to ensure that the needs of all agencies are met.
- The revised (1997) TLMP prescribed the use of harvest statistics to monitor deer, brown bear, black bear, marten, river otter, wolves, pink salmon, coho salmon, and Dolly Varden char. Because these populations and their harvest rates fluctuate in response to factors other than forest management, simple reviews of wildlife harvest statistics alone will not meet monitoring requirements. More review is needed to make better use of the harvest data.
- The National Forest habitats of some of the MIS chosen a decade ago received a high level of protection under the TLMP revision of 1997 (bald eagle, river otter, fish species) which may make these species a lower priority for limited Tongass funding.
- The MIS list is nine years old and may be outdated.
- Some MIS are difficult to detect and monitor (e.g., brown creeper) and may not be good candidates for effective and efficient monitoring.
- Funding is inadequate for wildlife model evaluation.
- Funding is inadequate to conduct scientific baseline studies to determine cause and effect relations between environmental stressors and anticipated responses over time.
- In many wildlife populations, changes that are significant enough to be detected and attributed to habitat alterations (e.g., forest management) would likely take decades to be evident in trend monitoring over time (e.g. at least 30 years for deer population declines from clear-cut harvest), well beyond the time interval of annual or periodic (5-10 years) monitoring efforts. This is not an insurmountable problem, but will require more effort to be place in survey designs.

**Current USFS National Direction, Case Law, and Scientific Literature**

The National Forest Management Act, Code of Federal Regulations (NFMA/CFR) prescribes the use of MIS for monitoring the effects of Forest Service activities on Fish and Wildlife Resources. These regulations (CFR 36, Part 219.19, also USDA Forest Service 1982) are presented in Appendix A. There are two relevant Ninth Circuit Federal Court rulings on monitoring MIS (D. Arrasmith pers. com.). These rulings support the use of habitat models if available population or related data are not ignored, and if directly monitoring population parameters is not reasonable due to costs or inadequate techniques. These court interpretations are important assumptions in this reassessment of MIS for wildlife and fish monitoring and evaluation under TLMP.

The NFMA regulations are currently under review. Any new regulations will likely include a more scientifically defensible handling of species and habitats of interest. Future regulations may require monitoring of focal species rather than Management Indicator Species (C.

Iverson pers. comm.). There is little scientific support for the use of MIS as indicators of the well being of other species; therefore, we have avoided selecting species to "indicate" other species.

The practice of monitoring MIS and linking population changes to management activities has been argued to be very difficult to implement (Landres et al. 1988, Neimi et al. 1997). Neimi et al. (1997) state:

> *The concept of indicator species has been used widely and critiqued in management activities (Thomas 1972, Zoneveled 1983, Morrison 1986, Verner et al. 1986, Landres et al. 1988). As discussed by Landres (1988), the idea of indicator species is a relatively old concept (Hall and Grinnel 1919) and is intuitively pleasing because management for many species may be simplified and made more cost-effective by considering only a small group of indicator species. Unfortunately, as further discussed by Landres et al. (1988), the implicit assumption in the use of indicator species is that habitat quality maintained for the indicator will be suitable for other species. Because these assumptions fail on both conceptual and empirical grounds, Landres et al. (1988) suggests that "this approach should be avoided."*

Neimi et al. (1997) found that the use of and monitoring MIS in the Chequamegon National Forest, even with a large data base, was not useful and recommended that monitoring be focused on key habitat types instead of a few "representative" species. In addition to improving habitat classifications, they suggested combining the monitoring of trends in habitat and birds within those habitats. Noon et al. (1997) also suggests using habitat as a surrogate for biotic populations.

Landres et al. (1988) provided the following recommendations for the selection and use of MIS:

1. Clearly state assessment goals,
2. Use indicators only when other assessment options are unavailable,
3. Choose indicator species by explicitly defined criteria that are in accord with assessment goals,
4. Include all species that fulfill stated selection criteria,
5. Know the biology of the indicator in detail and treat the indicator as a formal estimator in conceptual and statistical models,
6. Identify and define sources of subjectivity when selecting, monitoring, and interpreting indicator species,
7. Submit to peer review all assessment designs, data collection methods, statistical analyses, interpretations and recommendations, and
8. Direct research at developing an over-all strategy for monitoring wildlife that accounts for the natural variability in population’s attributes and incorporates concepts from landscape ecology.

Similar to Landres et al.'s (1988) approach, Noon et al. (1997) suggest that forest plan effectiveness monitoring follow the following steps:

1. Specify goals and objectives,
2. Characterize environmental stressors (anthropogenic disturbances) to ecological integrity,
3. Develop conceptual models that outline pathways from environmental stressors to the ecological effects on one or more resources, as measurable by indicators of stress,
4. Select indicators of the ecological stresses that may significantly affect wildlife and fish resources,
5. Determine detection limits for the indicators of stress, so as to guide sampling design,
6. Establish "trigger points" for management intervention, and
7. Establish clear connections to the management decision process.

If possible, species should be related to habitat attributes that reside within existing data bases at appropriate scales (Samson pers. comm.). More importantly, the species should be related to habitat attributes by cause and effect, not by correlation (Landres et al. 1988).

Crocker-Bedford (1998) described several problems with monitoring goshawks through trend studies of demographic parameters (nest occupancy, territory density, natality, mortality) over time. Demographic trends are difficult and very expensive to measure in a statistically meaningful manner. Goshawk trend studies typically require decades of data to be meaningful (such as the European goshawk studies described by Widen 1997). Even then, any apparent long-term trends in goshawk demographics could actually be do to weather, prey cycles, inconsistent data collection, inconsistent definitions, incomplete data storage, inadequate sampling and non-random sampling (either studying locales that are not representative of a broader region, or following a decline in occupancy over time of a suite of nests or territories even though the nests and territories may be slowly replaced elsewhere). By the time a demographic trend study has occurred at enough intensity and over a broad enough region and enough decades to be meaningful, a huge amount of financing will have been taken from other species (opportunity costs) and the effects of the environmental stressors on ecosystem integrity will already have been completed over vast areas. Even then, proponents of the activities that apparently caused the anthropogenic stresses on the ecosystem can correctly claim in court that there is no scientific (i.e., experimental) proof that their types of activities caused the demographic decline. The decline could just as well have been due to weather, diseases, and so forth, as described above.

Instead of trend monitoring of demographic parameters, Crocker-Bedford (1998) recommended that goshawk monitoring combine (1) assessment of trends of important habitats (with their hypothetical importance based on habitat selection indices and ecological assumptions, perhaps in models) along with (2) the experimental validation of the necessity of the habitats and habitat assumptions. Validating the assumptions of habitat models should entail the comparison of indicators (e.g. demographic data, home range sizes, spacing of territories, habitat selection indices, diets, etc.) between replicates of similar landscapes having different management treatments (ideally multiple pairs of treatment and control landscapes). Whenever possible data should be collected before treatment to demonstrate the pretreatment similarity of the landscapes with respect to the parameters (indicators) studied. Even so, retrospective studies allow more rapid insights into management questions at lower costs, and past aerial photos can suggest pretreatment similarity. Although Crocker-Bedford's (1998) article was on goshawks, the same concepts pertain to other wildlife species, especially those that are relatively sparse and long-lived.

**MIS Evaluation Process**

The process we present here is a hybrid of the approaches suggested by Landres et al. (1988) and Noon et al. (1997). To incorporate their suggestion of clearly defining all aspects of the monitoring program, we have summarized existing fish and wildlife analyses that framed key TLMP monitoring goals, objectives, and questions (Table 1). To identify potential MIS we relied heavily on analyses (Table 1) that screened species for management concerns.

**Table 1. Analyses used to highlight issues, objectives, and species of management concern**.

| | |
|---|---|
| Land and Resource Management Plan for Tongass National Forest, especially the Information Needs (Appendix B) and Chapter 6 on Monitoring. | USDA Forest Service. (1997). |
| Management indicator species for National Forest Lands in Alaska. | Sidle, W.B. and L.H. Suring. (1986). |
| Administrative Study Information Needs Assessment. | Iverson, G., C. Crocker-Bedford, E.J. DeGayner, and T. Schenck. (1998). |
| Management Indicator Species recommended for revision of the Chugach Land Management Plan. | Suring, L. H. (1998). |
| A Proposed Strategy for Maintaining Well-Distributed, Viable Populations of Wildlife Associated with Old-growth Forests in Southeast Alaska | Suring et al. (1993). |
| Scientific Information and the Tongass Land Management Plan: Key Findings from Scientific Literature, Species Assessments, Resource Analyses, Workshops, and Risk Assessment Panels. | Swanston et al. (1996). |
| Anadromous Fish Habitat Assessment | USDA Forest Service R10-MB-279 (1995) |

The primary goal of the TLMP monitoring plan, which is related to fish and wildlife issues, is to evaluate the success of the Forest Plan in conserving various wildlife habitats and populations. The Forest Plan poses the following five broad questions for fish, wildlife, and biodiversity management issues in the Monitoring and Evaluation Chapter:

1. Are population trends for fish and wildlife MIS and their relationship to habitat changes consistent with expectations (TLMP, pages 6-14, 6-6, and 6-5)?
2. Are contiguous blocks of old growth habitat being maintained in a forest-wide system of old-growth reserves to support viable and well distributed population's of old growth-associated species and subspecies (TLMP, page 6-5)?
3. Are the effects on biodiversity consistent with those estimated in the Forest Plan (TLMP, page 6-5)?
4. Are management practices consistent with current knowledge regarding sensitive species conservation (TLMP, page 6-5)?
5. Are the population levels and associated distribution of mammalian endemic species on islands and populations of the mainland consistent with the estimates in the Forest Plan (TLMP page 6-16)?
6. Are Fish and Wildlife Standards and Guidelines effective in maintaining or improving habitat (TLMP, pages 6-6 and 6-5)?

The current TLMP monitoring questions are too broad to develop useful monitoring protocols. The Information Needs section of TLMP (Appendix B) and the Administrative Study Information Needs Assessment (ASINA) (Iverson et al. 1998) were particularly useful in further defining and integrating these monitoring questions.

We propose that the current TLMP fish and wildlife monitoring questions be reframed as presented in Table 2 to more tightly tie them with management issues. This table links the monitoring questions with potential environmental "stressors" (i.e., management activities) and in turn links "stressors" of ecosystem integrity with potential MIS species. As described by Noon et al. (1997), "indicators" of ecological stress have some aspect of the biology of the species that can be measured and are influenced by the anthropogenic stressor. Subsequent, species-specific task groups will identify the actual "indicators" -- the actual

parameter to be measured during monitoring. Potential indicators include parameters such as population density, abundance, site fidelity, reproductive rate, mortality rate, home range size, population structure, and so forth. The species-specific task groups will likely select indicators based on their apparent demographic significance, along with the potential to discern (at a reasonable cost) differences in the indicators between landscapes that have been treated differently.

Since the objective of this paper is to identify potential MIS, species to be monitored are identified earlier in the process than is suggested by Noon (1997) and Mulder (1997). However, consistent with the Noon (1997) approach, this analysis does not identify indicators of ecological stress; but rather recommends potential MIS for which indicators will be developed.

The species listed as potential MIS were identified in past efforts (TLMP 1997, Suring 1998, Iverson et al. 1998, Sidle and Suring, 1988). However, additional information is needed to determine the subset of species to recommend for in-depth protocol development. Information relevant to recommending MIS is summarized in Tables 3, 4, and 5. These tables facilitate highlighting species most sensitive to management activities with ongoing population monitoring or habitat modeling activities.

**Table 2. Refinement of TLMP Monitoring Questions linked to Stressors, Potential Response MIS, and key forest management issues.**

Issue 1: Effects of Management on Landscape structure and composition on species abundance/persistence (adopted from Iverson et al. (1998).

| # | Questions | Stressors | Potential Response MIS |
|---|---|---|---|
| 1.a | Reserve system efficacy | Forest fragmentation, habitat loss | HCA design species * used by Suring et al. (1993) |
| 1.b | Landscape strategies - animal dispersal/movement facilitation | Forest fragmentation | Flying squirrel, red-back vole VPOP design species |
| 1.c | Effects of partial harvest systems relative to clearcutting | Removal of trees | Marten, flying squirrels, deer, goshawk, goshawk prey species |
| 1.d | Effects of timber harvest on populations and, in some cases, human use of these populations. | Conversion of old forest to young forest | Deer, marten, forest birds |
| 1.e | Riparian Buffer Efficacy | Example: exposure to wind and blowdown | Dolly Varden, Cutthroat trout, Coho, and pink salmon |
| 1.f | others identified by task groups | | |

* species most influential in the size, composition, and spacing of reserves

Issue 2: Effects of human disturbance on wildlife.

| | Questions | Stressors | Potential Response MIS |
|---|---|---|---|
| 2.a | Efficacy of access management strategies | Road and beach access (S&Gs) | Brown bear, marten, wolf, deer, black bear |
| 2.b | Effects of human disturbance during permitted activities | Road construction, tourism, flight seeing. | Mountain goats, bald eagles, swans, sea lions, harbor seals |
| 2.c | Effects of human disturbance during facility use | Waste management, Defense of Life and Property | Brown bear, black bear, harbor seals |

Table 3 displays the current MIS of TLMP (1997), as well as species recommended for MIS in the Chugach National Forest plan (Suring 1998). The potential MIS of Chugach NF were considered to facilitate Regional consistency for species used as MIS. The table also displays the results of the Administrative Study Needs Assessment (ASINA) of Iverson et al. (1998). The ASINA rated species for (1) habitat relationship (WHR) information needs, (2) population parameters information needs, and (3) possible importance as MIS (Iverson, 1998). The ASINA focused on species believed to be affected by forest management activities, and which influenced the design of TLMP Standards and Guidelines (S&Gs) or land allocations. For a species to rate as "high" (3) during the ASINA exercise, it had to be linked to design issues for S&Gs or old-growth habitat reserves, and be associated with some doubt as to the effectiveness of the TLMP conservation measures. A species for which current information and the TLMP are thought to be adequate for its conservation and management was rated "low" priority and assigned a 1. Each of the five authors of the ASINA (Iverson et al. 1998) assigned each species a 1, 2, or 3. The five ratings were then averaged to arrive at the ratings in Table 3.

**Table 3. Attributes of Species considered for MIS status.**

| Species Considered | Existing TLMP MIS | Recom. CLMP MIS 1) | | High rating in Wildlife information Needs assessment 2) | | | CFR species type 3) |
|---|---|---|---|---|---|---|---|
| | | | | WHR | Popul | MIS | |
| black bear | yes | no | | 1.4 | 1.2 | 1.2 | C,H |
| brown bear, | yes | yes | | 2.2 | 2.4 | 2.8 | C,H |
| America marten | yes | no | | 2.8 | 2.0 | 2.4 | C,H |
| bald eagle | yes | no | | 1.0 | 1.0 | 1.6 | S |
| Vancouver Can. goose | yes | no | | 1.2 | 1.0 | 1.0 | C,H |
| river otter, | yes | no | | 1.0 | 1.0 | 1.0 | C |
| mountain goat | yes | yes | | 1.8 | 1.8 | 1.4 | C |
| Sitka black-tailed deer | yes | yes | | 2.6 | 2.6 | 2.8 | C,H |
| hairy woodpecker | yes | no | | 1.2 | 1.0 | 1.2 | H |
| wolf | yes | no | | 2.8 | 2.4 | 2.6 | C,H |
| red-breasted sapsucker | yes | no | | 1.0 | 1.0 | 1.0 | H |
| brown creeper | yes | no | | 1.0 | 1.0 | 1.0 | H |
| red squirrel | yes | no | | 1.0 | 1.0 | 1.0 | H |
| marbled murrelet | no | yes | | 1.8 | 1.0 | 1.8 | S,H |
| flying squirrel | no | no | | 2.8 | 1.5 | 2.4 | S,H |
| red-backed vole | no | no | | 2.0 | 1.25 | 1.2 | S,H |
| northern goshawk | no | yes | | 2.4 | 2.25 | 2.2 | T,H |
| spruce grouse | no | no | | 1.2 | 1.25 | 1.0 | C,H |
| moose | no | yes | | 2.0 | 1.5 | 1.8 | C,H |
| dusky Canada goose | no | yes | | 2.0 | 2.25 | 1.8 | C |
| | | | | | | | |
| pink salmon | yes | yes | | n.a. | n.a. | n.a. | C,H |
| coho salmon | yes | yes | | n.a. | n.a. | n.a. | C,H |
| cutthroat trout | yes | yes | | n.a. | n.a. | n.a. | C,H |
| dolly Varden | yes | yes | | n.a. | n.a. | n.a. | C,H |
| rainbow trout | no | yes | | n.a. | n.a. | n.a. | C,H |

1) Recommended MIS for Chugach National Forest Plan revision (Suring 1998).

2) Displays species ratings for 1) habitat relations (WHR) information needs, 2) population parameter information needs, and 3) priority for MIS status. Average scores rated from 1.0 to 3.0. 3.0 = High, 2.0 = Medium, 1.0 = Low (Iverson et al. 1998).

3) The following categories are suggested by CFR 36, Part 219.19 (USDA Forest Service 1982).

- T = Endangered, Threatened or Regional Forester Sensitive
- H = special habitat needs significantly influenced by planned land management
- C = commonly hunted, fished, for trapped
- S = non-game species of special interest

The feasibility of monitoring MIS habitats and populations is a key concern. CFR 36, Part 219.19 (see Appendix A) directs the monitoring of MIS populations to determine how these populations are influenced by management activities. The original concept of CFR 36, Part 219.19, was to measure actual wildlife population changes. However, that rarely proved possible (Niemi et al. 1997). As discussed above in the section on Current Forest Service Direction, Case Law, and Scientific Literature, the objective of MIS monitoring can be most efficiently and accurately accomplished by considering habitat trends and wildlife habitat relationship models, and validating key assumptions in the habitat relationship models through quasi-experiments.

One concern of solely applying existing models is that little is learned about how to revise the next forest plan, unless rigorous model reviews are performed. Without model reviews, habitat capability projections for year 2054 made for the 1997 TLMP will simply carry into the 2007 Forest Plan Revision; thereby making the MIS an ineffective management tool. At a minimum, if models are to be used, attempts should be made to validate key assumptions within the models and to refine model parameters with new information. Otherwise, model runs become irrelevant GIS exercises that will not be useful in the evaluation of forest plan S&Gs and land allocations. There are habitat use data sets for deer, marten, and brown bears that could be used to test key assumptions of these models. However due to the nature of the data, these data sets need to be replicated, in time and space to give conclusive results.

Quantitative habitat capability models are available for existing wildlife MIS (Table 4). The only quantitative model deemed useful by TLMP planners, for analysis for the 1997 TLMP revision, was the deer habitat capability model. Some of the species shown as "N" for "no model" in Table 4 actually had extensive qualitative or "word" models used in analyses for the TLMP -- for example the goshawk habitat analyses, assumptions, and risk assessment in Iverson et al. (1996). The usefulness of all models will be evaluated by the species-specific monitoring task groups for the recommended MIS. They will determine which population parameters or most suited for data collection as indicators of environmental stress.

Table 4 also notes the species that are currently under study. The Alaska Region of USFS or the Tongass NF are currently contributing to ADF&G studies on brown bears, marten, wolves, deer and goshawks, and to USFS Forest Science Laboratory studies on red squirrels, flying squirrels and red back voles. The Thorne Bay Ranger District has just completed a study on spruce grouse. Some of these studies may be able be modified to meet monitoring needs. The species-specific monitoring task groups will consider this avenue.

Some species have been surveyed for population trends over many years (Table 4). The USFWS surveys geese, murrelets, and bald eagles. ADF&G surveys mountain goats. ADF&G and USFS jointly monitor deer pellet trends. These data may be useful in detecting long-term population trends; however, it is dubious whether the existing trend data can be related to habitat changes because the data are usually significant only when combined over vast areas.

Table 5 averages the three ratings for each species in Table 3, to arrive at an overall priority rating for the monitoring of each species. A break occurred between the 13 wildlife species that rated 1.7 or below, and the six wildlife species that rated from 2.3 to 2.7. Those six -- brown bear, American marten, Sitka black-tailed deer, Alexander archipelago wolf, flying squirrel, and Queen Charlotte goshawk -- are herein tentatively recommended as MIS for TLMP monitoring. Four fish species are herein recommended for MIS: pink salmon, Coho salmon, cutthroat trout, and Dolly Varden char.

Table 4. **Existing models, studies, and population surveys for potential MIS.**

| | OPPORTUNITIES TO MONITOR | | | | | |
|---|---|---|---|---|---|---|
| | Habitat Models | | Indicators of Stressors | | | Scale |
| Species Considered | Model exists? | Level of Review | Model validation Attempts | Current Admin. Studies | Agency conducting Pop. Trend Surveys 1) | stand or landscape? 2) |
| black bear | Y | minimal | | | ADF&G | landscape |
| brown bear | Y | publish | ? | yes | ADF&G | landscape |
| American marten | Y | study | yes | yes | ADG&G | landscape |
| bald eagle | Y | some | | | USFWS | both? |
| Vancouver Can. goose | Y | minimal | | | USFWS | stand |
| river otter | Y | minimal | | | ADF&G | stand |
| mountain goat | Y | | | | ADF&G | both? |
| Sitka black-tailed deer | Y | study, reviews | yes | yes | ADF&G USFS | both? |
| hairy woodpecker | Y | none | | | | stand |
| gray wolf | Y | some | | yes | ADF&G | landscape |
| red-breasted sapsucker | Y | none | | | | stand |
| brown creeper | Y | none | | | | stand |
| red squirrel | Y | minimal | | yes | | stand |
| marbled murrelet | N | n/a | | yes | USFWS | stand |
| flying squirrel | N | n/a | | yes | | stand |
| red back vole | N | n/a | | yes | | stand |
| northern goshawk | N | n/a | | yes | | landscape |
| spruce grouse | N | n/a | | yes | | stand? |
| moose | Y | | | | ADF&G | |
| dusky Canada goose | N | n/a | | | | |
| | | | | | | |
| pink salmon | N | n/a | | | ADF&G | stand |
| coho salmon | N | n/a | | | ADF&G | stand |
| cutthroat trout | N | n/a | | | | stand |
| Dolly Varden char | N | n/a | | | | stand |
| rainbow trout | N | n/a | | | | |

1) Includes harvest statistics, aerial surveys, pellet counts, etc.....
2) Appropriate scale of monitoring given the life history of the species and logistics of monitoring.

**Table 5. Management Issues linked to MIS Recommendations.**

| Species | Priority for Info Needs from Table 3 | Difficulty to monitor indicators 1) | Recommenda-tion | Management Issue from table 2. |
|---|---|---|---|---|
| | | | | |
| black bear | 1.3 | 2 | **Drop** | hunter access (2c) |
| brown bear | 2.5 | 2 | **Retain** | access/mortality, fish strm cover(2a-c) |
| America marten | 2.4 | 2 | **Retain** | trapper access (2a) productive OG (1a-d) |
| bald eagle | 1.2 | 3 | **Drop** | 1000' beach fringe (2b) |
| Vancouver Can. goose | 1.1 | 3 | **Drop** | wetlands (1.d 2.b) |
| river otter, | 1.0 | 1 | **Drop** | riparian/beach (1.b) |
| mountain goat | 1.7 | 3 | **Drop** | access and OG next to cliffs(1.d 2.b) |
| Sitka black-tailed deer | 2.7 | 2 | **Retain** | Winter range (1c-d) |
| hairy woodpecker | 1.1 | 1 | **Drop** | productive OG (1d) |
| wolf | 2.6 | 2 | **Retain** | deer abundance, (1d) access/mortality (2.a) |
| red-breasted sapsucker | 1.0 | 1 | **Drop** | productive OG, snags |
| brown creeper | 1.0 | 1 | **Drop** | productive OG, large trees (1d) |
| red squirrel | 1.0 | 2 | **Drop** | productive OG (1c |
| marbled murrelet | 1.5 | 2 | **do NOT add to list** | productive OG (1d) |
| flying squirrel | 2.3 | 2 | **ADD to list** | productive OG, dispersal (1a-c) |
| red-backed vole | 1.5 | 2 | **do NOT add to list** | productive OG (1a-c) |
| northern Goshawk | 2.3 | 2 | **ADD to list** | productive OG(1a,1c) prey abundance |
| spruce grouse | 1.2 | 1 | **do NOT add to list** | (1b,1d) |
| Moose | 1.8 | 2 | **do NOT add to list** | forage abund. (1d) |
| Dusky Canada goose | n/a | 3 | **do NOT add to list** | n/a |
| | | | | |
| Pink salmon | | 1 | **Retain** | riparian buffer (1e) |
| coho salmon | | 2 | **Retain** | buffer (1e), enhancement |
| cutthroat trout | | 2 | **Retain** | riparian buffer (1e) |
| Dolly Varden char | | 2 | **Retain** | riparian buffer (1e) |
| rainbow trout | | 2 | **do NOT add to list** | riparian buffer (1e) |

1) Difficulty of monitoring indicators of population stress

- 1 - monitoring techniques not available, not fully developed, or difficult and expensive to implement; monitoring results may not provide statistically valid information on effects of environmental stressors on population indicators
- 2 - monitoring techniques have been developed and successfully applied, may be expensive to implement; monitoring results generally provide statistically valid information on effects of environmental stressors on population indicators.
- 3 - monitoring techniques are fully developed and have been successfully applied in southeast Alaska; monitoring results provide reliable information on effects of environmental stressors on population indicators.

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Before the Tongass Forest Supervisor and Alaska Regional Forester make a final decision on the new MIS list, species-specific task groups should develop monitoring plans for the six wildlife species and four fish species that are tentatively recommended. The monitoring plans should be peer reviewed. If the species-specific task groups determine that monitoring plans will be unfeasible (inadequate techniques for the individual species given the issue of concern), or if USFS management determines that their costs are too exorbitant, then some species might be dropped from the final MIS list. On the other hand, if total cost is within anticipated funding, then more species could be added, above the six wildlife species and four fish species.

**Discussion of Individual Species**

In the section above, we recommended that six wildlife species and four fish species be considered for MIS monitoring plans: brown bear, American marten, Sitka black-tailed deer, Alexander archipelago wolf, flying squirrel, Queen Charlotte goshawk, pink salmon, coho salmon, cutthroat trout and Dolly Varden char. Species-specific teams should now develop monitoring plans for the ten species. Based on the technical feasibility of monitoring each species in relation to its perceived environmental stressor, and considering costs in relation to anticipated budgets, the tentative MIS list of ten species may need to be decreased or could possibly be increased.

This section discusses individual species, whether or not they are tentatively recommended for MIS status.

- American marten and brown bear. Marten and brown bears are linked to several monitoring questions. Both were given MIS status in 1988. Habitats and human access to their habitats have been consistent forest management issues and played an influential role in the design of the Forest Plan. The brown bear model has undergone a peer review and has been published (citation). Brown bears are a MIS for the Chugach NF. Marten were not recommended as a MIS on the Chugach NF because they have a high degree of monitoring difficulty (Suring 1988). On the Tongass, the marten monitoring task group may explore using a combination of habitat models and administrative studies to meet monitoring requirements.
- Subsistence species. Eight species that provide significant subsistence harvest are tentatively recommended for MIS selection, pending the development of effective and cost efficient monitoring schemes: brown bear, American marten, Sitka black-tailed deer, Alexander archipelago wolf, pink salmon, coho salmon, cutthroat trout and Dolly Varden char. The Forest Service manages habitats and populations of these species, and must ensure that land management practices and USFS approved activities maintain subsistence harvest to the extent practicable given other multiple-use goals, including sport harvests.
- Black bears. Black bears are a subsistence species and may be an emerging issue on the Tongass, but we have not recommended them for MIS status because their priority ranking for information needs was three species below the bottom of the recommended wildlife list. Black bear populations are difficult to survey, have fewer habitat concerns than other MIS, and are better understood than most of the tentatively recommended species.

- Goshawks. MIS status is tentatively recommended for goshawks. They were considered for MIS status in 1988, but passed over because goshawk habitat was thought to overlap with and other old growth associated species. Moreover, only two nest stands were known in 1988, and goshawks were believed to be difficult to monitor. Since then, goshawks have emerged as a forest management issue and played an influential role in the design of the Forest Plan. Furthermore, extensive inventory and study on goshawks in southeast Alaska has led to the discovery of many nest stands and the development of study techniques. The effectiveness of the Forest Plan in conserving goshawk habitat is unproven and controversial, as evidenced by the on-going lawsuit against the US FWS by petitioners for Threatened species status for the Queen Charlotte goshawk.
- Marbled murrelet. Murrelets are not recommended as a MIS. Murrelet populations are relatively stable and high in southeast Alaska. Murrelets are not an ideal MIS for TLMP because nest sites are very difficult to locate, populations are difficult to survey in forested habitats, and effects at sea confound effects of forest management. Murrelets were recommended for MIS status on the Chugach NF, primarily to monitor their recovery from the *Exxon Valdez* oil spill.
- Bald eagle. Bald eagles are not recommended as MIS for TLMP monitoring. Bald eagles are not associated with significant levels of uncertainty about how TLMP S&Gs will effect their populations relative to other species. The 1,000-foot beach buffers prescribed by TLMP, along with lake and stream buffers, are believed by most biologists to provide strong protection for nesting and roosting habitat. Their populations may be strongly influenced by prey (fish) abundance in the coastal marine environments; however, activities conducted or permitted by the Tongass NF are unlikely to have much affect on the prey species of bald eagles.
- Brown creeper, red-breasted sapsucker, and hairy woodpecker. The brown creeper, red-breasted sapsucker, and hairy woodpecker are recommended dropped as MIS. Sometimes these species can be difficult to monitor due to their low densities, cryptic behaviors, seasonal movements, and large year-to-year fluctuations in their populations. These species' habitat requirements overlap with and are largely represented by other old-growth associated species recommended for MIS status (e.g. especially flying squirrels). Although the recommended MIS do not satisfy the snag (dead tree) component of the habitat needs of woodpeckers, snag habitat on the Tongass is generally abundant, especially in comparison to National Forests where woodpeckers are assigned MIS status owing to concern for snag densities.
- Northern flying squirrel. The northern flying squirrel is recommended added as a MIS. Given its limited dispersal capabilities, its association with old-growth features, and its role in the TLMP old-growth reserve design, it is an important species to attempt to monitor. In 1997, the Alaska Region and the Forest Sciences Laboratory, both of the USFS, initiated flying squirrel studies. If the flying-squirrel monitoring task group deems population indicators of environmental stress can be reasonably monitored, flying squirrels may be a reasonable replacement for the brown creepers, red-breasted sapsucker, and hairy woodpecker.
- Alexander Archipelago Wolf and Sitka black-tailed deer. The wolf and deer are recommended as MIS. Both species played important roles in the design of TLMP, and both species are currently major parts of the USFS administrative study program. Better understanding the interactions between the two species, as well as the autecology of each, will help to validate key assumptions of TLMP, while at the same time provide direct data for federal subsistence regulations for hunting and trapping.
- Red back vole, spruce grouse, and moose. Red back vole, spruce grouse, and moose are not strongly associated with specific management concerns, and so are not recommended for MIS status at this time. Red back vole and spruce grouse research is underway and may cause us reconsider these species for MIS status in the future.
- River Otters. River otters are not recommended for MIS status. River otters have a high degree of monitoring difficulty and are not associated with large concerns about their

habitat, because the beach and riparian S&Gs almost certainly sufficiently protect their habitat.

- Dolly Varden char and cutthroat trout. These fish are recommended as MIS. These species live their lives in freshwater and are sensitive to changes in stream habitat (TLMP Fish/Riparian Panel Assessment). The Anadramous Fish Habitat Assessment identifies concern for "lack of protection for headwater streams" and both species commonly reside in these smaller streams. Additionally, small streams are often crossed with culverts, which may restrict migration.
- Coho salmon. Coho salmon are recommended as MIS. They high quality habitat, particularly pools with large wood or ponds for over-wintering. Juvenile coho are affected by migration restrictions at culverts. Overlapping monitoring objectives for monitoring TLMP -- for determining benefits of fish enhancement projects, for habitat concerns, and for assisting with in-season harvest management by ADF&G -- all support including coho as a MIS.
- Pink salmon. Pink salmon are recommended as MIS. Pinks require clean spawning gravel and forest management potentially causes sedimentation. They normally use the lower stream reaches some distance from much of the planned management activities. Escapement data is already being collected by ADF&G for many pink salmon spawning streams that may be useful in determining population's trends.

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Appendix A. Wildlife CFR 36, Sec. 219.19, which relates to the selection and use of MIS

Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area.

(a) Each alternative shall establish objectives for the maintenance and improvement of habitat for management indicator species selected under paragraph (g)(1) of this section, to the degree consistent with overall multiple use objectives of the alternative. To meet this goal, management planning for the fish and wildlife resource shall meet the requirements set forth in paragraphs (a)(1) through (a)(7) of this section.

(1) In order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species and the reasons for their selection will be stated. These species shall be selected because their population changes are believed to indicate the effects of management activities. In the selection of management indicator species, the following categories shall be represented where appropriate: Endangered and threatened plant and animal species identified on State and Federal lists for the planning area; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; non-game species of special interest; and additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality. On the basis of available scientific information, the interdisciplinary team shall estimate the effects of changes in vegetation type,[[Page 71]] timber age classes, community composition, rotation age, and year-long suitability of habitat related to mobility of management indicator species. Where appropriate, measures to mitigate adverse effects shall be prescribed.

(2) Planning alternatives shall be stated and evaluated in terms of both amount and quality of habitat and of animal population trends of the management indicator species.

(3) Biologists from State fish and wildlife agencies and other Federal agencies shall be consulted in order to coordinate planning for fish and wildlife, including opportunities for the reintroduction of extirpated species.

(4) Access and dispersal problems of hunting, fishing, and other visitor uses shall be considered.

(5) The effects of pest and fire management on fish and wildlife populations shall be considered.

(6) Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with State fish and wildlife agencies, to the extent practicable.

(7) Habitat determined to be critical for threatened and endangered species shall be identified, and measures shall be prescribed to prevent the destruction or adverse modification of such habitat. Objectives shall be determined for threatened and endangered species that shall provide for, where possible, their removal from listing as threatened and endangered species through appropriate conservation measures, including the designation of special areas to meet the protection and management needs of such species.