Chapter 13

Monitoring and Adaptive Management

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13 MONITORING AND ADAPTIVE MANAGEMENT

13.1 Introduction

Chapter 13 describes how our monitoring and adaptive management program will

- Ensure compliance to HCP/NCCP prescriptions.
- Assess the status of species and natural communities on MRC covered lands.
- Evaluate the effectiveness of our conservation measures in meeting HCP/NCCP goals and objectives.
- Determine if conservation measures need to be changed.

The adaptive management component of the program will determine how MRC collects, analyzes, and uses information to improve the environmental conditions for covered species and natural communities within our forestlands. The monitoring component of the program will evaluate whether our management actions comply with our HCP/NCCP and yield the expected benefits. Both management and monitoring must adapt to change—in the environment, in scientific research, and in technological advances—as MRC learns to improve our conservation efforts and the relevance of our data collection.

13.2 Types of Monitoring

Recent guidelines for regional conservation planning define monitoring as the "systematic and usually repetitive collection of information typically used to track the status of a variable or system" (Atkinson et al. 2007). In accordance with these guidelines, MRC implements 3 types of monitoring: compliance monitoring, effectiveness monitoring, and validation monitoring.[1]

DEFINITION	**Compliance monitoring** determines whether MRC is conforming to the regulatory provisions of our HCP/NCCP.
	Effectiveness monitoring tests whether MRC conservation measures, individually or in sum, meet the stated goals and objectives of our HCP/NCCP.
	Validation monitoring examines the validity of the assumptions upon which the MRC conservation measures are built.

While our definitions emphasize distinct differences, in reality, these 3 types of monitoring may overlap and interact. If MRC determines through effectiveness monitoring, for example, that we are not meeting our objectives for covered species, we may change our conservation measures. Changing our conservation measures would, in turn, impact compliance monitoring.

13.2.1 Compliance monitoring

By tracking the status of plan implementation, compliance monitoring establishes whether MRC is meeting our regulatory commitments under our HCP/NCCP. In effect, compliance monitoring is implementation monitoring. In addition, there is a correlation between compliance monitoring and effectiveness monitoring. Without compliance monitoring, our ability to interpret results from effectiveness monitoring becomes very limited.

[1] Section 13-10, *Monitoring Rare Plants*, uses "focused studies" synonymously with validation studies.

13.2.1.1 Compliance under the Programmatic Timber Harvest Plan (PTHP)

At a minimum, the PTHP process will consists of the following:

1. An MRC RPF will prepare a PTHP in accordance with our HCP/NCCP.
2. The MRC operations coordinator will review the plan and ensure that it complies with our HCP/NCCP.
3. The MRC operations coordinator, if necessary, will consult with the wildlife agencies prior to submitting the PTHP.
4. The MRC operations coordinator will include any results from consultations with the wildlife agencies in the PTHP.
5. The PTHP will include maps and the following information, where relevant, as enforceable language in section 2 of the PTHP:
    - Northern spotted owl
        - Previous 3 activity centers per territory within 0.7 mi. of the PTHP area and within 0.5 mi. of appurtenant roads.
        - Protection level of each activity center.
        - Pre- and post-harvest habitat maps and acreages for territories within 0.7 miles the THP area.
    - Marbled murrelet
        - Indication if the PTHP is in the Lower Alder Creek Management Area (LACMA).
        - Outcome of any assessment for marbled murrelet habitat and designation of the Murrelet Habitat Zone (MHZ) of the PTHP (section 10.3.2.3.3).
        - Protection levels provided for marbled murrelet habitat or a survey plan for murrelet habitat.
        - Indication if (a) MRC has completed ongoing radar monitoring in additional drainages (13.9.2.2-3); (b) trees will be assessed as primary and secondary murrelet trees; and (c) MRC will harvest secondary murrelet trees which our surveys indicate are not occupied.
    - Point Arena mountain beaver
        - Indication if the PTHP is within the Point Arena mountain beaver assessment area.
        - Potential habitat of the Point Arena mountain beaver in or adjacent to the PTHP area.
        - Occupied habitat of the Point Arena mountain beaver in or adjacent to the PTHP area.
    - Coastal tailed frog
        - Indication if there are watercourses occupied by coastal tailed frogs in the PTHP area and confirmation that MRC is treating occupied watercourses as Large Class II streams.
        - Indication if MRC proposes heavy equipment in a buffered area around any wet features (seeps, springs, wet areas, wet meadows, or wetlands) and if pre-project surveys are required.
    - Red-legged frog
        - Indication if there are potential or documented breeding sites in the PTHP area and confirmation or descriptions of pertinent conservation measures.
        - Indication if MRC proposes heavy equipment in a buffered area around any wet features (seeps, springs, wet areas, wet meadows, or wetlands) and if pre-project surveys are required.
    - Mass wasting
        - Field observations and mapping of TSUs.

- Aquatic management zones (AMZs)
  - Proposed AMZ restoration.
  - Alternatives for restoration treatments in AMZ (AC§8.2.3.4-1 to AC§8.2.3.4-22).
  - Proposed harvest within the AMZ.
  - Water drafting guidelines (Appendix E, section E.7, *Standards for Water Drafting*; Appendix T, *Master Agreement for Timber Operations*).
- Snags, wildlife trees, recruitment trees, and LWD
  - Process for marking, tracking, and mapping silvicultural units to ensure compliance to our HCP/NCCP.
  - Report on number of snags, wildlife trees, and recruitment trees in sample area.
- Hardwoods
  - Indication if the basal area of hardwoods in silvicultural units prior to harvest is $\geq$ 15 ft^2/ac or, if not, statement included of the actual basal area.
  - Indication if the stands covered in the harvest plan are Type I, Type II, or Type III hardwoods stands or are hardwood representative sample areas.
- Plants
  - Survey compliance
    - Date of survey effort; size and location of areas surveyed; communities and habitats covered by the survey; number of person-hours to complete the survey.

      NOTE

      A survey may not be completed at the time the PTHP is submitted for approval. MRC may amend a survey to an already approved PTHP. CDFG will have 15 days to review the survey results prior to commencement of operations.
    - List and map showing all occurrences of rare plant species, including an identification code or number and specific location (USGS quadrangle, watershed, and inventory block) for each occurrence.
    - Number of rare plant individuals (or alternative measure of abundance or cover) for each occurrence detected during the survey.
  - Conservation compliance
    - Management category of each covered rare plant species known in the PTHP area.
    - Approved variances to the standard conservation measures.
    - Description of how MRC will implement standard and alternative conservation measures.
- Additional species
    - Additional seasonal restrictions for any species not listed above.
    - Location of any habitat or disturbance buffers, retention areas, EEZs, or ELZs.
- Allowable deviations or alternatives to standard conservation measures (Chapters 8-11).
- Natural communities
    - Indication if the PTHP occurs in uncommon natural communities.
    - Map showing the area covered by PTHP and the proposed activities within the uncommon natural communities.

6. MRC will

- Submit to CAF FIRE, per State law and in accordance with the CFPR, the PTHP, and any major PTHP amendments subsequent to submission.
- Notify the wildlife agencies as described within our HCP/NCCP.

7. CAL FIRE will review the PTHP as follows:
    - There will be an initial office review of the PTHP to determine if the plan is within the scope of the PTEIR.
    - A pre-harvest inspection, if necessary, will occur in the field; the MRC coordinator will notify the wildlife agencies of the scheduled date so that they can attend.
    - There may be active inspections during conduction of the PTHP to ensure that operations are in compliance with our HCP/NCCP.
    - CAL FIRE will prepare and file the inspection reports in the PTHP record.
8. The MRC operations coordinator will prepare a PTHP completion report and submit it to CAL FIRE and the wildlife agencies.
9. CAL FIRE may request, post-harvest, a completion inspection; in that case, the MRC coordinator will notify the wildlife agencies of the scheduled date so they can attend.
10. The wildlife agencies may request a status on operations of a PTHP and schedule a field inspection with MRC.
11. The MRC operations coordinator will conduct field reviews, within the first 3 years of HCP/NCCP implementation, of up to 25 PTHPs, starting with all PTHPs with active operations in the initial year of our HCP/NCCP; this process will continue until 25 PTHPs have been reviewed or 3 years have elapsed, whichever comes first.
12. The MRC operations coordinator will submit a PTHP compliance report with compiled information on the annually reviewed PTHPS to CDF, NMFS, USFWS, and CDFG, as requested, prior to December 31 of the year in which MRC completed the PTHPs.

13.2.1.2 Non-PTHP compliance monitoring

MRC will submit annual reports for operations that are not directly related to a PTHP. These reports include annual sediment control and LWD placement (see Appendix D, *HCP/NCCP Report Timelines and Samples,* D.2.4).

13.2.2 Effectiveness and validation monitoring

Effectiveness monitoring assesses the biological success of our HCP/NCCP; specifically, it evaluates whether MRC is meeting our biological goals and objectives. Validation monitoring, or in some cases focused studies, tests hypotheses to determine whether the assumptions under which MRC is conducting operations are correct. Table 13-1 lists all our HCP/NCCP monitoring programs. Each monitoring program has a unique code. For example, in the code M§13.5.2.1-2, M indicates this is a monitoring program, 13.5.2.1 indicates the section number within our HCP/NCCP where there is a description of this specific monitoring program, and 2 indicates it is the second monitoring program in that section.

Table 13-1 HCP/NCCP Monitoring Programs

HCP/NCCP Monitoring Programs		
Monitoring Code	**Type**	**Description**
M§13.5.1.1-1	E	Timber Inventory: Riparian Stands
M§13.5.1.1-2	E	Timber Inventory: Riparian Canopy
M§13.5.1.1-3	E	Watershed Analysis: LWD Conditions
M§13.5.1.1-4	E	Watershed Analysis: Shade Conditions
M§13.5.1.1-5	E	Stream Temperature
M§13.5.1.2-1	V	Long-term Channel Monitoring: LWD
M§13.5.1.2-2	V	Focus Watersheds: Riparian Function
M§13.5.1.2-3	V	Watershed Size: Small Class II Watercourses
M§13.5.2.1-1	E	Watershed Analysis: Mass Wasting
M§13.5.2.1-2	E	Focus Watersheds: Mass Wasting
M§13.5.2.2-1	V	Forensic Monitoring: Landslide Observations
M§13.5.3.1-1	E	Road Inventory: Sediment Prevention
M§13.5.3.1-2	E	Watershed Analysis: Sediment Prevention
M§13.5.3.2-1	V	Focus Watersheds: Sediment Prevention
M§13.5.4.1-1	V	Focus Watersheds: Sediment Budget
M§13.5.4.1-2	V	Long Term Channel Monitoring: Stream Sediment
M§13.5.4.1-3	V	Focus Watersheds: Stream Sediment
M§13.5.5.1-1	E	Water Drafting
M§13.5.5.2-1	V	Water Drafting
M§13.6.1.1-1	E	Anadromous Salmonid Presence: Annual Salmonid Monitoring Basins (ASMB)
M§13.6.1.1-2	E	Anadromous Salmonid Distribution
M§13.6.1.1-3	E	Chinook Salmon Monitoring Reaches (CSMR)
M§13.6.1.2-1	V	Smolt Abundance
M§13.6.2.1-1	E	Baseline Distribution and Habitat Quality of Red-legged Frog Breeding Sites
M§13.6.2.1-2	E	Occupancy of Red-Legged Frogs in Documented Breeding Sites
M§13.6.2.1-3	E	Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites
M§13.6.3.1-1	E	Baseline Distribution of Coastal Tailed Frogs
M§13.6.3.1-2	E	Distribution and Relative Abundance of Coastal Tailed Frogs
M§13.8.1-1	E	Snags, Wildlife Trees, Recruitment Trees, and Downed Wood
M§13.8.1-2	E	Basal Area of Hardwoods in Timber Stands
M§13.8.1-3	E	Post-Harvest Follow-up on Hardwood Representative Sample Areas
M§13.8.1-4	E	Acreage and Number of Hardwood Representative Sample Areas
M§13.8.1-5	E	Acreage and Number of Old Growth Stands and Trees
M§13.8.1-6	E	Distribution and Area of Rocky Outcrops
M§13.8.2-1	E	Common Natural Communities
M§13.8.2-2	E	Uncommon Natural Communities
M§13.8.3-1	E	Invasive Species Control
M§13.9.1.3-1	E	Northern Spotted Owls: Level-1 and Level-2 Territories
M§13.9.1.3-2	E	Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat
M§13.9.1.4-1	V	Population Trends of Northern Spotted Owls
M§13.9.1.4-2	V	Identification of Nesting/Roosting Habitat for Northern Spotted Owls
M§13.9.1.4-3	V	Benefits of High Protection for Northern Spotted Owls and Their Territories

HCP/NCCP Monitoring Programs		
Monitoring Code	**Type**	**Description**
M§13.9.1.4-4	V	Effect of Harvest within 1000 ft of NSO Territories with Limited Protection
M§13.9.1.4-5	V	Effect of Habitat on Productivity of Northern Spotted Owls
M§13.9.1.4-6	V	Effect of Hardwood Density on Northern Spotted Owls
M§13.9.1.4-7	V	Effect of Barred Owl Control on Northern Spotted Owls
M§13.9.2.1-1	V	Activity Level of Marbled Murrelets in Lower Alder Creek
M§13.9.2.1-2	V	Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds
M§13.9.2.2-1	E	Murrelet Habitat Distribution in LACMA
M§13.9.2.2-2	E	Methods for Accelerating Growth of Murrelet Habitat
M§13.9.2.2-3	V	Radar Monitoring in Additional Drainages
M§13.9.3.1-1	E	Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver
M§13.9.3.1-2	E	Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems
M§13.9.3.2-1	V	Defining Habitat for Point Arena Mountain Beavers
M§13.9.3.2-2	V	Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems
M§13.10.3-1	E	Status and Trend of Covered Rare Plant Species

TABLE NOTES

E = effectiveness monitoring
V= validation monitoring

13.2.2.1 Conservation measures, contingencies, and definitions subject to change

Individual conservation measures target different biological goals and objectives. Some of these conservation measures are static. MRC can only change them through an amendment process outlined in the *Implementing Agreement*. Other conservation measures are dynamic. MRC may change them in response to data collected under the adaptive management program. Section 13.3.6 describes the allowable limits of change for these dynamic conservation measures. When a change is within these allowable limits, MRC can make it with approval of the wildlife agencies; however, when a change is outside the allowable limits, MRC may need to propose an amendment or minor modification to the HCP/NCCP, as described in section 1.13. Table 13-2 describes, in general, the conservation measures subject to change. Table 13-3 has the contingency for barred owls that is subject to change. In addition, some of the definitions surrounding specific conservation measures are also subject to change; Table 13-4 shows those definitions and the monitoring programs that determine what those changes may be. Finally, MRC will monitor the population trends of all northern spotted owls in the plan area (M§13.9.1.4-1) to determine if their total numbers increase, decrease, or remain stable.

Table 13-2 General Conservation Measures Subject to Change

General Conservation Measures Subject to Change		
Conservation Measure Code	**Monitoring Program**	**Monitoring Code**
Mass Wasting		
C§8.3.3.1.2-1 to C§8.3.3.1.7-3 C§8.3.3.1.8-1 to C§8.3.3.1.8-9	Focus Watersheds: Mass Wasting	M§13.5.2.1-2
	Watershed Analysis: Mass Wasting	M§13.5.2.1-1
	Forensic Monitoring: Landslide Observations	M§13.5.2.2-1
Road Upgrades and Abandonment		
C§8.3.3.1.2-1 to C§8.3.3.1.7-3	Focus Watersheds: Mass Wasting	M§13.5.2.1-2
	Focus Watersheds: Stream Sediment	M§13.5.4.1-3
	Road Inventory: Sediment Prevention	M§13.5.3.1-1
	Watershed Analysis: Mass Wasting	M§13.5.2.1-1
	Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2
AMZ Canopy and Large Tree Retention		
C§8.2.3.1.2-1 C§8.2.3.2.2-1 C§8.2.3.3.2-1 C§8.2.3.1.4-1	Focus Watersheds: Riparian Function	M§13.5.1.2-2
	Timber Inventory: Riparian Stands	M§13.5.1.1-1
	Timber Inventory: Riparian Canopy	M§13.5.1.1-2
	Watershed Analysis: Shade Conditions	M§13.5.1.1-4
	Stream Temperature	M§13.5.1.1-5
AMZ Retention Standards		
C§8.2.3.1.4-1 C§8.2.3.1.3-1 to C§8.2.3.1.3-3 C§8.2.3.1.7-1 -4	Focus Watersheds: Riparian Function	M§13.5.1.2-2
	Timber Inventory: Riparian Stands	M§13.5.1.1 -1
	Timber Inventory: Riparian Canopy	M§13.5.1.1-2
Northern Spotted Owl		
C§10.3.1.3.1-34	Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4

General Conservation Measures Subject to Change		
Conservation Measure Code	**Monitoring Program**	**Monitoring Code**
C§10.3.1.3.1-5 C§10.3.1.3.1-21	Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5
C§9.3.3.1-1 to C§9.3.3.1-3 C§9.3.3.2-1 to C§9.3.3.2-12 C§9.3.3.3-1 to C§9.3.3.3-3	Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6
	Marbled Murrelet	
C§10.3.2.3.1-3	Methods for Accelerating Growth of Murrelet Habitat	M13.9.2.2-2
C§10.3.2.3.11-9 C§10.3.2.3.12-9	Radar Monitoring in Additional Drainages	M§13.9.2.2-3
	Point Arena Mountain Beaver	
C§10.3.3.3-1	Creating Potential Habitat in or adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2
	Rare Plants	
C§11.7.1-11 C§11.7.2-8 C§11.7.3-8	Status and Trend of Covered Rare Plant Species	M§13.10.3-1

Table 13-3 Contingency Subject to Change

Contingency	Monitoring Program	Monitoring Code
	Northern Spotted Owl	
Barred Owls SECTION 10.3.1.2.5 Y§10.3.1.2.5-6	Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7

Table 13-4 Definitions Subject to Change

Definitions Subject to Change		
Definitions	**Monitoring Program Name**	**Monitoring Code**
Small Class II watercourses	Watershed Size: Small Class II Watercourses	M§13.5.1.2-3
NSO nesting/roosting habitat	Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2
Mapped boundaries of LACMA	Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1

Definitions Subject to Change		
Definitions	**Monitoring Program Name**	**Monitoring Code**
Potential habitat of Point Arena Mountain Beaver	Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1

13.2.2.2 Objectives and hypotheses

Sections 13.4 through 13.11 detail our effectiveness and validation monitoring programs. The objectives in the effectiveness monitoring programs link directly to one or more stated objectives in Chapters 8 through 11, where we propose our conservation measures. Except for physical processes, the hypotheses in the validation monitoring programs link directly to "key uncertainties" stated in Chapter 4 (*Covered Aquatic Species*), Chapter 5 (*Covered Terrestrial Species),* and Chapter 6 *(Covered Plant Species)*.

There are 8 monitoring programs for physical processes, shown in Table 13-5, with various parameters such as instream canopy and LWD, drainage areas of Small Class II watercourses, mass wasting observations, road inventory, and conditions of instream channels and sediment. MRC is already implementing most of these monitoring programs within watershed analysis. In the future, we may (a) continue the same frequency and survey effort; or (b) alter survey frequency and incorporate improved technologies or habitat models after HCP/NCCP commencement. For other physical monitoring programs, such as those for Small Class II watercourses or mass wasting forensics, MRC will need to plan new protocols prior to HCP/NCCP implementation.

Table 13-5 Validation Monitoring Programs for Physical Processes

Validation Monitoring	
Program Code	**Monitoring Program Description**
M§13.5.1.2-2	Focus Watersheds: Riparian Function
M§13.5.1.2-3	Watershed Size: Small Class II Watercourses
M§13.5.2.2-1	Forensic Monitoring: Landslide Observations
M§13.5.3.2-1	Focus Watersheds: Sediment Prevention
M§13.5.4.1-2	Long Term Channel Monitoring: Stream Sediment
M§13.5.4.1-3	Focus Watersheds: Stream Sediment
M§13.5.4.1-1	Focus Watersheds: Sediment Budget
M§13.5.5.2	Water Drafting

13.2.2.3 Testing assumptions

Many of the assumptions behind our conservation measures were based on research in locations different from the plan area or on information only indirectly related to a specific species or habitat. These assumptions and scientific sources must be sorted out and examined.

Effectiveness and validation monitoring are not mutually exclusive. While validating a hypothesis, one can evaluate the effectiveness of a conservation measure as well. Appropriate levels of LWD in fish-bearing streams, for instance, may be the objective of a conservation measure. Validation monitoring examines the assumption that abundance of anadromous salmonid will increase with LWD. An actual increase in abundance of anadromous salmonid may validate the assumption and show that LWD recruitment has been effective at meeting conservation objectives.

MRC will use various programs to assess habitat and species populations and test the performance of our conservation measures. We anticipate that most, if not all, of the monitoring programs will be implemented for the full term of our HCP/NCCP.

13.2.2.4 Use of statistics in monitoring programs

DEFINITION

Mean is the arithmetic average of a set of numbers; for example, the mean of 33 19 47 84 12 is 39

Median is the middle number in an ordered sequence of numbers; for example, the median of 12 19 33 47 84 is **33**. If there are an even number of numbers, then the median is the average of the two middle numbers; for example, the median of 12 19 **33 47** 84 92 is 40.

The basic function of statistics is to produce knowledge from raw data and allow for informed decisions. In applying statistics, one begins with a *population*. In our case, this might be, for example, a population of northern spotted owls or red-legged frogs. MRC routinely collects data in observational or experimental settings about various populations on our land. For practical reasons, we study a subset of a population, called a *sample*. If the sample is representative of the population, then inferences and conclusions made from the sample can be extrapolated to the population as a whole. A major problem lies in determining the extent to which the sample is representative. Results can be difficult to interpret and may not agree with intuition or expectation. Statistics help us to estimate randomness or uncertainty in our sample and in our data collection procedure.

Many of our monitoring programs compare 2 different sets of numbers, for example, the number of murrelet detections in the Lower Alder Creek Management Area (LACMA) during 2008 and 2009. Say, for example, the mean number of detections in 2008 and 2009 were 20 and 25 respectively. Intuitively, we might conclude that these mean numbers are different. Intuition, however, can be incorrect. To conclude with some level of certainty that there was, in fact, an increase in the number of murrelet detections between 2008 and 2009, we must look at the variability of our samples for both years. The difference in means may simply be due to the variability of our samples. In 2008, our detections may have varied wildly (0, 0, 100, 0, 0) for a mean of 20. In 2009, our detections continued to be erratic (20, 85, 0, 20, 0) for a mean of 25. In light of this variation in our detections, there is no statistical basis for concluding that the difference in the mean number of murrelet detections from 2008 to 2009 equates to an increase in murrelet detections.

DEFINITION

Null hypothesis is a basic statistical hypothesis to be tested, generally stated as 2 populations having equivalent parameters.

Alpha level is the probability of rejecting a hypothesis when it is, in fact, true.

Power is the probability of rejecting a hypothesis when it is, in fact, false.

Power analysis is the ability to find a statistically significant difference when a real difference exists.

As the above example shows, we test whether the mean number of murrelet detections from one year to the next is different by assessing the means and the variation in the surveys that generate those means in each year. To compare the means, we set up a *null hypothesis*, such as "The mean number of murrelet detections is equal in 2008 to 2009." The *alpha level* is the probability that we will reject the null hypothesis when the hypothesis is true. The *power* is the probability we will reject the null hypothesis when the hypothesis is false, i.e., we will make a correct decision. In terms of statistical tests, the higher the power, the more likely the test will detect a difference when there is an actual difference. In designing monitoring studies to compare means or medians, we are trying to balance power against alpha level so that we are more likely to detect a difference when there is one and less likely to mistakenly detect a difference when none exists.

The concepts of power and alpha level also relate to the statistical concepts of Type I and Type II error. A Type I error occurs when a researcher rejects the null hypothesis even though it is true; therefore, a lower alpha level means a decreased chance for a Type I error. A Type II error occurs when a researcher should have rejected a null hypothesis but instead fails to reject it. The power is the probability that a Type II error will not occur; consequently, a higher power means a decreased chance of a Type II error.

Because null hypotheses are usually stated as 2 equal populations, a Type I error can lead to the mistaken conclusion that a difference exists and precipitate an unnecessary action. On the other hand, a Type II error can overlook a difference when one occurs. A Type II error can be more important than a Type I if the missed difference is a serious decline in a covered species population. Power can be increased by increasing the acceptable alpha level, increasing the minimum detectable change, increasing the number of sampling units, or reducing the standard deviation.

We cannot, in our HCP/NCCP, lay out the statistical details of our study designs—most of which have not yet been developed. However, our intention, going forward, is to use existing monitoring programs or design new programs early in the plan implementation that incorporate the necessary statistical rigor for specific applications. As MRC develops each monitoring program, we will work with the wildlife agencies to ensure there is minimal statistical error.

MRC recognizes several principles of experimental design that are important to our monitoring programs. Replicates in space and time can help assure that findings can be extrapolated across the plan area. Random allocation of treatments is also important, but difficult to apply in a land management scenario. The BACI (Before-After-Control-Impact)[2] design is a powerful design that MRC will apply whenever feasible in developing effectiveness and validation monitoring programs (see rightmost columns of Figure 13-2).

13.2.2.5 Spatial scales for monitoring

Monitoring must evaluate effects at both small and large scales. MRC is using different spatial scales for effectiveness and validation monitoring (see Table 13-6). Some monitoring will be at a project or site-specific scale. Aquatic monitoring will often be at major tributary or river-reach scale. For many cumulative effects, the large basin or watershed scale is an appropriate size.

[2] BACI is a method for measuring the potential impact of an event on an ecological resource (e.g., fish distribution in a stream after removal of a fish passage barrier). One measures conditions *before* a planned activity and then compares the results to conditions after the activity. The comparison is done with a control site that remains the same before and after the activity.

Data on spotted owls and marbled murrelets will be collected at the inventory block scale since owls can move across basins and watersheds.

MRC has designed some of our monitoring programs to evaluate conditions at the planning watershed scale. In consultation with the wildlife agencies, we determined the most appropriate scale for each monitored parameter. Each objective has a monitoring program which balances the need for a representative sample with the intensity of effort required to achieve that representation. MRC conducts LWD monitoring, for example, at numerous watercourse segments within a planning watershed; we can rapidly conduct this monitoring throughout an area. In the case of long-term channel monitoring for stream morphology, however, we track changes at a single stream reach within a planning watershed; this is a labor-intensive program. By monitoring the most downstream reach within the planning watershed, we obtain vital information.

! MRC may or may not implement optional monitoring programs during the term of our HCP/NCCP. Only validation monitoring programs are optional.

Table 13-6 Spatial Scales of Effectiveness and Validation Monitoring

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
Silvicultural unit	• Silvicultural unit	• Basal Area of Hardwoods in Timber Stands	M§13.8.1-2
Project level	▪ Small-scale, site-specific issues or projects, e.g., individual PTHPs and roads	• Forensic Monitoring: Landslide Observations	M§13.5.2.2-1
		• Post-Harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3
		• Water Drafting	M§13.5.5.1
		• Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2
		• Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3
Major stream or river reach	• Class I watercourse typically with a hydrologic watershed smaller than a planning watershed	• Stream Temperature	M§13.5.1.1-5
		• Anadromous Salmonid Distribution	M§13.6.1.1-2

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
	• Major stream or segment of river within a planning watershed	• Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2
		• Long-term Channel Monitoring: LWD	M§13.5.1.2-1
Lower Alder Creek Murrelet Area	• Sub-planning watershed management area dedicated to retention of murrelet activity and habitat	• Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1
		• Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1
		• Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2
CalWater planning watersheds	• Planning unit between 5000-10,000 ac designated by the State of California	• Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1
		• Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1
		• Anadromous Salmonid Presence: ASMB	M§13.6.1.1-1
		• Timber Inventory: Riparian Stands	M§13.5.1.1-1
		• Focus Watersheds: Sediment Budget Stream	M§13.5.4.1-1
		• Distribution and Area of Rocky Outcrops	M§13.8.1-6
		• Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2
		• Focus Watersheds: Stream Sediment	M§13.5.4.1-3
		• Water Drafting	M§13.5.5.2-1
Watershed analysis unit (WAU)	• Plan area within a large basin	• Watershed Analysis: Mass Wasting	M§13.5.2.1-1
		• Road Inventory: Sediment Prevention	M§13.5.3.1-1

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
		• Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2
		• Radar Monitoring in Additional Drainages	M§13.9.2.2-3
		• Watershed Analysis: Shade Conditions	M§13.5.1.1-4
Inventory block	• Geographical separation of plan area into distinct management units	• Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1
		• Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2
Point Arena mountain beaver assessment area	• Areas up to 5 miles inland bounded by Cliff Ridge to the north and the southern edge of the Garcia inventory block to the south	• Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1
		• Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	M§13.9.3.1-2
		• Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1
		• Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2
Covered lands	• Plan area	• Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1
		• Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5
		• Population Trends of Northern Spotted Owls	M§13.9.1.4-1
		• Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2
			M§13.9.1.4-3

Spatial Scales of Effectiveness and Validation Monitoring			
Spatial Scale	**Description**	**Monitoring Program**	**Program Code**
		• Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-4
		• Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-5
		• Effect of Habitat on Productivity of Northern Spotted Owls	
		• Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6
		• Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7
		• Acreage and Number of Hardwood Representative Sample Areas	M§13.8.1-4
		• Common Natural Communities	M§13.8.2-1
		• Uncommon Natural Communities	M§13.8.2-2
		• Invasive Species Control	M§13.8.3-1

13.2.2.6 Elements of a monitoring plan

In developing our monitoring plans, MRC will follow guidelines from Oakley et al. (2003) and Elzinga et al. (1998). The basic elements of a monitoring plan are as follows:

- Introduction stating species, needs, and management conflicts.
- Ecological model identifying sensitive attributes to be measured and describing relationships between species biology and management activities.
- Management objectives and rationale for choice of attributes and amount of change that will be considered biologically significant.
- Monitoring design.
- Sampling objective and rationale for choice of precision and error rates.
- Sampling design, including description of sampling unit, size, distribution, and number, as well as proposed Quality Assessment (QA) and Quality Control (QC).
- Field measurement methods, including everything that someone would need to take-over a project and continue it.
- Timing (seasonal and phenological), frequency, and duration.
- Location, including maps and aerial photos to enable location of the sampling units.

- Data analysis approach.
- Sample data sheet(s).
- Responsible parties.
- Funding.
- Management response to results.

MRC will work with the wildlife agencies in developing our monitoring plans and obtain their approval before implementing them. Chapter 13 simply presents high level concepts for each monitoring program; this is not the substantive detail that must go into the actual monitoring plan. After commencement of our HCP/NCCP, the wildlife agencies, in addition to scheduling field inspection, may conduct monitoring in the plan area on their own initiative and with their own funding, as long as they adhere to MRC access rules.

13.2.2.7 Monitoring programs subject to harvest levels

The source of funding for MRC monitoring programs is primarily revenue from our timber harvest. Over the 80-year term of our HCP/NCCP, we expect our projected harvest levels to increase as our forests continue to recover. When this occurs, MRC will increase our milling capacity and customer base, and, in turn, increase capital improvements in our production facilities.

By the same token, a market downturn, as we experienced in 2009, will impact harvest levels and programs funded by harvest revenue. MRC will curtail many of our monitoring efforts if timber harvest drops below 37% of our allowable harvest level.[3] We chose 37% as the benchmark since levels below this number would result in possible reductions in both staff and milling capacity. Harvest levels are set within 5-year periods. Therefore, if our average allowable harvest level for a year was 40 mmbf, we would curtail monitoring efforts if harvests dropped below 15 mmbf. In no case, however, will MRC curtail the monitoring programs described in Table 13-6 for more than 10 years. If harvests remain lower than the average allowable harvest levels for a period exceeding 10 years, our monitoring programs will kick in again.

Harvest cutbacks may not affect all monitoring programs. In some cases, however, MRC will conduct monitoring less frequently or discontinue it altogether until harvest levels rebound. MRC may curtail monitoring in the same year of the reduced harvest or in the year following the reduced harvest. In either case, the HCP/NCCP monitoring coordinator will send written correspondence to the wildlife agencies within 1 week of our decision to limit monitoring. The coordinator will send the letter by July 1st of the year in which the curtailed harvest will occur.

Table 13-7 outlines the potential impact of low harvest levels on proposed monitoring programs. Table 13-8 sets the allowable harvest, as determined by the MRC growth-and-yield model. MRC will adjust harvest volumes as land purchases or sales change the size of the plan area. Our HCP/NCCP is for a term of 80 years. The actual date of HCP/NCCP commencement will determine the starting and ending "Harvest Year" in Table 13-8. We project that the HCP/NCCP will commence in 2012 and conclude in 2092.

[3] Rounded to the nearest whole number

Table 13-7 Monitoring Programs Subject to Harvest Levels

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Stream Temperature	M§13.5.1.1-5	• Skip no more than 3 years in a row and leave no more than 6 data gaps.
Watershed Analysis: LWD Conditions	M§13.5.1.1-3	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Watershed Size: Small Class II Watercourses	M§13.5.1.2-3	• No change.
Timber Inventory: Riparian Canopy	M§13.5.1.1-2	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Focus Watersheds: Riparian Function	M§13.5.1.2-2	• Discontinue monitoring until harvest reaches 75% of allowable harvest levels.
Focus Watersheds: Mass Wasting	M§13.5.2.1-2	• Discontinue monitoring until harvest reaches 75% of allowable harvest levels.
Watershed Analysis: Sediment Prevention	M§13.5.3.1-2	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2	• No change.
Timber Inventory: Riparian Stands	M§13.5.1.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Long-term Channel Monitoring: LWD	M§13.5.1.2-1	• No change.
Watershed Analysis: Mass Wasting	M§13.5.2.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.
Forensic Monitoring: Landslide Observations	M§13.5.2.2-1	• No change.
Road Inventory: Sediment Prevention	M§13.5.3.1-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Focus Watersheds: Sediment Prevention	M§13.5.3.2-1	• Discontinue until harvest reaches 75% of allowable harvest levels.
Focus Watersheds: Stream Sediment	M§13.5.4.1-3	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Water Drafting	M§13.5.5.1-1	• No change
Water Drafting	M§13.5.5.2-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1	• No change.
Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2	• No change.
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3	• No change.
Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1	• No change.
Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2	• Discontinue for 3 years
Anadromous Salmonid Presence: ASMB	M§13.6.1.1-1	• No change.
Anadromous Salmonid Distribution	M§13.6.1.1-2	• Discontinue monitoring for 3 years (1 cohort[4]), if low harvest levels occur when the distribution survey is scheduled to begin; otherwise, continue monitoring if the 3-year survey is already in progress.
Chinook Salmon Monitoring Reaches (CSMR)	M§13.6.1.1-3	• No change.
Smolt Abundance	M§13.6.1.2-1	• No change.
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1	• No change.
Basal Area of Hardwoods in Timber Stands	M§13.8.1-2	• No change.

[4] A cohort is a group of animals of the same species, identified by a common characteristic, which are studied over a period of time as part of a scientific investigation.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Post-harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3	• No change.
Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5	• No change.
Distribution and Area of Rocky Outcrops	M§13.8.1-6	• No change.
Common Natural Communities	M§13.8.2-1	• No change.
Uncommon Natural Communities	M§13.8.2-2	• No change.
Invasive Species Control	M§13.8.3-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Population Trends of Northern Spotted Owls	M§13.9.1.4-1	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1	• Continue if MRC has already initiated the study.
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2	• Discontinue until harvest exceeds 37% of allowable harvest levels.
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1	• No change.
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	M§13.9.3.1-2	• Continue if MRC has already initiated the study.

Harvest Falls Below 37% of Allowable Harvest Level		
Monitoring Program	**Monitoring Code**	**Potential Impacts**
Status and Trend of Covered Rare Plant Species	M§13.10.3-1	• Discontinue monitoring in non-operational areas until harvest levels exceed 37% of allowable harvest.

Table 13-8 Harvest Triggers to Reduce Monitoring

Harvest Triggers to Reduce Monitoring			
Harvest Year	**Allowable Harvest Volume Per Year (mbf)**	**37% of Allowable Harvest per Year (mbf)**	**75% of Allowable Harvest per Year (mbf)**
2011-2015	57,954	21,443	43,466
2016-2020	62,669	23,188	47,002
2021-2025	64,382	23,821	48,287
2026-2030	62,008	22,943	46,506
2031-2035	62,976	23,301	47,232
2036-2040	73,552	27,214	55,164
2041-2045	87,011	32,194	65,258
2046-2050	90,201	33,374	67,651
2051-2055	90,573	33,512	67,930
2056-2060	91,780	33,959	68,835
2061-2065	95,407	35,301	71,555
2066-2070	107,037	39,604	80,278
2071-2075	106,885	39,547	80,164
2076-2080	106,484	39,399	79,863
2081-2085	109,110	40,371	81,833
2086-2090	118,427	43,818	88,820
2091-2095	119,410	44,182	89,558

13.3 Adaptive Management

"Nothing is permanent but change." Heraclitus gave us that wise insight into the world over 2500 years ago. Adaptive management—a term that was coined in the 1970s and much later adopted by the conservation community—is the process of improving management policies and practices as things change. Our information about the natural world is never complete and too often it is simply wrong. As Figure 13-1 shows schematically, what we "know" is re-examined and tested, knowledge is corrected and extended, and management is adjusted. In other words, we are continually learning how to manage and we are managing in order to continually learn.

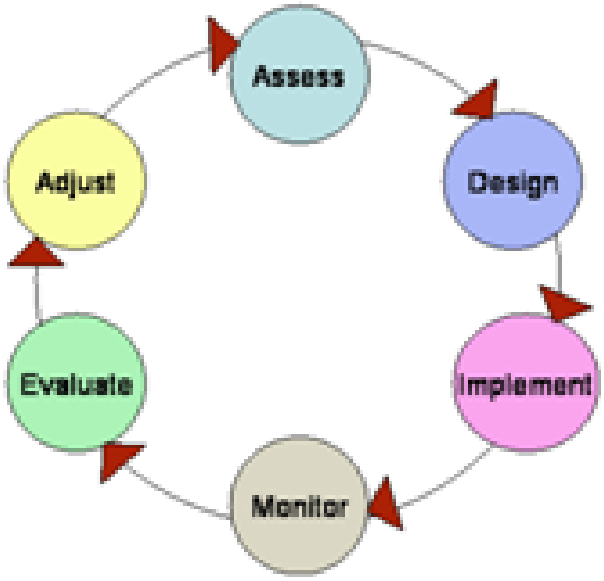

Figure 13-1 Adaptive Management Process

13.3.1 Inherent uncertainty in conservation effort

Our HCP/NCCP primarily uses a habitat-based approach to conserve covered species and natural communities in the plan area. However, our knowledge of covered species, their habitats, and the ecological systems that support them is incomplete. Lack of data introduces uncertainty into the effectiveness of HCP/NCCP conservation measures. Uncertainty is also an inherent component of ecological systems because of natural variation (e.g., rainfall, climate, species behavior, and species response). Ecosystems are complex, which makes predicting species and habitat responses to management actions difficult. Finally, future changes in land use outside the plan area also introduce uncertainty. To address such uncertainties, MRC enlists principles of adaptive management, which allow us to adjust conservation measures based on results of monitoring and experimentation. This approach provides greater assurance that we will achieve our biological goals and objectives for covered species and natural communities.

13.3.2 Definitions of adaptive management

DEFINITION

"Adaptive management is the process whereby management is initiated, evaluated, and refined (Holling 1978, Walters 1986). It differs from traditional management by recognizing and preparing for the uncertainty that underlies resource management decisions. Adaptive management is typically incremental in that it uses information from monitoring and research to continually evaluate and modify management practices. It promotes long-term objectives for ecosystem management and recognizes that the ability to predict results is limited by knowledge of the system. Adaptive management uses information gained from past management experiences to evaluate both success and failure, and to explore new management options." (Kershner 1997)

> Adaptive management "is a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned." (USFWS, Five-Point Policy for HCPs, 65 FR 106, 1 June 2000)

> Adaptive management uses "the results of new information gathered through the monitoring program of the plan and from other sources to adjust management strategies and practices to assist in providing for the conservation of covered species." (California NCCPA of 2003, CDFG Code 2805a)

MRC has designed our adaptive management program to be consistent with the above definitions. Our program incorporates the 4 adaptive management strategies that USFWS recommends for an HCP (65 FR 35252):

1. Identify uncertainties and the questions that need to be addressed to resolve the uncertainties.
2. Develop alternative strategies and determine which experimental strategies to implement.
3. Integrate a monitoring program that is able to detect the necessary information for strategy evaluation.
4. Incorporate feedback loops that link implementation and monitoring to a decision-making process.

Our HCP/NCCP also incorporates the concepts of passive and active adaptive management advocated and defined by USFWS for HCP implementation (65 FR 35250–35257). Through passive adaptive management, MRC will learn how to attain our biological goals and objectives based on the results of effectiveness monitoring. Through active adaptive management, we will resolve uncertainties about the best approaches for achieving specific objectives. Specifically, we will test hypotheses about covered species, covered natural communities, and physical processes; in addition, we will conduct studies to validate assumptions about covered plants.

13.3.3 Adaptive approach

Monitoring the outcomes of management is the foundation of an adaptive approach; thoughtful monitoring can both advance scientific understanding and modify management actions iteratively (Williams et al. 2007).

Adaptive management is necessary because of the degree of uncertainty and natural variability associated with ecosystems and their management. Based on the best scientific information currently available, MRC expects our conservation measures to achieve our biological objectives. However, there is uncertainty about management techniques, conditions within the permit area, regional habitat conditions, and the status of covered species and natural communities; any of these may change in unexpected ways during the course of HCP/NCCP implementation. Results of validation monitoring may indicate that some of our conservation measures are less effective

than anticipated. To address these uncertainties, MRC will use an adaptive management approach, based on validation monitoring, to inform our decisions.

The cornerstone of our monitoring and adaptive management program is experimentation (Figure 13-2). MRC will use information collected through validation monitoring to manage habitat and protect covered species and natural communities. Moreover, MRC will share results from our monitoring, as appropriate, with other regional restoration and management programs. Where feasible, we will use standardized protocols and methodologies to obtain monitoring data that can be coordinated regionally. A monitoring program design that is well-coordinated and scalable will enable MRC and others to measure and evaluate changes in resources as well as threats across the entire permit area and within the eco-region.

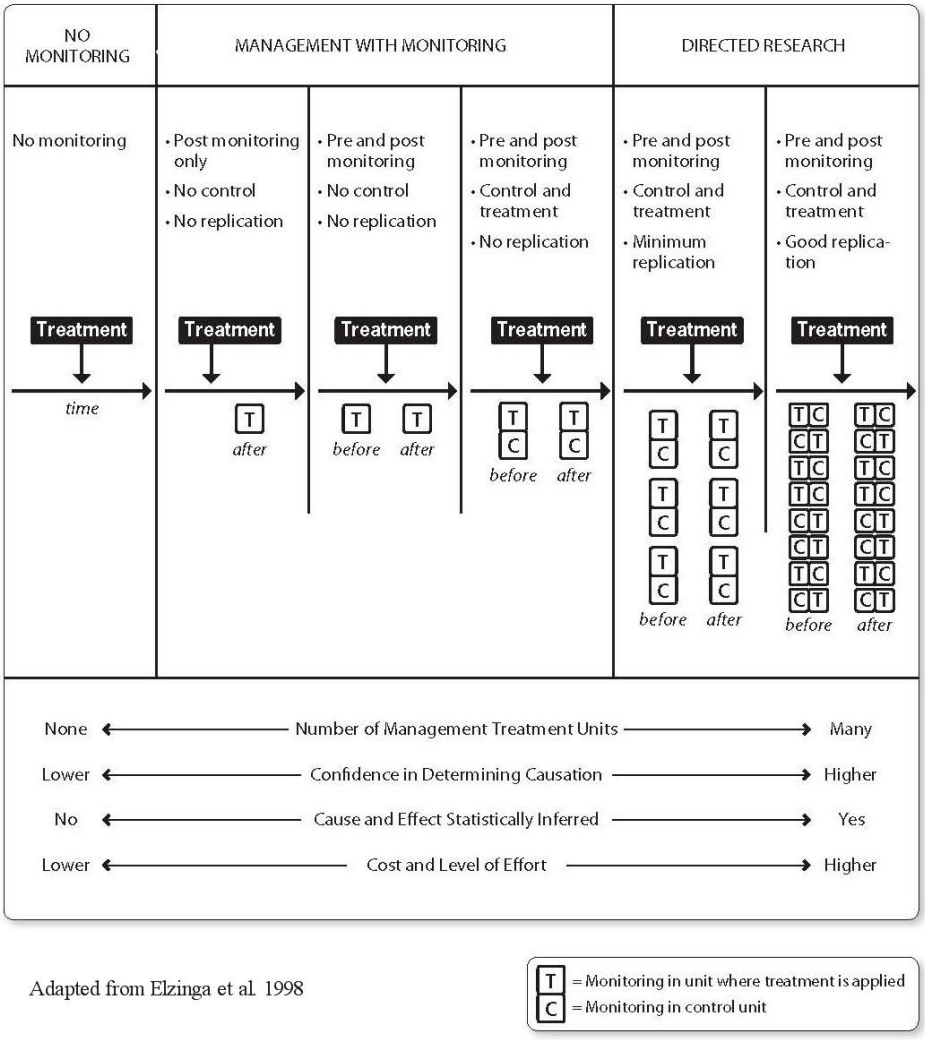

Figure 13-2 Continuum of Experimental Management

13.3.4 Integration of monitoring and adaptive management

There is a direct correlation between validation monitoring and adaptive management. Validation monitoring is the basis for adaptive management and adaptive management is dependent on

results from validation monitoring. Our HCP/NCCP integrates these 2 components into a single program. Such integration is critical to the successful implementation of our conservation strategies.

Our validation monitoring and adaptive management program will reveal the effectiveness of our conservation measures. We will revise conservation measures which do not achieve the goals and objectives of our HCP/NCCP. Moreover, we may revise conservation measures which exceed those goals and objectives, dialing down their prescriptions a bit. In effect, validation monitoring provides the impetus to change conservation measures as needed. Moreover, some conservation measures come with their own defined limits of allowable change (Table 13-9 through Table 13-12).

13.3.5 Conceptual models

Conceptual models are a useful tool that document HCP/NCCP assumptions about natural communities and covered species. MRC will follow recommended steps for developing conceptual ecological models (Atkinson et al. 2004):

1. Complete conceptual models for each covered species.
2. Identify critical uncertainties for covered species.
3. Identify pressures on natural community types including species-specific, local, regional, and global pressures.
4. Develop conceptual models for natural communities and include their relationships to covered species.
5. Cross-check the monitoring variables selected and described in our HCP/NCCP; monitor species groups or indices where applicable.

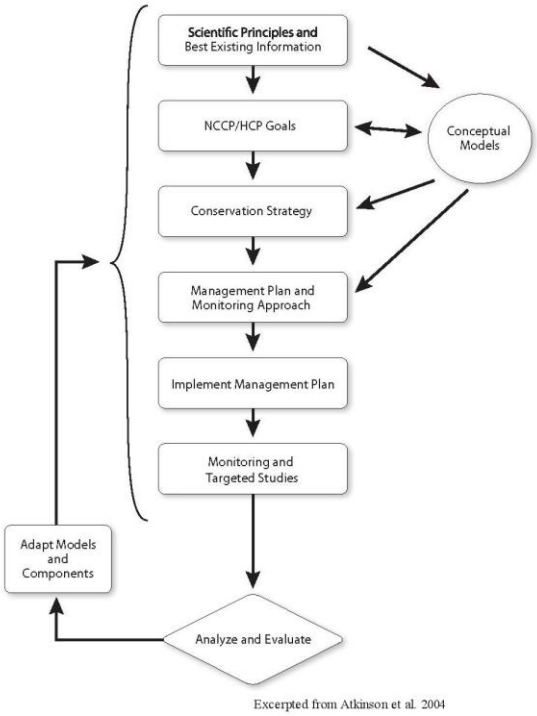

Figure 13-3 Adaptive Management Feedback Loop

During plan implementation, conceptual models will guide our monitoring and adaptive management (Figure 13-3). Using monitoring to provide information for adaptive management will require a framework for measuring responses. The process is as follows:

1. Identify threats to the species or natural community.
2. Identify the objectives of the conservation strategy.
3. Evaluate the effectiveness of the objective in meeting a goal.
4. Evaluate the effectiveness of the conservation measure against the expected outcome.

The adaptive management program allows for the adjustment of the conservation measures if the expected outcome fails to match the conservation objective or exceeds the conservation objective. One then adjusts the conservation measures as needed to achieve the expected outcomes and reduce the threats to the natural community.

13.3.6 Limits of allowable change

13.3.6.1 Conservation measures

Our conservation measures fall into categories: riparian, terrestrial species, and rare plants. In some cases, we have also included limits of allowable change. Limits ensure the wildlife agencies, MRC, and the public that changes to our HCP/NCCP will not be open-ended but must be within a specified range.

The results of validation monitoring may support modification of a conservation measure within the limits of allowable change. Generally, MRC will change only 1 conservation measure at a time. In some cases, however, MRC and the wildlife agencies may conclude, based on validation monitoring, to change more than one measure. MRC may adjust conservation measures within the limits of allowable change with the concurrence of the wildlife agencies; adjustments outside those limits require either a minor modification or major amendment to our HCP/NCCP. Table 13-9 through Table 13-11 document the limits of allowable change for conservation measures applicable to riparian function, terrestrial species, and rare plants.

Table 13-9 Riparian Conservation Measures Subject to Change

Riparian Conservation Measures Subject to Change						
Topic	**Habitat Process**	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
				Initial	**Low**	**High**
watercourse shade Class I AMZ	Stream water temperature	M§13.5.1.1-5	Inner band canopy retention C§8.2.3.1.2-1	85%	75%	95%
watercourse shade Large Class II AMZ	Stream water temperature	M§13.5.1.1-5	Inner band canopy retention C§8.2.3.1.2-1	85%	75%	95%
Class I AMZ basal area	Instream LWD recruitment	M§13.5.1.1-3 M§13.5.1.2-1 M§13.5.1.2-2	Floodprone/CMZ AMZ inner and middle band C§8.2.3.1.3-1 (trigger for harvest)	300 ft^2	260 ft^2	350 ft^2

Riparian Conservation Measures Subject to Change						
Topic	**Habitat Process**	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
				Initial	**Low**	**High**
			Site 2 & 3 AMZ inner and middle band C§8.2.3.1.3-2 (trigger for harvest)	200 ft^2	160 ft^2	260 ft^2
			Site 4 AMZ inner and middle band C§8.2.3.1.3-3 (trigger for harvest)	160 ft^2	120 ft^2	200 ft^2
Class I AMZ largest tree retention	Instream LWD recruitment	M§13.5.1.1-3 M§13.5.1.2-1 M§13.5.1.2-2	High LWD sensitivity, inner band C§8.2.3.1.4-1	30%	10%	50%
			High LWD sensitivity, middle band C§8.2.3.1.4-1	15%	10%	30%
			Moderate LWD sensitivity, inner band C§8.2.3.1.4-1	20%	10%	40%
			Moderate LWD sensitivity, middle band C§8.2.3.1.4-1	10%	5%	30%
			Low LWD sensitivity, inner band C§8.2.3.1.4-1	10%	5%	30%
			Low LWD sensitivity, middle band C§8.2.3.1.4-1	5%	5%	20%
AMZ restoration harvest	Stream water temperature; sediment inputs	M§13.5.1.1-5 M§13.5.3.2-1 M§13.5.4.1-2 M§13.5.4.1-3	Percent of linear distance of Class I and Large Class II AMZ within CalWater planning watershed per decade AC§8.2.3.4-9	0-15% (varies by site specifics)	0	15%
bank stability	Sediment inputs; stream habitat	M§13.5.3.2-1 M§13.5.4.1-2 M§13.5.4.1-3 M§13.5.1.1-3 M§13.5.1.1-2 M§13.5.1.2-2	No harvest distance from bankfull channel except for 50% of redwood clumps. AC§8.2.3.4-1	10 ft or greater (varies by site specifics)	5 ft	25 ft

Table 13-10 Terrestrial Conservation Measures Subject to Change

Terrestrial Conservation Measures Subject to Change					
Monitoring Program	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-3	80 ac core area C§10.3.1.3.1-1	80 ac	72 ac	90 ac
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	500 ft breeding season buffer C§10.3.1.3.1-39	500 ft	400 ft	600 ft
Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5	Amount of suitable habitat required within 0.7 miles C§10.3.1.3.1-5 C§10.3.1.3.1-25	500 ac	450 ac	550 ac
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	15 ft^2/ac retained C§9.3.3.2-1	15 ft^2/ac	5 ft^2/ac	25 ft^2/ac
Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2	Submit all PTHPs within LACMA for approval of the wildlife agencies C§10.3.2.3.1-4; C§10.3.2.3.1-23	Silvicultural prescriptions agreed upon by wildlife agencies and MRC	NA	NA
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2	Conduct timber operations, including felling, yarding, and enhancements of downed wood, at least 100 ft (30.48 m) away from active burrow systems or un-surveyed potential habitat. C§10.3.3.3-1	100 ft	No buffer	100 ft
Radar Monitoring in Additional	M§13.9.3.2-3	Allow harvest of secondary murrelet trees	Allow harvest of secondary	No harvest of secondary	Allow ongoing harvest of

Terrestrial Conservation Measures Subject to Change					
Monitoring Program	**Monitoring Code**	**Conservation Measure and Code**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
Drainages		C§10.3.2.3.11-9 C§10.3.2.3.12-9	murrelet trees if radar monitoring completed	murrelet trees	secondary murrelet trees

Table 13-11 Rare Plant Conservation Measures Subject to Change

Conservation Measure Description	**Management Category (MC)**	**Conservation Measure Code**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
buffer area width	MC1	Buffer width (ft) C§11.7.1-11	Forest[a] - 150 Other[b] – 50	Forest - 50 Other - 25	Forest - 200 Other - 75
	MC2	C§11.7.2-8	50	25	100
	MC3	C§11.7.3-8	50	25	75

TABLE NOTES
[a] Forest = Coastal redwood/Douglas fir; mixed hardwood-conifer/hardwood/broadleaf upland; and pygmy transition forest
[b] Other = Other vegetation and habitat types, including pygmy forest

13.3.6.2 Contingencies

Table 13-12 Contingency Measures Subject to Change

Monitoring Program	**Monitoring Code**	**Contingency Measures and Section #**	**Limits of Allowable Change**		
			Initial	**Low**	**High**
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	Barred owl contingencies Section 10.3.1.2.5	20% contingency trigger	No change	30% contingency trigger

13.4 Overview of Aquatic Monitoring

MRC will implement effectiveness and validation monitoring through 10 aquatic programs, shown in Table 13-13. Moreover, we will develop a review process to determine whether or not we are meeting the objectives outlined in Chapter 8, *Conservation Measures for Aquatic Habitat*. The schedules for this review process will depend upon the timing of the individual monitoring programs.

MRC chose to focus a significant portion of our efforts on monitoring elements of aquatic habitat (LWD, stream temperature, sediment, canopy cover, etc.) rather than on monitoring aquatic

species. Monitoring aquatic species across the entire plan area is time consuming, labor intensive, and expensive. Nevertheless, we do monitor the distribution of aquatic species with surveys for presence or absence, along with more focused efforts on species abundance.

Every aquatic monitoring program in Chapter 13 cross-references to an objective in Chapter 8. MRC designed a monitoring program for each objective in consultation with government agencies; our aim is to achieve the greatest amount of landscape coverage without overextending our resources.
Table 13-13 outlines the timing for aquatic monitoring efforts. Each monitoring program balances the need for a representative sample with the intensity of required effort required to achieve that representation. Processes such as wood transport in streams or mass wasting occur on very long (or indeterminable) time scales, typically coinciding with stochastic events. Other processes vary annually or seasonally, such as stream temperature or species distribution. MRC chose the sampling intervals listed below in order to monitor each objective.

Table 13-13 Aquatic Effectiveness and Validation Monitoring Programs

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Timber Inventory: Riparian Stands	M§13.5.1.1-1	• Every 10 years
Timber Inventory: Riparian Canopy	M§13.5.1.1-2	• Every 10 years
Watershed Analysis: LWD Conditions	M§13.5.1.1-3	• On average[5] once every 20 years
Watershed Analysis: Shade Conditions	M§13.5.1.1-4	• On average once every 20 years
Long-term Channel Monitoring: LWD	M§13.5.1.2-1	• At least once every 6 years
Focus Watersheds: Riparian Function	M§13.5.1.2-2	• Every 3 years
Stream Temperature	M§13.5.1.1-5	• Annually
Watershed Size: Small Class II Watercourses	M§13.5.1.2-3	• Initial examination in first 5 years
Watershed Analysis: Mass Wasting	M§13.5.2.1-1	• On average once every 20 years

[5] In the first 4 years of our HCP/NCCP, MRC will complete our initial effort at watershed analysis. Watershed analysis takes many years to complete. On average, we will start the process over again in 20 years, although in any given watershed the process may occur earlier or later.

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Forensic Monitoring: Landslide Observations	M§13.5.2.2-2	• Episodic
Focus Watersheds: Mass Wasting	M§13.5.2.1-2	• Every 3-5 years or after storms with at least a 5-year return interval, as determined by monitoring equipment at Caspar Creek
Road Inventory: Sediment Prevention	M§13.5.3.1-1	• Every 10 years
Focus Watersheds: Sediment Prevention	M§13.5.3.2-1	• Every 3-5 years or after storms with at least a 5-year return interval
Watershed Analysis: Sediment Prevention	M§13.5.3.1-2	• On average once every 20 years
Long Term Channel Monitoring: Stream Sediment	M§13.5.4.1-2	• At least once every 6 years
Focus Watersheds: Stream Sediment	M§13.5.4.1-3	• Every 10 years
Water Drafting	M§13.5.5.1-1	• Annually
Water Drafting	M§13.5.5.2-1	• Annually
Baseline Distribution and Habitat Quality of RLF Breeding Sites	M§13.6.2.1-1	• Complete initial distribution study for red-legged frogs within 2 years of HCP/NCCP implementation.
Occupancy of Red-Legged Frogs in Documented Breeding Sites	M§13.6.2.1-2	• Monitor documented red-legged frog breeding sites annually.
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	M§13.6.2.1-3	• Revisit all potential sites identified during the initial distribution study, as well as other new sites identified, every 5 years to assess which species are present and if red-legged frogs are expanding in range. • Monitor habitat quality of potential red-legged frog breeding sites every 5 years.

Aquatic Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Baseline Distribution of Coastal Tailed Frogs	M§13.6.3.1-1	• Complete distribution study for coastal tailed frogs within 2 years of HCP/NCCP implementation.
Distribution and Relative Abundance of Coastal Tailed Frogs	M§13.6.3.1-2	• Monitor for the presence, probable absence, and relative abundance of coastal tailed frogs at 10 sites annually. • Monitor all occupied streams about every 8 years.
Anadromous Salmonid Distribution	M§13.6.1.1-2	• Assess distribution annually for 3 consecutive years and, thereafter, every 12 years—throughout 450 sites.
Chinook Salmon Monitoring Reaches (CSMR)	M§13.6.1.1-3	• Monitor for the presence and relative abundance of Chinook salmon in 4 Chinook Salmon Monitoring Reaches (CSMR) annually.
Smolt Abundance	M§13.6.1.2-1	• Collect data on smolt abundance annually, rotating between 2 focus watersheds every 3 years.

13.4.1 Watershed analysis within aquatic monitoring

Watershed analysis provides baseline information for many of our conservation measures. An initial watershed analysis will not change or alter proposed conservation measures; however, future watershed analyses that feed data into the adaptive management process may bring about changes in both the conservation measures and monitoring programs of our HCP/NCCP. If such changes are outside of the limits of allowable change, they will require either a major amendment or minor modification to our HCP/NCCP, depending on the magnitude of the change.

MRC will re-visit watershed analysis, in its entirety, approximately every 20 years. There will be a total of 4 watershed analyses per watershed analysis unit—1 initial watershed analysis and 3 re-visits over the life of our HCP/NCCP. When proposing new methods, MRC will ensure their comparability with previous watershed analyses.

MRC will provide the agencies with module methods, hypotheses to be tested, and level of sampling. In consultation with the wildlife agencies, MRC may adapt priorities for road repair, determine new restoration actions, and alter monitoring or conservation measures through watershed analysis. Conservation measures revised through monitoring efforts, such as watershed analysis, will provide the same protection as standard conservation measures. This includes conservation measures with limits of allowable change (Table 13-9 through Table 13-11 13-12).

MRC may update watershed analysis components at any time as we identify information on aquatic species, habitat conditions, and the effects of management. We can perform this update through individual modules or through technical reports on specific conservation measures, restoration, or monitoring. MRC will notify the wildlife agencies when an update occurs and give them the opportunity to review methods and objectives. The following situations can affect a watershed analysis update:

- Development of new analytical techniques or research that may improve interpretations of existing information.
- Significant storms (> 25-year flood) that trigger significant watershed changes.
- Earthquake activity that triggers large volumes of sediment input from mass wasting.
- Social or regulatory changes requiring updated analysis.

In the future, MRC will conduct monitoring at the watershed scale by

1. Reviewing air photos, field observations, and other data collection activities according to watershed analysis protocols (see Appendix G, *Watershed Analysis: Background and Methods*).
2. Compiling, summarizing, and synthesizing watershed information produced by other MRC monitoring programs (Figure 13-4).

In a watershed analysis, for example, MRC will survey many stream segments in a watershed for the number and distribution of key LWD pieces, including LWD information from long term channel segments.

Future watershed analyses will summarize and synthesize information from each monitoring program within a watershed analysis unit. Data from watershed analyses may test hypotheses developed during focus watershed studies or "scale up" results from a sub-watershed scale to a watershed scale.

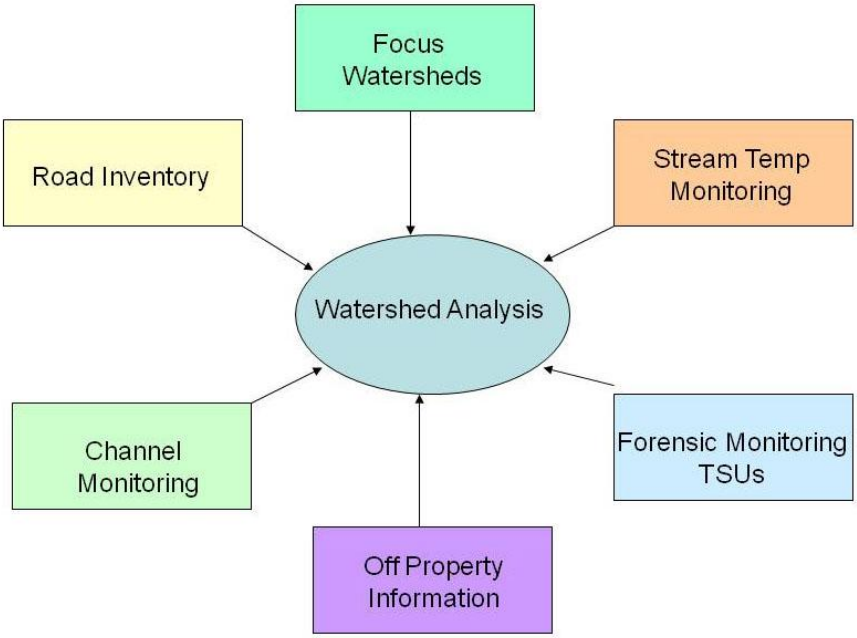

Figure 13-4 Programs Contributing Data to Watershed Analysis

13.4.2 Focus watershed studies

By monitoring focus watersheds, MRC can evaluate water quality and species response at the site scale and the watershed scale. After assessing management impacts in the focus watersheds, we can apply lessons learned to other areas of our land where property-wide monitoring programs indicate similar conditions and problems occur. Experiential knowledge will come from watershed analysis, long term channel monitoring, suspended sediment and turbidity monitoring, road inventory, timber inventory, distribution studies of anadromous salmonid, and stream temperature monitoring.

At first, we will assume that our proposed conservation measures will improve water quality and species habitat. This may not be the case; watershed conditions may remain the same or even degrade. Controlling all the erosion from culverts in a sub-watershed, for example, may not result in measurements of reduced fine sediment in spawning gravel. The reasons could be in our assumptions, such as duration of lag effects, or in our implementation of the conservation measures. Studies in the focus watersheds, such as those for suspended sediment monitoring, need to determine (1) the relationship between land management practices and water quality responses and (2) how we measure that relationship. MRC will create detailed protocols for the focus watershed studies within 1 year of the signing of our HCP/NCCP so that studies are repeatable and verifiable. The format for the protocols will follow the guidelines developed by Oakley et al. (2003) in *Guidelines for Long-term Monitoring Protocols*. Of course, as new knowledge and methods arise within the scientific community, MRC will ask new questions and design new studies within the monitoring programs—all with the assistance of the wildlife agencies and the North Coast Regional Water Quality Control Board.

Within 40 years of HCP/NCCP implementation, MRC will meet our commitments for all of the controllable erosion associated with high and moderate sites based on the initial road inventory. In addition, we will improve watershed conditions through stream and upslope restoration such as road maintenance and reconstruction; LWD placement; riparian restoration harvests; road decommissioning; and upslope canopy retention. Results from focus watershed studies will show us which, if any, of these restoration activities enhances or degrades watershed conditions. Armed with that information, we can, as we said earlier, apply these restoration activities to areas outside of the focus watersheds based on the data collected there from watershed analysis.

MRC has designated 4 areas for focus watershed studies that represent a range of topographic, environmental, and regulatory conditions on our land (Table 13-14). Each represents both a large proportion of the plan area and a range of conditions; as a result, we can ensure that monitoring evaluates the effects of our management decisions and practices. All of the focus watersheds are also CalWater planning watersheds—Cottaneva Creek, South Fork Albion River, Little North Fork Navarro, and Upper Elk Creek. Located within the Franciscan geologic region of the coastal belt, these 4 areas consist of a complex mixture of terrains and rock types with no single component dominating the landscape. From a geological perspective, therefore, the focus watersheds are not easily distinguishable from each other and from other watersheds in the plan area.

Two of the focus watersheds, Little North Fork Navarro and South Fork Albion, will receive intensive monitoring. Both areas are within watersheds listed as "sediment impaired" by Section 303(d) of the Clean Water Act; Little North Fork Navarro is also in a watershed that is "temperature impaired." The two watersheds provide contrasting forest and climate conditions. South Fork Albion is closer to the Pacific Ocean, with cooler air and water temperatures; it has forest stand conditions that would be desirable across the plan area. On the other hand, Little

North Fork Navarro has warmer air and water temperatures and is a younger forest. Little North Fork Navarro also has a moderate amount of hardwood stands; they will require more intense rehabilitation harvests in the short term, i.e., variable retention or transition treatments. All the focus areas are convenient for personnel with equipment to perform studies.

Upper Elk Creek and Cottaneva Creek represent, respectively, the southern and northern portions of the plan area. Upper Elk Creek has forest type, climate, and topographic environment of coastal watersheds in the southern portion of the plan area. MRC completely owns Cottaneva Creek, which has coho salmon, steelhead, and coastal tailed frogs. The forest stands in South Fork Cottaneva Creek are a mix of young forests with conditions similar throughout much of the plan area. This area receives, on average, much higher amounts of rainfall than the remainder of MRC forests and contains streams with suitable water temperatures for the aquatic species present.

Table 13-14 Focus Areas for Aquatic Monitoring

Focus Area	Watershed (ac)	Plan Area (ac)	% Plan Area	Covered Aquatic Species Present	Regulatory Issues
Designated Areas					
South Fork Albion River	5830	4696	80.5%	Coho salmon, steelhead, red-legged frog	Central ESU, Sediment TMDL
Little North Fork Navarro	7085	6423	90.6%	Coho salmon, steelhead, red-legged frog	Central ESU, Sediment TMDL, Temperature TMDL
Upper Elk Creek	9894	9136	92.3%	Coho salmon, steelhead, red-legged frog, coastal tailed frog	Central ESU
South Fork Cottaneva	3425	3425	100%	Coho salmon, steelhead, coastal tailed frog	Central ESU

13.4.3 Additions and deletions of land

At the commencement of the HCP/NCCP, the plan area consists of 213, 244 ac and 4 designated focus watersheds (Table 13-14). In the ensuing years, additions and deletions of land to the plan area may adjust both these numbers. If the plan area expands to 240,000 ac or more, MRC will add 1 additional focus watershed. If the plan area shrinks to 186,000 ac or less, MRC will subtract 1 focus watershed. During the entire term of our HCP/NCCP, the maximum number of focus watersheds in the plan area will be 5; the minimum number, 3. MRC will consult with the wildlife agencies and Water Quality if land purchases or sales necessitate the addition or deletion of a focus watershed. The decision to locate a new focus watershed within the plan area will weigh how well the proposed area "fits" within the study profile outlined above.

13.4.4 Long term channel monitoring

The long term channel monitoring program has essentially the same protocol as the focus watershed studies for LWD, canopy, stream channel profiles, permeability, V-star, and pebble counts. In long term channel monitoring, however, there is a longer period between sampling and a broader coverage across the plan area. The purpose of its data collection is to

- Draw conclusions about long-term processes through the monitoring of permanent stations.

- Supplement watershed analysis data.
- Track, across the plan area, the status of watershed" health" with knowledge from the focus watershed studies.

13.4.5 Timeline for aquatic monitoring

During the first 2 years of our HCP/NCCP, MRC will determine the initial distribution of amphibians, refining detailed protocols for the monitoring programs and completing our first watershed analysis. MRC will then start the focus watershed studies. These will continue for several years with interruptions for anadromous salmonid distribution, long-term channel monitoring, and amphibian monitoring. Throughout this whole process, we will conduct pre-project (or baseline) monitoring in areas designated for restoration harvests. After approximately 20 years, MRC will weigh the results and re-evaluate the timing of the monitoring programs in consultation with the wildlife agencies. All of the aquatic monitoring programs require significant resources for implementation, including personnel and equipment. Table 13-15 provides an estimated timeline for the first 20 years of the aquatic monitoring programs. Generally, monitoring programs in subsequent years of the plan will recycle through this initial 20-year schedule.

13.5 Monitoring aquatic habitat

MRC has proposed and developed some of the study designs for monitoring aquatic habitat under our HCP/NCCP. During the first 3 years of our HCP/NCCP, we will complete all outstanding study designs for aquatic monitoring.

Habitat monitoring falls into 4 major categories: (1) riparian function; (2) mass wasting; (3) surface erosion; and (4) instream sediment. Within these categories are monitoring programs or portions of programs that measure specific goals and objectives.

The term *segment* appears in 3 of our aquatic monitoring programs—watershed analysis, long-term channel monitoring, and focus watershed studies. A segment is typically 20-30 bankfull widths in length, i.e., roughly 300-1500 ft for most streams in the plan area.

In selecting segments for field observation, the GIS and science staff at MRC first stratify the watercourses within each planning watershed (more specifically, within each watershed analysis unit to be analyzed) by confinement and slope. They then choose segments for field observation based on numerous factors, including location within the watershed, potential fish habitat, stream temperature monitoring locations, and level of effort. MRC does not select segments for field observation that are over 20% in gradient. While we assume such segments do not provide fish habitat, we occasionally sample them for amphibians. Each planning watershed will have anywhere from 3 to 30 field-observed segments, depending upon how much of the planning watershed MRC owns. Segments for long-term channel monitoring and focus watershed studies are typically selected from the field observed segments in watershed analysis. Appendix G, *Watershed Analysis: Background and Methods*, provides details on MRC sampling efforts and intensity.

Table 13-15 Estimated Timeline for Aquatic Monitoring

Estimated Timeline for Aquatic Monitoring																				
Monitoring Code	**Monitoring Program**	**Years Since Start of HCP/NCCP**																		
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
M§13.5.1.1-1	Timber Inventory: Riparian Stands																				
M§13.5.1.1-2	Timber Inventory: Riparian Canopy																				
M§13.5.1.1-3	Watershed Analysis: LWD Conditions																				
M§13.5.1.1-4	Watershed Analysis: Shade Conditions																				
M§13.5.1.2-1	Long-term Channel Monitoring: LWD																				
M§13.5.1.2-2	Focus Watersheds: Riparian Function																				
M§13.5.1.1-5	Stream Temperature																				
M§13.5.1.2-3	Watershed Size: Small Class II Watercourses																				
M§13.5.2.1-1	Watershed Analysis: Mass Wasting																				
M§13.5.2.2-1	Forensic Monitoring: Landslide Observations																				
M§13.5.2.1-2	Focus Watersheds: Mass Wasting																				
M§13.5.3.1-1	Road Inventory: Sediment Prevention																				
M§13.5.3.2-1	Focus Watersheds: Sediment Prevention																				
M§13.5.3.1-2	Watershed Analysis: Sediment Prevention																				
M§13.5.4.1-2	Long Term Channel Monitoring: Stream Sediment																				

Estimated Timeline for Aquatic Monitoring																				
Monitoring Code	**Monitoring Program**	**Years Since Start of HCP/NCCP**																		
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
M§13.5.4.1-3	Focus Watersheds: Stream Sediment		■	■	■				■	■	■				■	■	■				■
M§13.5.4.1-1	Focus Watersheds: Sediment Budget		■										■								
M§13.6.2.1-1	Baseline Distribution and Habitat Quality of Red-legged Frogs Breeding Sites	■	■																		
M§13.6.2.1-2	Occupancy of Red-Legged Frogs in Documented Breeding Sites	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
M§13.6.2.1-3	Re-evaluate Habitat Quality and Species Presence within Red-legged Frogs Breeding Sites					■					■					■					■
M§13.6.3.1-1	Baseline Distribution of Coastal Tailed Frogs	■	■																		■
M§13.5.5.1-1	Water Drafting	■						■						■						■	
M§13.5.5.2-1	Water Drafting	■						■						■						■	
M§13.6.3.1-2	Distribution and Relative Abundance of Coastal Tailed Frogs	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
M§13.6.1.1-1	Anadromous Salmonid Presence: ASMB	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
M§13.6.1.1-3	Chinook Salmon Monitoring Reaches (CSMR)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
M§13.6.1.1-2	Anadromous Salmonid Distribution						■	■	■										■	■	■
M§13.6.1.2-1	Smolt abundance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

TABLE NOTES

■ Most monitoring programs are on-going (i.e., occurring every year), but the shaded cells indicate the years that the program will re-visit the same location.

13.5.1 Riparian function

MRC will use 7 monitoring programs to determine if our biological goals and objectives for riparian function are being met: (1) riparian stand; (2) riparian canopy; (3) watershed analysis of LWD conditions; (4) LWD conditions in long-term monitoring segments; (5) riparian function in focus watershed studies; (6) stream temperature; (7) watershed size for Small Class II watercourses.

13.5.1.1 Effectiveness monitoring

Riparian stands

Effectiveness Monitoring	
Timber Inventory: Riparian Stands	
PROGRAM CODE	M§13.5.1.1-1
O§8.2.2-1	• Develop and maintain Class I and Large Class II AMZs with large, dense conifer trees based on targets for basal area and size distribution.
MONITORING APPROACH	• MRC conducts inventory on a continuous basis. At any point in time, MRC will sample about 10% of our forested acres. Once a sample plot is 10 years old, we archive the existing data and acquire new data. We will incrementally sample more AMZs stands over the term of our HCP/NCCP because of their unique vegetation strata and other monitoring requirements. All the sample data on basal area, trees per acre, board foot volume, and habitat conditions, we incorporate into our landscape model. See Appendix U, *Inventory Strategy*, for further details.
MEASUREMENT CRITERIA	• Tables 8-5 through 8-8 show the targets for basal area and tree height. • More than 45% of vegetation strata in AMZs should be conifer/hardwood or conifer-dominated within 40 years of HCP/NCCP initiation, followed by non-decreasing percentages. • More than 90% of vegetation strata in AMZs should be conifer/hardwood or conifer-dominated 80 years after HCP/NCCP initiation.
ADAPTIVE MANAGEMENT	• MRC will review the status of riparian stands at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will examine the causes of deviation if we are not meeting our targets for AMZ characteristics. • MRC may re-vegetate certain areas with poor AMZ conditions such as abandoned landings or streamside roads. • MRC has defined the AMZ conservation measures subject to change through the adaptive management process (Table 13-8).

Riparian canopy

Effectiveness Monitoring	
Timber Inventory: Riparian Canopy	
PROGRAM CODE	M§13.5.1.1-2
O§8.2.2-2	• Achieve, per planning watershed, at least 70% canopy averaged across the entire Class I and Large Class II AMZ. ▪ More than 75% of the stands sampled during timber inventories will meet this canopy requirement within 30 years of HCP/NCCP initiation. ▪ More than 90% of the stands sampled during timber inventories will meet this canopy requirement within 80 years of HCP/NCCP initiation.
MONITORING APPROACH	• MRC conducts inventory on a continuous basis. At any point in time, MRC will sample about 10% of our forested acres. Once a sample plot is 10 years old, we archive the existing data and acquire new data. We will incrementally sample more AMZs stands over the term of our HCP/NCCP because of their unique vegetation strata and other monitoring requirements. All the sample data on basal area, trees per acre, board foot volume, and habitat conditions, we incorporate into our landscape model. See Appendix U, *Inventory Strategy*, for further details.
MEASUREMENT CRITERIA	• More than 75% of Class I and Large Class II AMZs will have at least 70% canopy cover across the inner, middle, and outer AMZ bands within 30 years of HCP/NCCP initiation. • More than 90% of Class I and Large Class II AMZs will have at least 70% canopy cover across the inner, middle, and outer AMZ bands within 80 years of HCP/NCCP initiation.
ADAPTIVE MANAGEMENT	• MRC will review the status of riparian stands at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will examine the causes of deviation if we are not meeting our canopy targets for riparian stands. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the AMZ conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed analysis of LWD conditions

Effectiveness Monitoring	
Watershed Analysis: LWD Conditions	
PROGRAM CODE	M§13.5.1.1-3
O§8.2.2-7	• Achieve *on-target* ratings for both stream shade and LWD at the planning watershed scale.
MONITORING APPROACH	• MRC will use information on riparian function from watershed analysis to ▪ Evaluate the condition of riparian stands for the recruitment of LWD throughout response and transport stream segments (< 20% gradient). ▪ Evaluate current and past LWD loading in a sample of response

Effectiveness Monitoring	
Watershed Analysis: LWD Conditions	
	and transport stream segments. ▪ Rate watercourse LWD quality, tracked by planning watershed. • MRC describes the methods for evaluating LWD recruitment in Appendix G, *Watershed Analysis: Background and Methods* (section G.3.3.2).
MEASUREMENT CRITERIA	• See Appendix S, *Targets for LWD and Effective Shade*.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our LWD targets. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not meeting our targets for LWD recruitment rates. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed analysis of shade conditions

Effectiveness Monitoring	
Watershed Analysis: Shade Conditions	
PROGRAM CODE	M§13.5.1.1-4
O§8.2.2-7	• Achieve *on-target* ratings for both stream shade and LWD at the planning watershed scale.
MONITORING APPROACH	• MRC will use information on riparian function from watershed analysis to ▪ Determine the average percent shade (measured with a solar pathfinder) for selected streams within each planning watershed ▪ Assess effective shade conditions at the planning watershed level based on the number of stream segments that meet the effective shade targets.[6] • MRC describes the methods for evaluating stream shade in Appendix G, *Watershed Analysis: Background and Methods* (section G.3.3.3).
MEASUREMENT CRITERIA	• See Appendix S, *Targets for LWD and Effective Shade.*
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our instream canopy targets. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

[6] Effective shade is dependent upon bankfull width and includes analysis of instream water temperature.

Stream temperature

Effectiveness Monitoring	
Stream Temperature	
PROGRAM CODE	M§13.5.1.1-5
OBJECTIVE O§8.2.2-6	• Decrease summer water temperatures, where possible, to manage for temperatures at or below MWMT targets for covered species (see the *Water Quality Control Plan for the North Coast Region*, i.e., the Basin Plan).
MONITORING APPROACH	• MRC will monitor stream temperatures, from approximately May to October, in 139 sites (*HCP/NCCP Atlas* MAPS 3A-C). • MRC will monitor all watercourses on our land where coho salmon are known to be present. • MRC will monitor at least 1 Large Class II watercourse in each CalWater planning watershed with coastal tailed frogs present. • MRC will attempt to capture a range of Class II stream sizes and locations across our land when selecting Large Class II monitoring sites. • MRC will monitor air temperature at 1 or more monitoring sites in every inventory block to assist in interpretation of stream temperatures. • MRC will monitor the effects of restoration harvests on stream temperatures in the focus watersheds using 2 sources: (1) annual stream temperatures collected at permanent monitoring sites; and (2) stream temperatures collected at restoration harvests. • MRC will phase in restoration harvests based on monitoring results and consultation with the wildlife agencies.
MEASUREMENT CRITERIA	• MRC will use MWMT and MWAT derived from continuous electronic temperature recorders with measurements taken at least every 30 minutes. We will place the stream temperature recorders in shallow pools (< 1 m in depth) directly downstream of riffles and out of direct sunlight. Placement of temperature recorders will be in locations where water is adequately mixed and unlikely to evaporate during the annual monitoring period. Each data recorder will be held in place with a piece of rebar, or concrete reinforcing rod, driven into the substrate. • MRC will perform accuracy tests on all temperature data recorders for pre- and post-data recording activities. We will test the accuracy of the temperature data recorders by placing the equipment in an ice and room temperature bath for at least 4 hours. Temperature readings recorded by the data recorder will be compared with temperature readings from a certified reference thermometer placed in the same medium in the bucket. MRC will interpret results using the manufacturer's suggested allowable error for the instrument. • MRC will monitor stream temperatures both upstream (or nearby) and downstream of AMZ restoration harvests, in ▪ Streams where MRC predicts direct shade to be lower than pre-harvest conditions by more than 10%. ▪ Streams that do not meet stream temperature targets. ▪ Streams that contribute flow to other streams that exceed the targets. • MRC will make the following observations while monitoring restoration

Effectiveness Monitoring	
Stream Temperature	
	harvests: ▪ Average canopy before and after harvest in each AMZ band and on both sides of the watercourse. ▪ Estimated average tree height of the canopy before and after harvest in each AMZ band. ▪ Stream shading measured with a solar pathfinder before and after treatment. The shade measurement will be the average of at least 10 observations taken in the middle of the active channel and evenly spaced along the restoration treatment area. MRC will take 2 measurements (equidistant from the banks) at each of the 10 locations (i.e., 20 observations in total) for streams with active channels greater than 30 ft in width. ▪ Azimuth of the watercourse pointing downstream and aspect of each AMZ. If there are multiple aspects and azimuths, we will include the distance of each. ▪ Stream flow data for at least 1 season before and after treatment. MRC will take the observations at the upstream and downstream ends of the AMZ restoration treatment. • MRC will collect air temperatures to adjust and interpret stream temperature observations, if we use before and after observations.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for stream temperatures. • MRC may re-vegetate certain areas with poor riparian conditions such as abandoned landings or streamside roads. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.1.2 Validation monitoring

LWD in long-term channel monitoring segments

Redwood or Douglas-fir trees can take decades to become mature and fall into stream channels. Plus, the input of LWD to stream channels is infrequent in response to episodic disturbances, such as wind, bank erosion, or mass wasting. All in all, the response and recovery of stream channels to disturbances can be very slow. MRC believes surveying for LWD in long term channel monitoring segments once per decade is appropriate given the slow response of LWD inputs and stream channels to management.

Validation Monitoring	
Long-term Channel Monitoring: LWD	
PROGRAM CODE	M§13.5.1.2-1
HYPOTHESIS SECTION 8.2.2	• Stream channels will respond to increases in LWD loading through increases in pool frequency, residual water depth, or residual pool volumes.
MONITORING APPROACH	• MRC will monitor at least 60 long-term channel monitoring segments a minimum of once every 6 years to evaluate the effectiveness of LWD inputs to streams across our land. • MRC has provided further details in Appendix G, *Watershed Analysis:*

Validation Monitoring	
Long-term Channel Monitoring: LWD	
	Background and Methods (section G.3.4).
MEASUREMENT CRITERIA	• Determine if LWD demand meets or exceeds mean LWD recruitment rates for northern California (section 8.2.4.8). • Assess active placement of LWD. • Evaluate, at the stream reach scale, stream channel response to LWD recruitment through changes in pool frequency, residual pool depth, or residual pool volumes.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if there are no increases in pool frequency, residual pool depth, or residual pool volumes. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not achieving the desired conditions for pool frequency, residual pool depth, or residual pool volumes. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Riparian function in focus watersheds

Validation Monitoring	
Focus Watersheds: Riparian Function	
PROGRAM CODE	M§13.5.1.2-2
HYPOTHESES SECTIONS 8.2.4.7-10	• Stream channels will respond to increases in LWD loading through increases in pool frequency, residual pool depth, or residual pool volumes. • Shade over streams will increase in response to riparian conservation measures.
MONITORING APPROACH	• MRC will determine the following, in observations taken every 3 years: ▪ Effectiveness of the riparian zone at shading the watercourses and maintaining appropriate stream temperatures in the focus watersheds. ▪ Long-term relationships between stream channel habitat, riparian conditions, and LWD recruitment rates. • MRC will provide protocol details for the focus watershed studies within 1 year of HCP/NCCP acceptance and signing.
MEASUREMENT CRITERIA	• MRC will track, in each of the focus watersheds, the timing and extent of upslope or AMZ forest management and compare results with monitored riparian functions of LWD and canopy closure. 1. MRC will conduct LWD surveys, in each of the focus watersheds, at 5-7 stream-monitoring segments covering a distribution of stream channel types (morphologies, gradients, location within network). We will initially select the stream monitoring segments by stratified random sampling based on the proportion desired within target stream channel types. The monitoring segments will be at least 20-30 bankfull widths in length. 2. MRC will measure, every 3 years, LWD in stream channel monitoring segments; refer to Appendix G, *Watershed Analysis:*

Validation Monitoring	
Focus Watersheds: Riparian Function	
	Background and Methods, section G.3.3.1. MRC will also document current riparian stand conditions along the monitoring segment, including basal area, vegetation strata, and canopy. The combination of AMZ stand conditions and stream channel LWD observations will help determine LWD recruitment rates within the focus watersheds. MRC can compare these rates to published LWD recruitment rates. In addition, we can use these detailed observations of LWD to interpret information from annual surveys. • MRC will monitor, in each of the focus watersheds, stream canopy closure and associated shade: 1. MRC will measure instream shade using a solar pathfinder. We will develop a sampling protocol for assessing shade in the focus watershed segments. These will be the same 5-7 stream monitoring segments used for LWD observations. We will monitor stream water temperatures annually throughout the focus watersheds. The surveys of instream shade in varying stream channel types should detect spatial and temporal changes in canopy across the plan area. 2. MRC will measure AMZ canopy, tree heights, and stand characteristics in conjunction with stream shading measurements throughout all the monitoring segments of the focus watersheds. The observations will include distribution of topography, aspect, and stream channel sizes. We will make observations infrequently—every decade—because canopy and tree height increases relatively slowly. Finally, we can use these detailed observations of riparian areas, shade, and canopy closure to interpret information from annual surveys.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation, if there are no increases in pool volume, frequency, and residual depth. • MRC will examine the causes of deviation if we are not meeting our targets for instream shade. • MRC may place LWD in streams or increase large tree retention within AMZ and mass wasting areas, if we are not achieving our targets for LWD recruitment rates or instream shade. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Watershed size

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
PROGRAM CODE	M§13.5.1.2-3
HYPOTHESIS SECTION 8.2.4.3	• 100 ac or less is the appropriate watershed size to characterize most Class II watercourses that do not flow during the warm summer period.
MONITORING APPROACH	• MRC will initially designate Class II watercourses as Small Class II watercourses if they are 100 ac or less in drainage area. We must then

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
	determine if this is the appropriate watershed size so that AMZ management does not increase water temperature (MWMT). We will address the watershed size at which a significant number (i.e., > 20%) of Small Class II watercourses retain year-round surface water. • MRC will determine watershed size for Small Class II watercourses with year-round surface water by evaluating adjacent and upslope areas post-harvest to determine if watershed size needs to be adjusted because of increased surface flows. • MRC will complete its initial examination of Small Class II watersheds for significant surface water within the first 5 years of our HCP/NCCP, depending on annual flow conditions.
MEASUREMENT CRITERIA	• MRC will map all watersheds to identify the point at which Small Class II watercourse size is ≤ 150 ac. From these maps, MRC will randomly select 20% of the watercourses that have not experienced recent upslope timber harvest (i.e., within the last 10 years) for observation within each CalWater planning watershed. • MRC will monitor the selected watercourses in July to determine if there is significant surface water. Significant surface water covers at least 25% of channel length in 100 ft sections with water depth ≥ 0.05 ft (.02m). We will measure the extent of significant surface water when both the first and second 100-ft section furthest upstream fails to meet this definition. This criterion is dependent upon natural water sources and not anthropogenic sources of flow such as ditch relief culverts. • MRC will map the extent of significant surface water within a watershed and record the date. ▪ MRC recognizes that observations of significant surface water flow will likely vary based on the amount of precipitation. In very wet years, streams that do not flow in dry years may flow all year in small watersheds. ▪ MRC will not attempt to map significant surface water in Small Class II watersheds in years with high or low summer stream flow. Low or high summer stream flow is a 33% deviation from the average stream flow observation at the South Fork Caspar Creek stream-flow gage on July 1. In 2005 based on observations from 1963-1995, the average stream flow for July 1 for the South Fork Caspar Creek was 0.34 ft^3 per second. Based on this average value, in years with less than 0.23 cfs or more than 0.44 cfs of stream flow, MRC will not conduct monitoring. If observations cannot be made in successive years, MRC may extend the length of time needed to complete the initial examination of Small Class II watersheds—estimated at 5 years—by the number of years measurements could not be taken. • MRC will re-evaluate the sites sampled in the initial 5-year effort to determine if the extent of significant surface flow has increased; this will take place in late summer, at approximately the same date as the pre-project sampling and following the first winter after harvest. ▪ If there is significant surface water, MRC will map its extent within the Small Class II watershed and record the date. ▪ If there is not significant surface water, MRC will note the date of observation and watershed size.

Validation Monitoring	
Watershed Size: Small Class II Watercourses	
	• MRC will survey 20% of Small Class II watercourses to determine their appropriate watershed size.
ADAPTIVE MANAGEMENT	• MRC will increase the upper size limit for Small Class II watercourses if significant surface water does not occur in watersheds between 100 and 150 ac. • MRC will decrease the designated watershed size for Small Class II watercourses if data indicates that significant surface water occurs in watersheds of an average size of less than 100 ac. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.2 Mass wasting

MRC will address sediment delivery from mass wasting through

- Observations in watershed analysis.
- Incidental landslide observations by MRC foresters.
- Forensic monitoring by a forensic geologist after forest harvest operations.
- Focus watershed studies.

13.5.2.1 Effectiveness monitoring

Mass wasting observations in watershed analysis

Effectiveness Monitoring	
Watershed Analysis: Mass Wasting	
PROGRAM CODE	M§13.5.2.1-1
OBJECTIVES O§8.3.2-1	• Reduce, by year 40 of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 10% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions.
O§8.3.2-2	• Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 20% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions.
MONITORING APPROACH	• MRC will establish baselines using the initial data from watershed analysis (see Appendix G, G.2.1.10, *MRC methods for estimating sediment input from mass wasting*). • MRC will update ▪ Landslide inventory to show the magnitude and location of mass wasting events within each watershed analysis unit. ▪ Boundaries of terrain stability units to improve the accuracy of our knowledge of terrain with greater risk for sediment delivery from mass wasting.
MEASUREMENT CRITERIA	• MRC will view a series of aerial photographs—at least 1 set per decade. Observations will focus on identifying the types of mass wasting processes active in the basin, the link between mass wasting and forest management

Effectiveness Monitoring	
Watershed Analysis: Mass Wasting	
	related activities, and the concentration of mass wasting processes. This will ensure that MRC partitions the plan area into the appropriate zones of relative mass wasting potential based on the likelihood of future mass wasting and sediment delivery to stream channels (see Appendix G, section G.2.1.4, *Landslide inventory*).
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Mass wasting in focus watersheds

Effectiveness Monitoring	
Focus Watersheds: Mass Wasting	
PROGRAM CODE	M§13.5.2.1-2
OBJECTIVES O§8.3.2-4 O§8.3.2-2	• Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting related to roads by at least 60% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions. • Reduce, within the 80-year timeframe of our HCP/NCCP, sediment delivery from mass wasting unrelated to roads by at least 20% of the rate (tons/mi^2/year) determined in the initial watershed analyses or established in TMDL load allocation reductions.
MONITORING APPROACH	• MRC will maintain an inventory of mass wasting features within each of the focus watersheds through watershed analysis assessments. • MRC will ensure the inventory observations are more frequent and more comprehensive than those for a watershed analysis in order to allow MRC to examine the effect of our forest management on mass wasting.
MEASUREMENT CRITERIA	• MRC will view the most recent available set of aerial photographs and conduct field observations of the entire focus watershed every 3-5 years. • MRC will make field observations to capture greater detail than the aerial photos (see Appendix J, *CLFA Checklist and Landslide Form*).
ADAPTIVE MANAGEMENT	• MRC will review the status of mass wasting sites at Years 30 and 70 of HCP/NCCP implementation to determine if we are meeting our targets on schedule. • MRC will determine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.2.2 Validation monitoring

Forensic monitoring and field observations of landslides

Validation Monitoring	
Forensic Monitoring: Landslide Observations	
PROGRAM CODE	M§13.5.2.2-1
HYPOTHESES SECTION 8.3.3.1	• MRC conservation measures for mass wasting will decrease the incidence of management-related landslides.
MONITORING APPROACH	• MRC will use forest managers to update the watershed analysis inventory database of mass wasting events and improve its accuracy. Our foresters spend a significant amount of time doing pre-project planning and post-project assessment. During these extended periods in the forest, they will document landslides with the incidental landslide observation form and add this information to our watershed analysis inventory database. Increasing the sample size of this database will provide, in turn, more accurate information for assessing the landslide incident rate. • MRC will observe mass wasting events during follow-up inspections of forest harvest areas and roads, typically after storm events[7] when the likelihood of mass wasting is greatest.
MEASUREMENT CRITERIA	• MRC will train forester managers to systematically collect data on landslides (see Appendix J, *CLFA Checklist and Landslide Form*). • MRC will conduct forensic investigations of landslides each year on 10 to 20% of the PTHPs to observe site conditions and document causative evidence. • MRC will use a professional geologist licensed in the State of California to supervise all forensic investigations of landslides (see Appendix J, *CLFA Checklist and Landslide Form*).
ADAPTIVE MANAGEMENT	• MRC will determine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC has defined the conservation measures for sediment control that are subject to change through adaptive management (Table 13-9).

13.5.3 Surface erosion

MRC will monitor surface erosion from road and skid trails by

- Comprehensive road inventory.
- Focus watershed studies.
- Watershed analysis.

[7] This will generally be every 3-5 years or after storms with at least a 5-year return interval as determined by monitoring equipment at Caspar Creek.

13.5.3.1 Effectiveness monitoring

Sediment prevention through road inventory

Effectiveness Monitoring	
Road Inventory: Sediment Prevention	
PROGRAM CODE	M§13.5.3.1-1
OBJECTIVE O§8.3.2-6	• Control 1,302,000 yd^3 of controllable erosion within the first 30 years of the HCP/NCCP.
MONITORING APPROACH	• MRC will inventory roads with permanent structures (culverts or bridges) every 10 years and update a database with information on road improvements, road decommissioning, and erosion control (see Appendix F, *Road Inventory Protocol*). • MRC will complete an initial inventory of all controllable erosion sites from skid trails via aerial photo analysis and field observations as described in section 8.3.3.2.11 *Skid trail system plan*.
MEASUREMENT CRITERIA	• MRC will use our database of road observations and road work to ▪ Provide information on the amount of controllable erosion controlled by upgrading and decommissioning roads. ▪ Document conditions of individual roads to allow MRC to monitor improvements. ▪ Set priorities for controllable erosion work (see section 8.3.3.2.1 to 8.3.3.2.3) • MRC will compare successive 10-year periods for how successful MRC was in repairing sources of controllable erosion and for the quality of individual road features.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for reducing erosion from roads and skid trails. • MRC may decide to increase road surface improvements (rocking); limit traffic usage (by time, quantity, or type); or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

Sediment prevention through watershed analysis

Effectiveness Monitoring	
Watershed Analysis: Sediment Prevention	
PROGRAM CODE	M§13.5.3.1-2
OBJECTIVE O§8.3.2-7	• Reduce point source erosion from roads, skid trails, or landings and sediment delivery associated with surface erosion by 50% within the first 30 years of our HCP/NCCP (i.e., from 4000 to 2000 yd^3 per mi^2 per year) and 70% within the initial 70 years of our HCP/NCCP (i.e., from 4000 to 1200 yd^3 per mi^2 per year).
MONITORING APPROACH	• MRC will analyze sediment inputs from roads and skid trails during each watershed analysis.
MEASUREMENT CRITERIA	• MRC discusses in Appendix G, G.2.2.3 and G.2.2.4 how we analyze sediment delivery from roads and skid trails respectively. The initial watershed analysis used a combination of field observations of point

Effectiveness Monitoring	
Watershed Analysis: Sediment Prevention	
	source erosion and estimates from a surface erosion model from the Standard Methodology for Conducting Watershed Analysis (WFPB 1995). Future watershed analysis efforts may use this model or other methods depending on the state of the technology at the time and information generated from focus watershed studies.
ADAPTIVE MANAGEMENT	• MRC will examine the cause of deviation if we are not meeting our targets for prevention of sedimentation from roads and skid trails. • MRC may decide to increase road surface improvements (rocking), change road classifications (traffic usage), or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.3.2 Validation monitoring

Sediment prevention through focus watersheds

Validation Monitoring	
Focus Watersheds: Sediment Prevention	
PROGRAM CODE	M§13.5.3.2-1
HYPOTHESIS SECTION 8.3.3.2	• MRC conservation measures for roads, skid trails, and landings will measurably reduce the amount of sediment entering stream channels, as compared with the sediment amounts documented in the baseline road inventory survey.
MONITORING APPROACH	• MRC will monitor roads and skid trails within each of the focus watersheds and record quantity and timing of sediment inputs at least twice per decade or after storms with a 5-year or more recurrence interval. In addition, we will collect data from road inventory monitoring at the beginning and end of every decade (Appendix F, *Road Inventory Protocol*).
MEASUREMENT CRITERIA	• MRC will collect post-winter observations of all potentially deliverable controllable erosion sites (crossings, culverts, landings, road slides, erosion features, and skid trail erosion sites) to better examine site characteristics and impacts from conservation measures. • MRC will not survey sites unless they were designated a priority on the baseline surveys.
ADAPTIVE MANAGEMENT	• MRC will examine the cause of deviation if we are not meeting our targets for prevention of sedimentation from roads and skid trails. • MRC may decide to increase road surface improvements (rocking); limit traffic usage (by time, quantity, or type); or decrease road density. • MRC has defined the riparian conservation measures subject to change through the adaptive management process (Table 13-9).

13.5.4 Instream sediment

MRC will monitor stream sediment by

- Long term channel monitoring.

- Focus watershed studies.
- Sediment budget.

13.5.4.1 Validation monitoring

Section 13.2 distinguishes effectiveness monitoring from validation monitoring. Sometimes, however, effectiveness monitoring and validation monitoring overlap. In the case of the validation monitoring programs discussed in this sub-section, namely M§13.5.4.1-1, M§13.5.4.1-2, and M§13.5.4.1-3, the focus watershed studies for sediment budget, long term channel monitoring, and stream sediment will help MRC draw conclusions about O§8.3.2-8:

O§8.3.2-8 Demonstrate an improving trend in the following parameters over the life of the HCP/NCCP based on MRC conducting (a) watershed analyses at least every 20 years, (b) long-term channel monitoring every 10 years, and (c) focus watershed studies every 3-5 years:

- Quality of stream gravel as measured by increased permeability and percent of fine particles < 0.85 mm.
- Stream-reach complexity as measured by residual pool depths and standard deviation of residual pool depths within long-term stream monitoring reaches.
- Proportion of fine sediment in pools (V-star).
- Decreased sediment inputs to the sediment budget for focus watersheds.

Sediment budget within focus watersheds

Validation Monitoring	
Focus Watersheds: Sediment Budget	
PROGRAM CODE	M§13.5.4.1-1
HYPOTHESIS SECTIONS 8.3.3.1 AND 8.3.3.2	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably reduce the amount of sediment entering stream channels, as compared with the sediment amounts documented in baseline road inventory and mass wasting surveys.
MONITORING APPROACH	• MRC will maintain a sediment budget within each of the focus watersheds. A sediment budget is represented by the equation: Sediment Input + Change in Storage = Sediment Output.
MEASUREMENT CRITERIA	• MRC will generate sediment budget estimates at the end of every decade. • MRC will measure and update *Sediment Input* from assessments of mass wasting, prevention of sedimentation from road and skid trails, and stream sediment monitoring. • MRC will determine *Change in Storage* through field surveys documenting quantities of stored sediments. We will calibrate the observations to the stream monitoring reaches that have longitudinal and cross-section profiles surveyed. Our intent is to use changes within longitudinal, cross-section profiles, and installed bank pins to assess changes in sediment storage. • MRC will determine *Sediment Output* from *Sediment Input* and *Change of Storage*, as well as observations of suspended sediment. We will only collect output information in a few of the focus watersheds and within limited timeframes. Our intent is to improve the accuracy of the sediment budget.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our

Validation Monitoring	
Focus Watersheds: Sediment Budget	
	targets for sediment prevention. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

Long term channel monitoring: stream sediment

Validity Monitoring	
Long Term Channel Monitoring: Stream Sediment	
PROGRAM CODE	M§13.5.4.1-2
HYPOTHESIS SECTIONS 8.3.3.1, 8.3.3.2 AND 8.3.3.3	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably improve instream habitat for covered aquatic species.
MONITORING APPROACH	• MRC will monitor 60 or more long-term channel monitoring segments at least once every 6 years using longitudinal profiles, cross sections, stream bed size distribution, V* observations, and gravel permeability observations; the channel monitoring segments will be identical to those in which LWD observations are made.
MEASUREMENT CRITERIA	**Longitudinal Profiles** • MRC, working upstream, will survey the stream elevation at the thalweg along the stream segment (Appendix G, section G.3.4, *Module: stream channel condition*). The following, all sensitive to sediment inputs, can be interpreted from the longitudinal profile: ▪ Changes in residual-pool depth. ▪ Proportion of riffle and pool habitat by length. ▪ Elevation fluctuations of the stream bed. ▪ Density of habitat-providing pools. **Cross Sections and Stream Bed Size Distribution** • MRC will mark with a permanent monument, within the long-term channel monitoring segment, the location for cross-section surveys and record this in the longitudinal profile survey. We will place the cross sections along relatively straight reaches of channel on riffles. Approximately 3-5 cross-section profiles will be taken along each monitoring segment. • MRC will establish rebar pins at both ends of the cross section—well above the flood-prone channel—to mark the cross section location. We will measure the elevation and the distance from the left bank pin at least every 5 ft or at any topographic changes visually apparent along the cross section. • MRC will identify the bankfull channel in the survey. At each cross section, we will characterize the size distribution of stream bed particles by a pebble count (Appendix G, section G.3.4, *Module: stream channel condition*). • Cross-section surveys provide information on stream channel response to sediment. Comparison between subsequent years provides information on changes to channel form. MRC will gather indications of sediment supply

Validity Monitoring	
Long Term Channel Monitoring: Stream Sediment	
	and stream channel response from ▪ Changes in bed elevation. ▪ Width-to-depth ratio of the stream channel. ▪ Size distribution of the stream bed. When combined with a longitudinal profile, the cross-section profiles give management insight into changes in habitat conditions within long-term channel monitoring segments. **Gravel Permeability** • MRC will take a total of 26 permeability measurements in each monitoring segment at a depth of 25 cm to assess the quality of habitat for spawning and survival of anadromous salmonid. Refer to Appendix H, H.3.1, *Determining adequate sample size*. **V*[8] Observations** • MRC will take V* observations in pools within the long term channel monitoring segment. The V* observations will follow the methods outlined in Hilton and Lisle (1993).
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if we are not meeting our targets for sediment prevention. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

Focus watershed studies: stream sediment

Validation Monitoring	
Focus Watersheds: Stream Sediment	
PROGRAM CODE	M§13.5.4.1-3
HYPOTHESIS SECTIONS 8.3.3.1, 8.3.3.2 AND 8.3.3.3	• Conservation measures for mass wasting, roads, skid trails, and landings will measurably reduce sediment amounts affecting instream habitat for covered aquatic species as compared with sediment amounts from baseline instream sediment measurements.
MONITORING APPROACH	• MRC will determine ▪ Stream channel response to stream sediments with longitudinal profiles, residual pool depths, cross sections, stream bed size distribution, V* observations, gravel permeability observations, bank erosion observations, and bulk gravel samples in multiple stream monitoring reaches covering a distribution of stream channel types (morphologies, gradients, location within network). **NOTE** MRC will make their observations in 3 to 5-year intervals per decade within the same channel segments used for observations of riparian function.

[8] The objective of V* is to track sediment transport, represented by the portion of pool filled with fine sediments.

Validation Monitoring	
Focus Watersheds: Stream Sediment	
	▪ Turbidity, suspended sediment, and stream-flow for interpretation of annual loads, discrete sediment, and turbidity events.
MEASUREMENT CRITERIA	• MRC will track the timing and extent of upslope or AMZ forest management to compare with monitored stream sediment observations. **Channel Monitoring** • MRC will conduct longitudinal profiles, residual pool depths, cross sections, stream bed size distribution, V* observations, gravel permeability observations, and bulk gravel samples in 5-7 stream-monitoring segments covering a distribution of stream channel types (morphologies, gradients, and location within network). • MRC will initially select the stream monitoring segments by stratified random sampling based on proportion desired within target stream channel types. The segments, identical to those monitored in riparian function, will be at least 20-30 bankfull widths in length. • MRC will measure longitudinal profiles, cross sections, stream bed size distribution, V* observations, gravel permeability observations, and bulk gravel samples in the stream channel-monitoring segments twice during 3-5 year time blocks per decade— specifically, during the first year and last year of a time block. Methods will be the same as the long term channel monitoring discussed previously, with the addition of bulk gravel sampling. • MRC will install bank erosion pins in varying cross sections, within the channel monitoring segments in focus watersheds, with varying vegetation or silvicultural treatments, bank exposure (height and cover), root depth, and shear stress. This will allow us to observe the level of sediment contribution from bank erosion and the effectiveness of MRC conservation measures for bank stability. **Suspended sediment and turbidity** • MRC will install and maintain, at or near the outlet of South Fork Albion and Little North Fork Navarro watersheds, an automated sampling station for turbidity and suspended sediment. • MRC will use collected data to generate accurate estimates of annual suspended sediment load, as well as turbidity duration and stream flow relationships. **NOTE** ▪ MRC will collect data at the continuous stations with programmable data loggers, pressure transducers, continuous turbidity meters, and automated pump samplers, operated by battery or solar panels. ▪ MRC will augment this data with frequent manual sediment samples and manual discharge measurements. ▪ MRC will correlate continuous stage data to manual discharge measurements made at different points along the hydrograph. ▪ MRC expects that, given a good correlation between turbidity and suspended sediment, over time sampling for suspended sediment will become unnecessary to establish a rating curve for suspended sediment to turbidity. ▪ MRC will install staff plates and continuous turbidity meters and periodically collect grab samples at major tributaries during storm events to measure changes in turbidity and suspended sediment due to changes in land management (roads, skid trails, etc.).

Validation Monitoring	
Focus Watersheds: Stream Sediment	
	• MRC will conduct continuous, automated sampling for turbidity and manual sampling for suspended sediment and discharge in the Cottaneva Creek focus watershed. • MRC will install a staff plate in the same location as the continuous turbidity samplers. **NOTE** ▪ MRC will periodically collect grab samples at continuous stream flow stations during storm events to measure turbidity and suspended sediment. ▪ MRC will also periodically collect grab samples at major tributaries during storm events to measure turbidity and suspended sediment. ▪ MRC will depend heavily on available resources for our sampling effort in the watersheds. If sampling is infrequent, detailed analysis of data may be limited; however, comparisons with data from nearby automated sampling stations may provide supplementary information. Our goal is to observe long-term trends in discrete suspended sediment loads. • MRC will allow the North Coast Regional Water Quality Control Board and the wildlife agencies to conduct turbidity, suspended sediment, and stream flow observations in the Noyo River and Big River and will assist with monitoring of these stations, if time permits.
ADAPTIVE MANAGEMENT	• MRC will examine the causes of deviation if sediment observations do not show a trend toward reduced suspended sediment and turbidity as well as increased stream channel complexity, pool depths, V*, fine sediment percentage, and permeability. • MRC may decide, based on the causes of deviation, to alter conservation measures related to sediment inputs.

13.5.5 Water drafting

13.5.5.1 Effectiveness monitoring

Effectiveness Monitoring	
Water Drafting	
PROGRAM CODE	M§13.5.5.1-1
OBJECTIVE O§8.4.1-3	• Maintain equivalent temperatures downstream and upstream and limit the reduction of the wetted width of the 1st downstream riffle as well as pool volume.
MONITORING APPROACH	• MRC will monitor annually a percentage of active water drafting sites to determine their adherence to the guidelines in the *Master Agreement for Timber Operations* (Appendix T) and their impacts to aquatic habitat. • MRC will monitor, during the entire drafting period and according to plans approved by the wildlife agencies, stream stage and stream temperature with continuous data-loggers. • MRC will conduct, as necessary, periodic measurements of residual pool depth, channel dimensions, and stream flow within any area impacted by water drafting, along with nearby control areas.
MEASUREMENT CRITERIA	• MRC will use digital recorders and flow meters to measure temperature,

Effectiveness Monitoring	
Water Drafting	
	riffle crest, residual pool depths, channel dimensions, and flow in order to assess aquatic habitat. • MRC will review monitoring reports on water drafting compliance for supplemental data (Appendix D, section D.2.11, *Water drafting*).
ADAPTIVE MANAGEMENT	• MRC will review the water drafting guidelines of MATO with the wildlife agencies every 4 years, as well as at Years 30 and 70 of HCP/NCCP implementation, to determine if we are meeting our objectives on schedule. • MRC will investigate to determine causes if we fail to meet our targets for suitable aquatic habitat adjacent to water drafting sites. • MRC may decommission water drafting sites or adjust their intake rates, if we do not meet our targets for aquatic habitat adjacent to water drafting sites.

13.5.5.2 Validation monitoring

Validation Monitoring	
Water Drafting	
PROGRAM CODE	M§13.5.5.2-1
HYPOTHESIS SECTION 8.2.2	• Aquatic organisms will respond to moderations in drafting rates, i.e., increases in residual water depths and decreases in water temperatures.
MONITORING APPROACH	• MRC will evaluate, within each focus watershed, drafting operations, aquatic habitat conditions, and condition of aquatic species (e.g., density and condition indices) to determine impacts to sensitive aquatic plants and animals.
MEASUREMENT CRITERIA	• MRC will determine response variation of salmonids, amphibians, rare plants, and benthic macroinvertebrates to treatment and controls.
ADAPTIVE MANAGEMENT	• MRC will investigate to determine causes if there are no improvements in the conditions of aquatic species. • MRC may adjust the water drafting guidelines in the *Master Agreement for Timber Operations* (Appendix T).

13.6 Monitoring covered aquatic species

13.6.1 Anadromous salmonid monitoring

MRC will update information on the presence of anadromous salmonids using annual spot checks in large basins. We will conduct more extensive distribution surveys throughout each watershed in 3-year cycles and collect annual estimates of the number of out-migrating salmon, particularly coho salmon. MRC will also survey Chinook Salmon Monitoring Reaches (CSMR) annually to evaluate the status of the species and the effectiveness of HCP/NCCP conservation measures.

The state and federal governments are working on a regional salmonid monitoring program in core areas which will overlap the MRC plan area. As more information becomes available, MRC and the wildlife agencies will evaluate both programs for compatibility and commonality. If we can mesh our monitoring program with the agencies' program without exceeding our anticipated monitoring costs for our HCP/NCCP or diminishing the plan's effectiveness, we may do so.

13.6.1.1 Effectiveness monitoring

Presence of anadromous salmonid in ASMB

Each year, MRC will conduct surveys for anadromous salmonid presence in our Annual Salmonid Monitoring Basins (ASMB). We selected basins in which we own all or most of the land to ensure that results reflect our own practices as opposed to activities outside our control. Using these criteria, we identified the following as ASMB:

- Hollow Tree Creek.
- Cottaneva Creek.
- Hardy Creek.
- Juan Creek.
- Howard Creek.
- North Fork Noyo River.
- Big River (above South Fork Big River).
- South Fork Big River.
- Albion River.
- South Fork Albion River.
- North Branch North Fork Navarro River.
- South Branch North Fork Navarro River.
- Greenwood Creek.
- Elk Creek.
- Mallo Pass Creek.
- Alder Creek.
- South Fork Garcia River.
- Ackerman Creek.

We may conduct surveys in main-stem segments or in tributaries of these basins.

A species is considered *present* in a watershed if it is detected at least once during 3 consecutive annual surveys. We selected a 3-year time period to recognize the distinct cohorts of coho salmon that result from its life cycle. That life cycle ideally might proceed as follows: (1) eggs in stream gravel (September–December); (2) alevin in stream gravel (January–June); (3) fry in fresh water (few months to 2 years). If MRC does not detect coho salmon, for example, in years 2010 and 2011 but does observe them in 2012, we will consider coho salmon *present* at the site for the time survey period of 2010-2012.

MRC surveyed all of the watersheds on our land during 2000-2002; the previous landowner surveyed these same sites from 1994-1996. This provides 2 monitoring cycles to serve as baseline data on species diversity and distribution within each watershed. Baseline data indicates that coho salmon are present in 10 of the monitored drainage basins: Hollow Tree Creek, Cottaneva Creek, North Fork Noyo River, Big River (upstream of South Fork Big River), South Fork Big River, Albion River (upstream of South Fork Albion River), South Fork Albion River, North Branch North Fork Navarro River, South Branch North Fork Navarro River, and South Fork Garcia River. Steelhead are present in all 18 drainage basins identified for annual monitoring.

Chinook salmon migrate to sea during their first year of life—typically within 3 months of emergence from spawning gravels—and spend most of their lives in coastal ocean waters (Healy 1991, Mills et al 1997, Moyle et al 1989). Due to their rapid migration after emergence from spawning gravels, we suspect that Chinook salmon are less sensitive than coho salmon to timber management. Monitoring their presence, however, can be difficult. The life cycles of coho salmon are easier to monitor. As a result, the status of coho salmon provides a more convenient

metric to evaluate the over-all effectiveness of MRC conservation measures on salmonid habitat. Nevertheless, Chinook salmon is a covered species in our HCP/NCCP and its habitat needs differ from the other covered salmonids. Therefore, MRC will monitor the status of Chinook salmon in the Chinook Salmon Monitoring Reaches (CSMR).

Effectiveness Monitoring	
Anadromous Salmonid Presence: Annual Salmonid Monitoring Basins (ASMB)	
PROGRAM CODE	M§13.6.1.1-1
OBJECTIVE O§10.2.1.2-1	• Maintain covered salmonids within major drainage basins. ▪ Maintain steelhead in 100% of the ASMB where baseline data and new surveys indicate their presence. ▪ Maintain coho salmon in 100% of ASMB, where baseline data and new surveys indicate their presence.
MONITORING APPROACH	• MRC will assess anadromous salmonid presence annually within the 18 major drainage basins identified.
MEASUREMENT CRITERIA	• MRC considers anadromous salmonid species *present* if we detect them once during 3 annual consecutive surveys in an ASMB. • MRC will conclude that a basin is supporting new fish species not present in previous surveys if we detect them on 2 or more occasions in a continuous 6-year time period. • MRC will use snorkeling or single-pass electro-fishing to determine if anadromous salmonid species are present; a survey site will consist of at least 20 pools within each major drainage basin identified. • MRC will consider the survey complete, if we detect coho and steelhead before sampling 20 pools. • MRC will collect data on "catch per unit effort" and correlate the time for first detection with fish abundance.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including formation of temporary barriers to fish passage, low discharge, status of regional trends, and physical habitat data. • MRC will meet and confer with the wildlife agencies regarding possible solutions and adjustments to conservation measures, such as remediation of barriers.

Anadromous salmonid distribution

Surveys for anadromous salmonid distribution will take place over a 3-year time period. In the first year of the survey, MRC will visit approximately 450 sites across our watersheds to examine the extent and distribution of juvenile anadromous salmonids. In the second and third years, we will sample all sites in which a species was known to be historically present, but remains undetected. If, during a 3-year time period, MRC does not observe a species known to be present from baseline data, we will consider it absent for survey statistics.

Effectiveness Monitoring	
Anadromous Salmonid Distribution	
PROGRAM CODE	M§13.6.1.1-2
OBJECTIVES O§10.2.1.2-2 O§10.2.1.2-3	• Maintain steelhead in 90% of sampling sites throughout the plan area, where baseline data and new information indicates their presence. • Maintain coho salmon in 85% of sampling sites throughout the plan area, where baseline data and new information indicates their presence. **NOTE** MRC set objectives for coho salmon and steelhead distribution at less than 100% to account for natural variations in flow and temporary barriers, such as log jams, which may impede accessibility. When we detect new fish species in a sampling site, we will consider that sampling site able to support the new species only if we detect them.
MONITORING APPROACH	• MRC will assess anadromous salmonid distribution annually over a 3-year period repeating the assessment every 12 years.
MEASUREMENT CRITERIA	• MRC will visit all major watercourses with fish. • MRC will use a hierarchical framework to select the initial locations of survey sites in each stream. Major streams are divided into lower, middle, and upper reaches. Smaller streams are divided into lower and upper reaches. • MRC will survey 1 site in each reach, or 3 sites in major streams and 2 sites in smaller streams. We will add other sites directly downstream and upstream of potential migration barriers to determine which anadromous salmonid species these barriers are impacting. • MRC will use snorkeling or single-pass electrofishing to determine if aquatic species are present. A survey site will contain a minimum of 2 consecutive habitat sequences (pool-riffle sequences) and have a minimum length of 90 ft. If future research improves methods to determine the probability that a species is absent, MRC will incorporate these methods into the distribution surveys. • MRC will collect data on "catch per unit effort" (i.e., the number of fish captured per unit effort of time). • MRC will conclude that a sampling site is supporting fish species not present in previous surveys if we detect them on 2 or more occasions.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including formation of temporary barriers to fish passage, low discharge, status of regional trends, and physical habitat data. • MRC will meet and confer with the agencies regarding possible solutions and adjustments to conservation measures, such as remediation of barriers.

Presence and relative abundance of Chinook salmon

Chinook salmon were historically present or are currently present in the following watersheds within the plan area:

- Hollow Tree Creek.
- North Fork Noyo River.
- Big River.
- Albion River.
- Garcia River.

Moreover, MRC believes that some streams are potential habitat for Chinook salmon. These potential streams are

- Cottaneva Creek.
- South Fork Big River.
- North Fork Navarro River.
- South Fork Albion River.
- Elk Creek.

MRC will identify 1 Chinook Salmon Monitoring Reach (CSMR) in each of the streams listed above, for a total of 10 CSMRs. By locating CSMRs in streams with historical evidence of Chinook salmon presence as well as in streams with no observations at all, MRC hopes to observe expansions in Chinook distribution and relative abundance over time as conditions for freshwater habitat improve.

MRC has identified 2 streams where we have encountered Chinook salmon most often during monitoring: Hollow Tree Creek and North Fork Noyo River. Every year, we will monitor 1 CSMR in Hollow Tree Creek and 1 in North Fork Noyo River for the presence and relative abundance of juvenile Chinook salmon. We will also randomly select 2 other CSMRs to monitor every year. This amounts to a total of 4 CSMR surveys per year, rotating through all the CSMRs roughly every 4 years. If MRC determines that Chinook salmon are occupying a CRMS for 2 consecutive monitoring cycles, we will survey that CSMR annually from that point forward.

MRC will monitor the habitat elements of Chinook salmon by selectively locating new Long Term Channel Monitoring (LTCM) segments within areas frequented by Chinook. Several other monitoring programs, such as those for stream temperature, sediment, and LWD, will also indirectly asses the quantity and quality of habitat available to Chinook salmon.

Effectiveness Monitoring	
Chinook Salmon Monitoring Reaches (CSMR)	
PROGRAM CODE	M§13.6.1.1-3
OBJECTIVE OS10.2.1.2-4	• Maintain Chinook salmon in the Chinook Salmon Monitoring Reaches (CSMR) currently identified for annual monitoring: Hollow Tree Creek and North Fork Noyo River (see *HCP/NCCP Atlas*, MAPS 3A-3C).
MONITORING APPROACH	• MRC will assess the presence and relative abundance of Chinook salmon juveniles annually within the 2 CSMRs most frequented by Chinook salmon, i.e., Hollow Tree Creek and North Fork Noyo River. • MRC will establish 8 additional CSMRs in streams which are currently unoccupied by Chinook salmon or which Chinook salmon may have occupied in the past, i.e., Cottaneva Creek, Big River, South Fork Big River, Albion River, South Fork Albion River, North Fork Navarro River, Elk Creek, and Garcia River. • MRC will randomly select 2 CSMRs from the list above to survey annually, in addition to Hollow Tree Creek and North Fork Noyo River. • MRC will survey a total of 4 CSMRs each year, rotating through all CSMRs every 4 years. • MRC will use snorkel surveys within each CSMR in early spring when juveniles are most likely to be present. • MRC will collect data on the relative abundance of Chinook salmon juveniles within each CSMR by surveying the same reaches over time.

Effectiveness Monitoring	
Chinook Salmon Monitoring Reaches (CSMR)	
	• MRC will monitor a CSMR annually, if we detect Chinook salmon there during 2 consecutive monitoring cycles. • MRC will ensure that each CSMR is similar in size (0.5 to 1.0 mi. long) and choose its location based on suitable habitat as well as accessibility and proximity to major landmarks.
MEASUREMENT CRITERIA	• MRC considers Chinook salmon *present* if we detect them once during 5 annual consecutive surveys in a CSMR. **NOTE** MRC selected a 5-year time period to determine *presence* in order to account for the lifespan of most fall-run Chinook salmon. The 5-year time period also provides MRC some flexibility in addressing the episodic nature of the species occurrence within the plan area. • MRC will collect data on the number of juveniles observed within the entire extent of a CSMR from at least 2 independent surveys per year. • MRC surveyors will snorkel the same CSMR and collect independent estimates of the number of juveniles observed on the same day; we will derive a mean number of fish observed from all surveys to represent the relative abundance for each CSMR in a given year. • MRC surveyors will target the best habitats when the width of a channel is too large to observe the entire wetted width. • MRC surveyors will embark on a survey at least 15 minutes apart and each surveyor will wait until another surveyor has departed a habitat unit (pool, riffle, glide, etc.) before entering it.
ADAPTIVE MANAGEMENT	• MRC will examine the probable causes of deviation including ▪ Formation of temporary barriers to fish passage. ▪ Low discharge. ▪ Status of regional trend. ▪ Physical habitat data. • MRC will meet and confer with the wildlife agencies about possible solutions and adjustments to conservation measures, such as remediation of fish barriers.

13.6.1.2 Validation monitoring

Smolt abundance

Out-migrating juvenile coho salmon and steelhead (smolts) are a preferred life stage to monitor since they have resided in a freshwater environment for at least 1 year and have been exposed to seasonal variation in habitat quality and availability.

The number of adult salmon who return to their natal streams to spawn is important in determining the abundance of smolts within a watershed. Salmon generally spend at least half their lives residing in the ocean; MRC has little or no control over the number of adults who return to spawn. Upon their return, however, the condition of their freshwater aquatic habitat largely determines the number of salmon eggs that will survive to become smolts. We hypothesize that the number of smolts will increase over time as freshwater habitat conditions improve. Testing of this hypothesis will occur in the focus watersheds where we will closely monitor both smolt abundance and habitat conditions.

MRC will not extrapolate data collected in the focal watersheds on smolt abundance and habitat conditions to other watersheds without agreement from the wildlife agencies that such extrapolation is appropriate. We will use information on smolt abundance to monitor trends in out-migrating smolts. With this trend data, we can make comparisons to measurements of suspended sediment or turbidity collected in these focus watersheds or to habitat conditions. In addition, we can use the data for controlled before-and-after experiments to assess the effectiveness of various land management applications.

Validation Monitoring	
Smolt Abundance	
PROGRAM CODE	M§13.6.1.2-1
HYPOTHESIS SECTIONS 4.2.9 AND 4.4.9	• Abundance of juvenile anadromous salmonid will increase as habitat conditions improve over time.
MONITORING APPROACH	• MRC will estimate abundance of out-migrating smolts during the late winter and spring within 2 focus watersheds—South Fork Albion River and Little North Fork Navarro River. • MRC will monitor instream habitat conditions over time to allow for comparison between habitat quality and smolt abundance.
MEASUREMENT CRITERIA	• MRC will estimate smolt abundance using out-migrant traps to capture juvenile coho salmon and steelhead. • MRC will install out-migrant traps as soon as stream discharge allows and remove them when the out-migration of coho salmon smolts subsides in late spring and none have been captured within a week. • MRC will operate out-migrant traps on an annual basis, rotating between 2 focus watersheds every 3 years; we may consider expanding these efforts into the other focus watersheds, depending on available resources. • MRC will collect information on the timing of smolt out-migration; smolt size; fish conditions, e.g., length-to-weight relationships; and community structure of juvenile anadromous salmonids. • MRC will use DARR software[9] to analyze trap efficiency and coho salmon smolt abundance. • MRC will monitor habitat conditions (Appendix G, G.3.5, *Module: fish habitat*).
ADAPTIVE MANAGEMENT AND MONITORING	• MRC will examine the relationship between the status of instream habitat conditions and the abundance of coho salmon smolts. • MRC will evaluate probable causes, if the abundance of coho salmon smolts significantly declines while habitat conditions are improving, and confer with the wildlife agencies about possible solutions • MRC may initiate escapement estimates to assist in evaluating habitat performance.

[9] Darroch Analysis with Rank-Reduction (DARR) is a method for estimating abundance of smolts from outmigrant trap data (Bjorkstedt 2005).

13.6.2 Red-legged frog monitoring (California and northern)

Currently, the documented distribution of this sub-species is incomplete throughout the plan area. Surveys will provide a better understanding of that distribution. Refer to Appendix N (section N.2.4, *Surveying potential breeding sites*) for a description of the survey method.

Red-legged frogs may not use the same breeding site each season, especially when there are several documented breeding sites within close proximity to one another. The species uses certain sites in a given season and different sites in other seasons; this is most likely due to the amount of potential breeding habitat available. Because of this variability, MRC assigned each potential or documented breeding site to a Red-Legged Frog Management Unit (RLFMU).

MRC designated RLFMUs based on our own data, which showed that most variation in breeding site use occurred when sites were within 1000 ft of each other. Therefore, all sites within 1000 ft of each other are combined into 1 RLFMU. As of 2009, the number of documented or potential breeding sites in each RLFMU ranges from 1 to 9.

13.6.2.1 Effectiveness monitoring

Baseline distribution and habitat quality of RLF breeding sites

Effectiveness Monitoring	
Baseline Distribution and Habitat Quality of Red-legged Frog Breeding Sites	
PROGRAM CODE	M§13.6.2.1-1
OBJECTIVES O§10.2.2.2-1 O§10.2.2.2-3	• Establish the baseline distribution of both potential and documented red-legged frog breeding sites by Year 2 of HCP/NCCP implementation. • Maintain habitat quality (e.g., maximum depth and surface area) at 90% of potential breeding sites identified during distribution surveys, including water drafting sites.
MONITORING APPROACH	• MRC will make an effort to identify and survey the majority of the potential red-legged frog breeding habitat within the initial 2 years of the plan. • MRC will survey at least 1 CalWater planning watershed within all of its inventory blocks every year during the initial distribution study; collecting data across a wide geographic range will minimize the potential influence of annual variation in weather patterns. • MRC will survey all CalWater planning watersheds where MRC owns land within the first 2 years of our HCP/NCCP implementation. • MRC will determine, within the first 2 years of our HCP/NCCP, which potential habitats red-legged frogs are using for reproductive purposes; a documented breeding site has embryonic (egg mass) or larval (tadpole) life stages. • MRC will measure habitat attributes including maximum depth and surface area of the lentic habitat.

Occupancy of red-legged frogs in documented breeding sites

Effectiveness Monitoring	
Occupancy of Red-Legged Frogs in Documented Breeding Sites	
PROGRAM CODE	M§13.6.2.1-2
OBJECTIVE O§10.2.2.2-2	• Maintain red-legged frogs in 100% of the red-legged frog management units (RLFMUs) where baseline surveys and new surveys indicate their presence.
MONITORING APPROACH	• MRC will monitor all documented breeding sites on an annual basis for actual use by red-legged frogs.
MEASUREMENT CRITERIA	• MRC will consider that an RLFMU supports red-legged frog populations if one or more documented breeding sites within the RLFMU remains occupied. • MRC will conclude that red-legged frogs are occupying a documented breeding site if we detect them breeding at least once during 3 years of consecutive surveys.
ADAPTIVE MANAGEMENT	• MRC will consider any reduction in the number of CalWater planning watersheds with active breeding sites or any reduction in the number of RLFMUs as *significant*. • MRC will determine the reasons for the reduction in the number of RLFMUs, chart the appropriate action with the wildlife agencies, and possibly create additional habitat in strategic locations or adjust conservation measures.

Habitat quality and species present within RLF breeding sites

Effectiveness Monitoring	
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	
PROGRAM CODE	M§13.6.2.1-3
OBJECTIVE O§10.2.2.2-3	• Maintain habitat quality (e.g., maximum depth and surface area) at 90% of potential breeding sites identified during distribution surveys, including water drafting sites.
MONITORING APPROACH	• MRC will re-examine every 5 years all potential and documented breeding habitat identified during the initial study. • MRC will conduct re-examinations to monitor for changes in the maximum depth or surface area of the habitat present. • MRC will conduct surveys (Appendix N, section N.2.4, *Surveying potential breeding sites*) to determine if red-legged frogs are using potential habitats and expanding in range.
MEASUREMENT CRITERIA	• MRC will document a breeding site and monitor it annually if we observe evidence of red-legged frog reproduction (i.e., egg masses of larvae present). • MRC will conclude that habitat quality has been maintained (on a site specific basis) if at least 75% of the maximum depth of a feature is maintained and at least 75% of the total surface area remains lentic habitat.
ADAPTIVE MANAGEMENT	• MRC will consider degraded habitat at more than 10% of potential

Effectiveness Monitoring	
Re-evaluate Habitat Quality and Species Presence within RLF Breeding Sites	
	breeding habitat sites as *significant*. We will construct new habitat at a one-to-one ratio if there is a loss of potential breeding habitat or enhance existing habitat to meet habitat objectives. For example, we may dig a site with a hand shovel or making an existing site larger.

13.6.3 Coastal tailed frog monitoring

Current knowledge of the distribution of coastal tailed frogs throughout the plan area is incomplete. For this reason, MRC is completing a baseline assessment of coastal tailed frog distribution. Appendix N (section N.6.1, *Monitoring distribution of coastal tailed frogs*) describes our survey methods.

MRC will monitor all occupied streams, identified during baseline distribution surveys or new surveys as well as streams pinpointed from incidental observations, on average once every 7-8 years throughout the term of our HCP/NCCP permit. Monitoring will focus on determining (1) whether coastal tailed frogs remain present in occupied sites and (2) the relative abundance of coastal tailed frogs at occupied sites. Over time, information on the occupancy and relative abundance of coastal tailed frogs throughout all occupied streams in the plan area should provide sufficient data for effectiveness monitoring. In any given year, MRC will monitor at least 10 streams for occupancy and relative abundance. We will cycle through about 13% of occupied sites per year.

13.6.3.1 Effectiveness monitoring

Baseline distribution of coastal tailed frogs

Effectiveness Monitoring	
Baseline Distribution of Coastal Tailed Frogs	
PROGRAM CODE	M§13.6.3.1-1
OBJECTIVE O§10.2.3.2-1	• Establish the baseline distribution of larval coastal tailed frogs by Year 2 of HCP/NCCP implementation.
MONITORING APPROACH	• MRC will survey at least 1 CalWater planning watershed within all of its inventory blocks every year during the initial distribution study; collecting data across a wide geographic range will minimize the potential influence of annual variation in weather patterns. Each CalWater planning watershed will have a minimum of 10 survey sites. The survey sites will be in different watercourses. We will survey all CalWater planning watersheds where MRC owns at least 25% of the acreage by Year 2 of our HCP/NCCP implementation. • MRC will perform a 30-minute time constrained search (TCS) in each of the streams selected for survey. Two persons will walk the selected stream in an upstream direction, searching all potential habitats; they will expend their greatest effort in the best habitats. Searches consist of looking for larvae attached to rocks on the stream bottom, turning over movable rocks while holding a dip net downstream to catch dislodged frogs, and using a glass-bottomed viewing box to search the stream channel. The search crew will record the amount of time spent before locating a frog.

Effectiveness Monitoring	
Baseline Distribution of Coastal Tailed Frogs	
MEASUREMENT CRITERIA	• MRC will consider coastal tailed frogs to be present if larval life stages are present within a survey location. • MRC will conduct distribution surveys during the most appropriate season (May to August) before larvae metamorphose and leave the stream environment.

Distribution and relative abundance of coastal tailed frogs

All occupied streams identified during baseline distribution surveys, new surveys, or incidental observations will be monitored once every 7-8 years (on average) throughout the permit term. Monitoring will focus on determining (1) whether coastal tailed frogs continue to remain present in occupied sites and (2) the relative abundance of coastal tailed frogs at occupied sites.

Effectiveness Monitoring	
Distribution and Relative Abundance of Coastal Tailed Frogs	
PROGRAM CODE	M§13.6.3.1-2
OBJECTIVE O§10.2.3.2-2	• Maintain larval coastal tailed frogs in 95% of sites where the baseline distribution survey, new surveys, or incidental observations indicate their presence. **NOTE** MRC set the distribution objective at less than 100% to account for sampling error.
MONITORING APPROACH	• MRC will determine presence or probable absence with a 60-minute time constrained search (TCS) in each of the sites where we detected coastal tailed frogs during baseline or new surveys. Two persons will walk the selected stream in an upstream direction, searching all potential habitats; they will expend their greatest effort in the best habitats. Searches consist of looking for larvae attached to rocks on the stream bottom, turning over movable rocks while holding a dip net downstream to catch dislodged frogs, and using a glass-bottomed viewing box to search the stream channel. The search crew will record the amount of time spent before locating a frog. • MRC will conduct surveys from May to August before larvae metamorphose and leave the stream environment. • MRC will re-examine the distribution of coastal tailed frogs by conducting presence or probable absence surveys at all occupied sites identified through baseline surveys, new surveys, or incidental observations. • MRC will survey 10 streams per year, randomly rotating through all of the occupied streams within the plan area, on average, every 8 years. • MRC will collect relative abundance estimates at each monitoring site where we have confirmed the presence of coast tailed frogs (Appendix N, section N.6.2, *Monitoring relative abundance of coastal tailed frogs*).
MEASUREMENT CRITERIA	• MRC will consider coastal tailed frogs to be present if there is evidence of larval life stages within a survey location. • MRC will posit a decline in the abundance of coastal tailed frogs if, after 3 survey cycles, the proportion of sites with demonstrable declines exceeds the sites with demonstrable increases.

Effectiveness Monitoring	
Distribution and Relative Abundance of Coastal Tailed Frogs	
ADAPTIVE MANAGEMENT	• MRC will consider altering AMZ conservation measures or increasing AMZ protections if (1) there is a 5% reduction in the number of sites occupied by coastal tailed frogs or (2) relative abundance has declined.

13.7 Overview of Terrestrial Monitoring

MRC will implement our terrestrial effectiveness and validation monitoring through the programs outlined in Table 13-16. These programs evaluate populations of terrestrial species in the plan area, as well as habitat and habitat components directly related to terrestrial species. Timber inventory provides feedback for some of these monitoring programs (see Appendix U, section U.7, *Structure Classes and Habitat Inferences).*

Successful completion of the terrestrial surveys may depend upon annual MRC harvests (see section 13.2.2.7 and Table 13-7).

Table 13-16 Terrestrial Effectiveness and Validation Monitoring Programs

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	M§13.8.1-1	▪ Sample annually. ▪ Tabulate and compare results from inventory every 10 years.
Basal Area of Hardwoods in Timber Stands	M§13.8.1-2	▪ Report annually.
Post-Harvest Follow-up on Hardwood Representative Sample Areas	M§13.8.1-3	▪ Sample when harvest occurs in these areas. ▪ Report annually.
Acreage and Number of Hardwood Representative Sample Areas	M§13.8.1-4	▪ Visit and assess over a 10-year period; report every 10 years.
Acreage and Number of Old Growth Stands and Trees	M§13.8.1-5	• Visit and assess over a 10-year period; report every 10 years. • Report annually on individual old growth trees
Distribution and Area of Rocky Outcrops	M§13.8.1-6	• Visit and assess over a 10-year period; report every 10 years.
Common Natural Communities	M§13.8.2-1	• Compile and report every 5 years.
Uncommon Natural Communities	M§13.8.2-2	• Compile and report every 5 years.
Invasive Species Control	M§13.8.3-1	• Report annually.

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Northern Spotted Owls: Level-1 and Level-2 Territories	M§13.9.1.3-1	• Complete and report annually.
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	M§13.9.1.3-2	• Report every 10 years.
Population Trends of Northern Spotted Owls	M§13.9.1.4-1	• Complete and report every 5 years. • Report annually and ensure 1/5 of covered lands have been surveyed.
Identification of Nesting/Roosting Habitat for Northern Spotted Owls	M§13.9.1.4-2	• Survey at least 100 nest sites of individual spotted owl territories; initial survey was completed in 2007. • Survey at least 100 nest sites of individual spotted owls starting 40 years after plan initiation; estimate that the effort will take 8 years. • Optional
Benefits of High Protection for Northern Spotted Owls and Their Territories	M§13.9.1.4-3	• Complete annually. • Report every 5 years. • Optional
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	M§13.9.1.4-4	• Complete. • Report every 5 years
Effect of Habitat on Productivity of Northern Spotted Owls	M§13.9.1.4-5	• Complete annually. • Report every 5 years. • Optional
Effect of Hardwood Density on Northern Spotted Owls	M§13.9.1.4-6	• Complete annually. • Report every 5 years.
Effect of Barred Owl Control on Northern Spotted Owls	M§13.9.1.4-7	• Complete annually until wildlife agencies and MRC decide to terminate. • Report annually.
Activity Level of Marbled Murrelets in Lower Alder Creek	M§13.9.2.1-1	• Complete and report annually.
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	M§13.9.2.1-2	• Complete and report annually.

Terrestrial Effectiveness and Validation Monitoring Programs		
Monitoring Program Description	**Monitoring Code**	**Timing**
Murrelet Habitat Distribution in LACMA	M§13.9.2.2-1	• Complete within the first 20 years of the plan. • Optional
Methods for Accelerating Growth of Murrelet Habitat	M§13.9.2.2-2	• No timeline • Optional
Radar Monitoring in Additional Drainages	M§13.9.2.2-3	• Rotate monitoring between 10 drainages on a 5 year basis. • Optional
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	M§13.9.3.1-1	• Complete surveys over 5 years. • Report every 5 years.
Creating Habitat with Timber Harvest within Dispersal Distance of Existing Burrow Systems	M§13.9.3.1-2	• Complete visits 2 years following harvest. • Document spatial extent when burrows discovered. • Report every 5 years
Defining Habitat for Point Arena Mountain Beavers	M§13.9.3.2-1	• Complete habitat surveys over 5 years along with surveys for spatial extent. • Report every 5 years. • Optional
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	M§13.9.3.2-2	• No timeline • Optional
Status and Trend of Covered Rare Plant Species	M§13.10.3-1	• Complete baseline surveys within 5 years of implementation. • Sample every 10 years thereafter. • Report within year following sampling.

The terrestrial monitoring programs separate species, habitat, and natural communities. Although wildlife trees, hardwoods, downed wood, and old-growth may be important habitat components for both northern spotted owls and marbled murrelets, MRC will monitor them in separate programs. While wildlife trees, hardwoods, downed wood, and old-growth are all parts of natural communities, MRC will monitor them in separate programs as well. Each monitoring program relates directly to a conservation strategy for a specific species, habitat type, or habitat feature.

For each covered species, MRC will monitor both population and habitat. Effectiveness monitoring for northern spotted owls, for example, will determine the number of Level-1 and Level-2 territories on covered lands, as well as the amount and distribution of owl habitat. In monitoring both population and habitat, MRC can examine whether conservation measures are

appropriate. Effectiveness monitoring may indicate that the number of Level-1 and Level-2 owl territories is decreasing. If the number falls below its original baseline by 20% over 2 years, MRC will implement contingency measures to attempt to correct the negative trend in northern spotted owl productivity.

13.7.1 Timeline for terrestrial monitoring

While terrestrial monitoring is constrained by personnel and financial resources, MRC will monitor Level-1 and Level-2 territories for northern spotted owls and marbled murrelet activity in LACMA every year of our HCP/NCCP. Most monitoring programs will start within the first 10 years of our HCP/NCCP. Table 13-17 provides an estimated timeline for the first 20 years of terrestrial monitoring. Monitoring programs in subsequent years of the plan will recycle through this same schedule, as appropriate.

Table 13-17 Estimated Timeline for Terrestrial Monitoring

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.8.1-1 Snags, Wildlife Trees, Recruitment Trees, and Downed Wood																				
M§13.8.1-2 Basal Area of Hardwoods in Timber Stands																				
M§13.8.1-3 Post-Harvest Follow-up on Hardwood Representative Sample Areas																				
M§13.8.1-4 Acreage and Number of Hardwood Representative Sample Areas																				
M§13.8.1-5 Acreage and Number of Old Growth Stands and Trees																				
M§13.8.1-6 Distribution and Area of Rocky Outcrops																				
M§13.8.2-1 Common Natural Communities																				
M§13.8.2-2 Uncommon Natural Communities																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.8.3-1 Invasive Species Control																				
M§13.9.1.3-1 Northern Spotted Owls: Level-1 and Level-2 Territories																				
M§13.9.1.3-2 Northern Spotted Owls: Distribution and Acreage of N/R Habitat																				
M§13.9.1.4-1 Population Trends of Northern Spotted Owls																				
M§13.9.1.4-2 Identification of Nesting/Roosting Habitat for Northern Spotted Owls OPTIONAL																				
M§13.9.1.4-3 Benefits of High Protection for Northern Spotted Owls and Their Territories OPTIONAL																				
M§13.9.1.4-4 Effect of Harvest within 1000 ft of NSO Territories with Limited Protection																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.9.1.4-5 Effect of Habitat on Productivity of Northern Spotted Owls OPTIONAL																				
M§13.9.1.4-6 Effect of Hardwood Density on Northern Spotted Owls																				
M§13.9.1.4-7 Effect of Barred Owl Control on Northern Spotted Owls																				
M§13.9.2.1-1 Activity Level of Marbled Murrelets in Lower Alder Creek																				
M§13.9.2.1-2 Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds																				
M§13.9.2.2-1 Murrelet Habitat Distribution in LACMA OPTIONAL																				
M§13.9.2.2-2 Methods for Accelerating Growth of Murrelet Habitat OPTIONAL																				
M§13.9.2.2-3 Radar Monitoring in Additional Drainages OPTIONAL																				

Estimated Timeline for Terrestrial Monitoring																				
Monitoring Program	**Years Since HCP/NCCP Initiation**																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
M§13.9.3.1-1 Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver																				
M§13.9.3.1-2 Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems																				
M§13.9.3.2-1 Defining Habitat for Point Arena Mountain Beavers Optional																				
M§13.9.3.2-2 Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems Optional																				

TABLE NOTES

Solid grey shaded areas indicate the years that surveys will be occur.

Purple shaded areas indicate (a) the years that MRC will tabulate surveys and report results or (b) the years that a cycle of surveys will be complete, e.g., 5-year surveys.

13.8 Monitoring Terrestrial Habitat

For our HCP/NCCP, terrestrial habitat includes hard snags, wildlife trees, and downed wood; hardwoods; old-growth; rocky outcrops; and natural communities. Effectiveness monitoring will ensure that MRC meets or exceeds the requirements to maintain these habitat components.

13.8.1 Effectiveness monitoring

Snags, wildlife trees, recruitment trees, and downed wood

The initial number of snags across covered lands may be much lower than our stated objective. Since we only established specific characteristics of wildlife trees in 2006 and have not begun marking recruitment trees for wildlife trees or snags, we will use the first 10 years of our HCP/NCCP to acquire baseline information on these habitat elements.

Effectiveness Monitoring	
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	
PROGRAM CODE	M§13.8.1-1
OBJECTIVES O§9.2.2-1	• Retain in Class I and Large Class II AMZ at least ▪ 1 hard snag or recruitment tree *on average per acre*[10] that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 2 hard snags or recruitment trees o*n average per acre* that is ≥ 24 in. dbh and ≥ 40 ft in height. ▪ 1 wildlife tree or recruitment tree *on average per acre* that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 6 hard logs *on average* per acre that are (a) ≥ 16 in. average diameter; (b) ≥ 6 ft long; and (c) derived from at least 3 trees.
O§9.2.2-2	• Retain in general forested areas at least ▪ 1 hard snag or recruitment tree *on average per acre* that is ≥16 in. dbh and ≥ 30 ft in height. ▪ 1 hard snag or recruitment tree *on average per acre* that is ≥ 24 in. dbh and ≥ 40 ft in height. ▪ 1 wildlife tree or recruitment tree *on average per acre* that is ≥ 16 in. dbh and ≥ 30 ft in height. ▪ 5 hard logs *on average per acre* that are (a) ≥ 16 in. average diameter; (b) ≥ 6 ft long; and (c) derived from at least 3 trees.
MONITORING APPROACH	• Sample forests for snags, wildlife trees, recruitment trees, and pieces of downed wood (see Appendix U, section U.2.1.4, *Data collection at plots*).[11] ▪ Sample vegetative strata within inventory blocks. ▪ Measure all snags, wildlife trees, recruitment trees (trees marked with an "R"), and downed wood within a 37.2 ft radius (0.10 ac) plot. • Compile information, every 10 years, about trends in number of snags, wildlife trees, recruitment trees, and pieces of downed wood for all covered lands. Compilation will include a yearly estimate of snags, wildlife trees, recruitment trees, and pieces of downed wood to allow for annual comparisons and estimates of trend direction. Annual estimates will

[10] MRC calculated the value by silvicultural unit and then standardized the value per acre.

[11] Samples will come from stands sampled for inventory. For reporting purposes, we will distinguish AMZ stands and owl core areas from general forest stands.

Effectiveness Monitoring	
Snags, Wildlife Trees, Recruitment Trees, and Downed Wood	
	also be included in an annual report (see Appendix D, D.4.2, *Snags, wildlife trees, recruitment trees, and downed wood*). There will be report breakdowns by planning watersheds, by inventory blocks, and by covered lands (the standard for agency review). • Establish a baseline mean number of snags, wildlife trees, and pieces of downed wood based on forest inventory data. As of 2010, covered lands have an average of 0.36 snags per acre and 6.4 downed logs per acre based on the definitions in the current inventory protocol.[12] • Examine trends over 10-year periods to determine if there is a discernible upward, stable, or downward trend in number of snags, wildlife trees, or recruitment trees from the baseline assessment. • Examine trends over 10-year periods to determine if there is a discernible upward, stable, or downward trend in pieces of downed wood.
MEASUREMENT CRITERIA	• An upward trend shows an obvious or statistically significant increase ($\alpha = 0.10$) in the number of snags, wildlife trees, recruitment trees, and pieces of downed wood from the baseline assessment. MRC will establish the baseline level of wildlife trees and recruitment trees after the first 10 years of HCP/NCCP implementation. • A static trend shows no detectable increase or decrease in the number of snags, wildlife trees, or pieces of downed wood over time from the baseline assessment, i.e., their number is not statistically different from the baseline ($\alpha = 0.10$). • A downward trend shows a statistically significant ($\alpha = 0.10$) decrease in the number of snags, wildlife trees, or pieces of downed wood from the baseline estimate.
ADAPTIVE MANAGEMENT	• If MRC detects an upward trend in any 10-year period, MRC and the wildlife agencies will concur on any changes to the recruitment requirement for snags, wildlife trees, recruitment trees, or pieces of downed wood. • If MRC detects a downward trend in any 10-year period, MRC and the wildlife agencies will concur on methods to improve performance such as ▪ Increase retention numbers, size, or condition of trees retained for recruitment. ▪ Provide screen trees for recruitment trees. ▪ Create snags.

[12] Currently, the inventory department collects data for downed wood with a diameter of at least 6 in. and a length of 10 ft or more. Snags must be at least 6 in. dbh and 10 ft or more in height.

Basal area of hardwoods in timber stands

Effectiveness Monitoring	
Basal Area of Hardwoods in Timber Stands	
PROGRAM CODE	M§13.8.1-2
OBJECTIVES O§9.3.2-1	• Retain, after harvest, 15 ft^2/ac of hardwoods > 6 in. dbh, if such hardwoods comprised at least 15 ft^2/ac of the total basal area of a silvicultural unit prior to harvest.
O§9.3.2-2	• Prohibit treatment of hardwoods > 6 in. dbh if such hardwoods comprise less than 15 ft^2/ac of the total basal area of a silvicultural unit prior to harvest.
O§9.3.2-5	• Retain hardwood areas within variable retention units.
MONITORING APPROACH	• Select, for sampling, silvicultural units[13] least likely to meet objectives. • Sample, at least 1 year after completion of harvest, 1 silvicultural unit from 2 separate PTHPs for a total of 2 sampled units per inventory block. • Survey each silvicultural unit with variable radius plots using a 20, 25, or 30 factor prism to determine basal area of hardwoods. • Complete 1 plot in every acre of a silvicultural unit and ensure that plots are a minimum of 50 ft from each other and within the boundary of the silvicultural unit. • Capture, in a GIS database, maps of all areas retained for hardwood retention. • Survey the entire PTHP area if the silvicultural unit is below basal area standards for hardwood. • Survey all silvicultural units within inventory blocks with PTHPs below hardwood standards.
MEASUREMENT CRITERIA	• Determine basal area by (a) dividing the total number of hardwood trees by the total number of plots and (b) multiplying trees per plot by the Basal Area Factor (BAF) in order to arrive at basal area retention for a silvicultural unit. **EXAMPLE** 20 trees/10 plots = average 2 trees/plot 2 trees X 20 (BAF) = 40 sq. ft. basal area retention • Track the number of acres retained per year as well as the cumulative number of acres.
ADAPTIVE MANAGEMENT	• MRC will ensure that PTHP silvicultural units within deficient inventory blocks have higher retention standards for hardwoods until the deficiency is corrected. **NOTE** For example, silvicultural unit-5 within the Rockport inventory block had, *on average*, a 10 ft^2/ac basal area of hardwoods after harvest. To make up for this deficiency, the next unit harvested in the Rockport inventory block, of

[13] A silvicultural unit is an area within a PTHP that has only 1 type of silviculture and that is non-contiguous with other areas of that same type.

Effectiveness Monitoring	
Basal Area of Hardwoods in Timber Stands	
	approximately the same or greater acreage as unit-5, must retain 20 ft^2/ac of basal area of hardwoods after harvest. Once deficiencies in unit-5 are counterbalanced with hardwoods from other silvicultural units in the Rockport inventory block, that inventory block can revert to the retention standard of 15 ft^2/ac of basal area after harvest.

Post-harvest follow-up on hardwood representative sample areas

Effectiveness Monitoring	
Post-Harvest Follow-up on Hardwood Representative Sample Areas	
PROGRAM CODE	M§13.8.1-3
OBJECTIVES O§9.3.2-6 O§9.3.2-7	• Harvest in representative sample areas only to maintain the relative proportion of hardwoods to conifers. • Designate 1487 ac as representative sample areas for early seral hardwood stands (Appendix B, *HCP/NCCP Atlas*, MAPS 4A-C).
MONITORING APPROACH	• Complete inventory cruise of all hardwood representative sample areas before and after harvest (Appendix U, section U.2, *Sampling Method*).
MEASUREMENT CRITERIA	• Determine relative site occupancy of hardwoods-to-conifers before and after harvest by ▪ Comparing basal area of each species by 8 in. size class before and after harvest. ▪ Comparing density of stems of each species before and after harvest.
ADAPTIVE MANAGEMENT	• If forestry operations result in a change in the relative proportion of hardwoods-to-confers in a representative sample area, MRC will designate a new representative sample area in the same general location and of the same general size, if possible, as a replacement.

Acreage and Number of Hardwood representative sample areas

Effectiveness Monitoring	
Acreage and Number of Hardwood Representative Sample Areas	
PROGRAM CODE	M§13.8.1-4
OBJECTIVES O§9.3.2-6 O§9.3.2-7	• Harvest in representative sample areas only to maintain the relative proportion of hardwoods to conifers. • Designate 1487 ac as representative sample areas for early seral hardwood stands (Appendix B, *HCP/NCCP Atlas*, MAPS 4A-C).
MONITORING APPROACH	• Review representative sample areas once every 10 years by aerial photos or satellite images and by ground visits to ensure they retain their desired characteristics.

Effectiveness Monitoring	
Acreage and Number of Hardwood Representative Sample Areas	
MEASUREMENT CRITERIA	• Compare the acreage of the original hardwood sample areas to current hardwood sample areas.
ADAPTIVE MANAGEMENT	• Review changes in current sample areas from the original 1487 ac of sample areas. • Substitute, if possible, a new representative sample area in the same general location and of the approximate acreage, if harvest changes the relative proportion of hardwoods to conifers in a representative sample area. • Meet with the wildlife agencies if changes are due to management practices—even practices outside of the hardwood sample areas—and determine if adaptive management is necessary.

Old growth

Effectiveness Monitoring	
Acreage and Number of Old Growth Stands and Trees	
PROGRAM CODE	M§13.8.1-5
OBJECTIVES	
O§9.4.2-1	• Maintain 101 ac of Type I old growth currently identified in the plan area, as well as any new Type I old-growth stands later discovered in the plan area, in order to retain their stand acreage and enhance stand function.
O§9.4.2-2	• Maintain 520 ac of Type II stands currently identified in the plan area, as well as any new Type II stands later discovered in the plan area in order to retain their stand acreage and enhance stand function.
O§9.4.2-3	• Increase acreage of mature and late successional forest within AMZ and LACMA (see M§13.9.2.2-1, M§13.5.1.2-2, M§13.5.1.1-1, M§13.5.1.1-2).
MONITORING APPROACH	• MRC will confirm the acreage of Type II old-growth stands during the first 40 years of our HCP/NCCP. • MRC will re-assess Type I and Type II old-growth acreage at least every 10 years or when the composition of the stand changes, e.g., with the discovery of new stands or after catastrophic fires or storms affect Type I stands or stands with Type II old-growth. • MRC acknowledges that drawing a “boundary line” around an old growth stand is difficult and will result in some observer bias. The intent is that the “boundary line” around each stand includes all old-growth trees within the stand and their screen trees. Type I stands will remain un-harvested reserves even if all their trees burn in a catastrophic fire or other natural disasters occur. • MRC will visit and assess, over a 10-year period, each Type I and Type II stand to ensure we maintain or enhance old-growth characteristics (e.g., density of old growth trees and presence of downed wood). • MRC will inventory single old-growth trees during timber cruises prior to harvest. • MRC will photograph, when possible, reference areas within Type I and Type II stands to assess changes over time.

Effectiveness Monitoring	
Acreage and Number of Old Growth Stands and Trees	
	• MRC will take aerial imagery at least once every 10 years, that show the boundaries of Type I and Type II old-growth stands. • MRC will report to the wildlife agencies the number of individual old-growth trees.
MEASUREMENT CRITERIA	• MRC will use acres of un-harvested old-growth (Type I) as well as number and acreage of Type II old-growth stands as indices of conservation effectiveness.
ADAPTIVE MANAGEMENT	• MRC does not expect acreage of old growth stands on our land to change drastically. • MRC expects Type II old-growth to increase slightly within the first 10 years of our HCP/NCCP as we discover new old growth stands. • MRC will report to the wildlife agencies any decrease in acres of old-growth stands. • MRC will meet with the wildlife agencies if the size of Type I or Type II old-growth stands decreases more than 10%. **NOTE** MRC set the "red flag" at a decrease that exceeds 10% because some stands may currently be misclassified or incorrectly mapped. Any reduction up to 10% could simply be a result of this type of measurement error. In fact, prior to HCP/NCCP implementation, we discovered errors that changed the amount of Type I acres by as much as 10%. • MRC will meet with the wildlife agencies to determine potential adaptive management if the number of individual old growth trees decline unexpectedly.

Rocky outcrops

Effectiveness Monitoring	
Distribution and Area of Rocky Outcrops	
PROGRAM CODE	M§13.8.1-6
OBJECTIVE O§9.5.2-1	• Preserve and maintain 3 rocky outcrops comprising 63 ac (20 ha) across 3 planning watersheds.
MONITORING APPROACH	• MRC will examine aerial imagery every 10 years to track changes in the number and size of rocky outcrops on our land. • MRC will identify all rocky outcrops on our land, excluding those in use as rock pits at the time of HCP/NCCP implementation. • MRC will evaluate acres of rocky outcrops by planning watershed using aerial photos and on-the-ground reconnaissance. • MRC acknowledges that drawing "boundary lines" around rocky outcrops is difficult. Our intent is to encompass all areas at least 1 ac in size in which ground cover is entirely rock and in which near vertical rock faces are at least 50 ft high and 100 ft long; these areas are not currently in use as rock pits.
MEASUREMENT CRITERIA	• MRC will use the number and size of rocky outcrops to detect changes across our land; rocky outcrops must be at least 1 ac in size and not

Effectiveness Monitoring	
Distribution and Area of Rocky Outcrops	
	currently in use as a rock pit to qualify for protection. • MRC will not use any of our current 63 ac of rocky outcrops for rock pits.
ADAPTIVE MANAGEMENT	• MRC anticipates that the actual acres of rocky outcrops on our lands may change as survey techniques improve. • MRC will meet with the wildlife agencies to determine potential adaptive management, if the distribution or area of rocky outcrops declines unexpectedly.

13.8.2 Natural communities

Obviously there is no single method to survey and monitor an entire ecosystem. At best, biologists can use indicators to judge the ongoing health of a natural community, for example:

- Is the acreage of a natural community shrinking or expanding?
- Is the population of a covered species in the natural community, such as the northern spotted owl, increasing, decreasing, or remaining stable?
- Is the distribution of an indicator species in a natural community changing?
- Is the species distribution within the natural community changing?

MRC is proposing that the level of monitoring intensity for a natural community be commensurate with the level of impact from management activities. Coastal redwood and Douglas-fir forest, mixed evergreen forest, and riparian forest comprise 98% of covered lands. The vast majority of the MRC monitoring effort will be in these 3 natural communities. Very limited monitoring will take place in the other natural communities—closed-cone or pygmy forest, oak woodland, salt marsh, and natural grassland—because they represent less than 2% of covered lands and little impact will occur in these areas. In pygmy forest, for example, there will be no timber harvesting and minimal road construction. Likewise, there will be no timber harvesting in oak woodlands; MRC will only conduct essential timber harvesting in conifer stands that border this natural community. Communities with few covered activities still merit monitoring to reveal changes in the status of constituent species or their habitat conditions. These changes may be due to human activity (e.g., litter, pollution, and alteration) or natural processes (e.g., succession and invasive species).

While Chapter 13 proposes specific monitoring goals for aquatic and terrestrial habitat and species, as well as rare plants, these goals in total can be a measure of the health of the MRC natural communities.

Common natural communities

This category applies to coastal redwood and Douglas-fir forest, mixed evergreen forest, and riparian forest. In this category, MRC will monitor covered species and their habitat through surveys and data gathering.

- Covered Species
  Monitoring abundance, richness, and distribution of covered species within a natural community can indicate whether changes are taking place that affect the health of the community. Analysis of data collected over time can show trends and signal declines and increases in the health of a community.
- Aquatic and Terrestrial Habitat

Monitoring abundance, richness, and distribution of habitat elements, such as snags, downed wood, or hardwoods, can show trends that signal declines and increases in the health of a community. More inclusive monitoring of species habitat, like the older forests preferred by northern spotted owls, may provide even better insight. All this information taken together can isolate limiting factors and improve community health.

Common natural communities

Effectiveness Monitoring	
Common Natural Communities	
PROGRAM CODE	M§13.8.2-1
OBJECTIVES O§9.6.1.2-1 O§9.6.1.2-2 O§9.6.1.2-3	• Regenerate harvested conifer forest with a mix of conifer species similar to the harvested stand. • Maintain various successional stages of coastal forest, including Type I and Type II old growth stands and representative hardwood forest areas. • Maintain existing stand dominance of native conifers other than redwood and Douglas-fir where this occurs.
MONITORING APPROACH	• MRC will review the number and species distribution of conifer species planted in harvested conifer stands. • MRC will conduct a review every 5 years of structure classes on covered lands. • MRC will assess the number of planted species to dominant species in any conifer stand in which conifers other than redwood and Douglas-fir predominate.
MEASUREMENT CRITERIA	• MRC will compare the number and species distribution of conifer species planted in a harvested stand with those that were harvested. If the distribution of planted conifer species is different from the distribution that existed prior to harvest, MRC will provide a rationale for the difference. MRC will consider proportion of planted species significantly different if it varies by more than 20% from the dominant conifer species mix. • MRC will continue ongoing review of structure classes in the expectation that there will be a trend towards mid-to-late successional stages. • MRC will review with the wildlife agencies if a change in structure class exceeds +/- 20%.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies, if any significant changes occur, to determine corrective actions, as needed. • MRC will review with the wildlife agencies any change in structure class which exceeds +/- 20% of the initial baseline numbers.

Uncommon natural communities

This category applies to closed-cone (pygmy and Bishop pine), oak woodland, and natural grassland. It is unlikely that covered activities will have a significant impact on these communities.

Effectiveness Monitoring	
Uncommon Natural Communities	
PROGRAM CODE	M§13.8.2-2
OBJECTIVES O§9.6.2.2-1	• Reintroduce and manage ecological processes or surrogates after obtaining approval of the wildlife agencies.
O§9.6.2.2-2	• Conserve 3274 ac of uncommon natural communities by limiting MRC activities within them: ▪ 135 ac of pygmy forest. ▪ 319 ac of Bishop pine. ▪ 1084 ac of oak woodlands. ▪ 1669 ac of grasslands. ▪ 67 ac of salt-marsh.
O§9.6.2.2-2	• Control any species which the wildlife agencies and MRC designate as an exotic invasive.
MONITORING APPROACH	**Pygmy forest and bishop pine** • MRC will delineate and provide acreage estimates of pygmy forest and bishop pine with each new set of satellite imagery, generally distributed in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our pygmy forest and bishop pine communities. • MRC will map and describe every 10 years the intensity and acreage of natural disturbances within our pygmy forest and bishop pine communities. • MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our pygmy forest and bishop pine communities. • MRC will establish 10 permanent vegetation composition plots in the pygmy forest community and 10 in the bishop pine community. • MRC will measure the plots within 5 years of their establishment and every 10 years thereafter. • MRC will ensure that each plot is 1/100th of an acre (11.8 ft radius). • MRC will record the following data for each plot: ▪ Species and dbh of every tree > 3 in. dbh. ▪ Height of every 3rd tree measured for dbh. ▪ Percentage of shrub cover by species. ▪ Herbaceous ground cover. ▪ Count of regenerating tree species. **Oak woodlands** • MRC will delineate and provide acreage estimates of our oak woodlands with each new set of satellite imagery, generally distributed in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our oak woodlands. • MRC will map and describe every 10 years the intensity and acreage of

Effectiveness Monitoring	
Uncommon Natural Communities	
	natural disturbances within our oak woodlands. • MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our oak woodlands. • MRC will establish 20 permanent vegetation composition plots within our oak woodlands. • MRC will measure the plots within 5 years of their establishment and every 10 years thereafter. • MRC will ensure that each plot is 1/10th of an acre (37.2 ft radius). • MRC will record the following for each plot: ▪ Species and dbh of every tree > 6 in. dbh. ▪ Height of every 3rd tree measured for dbh. ▪ Percentage of shrub cover by species. ▪ Count of regenerating tree species. **Grasslands** • MRC will delineate and provide acreage estimates of our grasslands with each new set of satellite imagery, generally distributed in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our grasslands. • MRC will map and describe every 10 years the intensity and acreage of natural disturbances within our grasslands. • MRC will describe specific information on other problems (such as feral pig damage or trash dumping) within our grasslands. • MRC will establish permanent photo point plots at 20 randomly selected locations within our currently existing grasslands. • MRC will take photos in every cardinal direction from each plot center within 5 years of plot establishment and every 10 years thereafter. **Salt-Marsh** • MRC will delineate salt-marsh and estimate its acreage with each new set of satellite imagery, and then distribute this information in 5-year intervals. • MRC will list and describe populations of new invasive plant species in our salt-marsh. • MRC will map and describe the intensity and acreage of natural disturbances within our salt marsh every 10 years.
MEASUREMENT CRITERIA	• MRC will compare all future data to baseline data in a report provided to the wildlife agencies within 1 year following measurements. • MRC will compare future data to baseline data to determine if species composition is changing in natural communities.

Effectiveness Monitoring	
Uncommon Natural Communities	
ADAPTIVE MANAGEMENT	• MRC will analyze the data and meet with the wildlife agencies to assess changes in species composition in these uncommon natural communities. **NOTE** If MRC and the wildlife agencies agree that there is a change in species composition in these communities, the wildlife agencies may provide financial assistance to MRC to address the changes that shift the natural community away from its current type (e.g., oak woodland shifting towards Douglas fir).

13.8.3 Invasive species control

Effectiveness Monitoring	
Invasive Species Control	
PROGRAM CODE	M§13.8.3-1
OBJECTIVES O§9.7.2-1	• Eradicate or reduce the cover, biomass, and distribution of target, non-native invasive plants, such as jubata grass, broom, and eucalyptus, in the plan area through an Invasive Plant Control Program (IPCP).
O§9.7.2-2	• Reduce the number and distribution of non-native, invasive animals, such as bullfrogs, if they threaten the ecological balance in natural communities or the populations of covered species.
O§9.7.2-2	• Implement, with external or MRC funding and with the cooperation of the wildlife agencies as well as other land agencies, control programs which benefit the region through information on existing and newly discovered invasive species.
MONITORING APPROACH	• MRC will provide the wildlife agencies an annual progress report on developing the Invasive Plant Control Program (IPCP). • MRC will develop a database, in consultation with the wildlife agencies, of current and historic outbreaks of invasive species in the plan area, including ▪ Relative size of the outbreak. ▪ GPS location. ▪ Treatment (chemicals, amount, and application). ▪ Control outcomes. • MRC will report annually to the wildlife agencies on known populations of invasive species in the plan area.
MEASUREMENT CRITERIA	• MRC will compare all future data to baseline data and issue a report to the wildlife agencies within 1 year of data collection.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies, if any significant changes occur, to determine corrective actions, as needed.

13.9 Monitoring terrestrial species

13.9.1 Northern spotted owls

13.9.1.1 Productive and strategic territories

Effectiveness monitoring for northern spotted owls consists of 2 monitoring programs. The first monitoring program determines reproductive status of known productive territories and whether "strategic" territories may produce young in the near future. The "strategic" territories may replace other Level-1 and Level-2 territories that decline in productivity as the owls within the territories grow older or are displaced. The second program tracks habitat distribution on the landscape to ensure MRC is meeting our objectives.

13.9.1.2 Banding program

As part of our monitoring and management, MRC proposes to band spotted owls. This will help us better understand the demographic patterns of our owl populations, as well as the success at reproduction and survival of individual owls protected by different management strategies. Banding under our HCP/NCCP permit will replace the typical recovery permit. In order to accommodate the wildlife agencies, we have accepted the following restrictions:

1. MRC must band or re-sight at least 60 northern spotted owls in every calendar year.
2. MRC will meet with the wildlife agencies, if we do not succeed in banding or re-sighting the requisite number of spotted owls, to determine if we can continue the banding program.
3. MRC will include in an annual report (a) re-sightings of spotted owls dispersing from other timberlands or other territories on covered lands; (b) calculations to determine owl demographic parameters[14] of populations (such as survival); and (c) lists of all bands placed on spotted owls.
4. MRC will report any injury or mortality to the wildlife agencies.
5. MRC will only use individuals approved by the wildlife agencies to band spotted owls.

If MRC does not adhere to the above restrictions, the wildlife agencies may rescind our banding authorization.

13.9.1.3 Effectiveness monitoring

Level-1 and level-2 territories of northern spotted owls

Effectiveness Monitoring	
Northern Spotted Owls: Level-1 and Level-2 Territories	
PROGRAM CODE	M§13.9.1.3-1
OBJECTIVES O§10.3.1.2-1	**Population Objective 1** • Maintain at least 28 Level-1 territories and 67 Level-2 territories during the first 60 years of our HCP/NCCP.
O§10.3.1.2-2	**Population Objective 2** • Increase to 34 Level-1 territories and 80 Level-2 territories by Year 75 of our HCP/NCCP.

[14] Because of the years of data collection needed to calculate these parameters, MRC may not be able to provide any statistically valid demographics until 10 years after HCP/NCCP implementation.

Effectiveness Monitoring	
Northern Spotted Owls: Level-1 and Level-2 Territories	
O§10.3.1.2-3 O§10.3.1.2-4	**Distribution Objective 1** • Achieve by Year 40 of our HCP/NCCP a distribution of spotted owl territories in each inventory block that is proportionate to its potential nesting/roosting habitat in the plan area, i.e., an inventory block with 10% of the total nesting/roosting habitat on MRC covered lands should have at least 10% of the Level-1 and Level-2 territories specified in the population objectives (see Table 10-7). **Distribution Objective 2** • Achieve by Year 75 of our HCP/NCCP a distribution of spotted owl territories in each inventory block that exceeds *Distribution Objective 1* by 20% (see Table 10-7).
MONITORING APPROACH	• MRC will use standard protocols to survey and monitor northern spotted owl reproduction (see Appendix K, section K.5, *Protocols*). • MRC will annually monitor all territories assigned high or moderate protection as well as strategic territories with limited protection to identify their productivity level, using the following parameters: ▪ Occupancy status (male, female, pair, absent, unknown). ▪ Nesting status (nesting, nesting unknown, or non-nesting). ▪ Number of fledglings produced (unknown, 0, 1, 2, or 3). • MRC will determine the number and locations of strategic Level-3 owls to monitor using the following parameters: ▪ Number of Level-1 and Level-2 owl territories in the previous year. ▪ Number of Level-3 territories within inventory blocks that may not meet distribution objectives. ▪ Proximity of Level-3 territories to harvests or other operations. • MRC will band and track Level-1, Level-2, and strategic Level-3 spotted owls.
ADAPTIVE MANAGEMENT	• MRC will implement contingency strategies, if the number of Level-1 and Level-2 territories falls below contingency triggers (section 10.3.2.5).

Distribution and acreage of nesting/roosting habitat

Effectiveness Monitoring	
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	
PROGRAM CODE	M§13.9.1.3-2
OBJECTIVES O§10.3.1.2-5 O§10.3.1.2-6	**Habitat Objective 1** • Achieve by Year 40 of our HCP/NCCP a landscape configuration in which 23% of all potential habitat is nesting/roosting habitat, while still maintaining separate objectives for each inventory block. **Habitat Objective 2** • Achieve by Year 75 of our HCP/NCCP a landscape configuration in which 25% of all potential habitat and 25% of each inventory block are nesting/roosting habitat.

Effectiveness Monitoring	
Northern Spotted Owls: Distribution and Acreage of Nesting/Roosting Habitat	
MONITORING APPROACH	• MRC will use data from our forest inventory and growth model to determine the amount of nesting/roosting habitat by inventory block every 10 years for all covered lands (see Appendix U, section U.7, *Structure Classes and Habitat Inferences*).
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies, if we do not meet *Habitat Objective 1* or *Habitat Objective 2*, to determine whether we should implement potential adaptive management strategies including ▪ Increasing the minimum habitat retention within 0.7 miles of core areas. ▪ Increasing core areas in owl territories with high protection to increase overall habitat.

13.9.1.4 Validation monitoring

Though limited in scope, validation monitoring requires more intensive effort than effectiveness monitoring. MRC will examine 6 hypotheses related to owl population trends, habitat classification, and protection levels. All validation monitoring programs are optional with the exception of those for Hypothesis 1 and Hypothesis 4. Hypotheses 3 through 6 use the MRC banding program as an assessment tool.

Population trends (required)

Validation Monitoring	
Population Trends of Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-1
HYPOTHESIS SECTION 5.2.10	• The number of northern spotted owl territories is stable or increasing on covered lands in the short-term and will increase in the long-term.
MONITORING APPROACH	• MRC will track trends of spotted owls by completing a rolling 5-year survey over covered lands; survey results will include the number of owl detections and territories located. • MRC will complete 3 surveys within 1 year in inventory blocks, covering an equivalent acreage every year (see Appendix K, section K.5, *Protocols*). • MRC will coordinate our survey efforts with other surveys (e.g., PTHP surveys and effectiveness monitoring for Level-1 and Level-2 territories) so that we do not "over-call" owls. • MRC will geographically stratify inventory blocks in order to decrease the effect of geography on results.
MEASUREMENT CRITERIA	• MRC will compare the number of territories located every 5 years with those located in the previous 5 years to determine if the number of territories has increased, decreased, or remained the same (see Appendix K, section K-7, *Survey plan for determining population trends*). • MRC will report on the number of territories detected annually and consult with the wildlife agencies on how to detect a trend in the number of territories.

Validation Monitoring	
Population Trends of Northern Spotted Owls	
ADAPTIVE MANAGEMENT	• MRC will examine the cause of any deviation from the previous number of territories and meet with the wildlife agencies. • MRC may convene a scientific review panel to examine the causes of decline and to recommend corrective actions.

Nesting/roosting habitat (optional)

Validation Monitoring	
Identification of Nesting/Roosting Habitat for Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-2
HYPOTHESIS SECTION 5.2.10	• MRC has used structure classes to correctly designate nesting/roosting habitat.
MONITORING APPROACH	• MRC has developed a nest site protocol to ground-truth areas around nest sites and compare habitat features around nests to random sites (see Appendix K, section K.3.3. *Comparison of nest tree and random tree*). • MRC will ground-truth at least 100 nest sites using this method. • MRC will complete the first set of nest sites by HCP/NCCP commencement. • MRC will undertake the nest-site survey again 40 years after HCP/NCCP commencement to determine if northern spotted owls select different nesting habitat as habitat changes in response to timber management. • MRC will enter data from the nest-site survey into a spreadsheet and translate the data into inventory structure classes, used to assign habitat types to stands. • MRC will categorize structure classes as nesting/roosting, foraging, or unsuitable habitat (section 10.3.1.4.7, *Validation of habitat typing*). **NOTE** MRC will not re-sample nest sites from the same northern spotted owl territory until we have measured all Level-1 and Level-2 territories. This should limit any statistical biases associated with a lack of independence.
MEASUREMENT CRITERIA	• MRC will determine what percentage of our sampled nest sites are in plots not identified in our inventory as nesting/roosting habitat.
ADAPTIVE MANAGEMENT	• MRC will meet with the wildlife agencies to discuss potential changes in habitat typing if our verification rate is less than 60% correct. **NOTE** MRC can only make changes to structure class assignments with prior approval of the wildlife agencies. • MRC will meet with the wildlife agencies to change structure class assignments if either believes a change is warranted—even in cases where MRC habitat typing proves to be 60% or more correct. • MRC will notify the agencies of any changes in structure class assignments, including affected acreage, through the annual report for northern spotted owls. • MRC will adjust or alter the rules for designating structure class, as required.

Benefits of high protection (optional)

Validation Monitoring	
Benefits of High Protection for Northern Spotted Owls and Their Territories	
PROGRAM CODE	M§13.9.1.4-3
HYPOTHESIS SECTION 5.2.10	• The demographic parameters of individual owls and owl territories with high protection will show more improvement than those with moderate protection.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for recapture identification). • MRC will assess productivity levels of all territories and individual owls protected with high and moderate protection using protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*. • MRC will assign owls the productivity level of the territory they inhabit at the time of assessment. • MRC will use 10 years of productivity data to assess a total productivity for each individual owl or owl territory assessed. • MRC will determine the total years of high protection for each individual owl or owl territory. • MRC will evaluate each territory on its assigned protections as well as on its functional protection (i.e., the average amount of habitat acreage present regardless of assigned productivity level) during the 10-year assessment timeline.
MEASUREMENT CRITERIA	• MRC will determine if high protection results in improved demographic parameters of northern spotted owls or owl territories. ▪ MRC will infer that assigned or equivalent high protection results in enhanced vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is greater than sites assigned moderate protection. ▪ MRC will infer that assigned or equivalent high protection results in equivalent vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is equal to sites assigned moderate protection. ▪ MRC will infer that assigned or equivalent high protection has a negative impact on vital rates or territory occupation if the number of fledglings, survival of adults, or fidelity to the territory is less than sites assigned moderate protection.
ADAPTIVE MANAGEMENT	• MRC will provide the most productive spotted owls with a 90-acre core area if a there is a detectable positive effect from the high protection measures. • MRC will provide the most productive spotted owls with a 72-acre core area if there is a detectable negative effect from the high protection measures. • MRC will only make adaptive management changes after at least 20 years of data collection, including contingencies.

Effect of harvest (required)

Validation Monitoring	
Effect of Harvest within 1000 ft of NSO Territories with Limited Protection	
PROGRAM CODE	M§13.9.1.4-4
HYPOTHESIS SECTION 5.2.10	• Harvesting within 1000 ft of an activity center with limited protection results in the death, dispersal, or reduction in fecundity of excess productive owls and implementation of protections does not curb their disappearance from covered lands.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 10 years of our HCP/NCCP. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for recapture identification). • MRC will assign all owls the productivity of the territory they inhabit in the assessment year. • MRC will assess—in each of the 3 years after harvest within 1000 ft of owls and owl territories with limited protection—the occupancy, pair status, and productivity level of all such owls and owl territories, using protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*.
MEASUREMENT CRITERIA	• MRC will infer that an individual owl is not adversely affected by a harvest if it continues to occupy a territory or its productivity does not decrease in the next 3 years. • MRC will infer that an individual owl is adversely affected by a harvest if it does not occupy a territory or its productivity decreases in the next 3 years. • MRC, in consultation with the wildlife agencies, will compile results every 5 years to determine how many "no effect" harvests constitute an overall result of "no effect" in limited protection territories.
ADAPTIVE MANAGEMENT	• MRC may use this study, with concurrence of the wildlife agencies, to decrease or increase the breeding season buffer by 100 ft for owl territories with limited protection. **NOTE** MRC also uses validation monitoring to confirm our requirements for post-harvest termination mitigation (Appendix Y, *Termination Mitigation*).

Effect of habitat on productivity (optional)

Validation Monitoring	
Effect of Habitat on Productivity of Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-5
HYPOTHESIS SECTION 5.2.10	• The pattern, arrangement, and amount of acreage of both foraging and nesting/roosting habitat within 0.7 miles of an activity center can affect the productivity of the associated owl and its territory.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will band each northern spotted owl with a color patterned band on one leg (for ease of re-sighting) and an individual USFWS numbered band on the other leg (for re-capture identification). • MRC will assess occupancy, pair status, and productivity level of (a) all banded owls, (b) all owls receiving high or moderate protection, and (c) some owls receiving limited protection, according to the protocols outlined in Appendix K, section K.5.3, *Protocols for determining reproductive status*. • MRC will assign all owls the productivity of the territory they inhabit in the assessment year. • MRC will compute the amount of each habitat type within 0.7 miles of selected spotted owl territories during the time frame of assessment.
MEASUREMENT CRITERIA	• MRC, in consultation with the wildlife agencies, will compile results every 5 years to determine if we need to make any changes in habitat protection.
ADAPTIVE MANAGEMENT	• MRC, with concurrence of the wildlife agencies, will decrease the amount of required habitat for moderate protection owls within 0.7 miles of the current activity center from 500 ac to 450 ac if owl productivity does not positively correlate with the amount of foraging and nesting/roosting habitat • MRC, with concurrence of the wildlife agencies, will increase the amount of required habitat for moderate protection owls within 0.7 miles of the current activity center from 500 ac to 550 ac if owl productivity does positively correlate with the amount of foraging and nesting/roosting habitat.

Effect of hardwood acreage on northern spotted owls (required)

Validation Monitoring	
Effect of Hardwood Density on Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-6
HYPOTHESIS SECTION 5.2.10	• There is no correlation between spotted owls and the amount and basal area of hardwoods, especially tanoaks within 0.7 miles of owl activity centers.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 10 years of HCP/NCCP implementation. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*. • MRC will assess productivity of all individual owls and territories selected for 3 consecutive years, using protocols outlined in Appendix K, section

Validation Monitoring	
Effect of Hardwood Density on Northern Spotted Owls	
	K.5.3, *Protocols for determining reproductive status*. • MRC will conduct a pilot study using 9 randomly selected spotted owl territories—3 from Navarro East inventory block, 3 from Navarro West inventory block, and 3 from Albion inventory block—that are not likely to be abandoned and that have a history of frequent occupation. **NOTE** MRC biologists determine annually which territories are likely to be abandoned by how long owls have been absent from those territories. If owls have been absent from a territory for 3 consecutive years, for example, we consider the territory abandoned. • MRC will evaluate, in each of the 3 years, hardwood basal area within several different spatial buffers up to 0.7 miles of activity centers using a sampling and inventory protocol agreed upon by us and the wildlife agencies. • MRC will determine if there is a correlation between spotted owl productivity and the amount of tanoak basal area in the vicinity of owl activity centers.
MEASUREMENT CRITERIA	• MRC will infer a positive relationship if there is a positive correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center. • MRC will not infer a relationship if there is no correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center. • MRC will infer a negative relationship if there is a negative correlation between owl productivity and basal area of hardwoods within several different spatial buffers up to 0.7 miles of an owl activity center.
ADAPTIVE MANAGEMENT	• MRC and the wildlife agencies will decide whether to continue this validation monitoring program based on the results of the pilot study • MRC and the wildlife agencies will determine a study plan for the remainder of the term, if they decide to continue the study. • MRC may increase hardwood retention within 0.7 miles of spotted owl activity centers, if there is a positive correlation between basal area of hardwoods and owl productivity.

Effect of barred owl control on northern spotted owls (required)

Validation Monitoring	
Effect of Barred Owl Control on Northern Spotted Owls	
PROGRAM CODE	M§13.9.1.4-7
HYPOTHESIS 5.2.10	• Occupancy of northern spotted owl territories where MRC has controlled or removed barred owls will improve. • Occupancy of northern spotted owl territories where MRC has not controlled or removed barred owls will decline.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 2 years of HCP/NCCP implementation. • MRC will follow all banding procedures outlined in Appendix K, section K.6.2, *Banding of northern spotted owls*.

Validation Monitoring	
Effect of Barred Owl Control on Northern Spotted Owls	
	• MRC will assess the demographic parameters of all individual northern spotted owls and their territories impaired by barred owls before MRC commences control efforts and for at least 10 years after such control efforts. • MRC will assess the demographic parameters of northern spotted owls and their territories where MRC has not controlled or removed barred owls for at least 10 years. • MRC will work with the wildlife agencies to gain the appropriate permits for the removal of barred owls from northern spotted owl territories; we will use these pilot efforts to guide further studies for barred owl control during HCP/NCCP implementation. **NOTE** After lethal removal of barred owls, MRC will make a reasonable attempt to locate authorized schools, museums, researchers, agencies, and others who can properly and legally use the carcasses. In the event that our attempts are unsuccessful, MRC will inform the wildlife agencies and offer them the specimens. After MRC exhausts all reasonable options for donation of the carcasses, we will burn or bury them in accordance with California State and federal law. • MRC will determine if there is any improvement in the demographics of northern spotted owl territories (i.e., greater productivity) following barred owl control. • MRC and the wildlife agencies will outline in a study plan the demographic parameters and statistical tests that MRC will use to determine the effectiveness of barred owl control.
MEASUREMENT CRITERIA	• MRC will infer a positive effect if occupancy and productivity of northern spotted owls improve after barred owl control and removal, and decline in areas where MRC has not implemented such control and removal. • MRC will not infer a relationship if there is no difference in the demographic parameters of northern spotted owls in areas with barred owl control and removal versus areas without such control and removal. • MRC will infer a negative effect if occupancy and productivity of a majority of northern spotted owls decline after barred owl control and removal or show no improvement over spotted owl demographics in areas where MRC has not implemented such control and removal. • MRC and the wildlife agencies will confer to determine how mixed results (i.e., no difference between northern spotted owl territories with control and those without) fit into adaptive management protocol.
ADAPTIVE MANAGEMENT	• If MRC infers a positive effect, we will continue with control of barred owls in northern spotted owl territories. • If MRC infers a mixed effect, MRC and the wildlife agencies will evaluate and improve the study plan to better understand the effect of barred owl removal on northern spotted owls. • If MRC infers a negative effect, we will implement a reduced contingency trigger (30% rather than 20% of the northern spotted owl population) and provide an 18 acre "no harvest" core area for all spotted owl pairs assigned limited protection.

13.9.2 Marbled murrelet

13.9.2.1 Effectiveness monitoring

Previous MRC surveys for murrelets in Lower Alder Creek were scattered throughout the watershed, rather than in consistent locations from year to year. As part of HCP/NCCP implementation, MRC will use permanent radar stations to determine the level of murrelet activity within Lower Alder Creek. These surveys will provide an index of murrelet abundance each year. MRC and the wildlife agencies will determine if the activity level of murrelets is increasing, decreasing, or remaining stable. By providing this information on murrelet activity trends in Lower Alder Creek, MRC will contribute considerably to regional knowledge of murrelet populations.

MRC will also complete annual radar surveys on the Navarro River, Greenwood Creek, and the Albion River as part of our effectiveness monitoring. Since we detected murrelets flying up the Navarro River in 2000 and 2001, we will survey this drainage for continued activity. However, MRC will not track activity trends due to the low number of detections. If additional detections occur on other drainages, MRC and the wildlife agencies may switch the monitoring effort to these locations. Moreover, the wildlife agencies may fund additional radar surveys above and beyond those in LACMA and the designated drainages.

Radar monitoring for murrelets in Lower Alder Creek

Effectiveness Monitoring	
Activity Level of Marbled Murrelets in Lower Alder Creek	
PROGRAM CODE	M§13.9.2.1-1
OBJECTIVE O§10.3.2.2-2	• Retain permanently all sites occupied by marbled murrelets.
MONITORING APPROACH	• MRC will establish and maintain 2 permanent radar survey stations (Appendix L, *Marbled Murrelet Data and Protocol*, Figure L-1) on the Lower Alder Creek drainage, specifically at the rock pit approximately 1 mile above the mouth of Alder Creek and 1 mile west of the rock processing plant (closer to the coast). • MRC began a pilot project[15] in 2011 to assess annual variation, determine our ability to detect trends in numbers of detections, and establish a baseline activity level in Lower Alder Creek. • MRC will continue the pilot project through 2011 at which point MRC and the wildlife agencies will decide on any alterations to the project. • MRC will, as part of the pilot project, ▪ Conduct all surveys from June 15th–July 31st in order to maximize detections. ▪ Conduct 5 surveys at each of the sites for a total of 10 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise.

[15] Although MRC completed previous radar surveys near these radar stations, there were inconsistencies in the number of completed surveys, the time of year, and the location of the survey stations. For this reason, we will use data from surveys completed in 2007 through 2011 to establish a baseline number of murrelet detections in lower Alder Creek. We will use this baseline to assess whether the number of murrelet detections is declining. To assess the statistical power of our current proposal, we used data from 2003 through 2005. The results of this analysis are in Appendix L, section L.2, *Radar Surveys in LACMA*.

Effectiveness Monitoring	
Activity Level of Marbled Murrelets in Lower Alder Creek	
	▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph each radar site annually and provide these photos to the wildlife agencies in an annual report; take photos looking in the direction of the area surveyed by the radar unit. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) for surveys following the 2011 survey season. • MRC, in consultation with the wildlife agencies, will complete a power analysis on the data from the completed pilot study. From this analysis we will assess any detectable decrease in the murrelet population and possibly change survey efforts or protocol with the agreement of the wildlife agencies. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC and the wildlife agencies will concur on a monitoring plan if additional occupied murrelet sites are located in the plan area. • MRC will use the mean or median number (or other measures of abundance with the agreement of the wildlife agencies) of murrelet detections per radar survey per year; data from 2007-2011 will provide the baseline index for activity levels of murrelets in Lower Alder Creek. • MRC will analyze surveys prior to 2011 and thereafter to determine the number of detections at each survey station; for example, the number of detections closer to the mouth of Lower Alder Creek is vastly greater than the number of detections at the rock pit. • MRC will include survey statistics in an annual report, such as mean, median, range of detections, standard error, and standard deviation of detections.
MEASUREMENT CRITERIA	• MRC will compare annual detections of murrelets with the baseline number of detections in future years to uncover any decline in the number of detections.
ADAPTIVE MANAGEMENT	• MRC will continue to monitor permanent radar stations in Lower Alder Creek even if murrelets decline or if they are no longer detected for the term of the plan. • MRC and the wildlife agencies may explore independent correlates of trend including prey base, offshore conditions, and disease. • MRC may take a more conservative approach to conservation measures in Lower Alder Creek, providing (a) larger disturbance buffers and more habitat protections for known occupied sites; (b) active corvid management; and (c) temporary restrictions on harvesting.

Radar monitoring for murrelets in Navarro, Greenwood Creek, and Albion

Effectiveness Monitoring	
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	
PROGRAM CODE	M§13.9.2.1-2
OBJECTIVE O§10.3.2.2-3	• Maintain murrelet presence in the Navarro River watershed and in drainages in which, in the future, MRC biologists detect murrelets.
MONITORING APPROACH	• MRC will establish and maintain 6 permanent survey stations for radar monitoring with concurrence of the wildlife agencies—2 on Navarro River, 2 on Albion River, and 2 on Greenwood Creek. **NOTE** Our intent is to set up radar monitoring stations on drainages where murrelets currently occur or likely will occur in the future. • MRC will ▪ Conduct all surveys from June 15th through July 31st in order to maximize detections. ▪ Conduct 2 surveys at each of the sites for a total of 12 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise. ▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph annually each radar site in the direction of the area surveyed and provide these photos to the wildlife agencies in an annual report. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) after the initial survey season. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC will include survey statistics in an annual report, such as mean, median, range of detections, standard error, and standard deviation of detections.
MEASUREMENT CRITERIA	• MRC will compare annual detections of murrelet in the Navarro River, Albion River, and Greenwood Creek with previous data. • MRC will consider even 1 "murrelet-type" detection in the Albion River or Greenwood Creek a major finding that requires consultation with the wildlife agencies.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies if any murrelet-type detections occur on Greenwood Creek or Albion River. • MRC will consider all potential trees as primary murrelet trees in drainages where murrelet-type detections occur until MRC and the wildlife agencies agree and implement a plan to narrow down the areas where murrelets are present and absent. For example, in the Navarro watershed, MRC considers all potential trees as primary murrelet trees in the Navarro West inventory block; in the Navarro East inventory block, however, potential trees can be

Effectiveness Monitoring	
Murrelet Occupancy in Navarro, Greenwood Creek, Albion River Watersheds	
	either primary or secondary murrelet trees.

13.9.2.2 Validation monitoring

MRC will conduct validation monitoring on 3 hypotheses for marbled murrelets:

1. Current LACMA boundary covers all murrelet habitat within the Lower Alder Creek planning watershed.

   NOTE
   To our knowledge, we have included all potential murrelet habitat in the Lower Alder Creek watershed within LACMA; however, we have not completed a field review of all stands in the Lower Alder Creek watershed. As a result of habitat assessment, we may add or switch acres in LACMA to better protect potential habitat stands contiguous with LACMA.

2. Specific silvicultural techniques for specific stands will accelerate growth of marbled murrelet habitat.

   NOTE
   Management within LACMA will allow stands without current habitat to progress quickly to potential nesting stands. To further accelerate growth of marbled murrelet habitat, MRC may experiment with silvicultural prescriptions elsewhere in the plan area.

3. Murrelets may re-colonize other areas of MRC forestland.

   NOTE
   MRC will rotate radar stations in watersheds where murrelets are more likely to occur to determine if murrelets may be in areas previously thought to be unoccupied.

These 3 adaptive management programs are optional; MRC may or may not implement them during the term of our HCP/NCCP.

Murrelet habitat distribution in LACMA (optional)

Validation Monitoring	
Murrelet Habitat Distribution in LACMA	
PROGRAM CODE	M§13.9.2.2-1
HYPOTHESIS SECTION 5.3.8	• The current LACMA boundary covers all areas of murrelet habitat in the Lower Alder Creek drainage.
MONITORING APPROACH	• MRC, in consultation with the wildlife agencies, will determine within the first 5 years of our HCP/NCCP a system to evaluate areas of potential murrelet habitat within the Lower Alder Creek watershed that are contiguous with but outside of LACMA and that may provide better habitat. • MRC, in consultation with the wildlife agencies, will determine whether an area is characteristic of murrelet habitat or not; the most basic criteria is whether there are at least 3 potential habitat trees each within 100 ft of another. • MRC will set up radar or ground-observer stations for areas of potential murrelet habitat and, if possible, conduct surveys.
MEASUREMENT CRITERIA	• MRC will determine that murrelets are occupying an area if any murrelets exhibit behavior indicative of occupancy.

Validation Monitoring	
Murrelet Habitat Distribution in LACMA	
ADAPTIVE MANAGEMENT	• MRC may add newly discovered occupied stands within the Lower Alder Creek drainage to LACMA and extend the associated conservation measures to the stands as long as the maximum acreage of LACMA remains less than 1437 ac. • MRC, with the agreement of the wildlife agencies, may trade suitable habitat areas contiguous with the current boundary of LACMA for existing habitat areas in LACMA if LACMA has reached its maximum acreage of 1437 ac. **EXAMPLE** Area-1 is in LACMA; there have been no murrelet detections in Area-1. Area-2 is outside LACMA but within the Lower Alder Creek drainage; there have been murrelet detections in Area-2. MRC, with agreement of the wildlife agencies, could *trade* Area-2 for Area-1.

Accelerating murrelet habitat growth (optional)

Validation Monitoring	
Methods for Accelerating Growth of Murrelet Habitat	
PROGRAM CODE	M§13.9.2.2-2
HYPOTHESIS SECTION 5.3.8	• Specific silvicultural prescriptions will generate suitable marbled murrelet habitat quicker than not managing a stand silviculturally.
MONITORING APPROACH	• MRC will develop, in consultation with the wildlife agencies, a study plan within the first 5 years of our HCP/NCCP. • MRC will pre-test the proposed methods over a period of at least 5 years in 2 or more stands outside of LACMA before implementing them within LACMA, with the exclusion of murrelet core areas. • MRC will establish permanent paired habitat plots in stands in the Lower Alder Creek Habitat Area (LACHA) or the Lower Alder Creek Buffer Area (LACBA), managing one area with habitat improvement and leaving the other unmanaged. • MRC will evaluate permanent plots once every 5 years for changes in stand structure and individual trees. • MRC will measure all characteristics that could affect whether a stand is murrelet habitat or not (i.e., dbh, tree species composition, diameter of largest limbs, canopy cover, etc.). • MRC will permanently mark and identify trees in the plots so that they can be monitored throughout the term of our HCP/NCCP.
MEASUREMENT CRITERIA	• MRC will compare habitat characteristics between the managed and unmanaged stands.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies, after 20 years of monitoring, if (1) there is no detectable change between managed and unmanaged stands; or (2) unmanaged stands are producing murrelet habitat faster than managed stands; or (3) managed stands are producing murrelet habitat faster than unmanaged stands. • MRC and the wildlife agencies will decide if specific silvicultural prescriptions can be implemented for specific stands within LACMA that will not require wildlife agency consultation.

Validation Monitoring	
Methods for Accelerating Growth of Murrelet Habitat	
	• MRC may waive this adaptive management if both MRC and the wildlife agencies agree that (1) new research adequately addresses the issue of how to manage forests to accelerate habitat for marbled murrelets; and (2) MRC implements the methods behind that research.

Radar monitoring in additional drainages (optional)

Validation Monitoring	
Radar Monitoring in Additional Drainages	
PROGRAM CODE	M§13.9.2.2-3
HYPOTHESIS SECTION 5.3.8	• Murrelets will re-colonize other areas of MRC forestland.
MONITORING APPROACH	• MRC will rotate radar monitoring stations in 9 additional drainages over a 10-year period: [16] 1. Juan Creek (Rockport inventory block). 2. Hardy Creek (Rockport inventory block). 3. Mallo Pass Creek (South Coast inventory block). 4. Elk Creek (South Coast inventory block). 5. Russell Brook (Big River inventory block). 6. Noyo River (Noyo inventory block). 7. Hollowtree Creek (Rockport inventory block). 8. Garcia River (Garcia inventory block). 9. Cottaneva Creek (Rockport inventory block). • MRC will complete 2 radar surveys on 2 of the 9 drainages every year, i.e., 4 radar surveys per year. • MRC will ▪ Conduct all surveys from June 15th through July 31st in order to maximize detections. ▪ Conduct 5 surveys at each of the sites for a total of 10 surveys throughout the year. ▪ Start surveys 75 minutes before sunrise and end them 75 minutes after sunrise. ▪ Maintain each radar station by topping small trees and shrubs less than 4 in. dbh to keep them below road level. ▪ Seek approval of the wildlife agencies for any other management at the radar sites. ▪ Photograph annually each radar site in the direction of the area surveyed and provide these photos to the wildlife agencies in an annual report. ▪ Determine, in consultation with the wildlife agencies, the appropriate radar settings (or range of radar settings) after the initial survey

[16] The *HCP/NCCP Atlas* (MAPS 6A-C) shows the plan area, the inventory blocks, locations of documented detections from past murrelet surveys, and points of no detection.

Validation Monitoring	
Radar Monitoring in Additional Drainages	
	season. • MRC may change, after consultation with the wildlife agencies, the locations of proposed survey sites if better sites emerge. • MRC will include in the annual report survey statistics, such as mean, median, range of detections, standard error, and standard deviation of detections. • MRC and the wildlife agencies will review the ongoing need for this monitoring program after every 10-year cycle.
MEASUREMENT CRITERIA	• MRC will use the number of murrelet-type detections in each drainage to evaluate the hypothesis.[17]
ADAPTIVE MANAGEMENT	• MRC, if we do not complete this monitoring program in any given year, will consider all trees in all covered lands outside of Navarro, Albion, and Greenwood Creek watersheds as primary murrelet trees until we re-commence the program. • MRC will confer with the wildlife agencies if any murrelet-type detections occur during any surveys. • MRC will consider all potential trees as primary murrelet trees in drainages where murrelet-type detections occur until MRC and the wildlife agencies agree and implement a plan to narrow down the areas murrelets occupy. • MRC will designate primary and secondary murrelet trees in areas murrelets do not occupy.

13.9.3 Point arena mountain beaver

13.9.3.1 Effectiveness monitoring

MRC has not consistently monitored burrow systems of Point Arena mountain beavers in the past; information is sparse on burrow systems and spatial extent. We will use the spatial extents of known burrow systems to determine whether we are protecting the burrow systems under the proposed conservation measures. An on-going study of the Point Arena mountain beavers, begun in 2004, may help us to design a more effective monitoring program (Zielinski and Mazurek 2006).

Spatial extent of PAMB burrow systems

Effectiveness Monitoring	
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	
PROGRAM CODE	M§13.9.3.1-1
OBJECTIVE O§10.3.3.2-1	• Maintain or enhance at least 85% of the known burrow systems of Point Arena mountain beaver in the plan area (i.e., 12 of 14).
MONITORING APPROACH	• MRC will establish the initial size of known burrow systems by measuring their spatial extent. • MRC will designate any burrow greater than 32 ft (10 m) from its nearest burrow as a separate burrow system.[18]

[17] Appendix L, *Marbled Murrelet Data and Protocol*, defines "murrelet-type detection" on p. L-1.

Effectiveness Monitoring	
Spatial Extent of Known Burrow Systems of Point Arena Mountain Beaver	
	• MRC will re-visit each known mountain beaver burrow system in the initial year of HCP/NCCP implementation and every 5 years thereafter to assess whether it is active or inactive and its spatial extent. We will initially place fern bundles at the entrance to the 5 burrow openings exhibiting the greatest likelihood of being active in a system to determine if a site is active or inactive; sites in which bundles remain after 4 days will be considered inactive. Later, MRC may use hair snares or camera stations to assess active burrow systems. Other signs of an active burrow include fresh excavations and herbaceous plant clippings near or around the burrow. Signs of an inactive burrow include growth of vegetation over the burrow entrance, cobwebs over the burrow entrance, and a general appearance of abandonment. • MRC will set a reference point with a permanent marker and measure the distance from this point to openings at the edges of the burrow system (Figure 13-5). • MRC will convert information on burrow systems to GIS coverage in which polygons will represent each burrow system; GIS will determine the size of each burrow system.
MEASUREMENT CRITERIA	• MRC, in consultation with the wildlife agencies, will determine our ability (or statistical power) to detect differences in the size of burrow systems after completing 2 rounds of measurements on all surveyed burrow systems. • MRC will compare the area of each burrow system to previous assessments of the spatial extent of each burrow system. • MRC, in consultation with the wildlife agencies, will determine by year 2025 (1) the detectable size differences in average spatial extent of all burrow systems and (2) the spatial extent of individual burrow systems.
ADAPTIVE MANAGEMENT	• MRC will halt research and consult with the wildlife agencies if the number of active burrow systems falls below our objectives, namely 12. • MRC will consult with the wildlife agencies if we detect a decreasing trend in the spatial extent of burrow systems.

[18] In completing initial surveys of mountain beaver burrow systems, MRC surveyors generally noted that if another burrow was not found within 32 ft (10 m) of the last burrow, it was exceedingly unlikely to find more burrows farther away. As a result, we collected all baseline data with 32 ft as the minimum distance between two separate burrow systems.

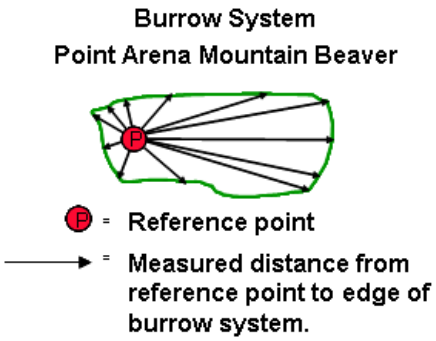

Figure 13-5 Measuring Spatial Extent of Burrow System

Creating habitat within dispersal distance of existing burrow systems

As part of the conservation measures and monitoring efforts for Point Arena mountain beaver, MRC has agreed to create new habitat for mountain beaver in the plan area. Both MRC and the wildlife agencies believe that, if successful, these efforts may increase the mountain beaver population and contribute directly to its recovery. MRC proposes to create patches of habitat within dispersal distance of existing burrow systems when timber harvest operations are nearby. This will entail harvesting small groups of trees to open up the canopy and allow herbaceous vegetation to grow. MRC and the wildlife agencies will monitor the success of these efforts to determine if further adaptive management is necessary. If the efforts prove successful, MRC, with the agreement of the wildlife agencies, may ratchet up the effort and create new habitat adjacent to or even within existing burrow systems (M§13.9.3.2-2).

Effectiveness Monitoring	
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	
PROGRAM CODE	M§13.9.3.1-2
OBJECTIVE O§10.3.3.2-2	• Create at least 1 site of potential habitat for each active burrow system when harvest occurs within the assessment area for Point Arena Mountain Beaver.
MONITORING APPROACH	• MRC will assess, after harvest, whether a managed area meets the habitat description. • MRC will document the length, diameter, species, and decay class of any downed wood pieces within a burrow system discovered in newly created habitat. • MRC, in consultation with the wildlife agencies, may add downed wood adjacent to or within the boundaries of newly created habitat. • MRC will follow the protocol for assessing spatial extent of burrow systems discovered in the newly created habitat. • MRC will monitor, within 100 ft (30 m) of a burrow system, the status (active or inactive) and spatial extent of the burrow system 2 years before and 5 years after timber harvest. **NOTE** If MRC biologists decide that additional years are necessary to detect a change in the burrow system, they will consult with the wildlife agencies before halting the monitoring effort.

Effectiveness Monitoring	
Creating Habitat with Timber Harvest within Dispersal Distance of Existing PAMB Burrow Systems	
MEASUREMENT CRITERIA	• MRC will evaluate the relative change between control and treated burrow sites in a Before-After-Control-Impact (BACI) approach, i.e., Area $_{control}$ − Area $_{treatment}$. • MRC will infer a positive effect if the relative area of the treatment site increases at least 1250 ft^2 more than the pre-manipulation area.[19] • MRC will infer a negative effect if the relative area of the treatment site decreases at least 1250 ft^2 less than the pre-manipulation area. • MRC will infer no effect for any change between these thresholds. **NOTE** MRC is proposing *a priori* inferences, as opposed to conducting statistical tests. There are inherently low sample sizes available and limited pre- and post-evaluation periods to quantify variability. Moreover, it is unlikely that the control and treatment experiments will be simultaneous.
ADAPTIVE MANAGEMENT	• MRC will confer with the wildlife agencies to determine if MRC should create more habitat with timber harvest.

13.9.3.2 Validation monitoring

The current definition of potential habitat for Point Arena mountain beavers is very broad (USFWS 2002). This is due to a lack of knowledge on habitat requirements for Point Arena mountain beavers (USFWS 1998a), especially on timberlands. As a result, MRC has applied a broad definition to our conservation measures for the Point Arena mountain beaver. We propose to complete research on our land; from that research there may emerge a more accurate definition of suitable habitat for Point Arena mountain beavers. All validation monitoring for Point Arena mountain beavers is optional.

Defining PAMB habitat (optional)

Validation Monitoring	
Defining Habitat for Point Arena Mountain Beavers	
PROGRAM CODE	M§13.9.3.2-1
HYPOTHESIS SECTION 5.4.9	• Our current habitat definition correctly describes potential habitat for Point Arena mountain beaver (section 10.3.3.2.1).
MONITORING APPROACH	• MRC will measure the spatial extent of all known burrow systems of Point Arena mountain beavers in the plan area. • MRC, after flagging spatial extent, will estimate the center point of the burrow system and measure soil texture, site impacts (i.e., timber harvest, vegetation management, and cattle grazing), aspect, slope, and canopy cover for the burrow system. • MRC will measure ground-cover using the line-transect method—establishing 2 transects (20 m in length, 1 m wide) in cardinal directions (i.e., north-south and east-west) centered on the center point of the burrow system. • MRC will measure canopy cover (using a spherical densiometer) at the boundaries of a burrow system in four cardinal directions (i.e., north, south, east, and west).

[19] The number 1250 ft^2 is approximately ½ the size of the smallest measured burrow system in the plan area.

Validation Monitoring	
Defining Habitat for Point Arena Mountain Beavers	
	• MRC will identify and determine relative abundance (%) of each plant species at a 1X1 m quadrant in the center of the burrow system and at 4 other 1X1 m quadrants in locations prescribed by random numbers. • MRC will use a random number table to determine a random distance and azimuth for placement quadrants in the burrow system. • MRC will count and identify tree species and determine height and dbh (for trees whose dbh is 4 in. or more) of all trees within the boundary of a burrow system. • MRC will identify species, diameter, and decay class of tree stumps within the burrow system. • MRC will count and identify by species all trees less than 4 in. dbh within the boundary of a burrow system. • MRC will use a random number table to generate a random azimuth. We will move the plot up to another 329 ft (100 m) following the random azimuth to a new point. The new point must fall within an area that meets the definition of potential habitat for Point Arena mountain beaver. If the new area does not meet the definition, we will move the plot another 329 ft (100 m) following the new azimuth from the original burrow system. At the end point, MRC will re-create the spatial extent of the initial burrow system using measurements from that burrow system. This will create, in effect, a replica of the spatial extent of the original burrow system. If the random site contains any burrows of Point Arena mountain beaver, the recreated site will be moved another 329 ft (100 m). The end point then becomes the new center point of the "random site." MRC will then use the same procedure as above to measure and record habitat characteristics of the re-created site with habitat characteristics of the actual burrow system.
MEASUREMENT CRITERIA	• MRC and the wildlife agencies will determine if data analysis from a pilot study suggests we should take action under adaptive management.
ADAPTIVE MANAGEMENT	• MRC and the terrestrial wildlife agencies will agree on any changes in the definition of potential habitat, if data analysis indicates the current definition is too narrow or too broad.

Creating potential habitat in or adjacent to existing burrow systems (optional)

Validation Monitoring	
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	
PROGRAM CODE	M§13.9.3.2-2
HYPOTHESIS SECTION 5.4.9	• Timber harvest and other management techniques can create new habitat for Point Arena mountain beavers and allow for the expansion of burrow systems into new areas.
MONITORING APPROACH	• MRC will establish control and experimental burrow systems with similar topographical and vegetation conditions; the control plot will be no-harvest within a buffer area and the experimental plot will have harvest within 100 ft of a burrow system or within a burrow system. • MRC will monitor, within 100 ft of a burrow system, the status (active or inactive) and spatial extent of the burrow system 2 years before and 5 years after timber harvest. **NOTE**

Validation Monitoring	
Creating Potential Habitat in or Adjacent to Existing PAMB Burrow Systems	
	If MRC biologists decide that additional years are necessary to detect a change in the burrow system, they will consult with the wildlife agencies before halting the monitoring effort. • MRC will document the length, diameter, species, and decay class of any downed wood pieces within the burrow system. • MRC, in consultation with the wildlife agencies, may add downed wood adjacent to or within the boundaries of the burrow systems to determine its effect on the spatial extent of those systems. • MRC will assess, after harvest, whether the managed area meets the habitat description and exhibits burrows.
MEASUREMENT CRITERIA	• MRC will evaluate the relative change between control and treated burrow sites in a Before-After-Control-Impact (BACI) approach, i.e., Area $_{control}$ – Area $_{treatment}$. • MRC will infer a positive effect if the relative area of the treatment site increases at least 1250 ft^2 more than the pre-manipulation area. • MRC will infer a negative effect if the relative area of the treatment site decreases at least 1250 ft^2 less than the pre-manipulation area. • MRC will infer no effect for any change between these thresholds. **NOTE** MRC is proposing *a priori* inferences, as opposed to conducting statistical tests. There are inherently low sample sizes available and limited pre- and post-evaluation periods to quantify variability. Moreover, it is unlikely that the control and treatment experiments will be simultaneous.
ADAPTIVE MANAGEMENT	• MRC and the wildlife agencies may allow harvest within 100 ft of burrow systems without the need for consultation if ▪ At least 3 burrow systems have had no effect or a positive effect following timber harvest. AND ▪ No burrow systems have experienced a negative effect following timber harvest. • MRC will ensure that felled trees fall outside the burrow systems of Point Arena mountain beavers. • MRC will not plant conifers within 100 ft of a burrow system, if the wildlife agencies allow us to harvest within the protected buffer for mountain beavers. • MRC will meet with the wildlife agencies to determine a future course for conservation measures and experimentation, in the event that a harvest has a negative effect on the spatial extent of a burrow system. • MRC will meet with the wildlife agencies to develop habitat management guidance derived from the monitoring studies (e.g., LWD management and canopy management).

13.10 Monitoring Rare Plants

13.10.1 Elements of rare plant strategy

The conservation strategy for covered rare plants relies on 3 key elements: (1) conservation measures (see Chapter 11, *Conservation Measures for Rare Plants*); (2) monitoring; and (3) adaptive management. The intent of the conservation measures for rare plants is to

- Conserve the natural communities, habitats, and occurrences of covered rare plant species found in the plan area.
- Contribute to the recovery of covered rare plant species in the plan area that are listed as *threatened* or *endangered* by CDFG or USFWS.
- Manage and conserve rare plant species that are not listed as *threatened* or *endangered* so that listing remains unnecessary.

We will assess the effectiveness of our conservation measures through a long-term monitoring program that tracks the abundance and distribution of covered rare plants throughout our land. Monitoring results will reveal *trend*, i.e., whether rare plant species are decreasing, stable, or increasing on our land. We will evaluate trend conditions and other factors to determine whether we are meeting our conservation objectives or whether we need to propose changes in our conservation measures.

Rare plant monitoring will include effectiveness and compliance monitoring. In addition, MRC will use targeted studies to improve knowledge of some covered rare plants and to select appropriate species-specific conservation measures. In general, the monitoring protocols, which are species-specific, should

- Confirm that MRC is conducting rare plant surveys according to CDFG guidelines.
- Confirm that MRC is implementing conservation measures as prescribed in the rare plant conservation strategy.
- Evaluate the effectiveness of conservation measures.
- Determine whether MRC is meeting conservation objectives.

13.10.2 Implementation of rare plant monitoring

MRC will implement effectiveness monitoring for rare plants. We will scale the effectiveness monitoring according to the rarity and threat level of each plant species and the significance of its occurrences on our land, as expressed in each species management category (section 11.5.2, *Assigning covered rare plants species to management categories*). We will monitor species of highest concern (i.e., Management Category 1 and Management Category 2) more intensively, both in terms of survey frequency and data collected. Likewise, we will monitor species of lesser concern (i.e., Management Category 3 and Management Category 4) less intensively, while still collecting sufficient data for evaluation.

Effectiveness monitoring will consist of status and trend monitoring for Management Category 1 through Management Category 3, and presence or absence monitoring for Management Category 4. Status and trend monitoring will include measurements of abundance and distribution, as well as assessment of habitat characteristics. In addition, for each PTHP or covered activity, MRC will collect information on operation type, vegetation, and disturbance. Monitoring methods for rare plants must be species-specific and situation-specific (Elzinga et al. 1998); MRC will develop these protocols within 1-5 years of HCP/NCCP approval using the guidelines in section 13.10.2.2. The basis for specific monitoring protocols and elements (e.g., sample plot size, sample plot location) are characteristics such as life-form (e.g., annual, herbaceous perennial, shrub, and tree), size range of the plant, habitat characteristics, and distribution in the plan area. Atkinson and others (2004) support the use of different levels and frequencies of effectiveness monitoring for species in different management categories. Menges and Gordon (1996) propose scaling monitoring levels for rare plants to rarity and threat status, with the rarest and most threatened species receiving the most intensive monitoring. For the rarest plants, Menges and Gordon (1996) also recommend demographic monitoring (i.e., tracking the fate of individual plants throughout their life cycle) as a part of long-term effectiveness monitoring. However,

MRC is not proposing this approach for any of the species currently known on our land. Demographic monitoring can produce valuable data (Travis and Sutter 1986, Pavlik et al. 1993, Pavlik 1994), but it is labor-intensive and expensive (Menges and Gordon 1996); it should only be used when the data it produces is essential to determine status and trend as well as to select appropriate management options (Pavlik 1997).

In the future, MRC will consider demographic monitoring for plant species (1) if they are extremely rare and endangered in California; (2) if their growth form is suitable for demographic monitoring; and (3) if monitoring would provide essential management information. Examples of such plants include species ranked S1.1—known from 6 or fewer occurrences worldwide and highly endangered throughout their ranges. Roderick's fritillary (*Fritillaria roderickii*) and seacoast ragwort (*Senecio bolanderi* var. *bolanderi*) are examples of covered species for which demographic monitoring might be appropriate at some future date. Currently these two species are not known to occur in the plan area. MRC would not propose demographic monitoring for a species like Santa Cruz clover unless an occurrence was found on our land and the selection of conservation measures for it required a detailed life history.

The development of management-oriented models is an important component of long-term effectiveness monitoring for covered rare plant species (Atkinson et al. 2004). Models in our HCP/NCCP are basic and general. MRC may develop more detailed conceptual models for the most intensively monitored rare plants, i.e., Management Categories 1 and 2.

13.10.2.1 Evaluation of trend

MRC and the wildlife agencies will use trend to determine whether we are meeting conservation objectives. We will evaluate trend conditions as increasing, stable, or decreasing for all covered rare plant species with 1 or more occurrences in the plan area. Definitions for trend conditions will be species-specific and will use factors that indicate likelihood of long-term survival, such as number of occurrences, reproductive capacity, and other factors. MRC will develop definitions for species-specific trend conditions and determine trend as information becomes available from monitoring results and other sources. Table 13-18, using made-up data, shows an example of trend evaluation for coast lily (*Lilium maritimum*).

Table 13-18 Example of a Trend Evaluation

Example of a Trend Evaluation													
Inventory Block	CNDDB Occ Number	Year First Detected	Number individuals in First Year (baseline)	MONITORING DATA SUMMARY									Trend For Occurrence
				2007			2008			2009			
				# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	
Albion	105	2003	5	7	2	0	9	5	1	15	4	2	increasing
Rockport	117	2004	8	8	3	1	7	2	0	10	1	1	stable
Annapolis	125	2004	2	4	1	0	5	1	0	6	2	0	increasing
Navarro W	142	2005	16	12	2	1	8	3	1	6	4	0	decreasing
Garcia	145	2005	7	6	1	0	7	1	1	6	1	2	stable

Example of a Trend Evaluation

Inventory Block	CNDDB Occ Number	Year First Detected	Number individuals in First Year (baseline)	MONITORING DATA SUMMARY									Trend For Occurrence
				2007			2008			2009			
				# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	# REPRO	# VEG	# SEEDL	

TREND FOR SPECIES IS INCREASING-STABLE

Until and unless statistical measures can show otherwise, the following conventions will apply as trend definitions for single occurrences and for species in the plan area:

- *Trend Definitions for Single Occurrences*
  - INCREASING: Number of reproductive and vegetative individuals (combined) shows > 20% increase over time from baseline.
  - STABLE: Number of reproductive and vegetative individuals (combined) shows < 20% increase or decrease over time from baseline.
  - DECREASING: number of reproductive and vegetative individuals (combined) shows ≥ 20% decrease over time from baseline.
  - TREND NOT DETERMINED: Less than 3 monitoring events since baseline or variability in number of individuals is greater than described in definitions above.

- *Trend Definitions for Species in the Plan Area*
  - INCREASING: Majority[20] of occurrences are increasing.
  - INCREASING-STABLE: Majority of occurrences are increasing or stable.
  - STABLE: Majority of occurrences are stable.
  - STABLE-DECREASING: Majority of occurrences are stable or decreasing.
  - DECREASING: Majority of occurrences are decreasing.
  - TREND NOT DETERMINED: Variability is greater than described in definitions above.

13.10.2.2 Targeted studies

MRC is proposing targeted studies[21] to improve our biological knowledge of covered plant species and to select the most effective conservation measures for them. These studies will follow guidelines from *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans* (Atkinson et al. 2004).

Targeted studies increase the effectiveness of monitoring and management by improving knowledge about the ecological system and about management techniques. Targeted studies, which may be implemented on a short or long term, typically

- Resolve critical uncertainties about natural systems under management (e.g., plant succession and weed dynamics in response to fire; top-down predator effects on food webs; identification of stress-sensitive and stress-tolerant species).
- Apply experimental management treatments.

Advantages of using targeted studies include the ability of management to

- Focus on the most critical aspects of a question.
- Spend a shorter duration compared to validation monitoring.
- Provide results that are scientifically valid, i.e., based on experiment and controls.

MRC is proposing targeted studies (1) to determine optimum buffer conditions for rare plant occurrences, (2) to investigate the characteristics of early successional rare species, and (3) to

[20] Majority, in the context of all trend definitions, means greater than 50 percent.
[21] Targeted studies are a form of validation monitoring.

select appropriate conservation measures for such species. Additional targeted studies may be proposed during future phases of our HCP/NCCP.

Determining optimum buffer conditions

MRC is proposing a targeted study to determine optimum buffer widths and management conditions necessary to protect covered rare plant occurrences. The intent of the buffer is to minimize the effects of covered activities on the core occurrence area by delineating a zone where habitat conditions favored by the rare plant will be maintained and harmful effects will be minimized (section 11.7.1.1). The buffer should maintain habitat characteristics important to a covered rare plant species, including microclimatic factors (humidity, temperature, and solar radiation); hydrology and soil characteristics; and populations of beneficial mycorrhizal fungi and potential pollinators. In addition, buffers will limit the range of disturbances associated with covered activities, such as soil compaction and vegetation removal.

MRC is unaware of published studies from California that have investigated the question of buffer width.[22] Studies by Harris (1984, 1988) and Russell et al. (2000) have examined changes in microclimatic factors in old-growth forests that are associated with adjacent clearcuts. Russell et al. (2000) studied the influence of clearcuts on adjacent old-growth redwood forests in northern California. They concluded that changes in microclimatic factors associated with clearcuts penetrated significant distances into old-growth forests—in some cases, distances approximately equal to 3 times the height of the dominant trees in the area. Their findings support the position that timber harvest activities can modify habitat conditions in areas distant from harvest activity. The use of buffers to minimize the impacts of covered activities on core occurrence areas of covered rare plants is supported by their findings.

Scientific data on which to base the selection of specific buffer widths and management conditions is very limited. The buffer widths and buffer management protocols proposed in our HCP/NCCP represent our best professional judgment, based on studies like those cited above and field observations of consultants and agency biologists familiar with the species, habitats, and timber harvest practices of coastal northern California. MRC is proposing a targeted study to examine the effectiveness of a range of buffer widths and buffer management protocols and to determine the optimum buffer widths and conditions.

MRC may develop a targeted study to examine buffer widths for covered rare plants after approval of our HCP/NCCP and collection of several years of monitoring data. Our targeted study will focus on issues identified by both MRC and the wildlife agencies. The study design process will

- Review relevant literature and other information, including the viewpoints of agency biologists and other scientists who have considered this problem.

- Include several different covered rare plant species that exhibit a range of variation in life form (e.g., annual, herbaceous perennial, shrub, and tree) and habitat preferences (e.g., forests, grasslands, wetlands).

- Include microclimatic variables that are known to be important to rare plant survival and reproduction, and that can be accurately measured.

[22] We are aware, however, that agency biologists working in northwestern California—Clare Golec (Caltrans), Tony LaBanca (CDFG), Linnea Hanson (USFS), and Dave Imper (USFWS)—have discussed the subject of appropriate buffer width.

- Investigate buffer effectiveness in response to a range of intensity of silvicultural activity in the adjacent harvested timberlands.

- Investigate a range of buffer widths and conditions (e.g., locale) for each covered rare plant species included in the study.

- Use an experimental approach with adequate controls and replicates.

- Organize and present findings in the final report so that they can be readily applied to adaptive management.

Monitoring methods for early successional species

MRC may propose an additional targeted study (1) to improve knowledge of the biology of the early successional species Humboldt milk-vetch (*Astragalus agnicidus)* and (2) to develop a monitoring strategy for this species. Standard monitoring methods for determining status and trend, and for evaluating whether conservation measures are being met, may not be effective (Elzinga et al. 1998). Many early successional species in California germinate vigorously in response to certain types of disturbance. They grow, produce seed crops, then decline in abundance (at least, above-ground individuals) as the habitat matures and the time since disturbance increases. Species of this type are known to persist for decades as seeds in the soil seed bank, even though there is no presence above ground (Leck et al. 1989). Evaluations of status and trend that rely mainly on standard measurements, such as numbers of extant individuals or area currently occupied, may not accurately represent the ability of these species to survive over the long term (Elzinga et al. 1998).

MRC may develop a targeted study to examine Humboldt milk-vetch after approval of our HCP/NCCP and after conducting pilot studies to test monitoring methods. If implemented, this targeted study will focus on issues identified by both MRC and the wildlife agencies. The study design process will

- Review relevant literature, including Berg and Bittman (1988), Hiss and Pickart (1992), Pickart et al. (1991), and Bencie (1997).

- Conduct reconnaissance-level field visits to Humboldt milk-vetch occurrences in the plan area.

- Summarize existing information, including data from PTHPs and other field observations, on the responses to disturbance exhibited by Humboldt milk-vetch, including responses to natural and human-caused disturbances.

- Consider demographic monitoring (tracing the fate of individuals) of a sample of Humboldt milk-vetch to determine life cycle characteristics, including year-to-year changes in plant size and seed production that occur over time.

- Consider a limited-scale investigation of the seed bank characteristics of Humboldt milk-vetch.

- Consider limited-scale experimental translocation (using seed as the propagule) to compare seed germination and seedling survival under different disturbance regimes.

- Consider the effects of reforestation on Humboldt milk-vetch.

- Consider a limited-scale experiment using fire to promote habitat quality and stimulate seed production.

13.10.3 Effectiveness monitoring

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
PROGRAM CODE	M§13.10.3-1
OBJECTIVES	**Management Category 1 (MC1)**
O§11.2-1	• Maintain all covered rare plant occurrences in the plan area at stable-to-increasing levels of abundance and distribution (i.e., occurrence trend is stable-to-increasing).
O§11.2-2	• Avoid or minimize mortality of individual plants.
O§11.2-3	• Minimize direct and indirect adverse impacts to core occurrences, such as ground disturbances, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-4	• Retain existing site conditions of importance to covered rare plants, such as microclimatic factors (sun/shade levels, humidity); soil factors (soil structure, soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
	Management Category 2 (MC2)
O§11.2-5	• Maintain a stable-to-increasing number of occurrences in each inventory block where the covered species is known (i.e., species trend is stable-to-increasing).
O§11.2-6	• Maintain, on average, stable-to-increasing levels of abundance and distribution for the covered species throughout its range in the plan area (i.e., species trend is stable-to-increasing).
O§11.2-7	• Minimize mortality of individual plants.
O§11.2-8	• Reduce direct and indirect adverse impacts, such as ground disturbances, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-9	• Minimize changes in site conditions of importance to rare plants, such as microclimatic factors (sun/shade levels, humidity); soil factors (soil structure, soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
	Management Category 3 (MC3)
O§11.2-10	• Maintain stable-to-increasing levels of abundance and distribution within all inventory blocks where the covered species is found (i.e., species trend is stable-to-increasing).
O§11.2-11	• Reduce mortality of individual rare plants, as feasible.
O§11.2-12	• Reduce, as feasible, direct and indirect adverse impacts, such as ground disturbance, accelerated erosion, accelerated sedimentation, fuel spills, slash deposition, and increases in number or cover of invasive pest plants.
O§11.2-13	• Minimize, as feasible, changes in site conditions of importance to rare plants,

Effectiveness Monitoring

Status and Trend of Covered Rare Plant Species

	such as microclimatic factors (sun/shade levels, humidity); soil factors (soil moisture regime, soil compaction level); local hydrology; ground disturbance levels; and plant species composition of the community and habitat.
O§11.2-14	**Management Category 4 (MC4)** • Maintain number and size of occurrences in the plan area so that the species continues to qualify for its current S rank or an S rank that denotes greater abundance.
O§11.2-15	• Reduce mortality of individual rare plants, as feasible.
O§11.2-16	• Maintain stable-to-increasing occurrences in the plan area, mainly through community-based conservation measures.
MONITORING APPROACH	• MRC will monitor status and trend of covered rare plants on our land. • MRC will monitor individual plant species and occurrences at a level that is appropriate, based on the management category of each species. • MRC will design species-specific and situation-specific monitoring protocols, including sampling methods that meet accepted standards for accuracy and precision, using guidelines from *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans* (Atkinson et al. 2004) and *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998). • MRC will submit monitoring designs to the wildlife agencies for review. • MRC will use a pilot program to test the effectiveness and efficiency of initial monitoring approaches (Elzinga et al. 1998, Atkinson et al. 2004). • MRC will modify initial monitoring protocols, as needed, in response to new information, including detection of new core occurrences in the plan area and emergence of new information on the biological and ecological characteristics of covered rare plant species (Atkinson et al. 2004). • MRC will use the status and trend of individual core occurrences and of the species as a whole in the plan area to determine trend and evaluate whether we are meeting our conservation objectives.
MEASUREMENT CRITERIA	• MRC will use the following guidelines in developing species-specific and situation-specific monitoring protocols for each covered rare plant species known to occur in the plan area: **Management Categories 1 and 2/Monitoring Approach 1** **Monitoring Requirements: Plant Data** • MRC will monitor occurrences. **Number and frequency** ▪ MRC will monitor all occurrences in the plan area once a year until the initial status and trend of each occurrence (i.e., stable, decreasing, increasing) is established. NOTE The monitoring time required to determine status and trend will vary with the individual species and its characteristics. ▪ MRC will adjust monitoring frequency, after we have determined initial status and trend, as follows: ▫ If the trend for an occurrence is stable-to-increasing, monitor once every 5 years; in addition, for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry. ▫ If the trend for an occurrence is declining, continue monitoring

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once per year until trend improves to stable-to-increasing; apply adaptive management.

Area

- MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole, including its management history.

Time of Year

- MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
- MRC will monitor occurrences at approximately the same time each year.

Qualitative data

- MRC will record a general description of each occurrence, including size of plants; vigor of plants; rough estimate of percentage of flowering and percentage of fruiting; disease condition; predation; insects or other potential pollinators observed visiting the plants; soil or substrate type and condition; associated species of plants; invasive weeds in area; and other factors needed to assess self-sustainability.
- MRC will take color landscape-scale photos from 1 or more permanent vantage points.

Quantitative data

- MRC will determine abundance for each occurrence using a census of all individuals, if practical.

  NOTE

  If a census is not practical, MRC will estimate abundance, using appropriate sampling methods and will analyze results with statistical tests (Elzinga et al. 1998) to estimate occurrence size. If estimating abundance is not feasible because the life form (e.g., mat-forming or rhizomatous habitat, floating or submerged aquatics, etc.) makes it difficult to count separate individuals, or for other reasons, MRC will estimate cover using appropriate methods (Elzinga et al. 1998).
- MRC will use life stage to record the number or percent of reproductive and non-reproductive individuals.

  NOTE

  For annuals, MRC will estimate the number or percent of reproductive and non-reproductive individuals. For perennials (herbaceous and woody), MRC will estimate the number or percent of seedlings, non-reproductive adults, and reproductive adults.
- MRC will select the appropriate census or sampling unit (e.g., individual plant; plant part such as inflorescence, fruit, or stem), according to guidelines in Elzinga et al. (1998).
- MRC will determine, for early successional species only (e.g., *Astragalus agnicidus*, *Sidalcea malachroides*), a measure of long-term reproductive capability or viability (e.g., estimated seed production).

- MRC will determine trend.
  - MRC will develop, during monitoring protocol design, definitions for conditions of occurrence trend and species trend (stable, increasing, decreasing) that are species-specific.

NOTE

Effectiveness Monitoring

Status and Trend of Covered Rare Plant Species

In general, definitions will incorporate parameters related to self-sustainability, such as area occupied; number or cover of individuals; and measures of viability like seed production (Pavlik 1996).

- MRC will evaluate data and determine trend for each occurrence and for all occurrences in the plan area.
- MRC will apply adaptive management in consultation with the wildlife agencies, based on trend condition. If the overall trend for the species in the plan area is (1) declining—conservation measures may increase; (2) stable—conservation measures will remain the same; (3) increasing—conservation measures may decrease.
- MRC will retain current management and monitoring, if the overall trend for species in the plan area is stable or increasing.

- MRC will monitor invasive pest plants and weed control efforts.
  - MRC will initially record for each species of invasive pest plant found in core occurrence and buffer areas the following information:
    - Name of invasive plant species.
    - Estimated percent cover of weeds in each core occurrence area and buffer area.
    - Observed and potential impacts to rare plants, including ecosystem and community effects.

  - MRC will record, after weed control treatment, the estimated percent cover of weeds within areas where weeds were controlled and in adjacent areas where weeds were not controlled.

Management Category 3/Monitoring Approach 2

Monitoring Requirements: Plant Data

- MRC will monitor occurrences.

Number and frequency

- MRC will monitor a representative sample of occurrences in the plan area once a year until the initial status and trend of the monitored occurrence (i.e., stable, decreasing, increasing) is established.

  NOTE

  A representative sample of occurrences will include (1) one or more occurrences in each inventory block in which the species occurs; (2) occurrences that encompass the range limits of the species in the plan area for geographic distribution, size, and community or habitat type; and (3) enough occurrences so that overall status and trend for the species in the plan area can be tracked over the long-term. Selection of occurrences will follow guidance in Elzinga et al. (1998). If MRC discovers additional occurrences—after the initial monitoring program is established and within the timeframe of our HCP/NCCP—and these occurrences have special conservation significance due to size, ecology, or location, MRC may add them to the subset undergoing long-term status or trend monitoring.

- MRC will adjust monitoring frequency, after we have determined initial status and trend, as follows:
  - If the trend for an occurrence is stable-to-increasing, monitor once every 5 years; in addition, for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry.
  - If the trend for an occurrence is declining, continue monitoring once per year until trend improves to stable-or-increasing and

Effectiveness Monitoring

Status and Trend of Covered Rare Plant Species

apply adaptive management.

Area

- MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole, including its management history.

Time of Year

- MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
- MRC will monitor occurrences at approximately the same time each year.

Qualitative data

- MRC will prepare a general description of the occurrence, including size of plants; vigor of plants; rough estimate of percentage of flowering and percentage of fruiting; disease condition; predation; insects or other potential pollinators observed visiting the plants; soil/substrate type and condition; associated species of plants; invasive weeds in area; and other factors needed to assess self-sustainability.
- MRC will take color landscape-scale photos from 1 or more permanent vantage points.

Quantitative data

- MRC will determine abundance using a census of all individuals, if practical; otherwise, we will estimate cover by cover class using visual estimates in representative sample plots (Elzinga et al. 1998).
- MRC will use life stage to record the number or percent of reproductive and non-reproductive individuals.

  NOTE
  For annuals, MRC will estimate the number or percent of reproductive and non-reproductive individuals. For perennials (herbaceous and woody), MRC will estimate the number or percent of seedlings, non-reproductive adults, and reproductive adults.
- MRC will select the appropriate census unit (e.g., individual plant; plant part such as inflorescence, fruit, or stem), according to Elzinga et al. (1998).

- MRC will determine trend.
  - MRC will develop, during monitoring protocol design, definitions for conditions of occurrence trend and species trend (stable, increasing, decreasing) that are species-specific.

    NOTE
    In general, definitions will incorporate parameters related to self-sustainability, such as area occupied; number or cover of individuals; and measures of viability like seed production (Pavlik 1996).
  - MRC will evaluate data and determine trend for all monitored occurrences in the plan area.
  - MRC will apply adaptive management in consultation with the wildlife agencies, based on trend condition. If the overall trend for the species in the plan area is (1) declining—conservation measures may increase; (2) stable—conservation measures will remain the same; (3) increasing—conservation measures may decrease.

Effectiveness Monitoring

Status and Trend of Covered Rare Plant Species

- MRC will monitor invasive pest plants and weed control efforts.
  - MRC will initially record for each species of invasive pest plant found in core occurrence and buffer areas the following information:
    - Name of invasive plant species.
    - Estimated percent cover of weeds in each core occurrence area and buffer area.
    - Observed and potential impacts to rare plants, including ecosystem and community effects.
  - MRC will record, after weed control treatment, the estimated percentage of weed cover within areas where weeds were controlled and in adjacent areas where weeds were not controlled.

Management Category 4/Monitoring Approach 3

Monitoring Requirements: Plant Data

- MRC will monitor occurrences.

Number and frequency

- MRC will monitor presence/absence on a representative sample of occurrences in the plan area.

  NOTE

  A representative sample of occurrences will include (1) one or more occurrences in each inventory block in which the species occurs; (2) occurrences that encompass the range limits of the species in the plan area for geographic distribution, size, and community or habitat type; and (3) enough occurrences so that overall status and trend for the species in the plan area can be tracked over the long term. Selection of monitoring sites will follow guidance in Elzinga et al. (1998). If MRC discovers additional occurrences—after the initial monitoring program is established and within the timeframe of our HCP/NCCP—and these occurrences have special conservation significance due to size, ecology, or location, MRC may add them to the subset undergoing long-term status/trend monitoring.

- MRC will adjust monitoring frequency, after we determine initial status and trend, as follows:
  - If trend for occurrence is stable-to-increasing, monitor once every 5 years; for PTHP areas, monitor once in the year prior to stand entry and once in the year following stand entry.
  - If trend for occurrence is declining, continue monitoring once per year until trend improves to stable-to-increasing and apply adaptive management.

Area

- MRC will monitor all of the core occurrence area (which may contract or expand from year to year), or one or more sub-areas that are representative of the occurrence as a whole.

Time of Year

- MRC will monitor all occurrences at a time of year when we can accurately detect and identify the species, typically during the flowering or fruiting period.
- MRC will monitor occurrences at approximately the same time each year.

Qualitative data

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
	▪ MRC will prepare a general description of the occurrence, including, at a minimum, a rough visual estimate of number of individuals or area covered by rare plants and a summary of occurrence characteristics important to conservation. ▪ MRC will take color landscape-scale photos from 1 or more permanent vantage points. • MRC will determine trend. ▪ MRC will base determination of species trend on data about presence or absence of occurrences. ▪ MRC will apply adaptive management in consultation with the wildlife agencies, if loss of occurrences in the plan area results in a change in S rank from less rare to more rare (e.g., from S4 to S3). • MRC will monitor invasive pest plants. ▪ MRC will list invasive pest plants observed in the vicinity of the occurrence and will note observed and possible future impacts to rare plants, including ecosystem and community effects. **Management Category 1-4/ Monitoring Approach 1-3** **Monitoring Requirements: Operation Type, Vegetation, and Disturbance Data** • MRC will collect, for each PTHP or other covered activity, the following data: ▪ Operation type (e.g., yarding, road maintenance, silviculture). ▪ Tree characteristics before and after harvest (species mix, density, and size class). ▪ Seral stage (primary, early, middle, late, mature), using consistent and objective definitions. ▪ Percent canopy cover, measured with the best available method, e.g., vertical densitometer or aerial photography. ▪ Understory species composition. ▪ Level of pre-harvest physical disturbance (none, low, medium, high), using consistent and objective definitions. ▪ Type of pre-harvest physical disturbance (road maintenance or use, erosion, landslides, blow-down, fire, flood effects).
ADAPTIVE MANAGEMENT	• MRC will determine the trend of all rare plant species found in the plan area, based on species-specific definitions of trend condition (declining, stable, or increasing) developed as a part of monitoring protocols. • MRC will determine whether conservation objectives are being met. • MRC will confer with the wildlife agencies on a regular basis (i.e., at least every 5 years or upon request) to decide whether we should modify conservation measures. ▪ If MRC or the wildlife agencies propose to modify conservation measures, they must determine whether adequate information exists—in the scientific literature, targeted studies, or other sources—to do so. ▪ If adequate information exists to modify existing conservation measures or to select an alternative conservation measure, MRC and the wildlife agencies may jointly select and approve the change, consistent with goals and objectives. ▪ If adequate information does not exist to modify existing conservation

Effectiveness Monitoring	
Status and Trend of Covered Rare Plant Species	
	measures or if monitoring reveals declines, MRC and the wildlife agencies will work together to develop the goals for a targeted study and select a person to design the study, collect and interpret study data, and make recommendations based on study findings. • MRC and the wildlife agencies will, jointly or individually, fund or seek funding for any targeted studies that they decide to implement. • MRC and the wildlife agencies will act on the findings of the targeted study in a timely manner. • MRC and the wildlife agencies may convene a science panel to advise the parties in the resolution of any disagreements that may persist during the adaptive management process (see section 13.11)

13.10.4 Adaptive management

Adaptive management for covered rare plants will be an interactive, long-term process that uses the results of monitoring and targeted studies to evaluate the effectiveness of conservation measures and make adjustments in conservation measures, if warranted. Adaptive management, required by the revised Natural Community Conservation Planning Act (2003), applies to covered rare plants as well as natural communities. It is inherent in the process that MRC and the wildlife agencies will use to determine management categories for rare plants. If the status of a covered rare plant improves or declines in the plan area, as determined through monitoring, there may be changes to its management category and to its conservation measures. Adaptive management also kicks in when MRC is not meeting conservation objectives. If trend condition and other information provided in the MRC annual status report to the wildlife agencies indicate that MRC is not meeting the conservation objectives, then MRC and the wildlife agencies will confer on appropriate modifications to the conservation measures. MRC will also confer with the wildlife agencies if conservation measures prove to be more restrictive than necessary; either MRC or the wildlife agencies may recommend modifications in this case. The long-term goal is to manage and conserve rare plant species that are not listed as *threatened* or *endangered* so that listing remains unnecessary

Key elements in implementation of adaptive management include the following:

- MRC will determine the trend of all covered rare plant species found in the plan area, based on species-specific metrics of trend condition (declining, stable, or increasing) developed in conjunction with monitoring protocols.

- MRC will determine whether we are meeting conservation objectives, based on trend and other factors.
- MRC will confer with the wildlife agencies on a regular basis (i.e., at least every 5 years or upon request) to decide whether we should modify conservation measures.

- MRC and the wildlife agencies must determine whether adequate information exists—in the scientific literature, targeted studies, or other sources—to modify conservation measures.

- MRC and the wildlife agencies will jointly select and approve

modifications to conservation measures, if adequate information exists to do so.

- MRC and the wildlife agencies will work together to fill information gaps, using, for example, targeted studies, if adequate information does not exist for modifying conservation measures.
- MRC and the wildlife agencies will develop goals and select a person to design a targeted study, collect and interpret study data, and make recommendations based on study findings, if such a study is warranted.
- MRC and the wildlife agencies will, jointly or individually, fund or seek funding for any targeted studies that they decide to implement.
- MRC and the wildlife agencies will act on the findings of the targeted study in a timely manner.

13.11 Program Structure for Adaptive Management and Monitoring

MRC oversees the programs for adaptive management and monitoring. The wildlife agencies will provide input and help guide the programs, but MRC has ultimate responsibility for implementing the programs. MRC will prioritize HCP/NCCP activities, develop annual and long-term work plans, and disseminate annual reports. The wildlife agencies—USFWS, NMFS, and CDFG—are responsible for ensuring the proper implementation of our HCP/NCCP. Based on the annual reports they receive, they will guide the efforts of MRC so that our HCP/NCCP remains in compliance.

A Science Panel will provide technical interpretations of issues in dispute and assist MRC and the wildlife agencies to reach consensus. If monitoring indicates that a conservation measure needs modification, MRC will meet with the wildlife agencies to determine the necessary changes. If MRC and the wildlife agencies cannot reach agreement on a change to a conservation measure, they will consult a scientific review panel. The scientific review panel will consist of experts in a discipline relevant to the conservation measure. The panel will include

- One person chosen by the wildlife agencies.
- One person chosen by MRC.
- One person acceptable to both MRC and the wildlife agencies.

The wildlife agencies will consider the findings and recommendations of the scientific review panel in determining changes to conservation measures.
For monitoring purposes, the 80-year term consists of 20-year intervals. At the end of 20, 40, and 60 years, MRC and the wildlife agencies will convene and discuss whether to change the monitoring programs, particularly the intensity of sampling. The wildlife agencies may ask for a review of a monitoring program any time during the term of our HCP/NCCP. Likewise, MRC, with approval of the wildlife agencies, can initiate minor changes to a monitoring program. As scientific knowledge and technology improve over the course of 80 years, MRC or the wildlife agencies will likely suggest many changes in monitoring methods and protocols.

13.11.1 Partnerships

MRC cannot shoulder the total cost of researching all issues of forest management that may arise during the term of our HCP/NCCP. However, we are willing to partner with governmental agencies, research institutions, as well as public and non-governmental organizations to examine the scientific justification for our current and future land management practices. Under such an arrangement, research partners must follow the rules in place for individuals or contractors entering and using our forest lands. MRC will share with the wildlife agencies any data gathered in research partnerships that might be useful in evaluating HCP/NCCP performance.

13.12 Reporting Requirements

MRC will prepare reports over the term of our HCP/NCCP that document permit compliance, as well as management actions, monitoring results, and targeted studies. Appendix D, *HCP/NCCP Report Timelines and Samples,* contains reporting schedules, report examples, and a cross-reference table to specific sections in Chapter 13 that link to the report examples. These reports provide the wildlife agencies with data on compliance, validation, and effectiveness monitoring for aquatic and terrestrial habitat and species, as well as information on roads, mass wasting, and timber inventory. The purpose of the reports is to communicate the findings of the monitoring and adaptive management program about the effectiveness of MRC in meeting the goals and objectives of our HCP/NCCP. Although MRC will submit most reports annually, there are different report intervals. Finally, MRC will submit reports to designated representatives of the wildlife agencies and share them with other interested parties, as appropriate.

The goals of the reports are to

- Demonstrate to the wildlife agencies that MRC is properly implementing our HCP/NCCP.
- Disclose and correct any problems with HCP/NCCP implementation.
- Document issues with HCP/NCCP implementation that may require consultation with wildlife agencies.
- Identify administrative or minor changes to HCP/NCCP components that could increase the effectiveness of conservation measures.

13.12.1 Compliance Reporting

To ensure that PTHPs conform to HCP/NCCP conservation measures and to assist the wildlife agencies in verifying compliance, MRC will provide the wildlife agencies with notices of operation start and completion, as well as compliance reports. In some cases, an individual report may serve several purposes. A report may indicate, for example, how MRC is complying with HCP/NCCP requirements and whether a group of conservation measures are effective.

For those years in which monitoring occurs, MRC will submit year-end reports to the wildlife agencies on

- Aquatic habitat and species.
- Long-term channels.
- LWD recruitment and placement.
- Sediment control.
- Northern spotted owls.
- Marbled murrelets.
- Point Arena mountain beavers.

- Snags, wildlife trees, and downed wood.
- Hardwoods.
- Rare plants.

MRC will submit reports every ten years to the wildlife agencies on

- Natural communities.
- Old growth.
- Rocky outcrops.

13.12.2 Website and workshops

Monitoring reports pertaining to our HCP/NCCP will be available to the public on the MRC website (www.mendocinoredwoodcompany.com). In addition, during each year of HCP/NCCP implementation, MRC will conduct public workshops that assess our progress in meeting the conservation objectives of the plan.