U.S. Fish & Wildlife Service

National Marine Fisheries Service

Green Diamond Resource Company, Del Norte and Humboldt Counties, California

Final Environmental Impact Statement

For Authorization for Incidental Take and Implementation of a Multiple Species Aquatic Habitat Conservation Plan and Candidate Conservation Agreement with Assurances

Volume 1 of 2

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prepared by

CH2MHILL

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Cover Sheet

Title of Proposed Action:	Issuance of Federal Incidental Take Permits/Enhancement of Survival Permits and Implementation of a Multiple Species Aquatic Habitat Conservation Plan for Green Diamond Resource Company Lands in Northern California	
Responsible Officials:	Steve Thompson California/Nevada Operations Manager U.S. Fish and Wildlife Service 2800 Cottage Way Sacramento, CA 95825	Rodney R. McInnis Regional Administrator National Marine Fisheries Service 501 West Ocean Blvd., Suite 4200 Long Beach, CA 90802
Agency Contacts:	Ms. Amedee Brickey U.S. Fish and Wildlife Service 1655 Heindon Road Arcata, CA 95521 (707) 822-7201	Mr. John P. Clancy National Marine Fisheries Service 1655 Heindon Road Arcata, CA 95521 (707) 825-5175
Legal Authority:	Endangered Species Act of 1973, as amended, Sections 10(a) and 10(b)	
Location of Proposed Action:	Portions of lands owned by Green Diamond Resource Company Humboldt and Del Norte Counties, California	
Applicant Name:	Green Diamond Resource Company P.O. Box 68 Korbel, CA 95550 (707) 668-4451 Contact: Mr. Tharon O'Dell	
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Abstract

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (collectively referred to as the Services) are responding to applications from Green Diamond Resource Company (Green Diamond) (previously Simpson Resource Company) for an Incidental Take Permit (ITP) and Enhancement of Survival Permit (ESP), respectively, as authorized under Section 10 of the Federal Endangered Species Act (ESA). Green Diamond has initiated efforts to expand and improve its aquatic species conservation and ecosystem management on its forestlands in Humboldt and Del Norte Counties, California. Green Diamond's aquatic species management activities have resulted in the development of a comprehensive multiple species Aquatic Habitat Conservation Plan/Candidate Conservation Agreement with Assurances (AHCP/CCAA). The AHCP/CCAA was prepared to support the ITP and ESP applications to the Services. (It should be noted that Green Diamond's AHCP/CCAA is not intended to address Federal Clean Water Act/Total Maximum Daily Load requirements.)

Green Diamond's ITP application to NMFS, if approved, would allow the incidental take of several fish species listed as threatened under the ESA that may be impacted by otherwise lawful timber harvesting and forest management activities conducted on Green Diamond's lands in northern California. These species are coho salmon (Southern Oregon/Northern California Coast Evolutionary Significant Unit [ESU]), Chinook salmon (California Coastal ESU), and steelhead (Northern California DPS). The ITP application to NMFS and the ESP application to USFWS would also cover other, currently unlisted, aquatic species should they become listed in the future. These unlisted species are Chinook salmon (Southern Oregon and Northern California Coastal ESU, Upper Klamath/Trinity Rivers ESU), steelhead (Klamath Mountains Province ESU), coastal cutthroat trout, rainbow trout, southern torrent salamander, and tailed frog.

Green Diamond could conduct timber harvesting and other covered activities under the proposed AHCP/CCAA, but could also conduct these activities without the AHCP/CCAA. In this document, the environmental effects of implementing Green Diamond's proposed AHCP/CCAA are compared to the effects of managing without the AHCP/CCAA. Three other alternatives are also considered.

The AHCP/CCAA would likely provide improved aquatic habitat conditions relative to the No Action Alternative. Although aquatic habitat conditions (and therefore anadromous fish populations) are also anticipated to improve under the No Action Alternative relative to existing conditions, the improvements are expected to be greater under the proposed AHCP/CCAA and other alternatives. In many cases, these improvements would benefit a broader range of species than just the covered AHCP/CCAA species. As described in Green Diamond's proposed AHCP/CCAA, the impacts of take to listed covered species are minimized and mitigated to the maximum extent practicable. Impacts to unlisted covered species are avoided or minimized to the extent that any authorized take, should the species become listed in the future, will not appreciably reduce the likelihood of survival and recovery in the wild of the species.

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Acronyms and Abbreviations

7DMAVG	7-day mean average (temperature)
AHCP	Aquatic Habitat Conservation Plan
AQMB	Air Quality Management Board
ASL	above mean sea level
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	best management practices
BOF	Board of Forestry
CCAA	Candidate Conservation Agreement with Assurances
CCR	California Code of Regulations
CDC	California Department of Conservation
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CDPR	California Department of Pesticide Regulation
CEG	Certified Engineering Geologist
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFPR	California Forest Practice Rules
CFR	Code of Federal Regulations
CFS	cubic feet per second
CMZ	Channel Migration Zone
CNDD	California Natural Diversity Database
CSC	coastal scrub
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationships System

dbh	diameter at breast height
DEIS	Draft Environmental Impact Statement
DFR	Douglas-fir
DPS	distinct population segment
EEZ	Equipment Exclusion Zone
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ELZ	Equipment Limitation Zone
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESP	Enhancement of Survival Permit
ESU	Evolutionarily Significant Unit
FEIS	Final Environmental Impact Statement
FR	Federal Register
HCP	Habitat Conservation Plan
HPA	Hydrographic Planning Area
IA	Implementation Agreement
ITP	Incidental Take Permit
km	kilometers
KMC	Klamath Mixed Conifer
LAC	lacustrine
LWD	large woody debris
MHC	montane hardwood conifer
MHW	montane hardwood
MSP	maximum sustained production
MWAT	Maximum Weekly Average Temperature
NEPA	National Environmental Protection Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service

NOI	Notice of Intent
NRHP	National Register of Historic Places
NSOHCP	Northern Spotted Owl Habitat Conservation Plan
NWFP	Northwest Forest Plan
PALCO	Pacific Lumber Company
PFA	Post Fledging Area
PGS	perennial grassland
PM_{10}	particulate matter less than 10 microns in diameter
RDW	redwood
RIV	riverine
RM	river mile
RMZ	Riparian Management Zone
RNP	Redwood National Park
RPF	Registered Professional Forester
RWQCB	Regional Water Quality Control Board
SMRA	Surface Mining and Reclamation Act
SMZ	Slope Management Zone
SR	State Route
STA	Special Treatment Area
SWRCB	State Water Resources Control Board
SYP	Sustained Yield Plan
THP	Timber Harvesting Plan
TMDL	total maximum daily load
TPZ	Timberland Production Zone
TSS	total suspended solids
URB	urban
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WLPZ	Watercourse and Lake Protection Zone

WTM	wet meadow
YTFP	Yurok Tribal Fisheries Program

Addendum: Update on Projected Initial Plan Area

ADDENDUM

Update on Projected Initial Plan Area

Section 1.4 of this Final Environmental Impact Statement (FEIS) defines the Action Area as all commercial timberland acreage within 11 Hydrographic Planning Areas (HPAs) on the west slopes of the Klamath Mountains and the Coast Range of California in Del Norte and Humboldt Counties where Green Diamond owns lands or harvest rights during the 50-year permit term. Under the Proposed Action, the Action Area will adjust during the permit term in response to real property transactions involving Green Diamond. The FEIS considers these potential adjustments in the Action Area by analyzing the impacts of the Proposed Action and alternatives on all commercial timberlands within the 11 HPAs constituting the Primary Assessment Area.

The initial Action Area and related permit conditions will be established based on Green Diamond's ownership and harvest rights at the time of permit issuance. The Services anticipate that the current estimate of the Action Area provided in Section 1.4 of the FEIS will be adjusted based on the following Green Diamond real estate transactions that have recently occurred or are reasonably certain to occur before or soon after an approval of the Proposed Action:

Sale of Goose Creek Tract

The Western Rivers Conservancy has exercised a legally binding option to purchase all of Green Diamond's 9,478-acre Goose Creek tract located in the Smith River HPA. The sale of this tract is proceeding in three phases. Western Rivers has closed on the purchase of Phase I (3,858 acres) and Phase IIA (1,844 acres) and these lands have been conveyed to Western Rivers. Western Rivers is expected to complete the acquisition of the Goose Creek tract and close on the purchase of Phase IIB (3,776 acres) before or soon after the potential approval of the Proposed Action. The Goose Creek land acquired from Green Diamond by Western Rivers has been conveyed or will be conveyed to the United States for management as part of the Six Rivers National Forest and subject to the Northwest Forest Plan Amendments and PACFISH biological opinion. The Services consider ownership and management of the Goose Creek tract as part of the Six Rivers National Forest to provide conservation benefits that are comparable to those under the Proposed Action. Should the transfer of Goose Creek Phase IIB occur after the issuance of the permits, the transfer would not compromise the effectiveness of the Plan.

Property Under Threat of Condemnation

Green Diamond has recently received notice that the California Department of Transportation intends to take two small parcels of Green Diamond land for public use as highway right of way. Green Diamond has agreed to sell a parcel of 1.88 acres abutting California State Route 299 to the State of California prior to the potential approval of the Proposed Action. Another parcel of 0.15 acres abutting California State Route 197 is likely to be acquired by the State prior to the potential approval of the Proposed Action.

Executive Summary

Executive Summary

This Final Environmental Impact Statement (FEIS) addresses the potential environmental effects that could result from implementing Green Diamond Resource Company's (Green Diamond) Aquatic Habitat Conservation Plan/Candidate Conservation Agreement with Assurances (AHCP/CCAA). The FEIS has been prepared in accordance with the National Environmental Policy Act (NEPA).

This FEIS comprises two volumes. Volume I contains: (1) a description of the No Action Alternative, the Proposed Action, and other action alternatives; (2) a summary description of baseline conditions; and (3) the analysis of potential environmental effects that could result from implementation of the AHCP/CCAA. It also includes the identification of the NEPA Preferred Alternative, modifications and updates to the EIS and proposed AHCP/CCAA since the publication of the Draft EIS (DEIS), and appendices containing additional information. Volume II provides a summary of major comment areas, copies of all public comments and letters received by the lead agencies, and the responses to the comments.

ES-1 Introduction

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (collectively referred to as the Services) are responding to applications from Green Diamond Resource Company (formerly Simpson Resource Company) for an Incidental Take Permit (ITP) and Enhancement of Survival Permit (ESP), respectively, as authorized under Section 10 of the Federal Endangered Species Act (ESA). Green Diamond has initiated efforts to expand and improve its aquatic species conservation and ecosystem management program on its forestland in Humboldt and Del Norte Counties in California. Green Diamond's recent efforts have resulted in the development of the multi-species AHCP/CCAA). The AHCP/CCAA was prepared to support applications for an ITP and ESP from the Services.

Green Diamond is requesting authorization for the incidental take of two fish Evolutionarily Significant Units (ESUs) and one Distinct Population Segment (DPS) that are listed as threatened under the ESA and that overlap Green Diamond's lands in northern California. These fish ESUs/DPSs are the Southern Oregon/Northern California Coast coho salmon ESU, the California Coastal Chinook salmon ESU, and the Northern California steelhead DPS. Green Diamond also is requesting authorization for the incidental take of three other fish ESUs, two fish species and two amphibian species that are currently unlisted, if they become listed in the future. These unlisted ESUs/species are Chinook salmon (Southern Oregon and Northern California Coastal ESU, Upper Klamath/Trinity Rivers ESU), steelhead (Klamath Mountains Province ESU), coastal cutthroat trout, rainbow trout, southern torrent salamander, and tailed frog. Chapter 3 of the proposed AHCP/CCAA describes the ESUs/species for which Green Diamond is seeking Permit coverage. Green Diamond has proposed an AHCP/CCAA duration (Permit period) of 50 years. (It should be noted that Green Diamond's AHCP/CCAA is not intended to address Federal Clean Water Act/Total Maximum Daily Load requirements.)

NMFS and USFWS have determined that issuance of an ITP by NMFS and issuance of an ESP by USFWS are major Federal actions that trigger the National Environmental Policy Act (NEPA) requirement for the analysis and disclosure of the potential environmental impacts of the actions. Pursuant to NEPA, the environmental consequences of the Federal incidental take authorizations are analyzed in this Environmental Impact Statement (EIS), which was prepared with the USFWS and NMFS as co-lead Federal agencies.

This Executive Summary includes the following sections:

- ES-2 Purpose and Need of the Proposed Action
- ES-3 Action Area
- ES-4 Proposed Action and Alternatives
- ES-5 Public Scoping Issues
- ES-6 Preferred Alternative
- ES-7 Summary of Impacts

Table ES-2 is a comparative summary of the impacts of the Proposed Action and alternatives, including the No Action Alternative.

ES-2 Purpose and Need of the Proposed Action

The USFWS and NMFS are responding to applications from Green Diamond for: (1) an ESP pursuant to Section 10(a)(1)(A) of the Federal ESA; and (2) an ITP pursuant to Section 10(a)(1)(B) of the ESA, respectively. Pursuant to ESA Section 10(a), if NMFS finds that all ESA requirements for ITP issuance are met, NMFS is required to issue the requested Permit. Similarly, USFWS may approve an ESP if it finds that the CCAA meets the regulatory requirements for such permits. In addition, implementing the provisions of these permits will further the NMFS and USFWS long-term objective of ensuring long-term survival of ITP/ESP species, while allowing otherwise lawful activities of the applicant to continue. The Services' purpose and need in this action, therefore, is to respond to Green Diamond's ITP and ESP application for incidental take authorization pursuant to an HCP/CCAA that provides protection and conservation to listed, proposed, and unlisted species and their habitats consistent with the requirements of Section 10(a)(1)(A) and Section 10(a)(1)(B) of the ESA.

The applications request that NMFS approve Green Diamond's application and issue an ITP, and USFWS approve Green Diamond's application and issue an ESP. The Services' approval and issuance of these Permits are the NEPA "actions" analyzed in this EIS.

ES-3 Action Area

As discussed in Chapter 1, the Action Area includes all commercial timberland acreage within the 11 Hydrographic Planning Areas (HPAs) on the west slopes of the Klamath Mountains and the Coast Range of California in Del Norte and Humboldt counties where Green Diamond owns lands or harvesting rights, during the period of such ownership within the term of the Permits. The Action Area is currently 416,532 acres, including approximately 1,866 acres of lands on which Green Diamond owns perpetual harvesting rights. The Action Area acreage will

adjust during the Permit term to reflect real property transactions involving Green Diamond.[1] To account for those potential adjustments, the EIS analyzes possible impacts of the Proposed Action and the alternatives on all commercial timberlands within the 11 HPAs, defined as the "Primary Assessment Area." Under Alternative C, the Action Area and Primary Assessment Area contain additional areas outside the 11 HPAs that are known as "rain-on-snow" areas (see Section 2.5).

ES-4 Proposed Action and Alternatives

The process used in developing the alternatives to the Proposed Action included the review and analysis of the purpose and need for the Action, oral and written comments received during public scoping, detailed information provided in the AHCP/CCAA, and the issues described in Chapter 1.

Five alternatives are considered in detail in this EIS, as summarized in Table ES-1. The No Action Alternative and the three action alternatives represent the reasonable range of alternatives to the Proposed Action. Key attributes of the No Action, Proposed Action, and three action alternatives are summarized in more detail in Table 2.7-1 at the end of Chapter 2. Additional alternatives were considered; those eliminated from detailed evaluation are summarized in Section 2.6. This EIS compares the Proposed Action and the other three action alternatives against the No Action Alternative as required by NEPA.

TABLE ES-1
Alternatives Analyzed in Detail in the Green Diamond AHCP/CCAA EIS

Title	Brief Description
No Action (No Permit/No Plan)	• Continuation of Green Diamond's existing timber harvesting and forest management practices in the Action Area under existing regulations (see Sections 2.1.1 and 2.1.2) • Continued application of existing measures for protection of fish and wildlife habitat (Section 2.1.3) • Continued implementation of measures contained in Green Diamond's NSOHCP and associated IA that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations • Continued implementation of measures designed to avoid take of other listed species; continued implementation of other measures to mitigate or avoid significant impacts to unlisted species (Section 2.1.4 and 2.1.5)

[1] Additional commercial timberlands that Green Diamond may acquire in the future may be added to Green Diamond's Initial Plan Area (known herein as the current Action Area), subject to Green Diamond submitting to the Services a description of the lands it intends to add, along with a summary of relevant characteristics they share with existing Action Area lands within that HPA. Up to 15 percent of the current Action Area (e.g., 61,821 acres), including areas on which Green Diamond owns perpetual harvesting rights, may be added to or deleted from the Action Area without an amendment to the proposed HCP/CCAA. The 15 percent cap would not apply to certain categories of land transfers as specified in the proposed Implementation Agreement between Green Diamond and the Services.

TABLE ES-1
Alternatives Analyzed in Detail in the Green Diamond AHCP/CCAA EIS

Title	Brief Description
Proposed Action	• Continuation of existing operations pursuant to existing regulations, other applicable laws, and Green Diamond's NSOHCP, as augmented by the proposed AHCP/CCAA Conservation Strategy • Incidental take coverage for three listed fish ESUs/DPSs, three unlisted fish ESUs, two unlisted fish species, and two unlisted amphibians through issuance of an ITP by NMFS and an ESP by the USFWS • AHCP/CCAA/ITP/ESP obligations for the covered species and their habitats, to include: (1) fixed and variable RMZ/EEZ widths for Class I, II, and III watercourses and implementation of other riparian measures; (2) implementation of road management, slope stability, and ground disturbance measures; and (3) effectiveness and implementation monitoring
Listed Species Only (Alternative A)	• Same as the Proposed Action except for no incidental take coverage for unlisted species/ESUs and, consequently, no monitoring of amphibian populations
Simplified Prescription Strategy (Alternative B)	• Continuation of existing operations pursuant to existing regulations, other applicable laws, and Green Diamond's NSOHCP, as augmented by an AHCP/CCAA conservation strategy • An AHCP/CCAA would be implemented for the same fish and wildlife species covered by the Proposed Action, and an ITP/ESP would be issued for those species. • Obligations for the covered species include fixed, no-cut riparian buffer widths for Class I and II watercourses on the fee-owned lands of the Action Area.
Expanded Species/Geographic Area (Alternative C)	• Same as Proposed Action except that conservation measures would be applied over an expanded area (an additional 25,677 acres) which has a different hydrology (rain-on-snow hydrology) than the majority of the area that would be covered under the Proposed Action • The HCP/ITP would provide incidental take coverage for three listed fish ESUs/DPSs, three unlisted fish ESUs, two unlisted fish species, one listed fish species, four unlisted amphibians, one unlisted reptile, and two listed bird species through issuance of ITPs by NMFS and the USFWS • Modifications to the HCP/ITP obligations that include additional species-specific measures

ES-5 Scoping and Public Review Process

ES-5.1 Public Scoping

Following publication of a Notice of Intent (NOI), which appeared in the *Federal Register* on July 11, 2000, the Services initiated the EIS and began the scoping process. Scoping meetings were held on July 11 and July 12, 2000 in Eureka and Crescent City, California. Attendees were given an overview of Green Diamond's proposed AHCP/CCAA and asked to present their questions, concerns, and information pertinent to development of the associated EIS. Green Diamond also held a series of six informational meetings with cooperating agencies and local tribal groups. The meetings were held on August 11, August 18, August 25, August 29, August 30, and September 21, 2000 at various locations. All comments are summarized in greater detail in the Scoping Report for this EIS dated September 18, 2000 and included herein as Appendix B.

ES-5.2 DEIS Public Review Process

A Notice of Availability (NOA) for the DEIS was published in the Federal Register by NMFS and USFWS on August 16, 2002. The public review period was scheduled for 90 days from August 16, 2002 to November 14, 2002. Two public meetings to formally introduce Green Diamond's proposed AHCP/CCAA and the DEIS were held on September 4, 2002, in Eureka, California. Approximately 20 people attended the DEIS public meeting. A total of 20 oral questions and comments were received from the two meetings held in Eureka. In addition, 25 comment letters were received during the 90-day public review period that closed on November 14, 2002, comprising 1,267 separate comments. Written comments, plus oral comments received at the public meetings, are included in Volume II of this FEIS. See Volume II for a description of the comments received, and the responses to comments.

ES-5.3 FEIS Public Review Process

The public outreach process will continue through completion and approval of the Record of Decision (ROD) by the Services. Statements on the FEIS will be accepted by the Services considered in the decision on the Proposed Action. The FEIS is being distributed for a 30-day notification period.

ES-6 Differences between the DEIS and FEIS

This section presents the key changes to the DEIS in this FEIS as summarized below. These revisions do not alter the significant conclusions in the DEIS.

- Revisions to text have been made to reflect changes in the listing of steelhead, one of the covered species, from the "Northern California Evolutionarily Significant Unit (ESU)" to the "Northern California Distinct Population Segment (DPS)." The DPS policy adopts criteria similar to, but somewhat different from, those in the ESU policy for determining when a group of vertebrates constitutes a DPS: the group must be discrete from other populations, and it must be significant to its taxon. A group is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors." Using the DPS policy, resident

rainbow trout are considered "markedly separated" from the anadromous form and are not included in the current steelhead listing (71 FR 834).

- Refinements and clarifications have been made to Green Diamond's Operating Conservation Strategy (see AHCP/CCAA Section 6); these changes are also reflected in the FEIS.
- Additional information has been provided to explain and clarify in greater detail the basis for the cumulative effects analysis in Chapter 4 (*Environmental Consequences*) relating to geology and geomorphology (Section 4.2) and aquatic resources (Section 4.3).
- A new Section 4.13, *Summary of Cumulative Impact Analysis*, has been prepared that summarizes the overall cumulative effect to the environment as a result of implementation of the Proposed Action and the other alternatives.

ES-7 Preferred Alternative

CEQ regulations require that the Record of Decision specify "the alternative or alternatives which were considered to be environmentally preferable" (40 CFR 1505.2(b)). The environmentally preferred alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic cultural and natural resources. NEPA's Section 101 calls for Federal agencies to make decisions to achieve "conditions under which man and nature can exist in productive harmony and full fill the social, economic, and other requirements of present and future generations of Americans." Federal agencies should strive to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences. It also calls for Federal agencies to achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Based on the analysis of alternatives in the FEIS, there are more similarities than differences in the overall effects of the alternatives on the human environment, thus making it difficult to choose any particular alternative in the FEIS as the environmentally preferred alternative. Upon further review, the Services will identify the Environmentally Preferred Alternative or Alternatives in the Record of Decision as required by NEPA.

ES-8 Summary of Impacts

ES-8.1 Overview

This section presents a summary of the impacts of implementing the proposed AHCP/CCAA, which contains prescriptive conservation measures related to Green Diamond's forestry management and related activities. The AHCP/CCAA conservation strategy is designed to: (1) avoid the environmental effects that could cause take; and (2) minimize and mitigate the potential impacts of take. The AHCP/CCAA measures are summarized above and in Chapter 2 of this EIS. The potential direct, indirect, and cumulative effects of the Proposed Action and alternatives, including the No Action Alternative, are described and evaluated in Chapter 4 (*Environmental Consequences*) for the

resource areas listed below. (The affected environment for each of these resource areas is presented in Chapter 3, *Affected Environment*.)

- Geology, Geomorphology, and Mineral Resources (Section 4.2)
- Hydrology and Water Quality (Section 4.3)
- Aquatic Resources (Section 4.4)
- Vegetation/Plant Species of Concern (Section 4.5)
- Terrestrial Habitat/Wildlife Species of Concern (Section 4.6)
- Air Quality (Section 4.7)
- Visual Resources (Section 4.8)
- Recreational Resources (Section 4.9)
- Cultural Resources (Section 4.10)
- Land Use (Section 4.11)
- Social and Economic Conditions (Section 4.12)

Table ES-2 (at the end of this Executive Summary) provides a comparative overview of the impacts of the Proposed Action (i.e., the proposed AHCP/CCAA) and the alternatives for each of the resource areas assessed in this EIS. Detailed analysis of impacts is contained in Chapter 4 (*Environmental Consequences*).

ES-8.2 Summary of Impacts

On the basis of the assessment of direct and indirect impacts presented in Chapter 4, implementing the proposed AHCP/CCAA or the other action alternatives would result in either no change to the environment or slight improvements to the environment.

Implementing the Proposed Action would improve the overall condition of habitat for the covered species in the Action Area. Implementation of the AHCP/CCAA would contribute to the development and maintenance of properly functioning habitat and, therefore, would also help to preclude the possible need to list unlisted covered species in the future. Implementing the Proposed Action or the action alternatives would result in additional benefits to the environment.

Overall, the critical resources assessed in this EIS are the aquatic species covered by the AHCP/CCAA measures and the resource areas that contribute most directly to their maintenance (e.g., geology, geomorphology, hydrology, and water quality). Hydrology, riparian conditions, sediment production and delivery, the potential for mass soil movement, and water quality conditions have the greatest potential to affect aquatic habitat quality in the Primary Assessment Area (see Chapter 4). Implementing the measures contained in the Proposed Action would result in either no change or an improvement in conditions for the benefit of the covered species and their riparian habitat. Key AHCP/CCAA provisions that would contribute to such improved conditions are summarized below and in Chapter 2. They include:

- Implementation of an ownership-wide Road Management Plan that provides for road-related fish passage enhancement (barrier removal); implementation of practices that are designed to minimize sediment discharge to Class I, II, and III streams; and decommissioning of some roads. The proposed Road Management Plan provides for accelerated repair (over a 15-year period) of high- and moderate-risk sediment delivery

sites on roads on the Green Diamond fee ownership, in accordance with the schedule established in the proposed AHCP/CCAA.

- Protection of specified unique geomorphic features (i.e., channel migration zones and floodplains).
- Adoption of various slope stability and ground disturbance conservation measures.
- Implementation of effectiveness monitoring, plus adaptive management with structured feedback loops.

Under the No Action Alternative, environmental conditions are also anticipated to improve over time but not at the accelerated rate at which they would improve under the Proposed Action. The differences among the alternatives is summarized above and detailed in Chapter 2.

The AHCP/CCAA conservation measures under the Proposed Action differ from the No Action Alternative in the following ways.

- The No Action Alternative would apply existing regulations and guidelines, whereas the Proposed Action would apply the additional AHCP/CCAA conservation measures (in conjunction with existing regulations and guidelines). The additional conservation measures of the Proposed Action are designed to minimize erosion and sediment-causing activities throughout the Primary Assessment Area on an accelerated basis.
- The No Action Alternative would apply the existing regulations and guidelines only on a THP-by-THP basis, whereas the Proposed Action would apply the additional AHCP/CCAA conservation measures (in conjunction with existing regulations and guidelines) more broadly throughout each of the HPAs in the Action Area. Application of the Proposed Action conservation measures on an ownership-wide basis throughout the Action Area would result in broader (i.e., not on a THP-by-THP basis) and expedited application of the conservation measures compared with existing conditions or the conditions expected to occur over time under the No Action Alternative.

ES-8.3 Cumulative Impacts

Adverse conditions currently exist in some areas of the 11 HPAs, primarily as a result of past practices. Continuing impacts of these past practices include conditions associated with a general lack of LWD, lack of riparian vegetation, and aggraded stream channels (AHCP/CCAA Sections 4.2 through 4.6). Many of these areas and conditions may recover over the next 50 years, while others, such as low gradient aggraded stream channels may take longer than 50 years to recover (AHCP/CCAA Section 4.2).

The No Action Alternative, in which Green Diamond continues to conduct its timber management program pursuant to its institutional BMPs and the CFPRs, would result in an improving trend from the current adverse conditions and will lead to an overall reduction in the level of adverse environmental conditions which currently exist in some areas of the HPAs. However, this improvement may not reduce the level of concern below a level of significance within the next 50 years.

Management of the Action Area under all the action alternatives would further improve current conditions relative to implementation of the No Action Alternative. The benefits to

geomorphology are expected to be equal or slightly greater under the Proposed Action and Alternatives A and C than under Alternative B, because of differences (or, in some cases, absences) in a broad range of enhanced forest management practices and implementation of an adaptive management monitoring program with structured feedback mechanisms. The sediment control benefits associated with implementation of the Road Management Plan and the accelerated road sediment site repairs under the Proposed Action, Alternative A, and Alternative C will result in a greater reduction in sediment delivery compared to all the other sediment conservation measures combined. Therefore, implementation of the Road Management Plan, the accelerated road repair, and limitations on equipment use during wet weather conditions provide the greatest benefit to the covered species.

Implementation of the measures contained in the Proposed Action would result in equivalent or improved water quality conditions, as discussed in Sections 4.3.2 through 4.3.6. Hydrologic conditions associated with the Proposed Action and other action alternatives are not anticipated to significantly change compared with existing conditions or the No Action Alternative. One potential for an impact under the action alternatives is a slight (and less than significant) change in water temperature resulting from increased shade attributable to overstory canopy closure retention requirements. Another possible impact is locally increased peak flows on a short-term basis following harvesting. These impacts would be insignificant given implementation of the riparian management prescriptive measures included in the Proposed Action (AHCP/CCAA Section 6.2.1).

The aquatic and riparian habitat conditions would improve under the Proposed Action relative to existing conditions and relative to implementation of the No Action Alternative. The anticipated improvement in riparian conditions and the reduction in sediment production and delivery to streams would speed the improvements expected over time under the No Action Alternative, and would likely result in improved physical habitat for the covered species. Improvements in aquatic and riparian habitat benefiting the covered species would, in general, benefit other species associated with these habitats. It is expected that benefits to all of these species and their habitats under the Proposed Action would accumulate incrementally over the next 50 years as the improved forest management practices and conservations measures are implemented throughout this period.

Conditions resulting from implementation of all the action alternatives related to air quality (Section 4.7), visual resources (Section 4.8), recreation (Section 4.9), and cultural resources (Section 4.10) are anticipated to be the same as those expected to result under the No Action Alternative.

The Proposed Action would result in an improvement in the overall condition of habitat for the covered species in the Action Area over the 50-year term of the Plan and the Permits. Implementation of the Proposed Action would contribute to the development and maintenance of properly functioning habitat. Implementation of the Proposed Action or any of the action alternatives would result in an overall reduction in adverse impacts to the environment compared to existing conditions. However, ongoing impacts associated with past activities (i.e., the persistence of historic management-generated sediment), present actions, and reasonably foreseeable future actions are expected to continue, although with a decreasing trend in impact, over the term of the Permits with implementation of the Proposed Action (Section 2, Section 4.2).

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
4.2 Geology, Geomorphology and Mineral Resources				
Surface Erosion				
The potential for riparian management and harvest-related (i.e., non road-related) activities to affect surface erosion is expected to remain about the same as under current conditions.	The risk of sediment delivery through harvest-related surface erosion is expected to decrease slightly relative to the No Action Alternative.	Same as the Proposed Action.	Similar to the Proposed Action.	Same as the Proposed Action.
Erosion from fire areas is not expected to differ from current conditions.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
Mass Soil Movement				
The risk of mass soil movement owing to timber harvesting in sensitive areas would decrease under the No Action Alternative.	The risk of mass soil movement owing to timber harvesting in sensitive areas would decrease relative to the No Action Alternative through implementation of slope stability and other conservation measures.	Same as the Proposed Action.	The risk of mass soil movement owing to timber harvesting would decrease relative to the No Action Alternative, but would likely be greater than would occur under the Proposed Action.	Same as the Proposed Action.
Shallow landslide potential would be reduced under the No Action Alternative.	Shallow landslide potential would decrease relative to the No Action Alternative through implementation of slope stability conservation measures.	Same as the Proposed Action.	Shallow landslide potential would decrease relative to the No Action Alternative, but would increase relative to the Proposed Action.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
The risk of deep-seated landslides is expected to remain the same as current conditions.	Deep-seated landslide potential would decrease relative to the No Action Alternative through implementation of slope stability conservation measures.	Same as the Proposed Action.	Same as the No Action Alternative.	Same as the Proposed Action.
Soil creep is expected to remain the same as under current conditions.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
Road-Related Sediment Production				
Sediment production from roads and landings is expected to remain the same or decrease relative to current conditions.	Numerous additional protective measures would decrease sediment production from roads and landings relative to the No Action Alternative.	Same as the Proposed Action.	Sediment control measures would likely decrease sediment production from roads and landings relative to the No Action Alternative, but would offer less protection than the Proposed Action.	Same as the Proposed Action.
The potential for road construction and use to affect mass soil movement is expected to decrease relative to current conditions.	Management measures related to road construction and use under the Proposed Action would substantially reduce the potential for road-related mass soil movement relative to the No Action Alternative.	Same as the Proposed Action.	Same as the No Action Alternative.	Similar to the Proposed Action.
Sediment production related to skid trails is expected to decrease relative to current conditions.	Sediment production from skid trails would likely be reduced relative to the No Action Alternative.	Same as the Proposed Action.	Sediment control measures would likely decrease sediment production from skid trails relative to the No Action Alternative, but would offer less protection than the Proposed Action.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
4.3 Surface Water Hydrology and Water Quality				
Hydrology				
No substantive changes in the existing hydrologic regime or in the magnitude and timing of naturally occurring peak or low (base) flows are anticipated.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
Water Temperature				
Generally suitable water temperatures are expected to remain at suitable levels. Stream shading is expected to improve over time compared with current conditions, contributing to slight decreases in water temperatures.	Similar to the No Action Alternative, stream shading would likely improve over time to a greater degree than under the No Action Alternative, contributing to slight decreases in water temperatures.	Same as Proposed Action.	Stream shading is expected to increase slightly more than under the Proposed Action due to the non-managed riparian buffers, contributing to slight decreases in water temperatures.	Same as Proposed Action.
Sediment-Related Water Quality Parameters				
Suspended sediment levels, turbidity, and nutrient and contaminant loading are expected to decline over time as sediment delivery is reduced.	Conservation measures implemented under the Proposed Action would likely reduce suspended sediment, turbidity, and nutrient and contaminant loading over time to a greater degree than under the No Action Alternative.	Same as the Proposed Action.	Sediment control measures would be similar to the No Action Alternative, with increased sediment filtration provided by the non-managed riparian buffers.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
4.4 Aquatic Resources				
Hydrologic Effects				
Because no substantive changes in peak or low (base) flows are anticipated, there would likely be no flow-related changes in channel morphology, incidence of bed scour and bank erosion, or quality of aquatic habitat relative to existing conditions.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
Large Woody Debris Recruitment				
Current levels of large woody debris recruitment would likely be maintained or enhanced over time.	With increased riparian protection under the Proposed Action, LWD recruitment would increase relative to the No Action Alternative.	Same as the Proposed Action.	LWD recruitment may increase slightly more than under the Proposed Action due to the non-managed riparian buffers.	Same as the Proposed Action.
Stream Shading				
As it relates to stream shading, canopy coverage would likely increase relative to current conditions, with improvements over time as riparian stands grow and mature.	Canopy closure is expected to increase relative to the No Action Alternative, with corresponding benefits to stream shading.	Same as the Proposed Action.	Canopy closure is expected to increase slightly more than under the Proposed Action due to the non-managed riparian buffers, with corresponding benefits to stream shading.	Same as the Proposed Action.
Sediment Filtration				
Sediment filtration, relative to current conditions, is expected to remain the same or increase over time.	Sediment filtration would not be substantially different relative to the No Action Alternative.	Same as the Proposed Action.	Similar to the Proposed Action, with increased sediment filtration provided by the non-managed riparian buffers.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
Bank Stability				
Riparian conservation measures under the No Action Alternative will improve bank stability relative to existing conditions, primarily along Class I watercourses.	Riparian protection under the Proposed Action will increase bank stability relative to the No Action Alternative, particularly along Class II and III watercourses.	Same as the Proposed Action.	Similar to the Proposed Action.	Same as the Proposed Action.
Nutrient Input (Leaf and Litterfall)				
Riparian conservation measures under the No Action Alternative will favor conifers over hardwoods in the WLPZs. In the long term, this may reduce the amount of high quality leaf and litterfall relative to current levels.	Increased riparian protection under the Proposed Action will favor conifers over hardwoods in the RMZs. In the long term, this may reduce the amount of high quality leaf and litterfall relative to existing conditions and similar to the No Action Alternative.	Same as the Proposed Action.	Similar to the Proposed Action, with decreased amounts of high quality leaf and litterfall in the long term provided by the non-managed riparian buffers.	Same as the Proposed Action.
Sediment Production and Delivery				
Sediment production and delivery to Primary Assessment Area streams would likely be reduced relative to existing conditions.	Sediment production and delivery to Primary Assessment Area streams would be reduced under the Proposed Action relative to the No Action Alternative, primarily from the accelerated road work.	Same as the Proposed Action.	Sediment production and delivery to Primary Assessment Area streams under Alternative B would be generally comparable to the No Action Alternative.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
Aquatic Habitat				
A positive trend in the quality of aquatic habitat is expected, with a concomitant benefit to anadromous and resident salmonids.	Aquatic habitat conditions related to forestry management activities are expected to improve under the Proposed Action relative to existing conditions and to the No Action Alternative.	Same as the Proposed Action.	Similar to the No Action Alternative, with the non-managed riparian buffers contributing to the positive trend in the quality of aquatic habitat.	Same as the Proposed Action.
Water quality and substrate conditions would likely improve over time as sediment inputs are decreased.	Water quality and substrate conditions are expected to be equal or slightly improve under the Proposed Action relative to existing conditions and to the No Action Alternative.	Same as the Proposed Action.	Similar to the No Action Alternative, water quality and substrate conditions would likely improve over time as sediment inputs are decreased.	Same as the Proposed Action.
Because little change or improvement in canopy cover, shading, or sediment production and delivery is expected, thermal conditions are likely to remain similar to existing conditions.	Because improvements in canopy cover, shading, and reduced sediment production and delivery are anticipated, future thermal conditions would be improved relative to existing conditions and relative to the No Action Alternative.	Same as the Proposed Action.	Because canopy coverage and shading would likely increase, and there would be little change in sediment production and delivery, future thermal conditions would improve slightly relative to existing conditions, but to a lesser extent than under the Proposed Action..	Same as the Proposed Action.
Habitat complexity would likely increase slightly through increased LWD recruitment, bank stability, canopy coverage, and reduced sediment input over time relative to existing conditions.	Habitat complexity would likely increase over time through increased LWD recruitment, bank stability, canopy coverage, and reduced sediment inputs relative to existing conditions and to the No Action Alternative.	Same as the Proposed Action.	Similar to the Proposed Action, with the non-managed buffers contributing to the increase in LWD recruitment, bank stability, and canopy closure.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
Restoration and maintenance of fish passages during road upgrades and new road construction would occur in association with THP implementation. Systematic and comprehensive barrier removal over the entire ownership would not occur.	The Road Management Plan under the Proposed Action will result in an inventory, prioritization, and elimination of fish passage problems at road crossings over time in a systematic process.	Same as the Proposed Action.	Same as the No Action Alternative.	Same as the Proposed Action.
4.5 Vegetation/Plant Species of Concern				
Riparian Management Effects				
Vegetation management activities in riparian areas would be expected to remain relatively unchanged from existing timber harvesting practices, and similar species compositions would be retained. Riparian vegetation would likely be composed of a greater number of mature trees, over time, compared with existing conditions.	Vegetation management activities in riparian areas would result in a more desirable plant community composition over time. More conifers would be maintained where mostly hardwoods currently exist in riparian areas. Due to limited harvest activities in riparian areas, riparian vegetation would be composed of a greater number of mature trees by the end of the Permit term compared with either existing conditions or conditions under the No Action Alternative.	Same as the Proposed Action.	Similar to the No Action Alternative, but the riparian areas and corridors would not be disturbed or manipulated, favoring shade-tolerant and woody species over shade-intolerant and non-woody species.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
Listed Plant Species and Other Plant Species of Concern				
Potential impacts to listed plant and other plant species of concern are anticipated to be minimal. Continued implementation of existing regulations and operating guidelines, including Green Diamond's Plant Protection Program will avoid or minimize potential adverse impacts to listed plant species.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
4.6 Terrestrial Habitat/ Wildlife Species of Concern				
Riparian Management Effects				
There would be retention of a greater number of mature forest stands throughout the Primary Assessment Area, especially in riparian zones and northern spotted owl protection zones, relative to existing conditions. The species that would benefit the most from this effect include frogs, salamanders, herons, eagles, bats, marbled murrelets, and owls.	Vegetation structure in riparian areas would be more diverse and less intensively harvested compared to the No Action Alternative. Vegetation management activities in riparian areas would result in maintenance of a greater number of conifers where mostly hardwoods currently exist in riparian areas. The species that would benefit the most from this effect include frogs, salamanders, herons, eagles, bats, marbled murrelets, and owls.	Same as the Proposed Action.	Similar to the No Action Alternative, except riparian areas and corridors would not be disturbed or manipulated. Vegetation in riparian areas would develop naturally over time, resulting in a greater number of stands with older, mature trees compared to the No Action Alternative. The species that would benefit the most from this effect include frogs, salamanders, herons, eagles, bats, marbled murrelets, and owls.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
Listed Wildlife Species and Other Wildlife Species of Concern				
Continued compliance with existing regulations and implementation of Green Diamond's NSOHCP should result in development of greater structural diversity and a greater number of stands with late-seral forest characteristics, relative to what currently exists, especially within WLPZs. This trend is beneficial to listed species and other wildlife species of concern that breed or forage in older trees or late-seral stands. These species include the bald eagle, marbled murrelet, northern spotted owl, osprey, Vaux's swift, Humboldt marten, red tree vole, and tailed frog.	Potential benefits to listed species under the Proposed Action would generally be greater than under the No Action Alternative, primarily because of increased overstory-canopy requirements within Class II RMZs, retention of all LWD within Class III Tier A EEZs, and retention of evenly distributed conifer trees within SMZs. Also, slightly more land would likely be left undisturbed in riparian areas relative to the No Action Alternative. These differences would amplify benefits described under the No Action Alternative for listed species and other wildlife species of concern that breed or forage in older trees and late-seral-forest stands.	Same as the Proposed Action.	Similar to the No Action Alternative. Potential benefits to listed species under Alternative B would generally be greater than under the No Action Alternative, primarily because slightly more land would likely be left undisturbed in riparian areas relative to the No Action Alternative. These differences would amplify benefits described under the No Action Alternative for listed species and other wildlife species of concern that breed or forage in older trees and late-seral-forest stands.	Similar to the Proposed Action, with the exception of short-term adverse impacts to some species from the phased harvesting of isolated marbled murrelet stands. Phased harvesting would result in short-term impacts to listed species and other wildlife species of concern that breed or forage in older trees and late-seral-forest stands. Species that would benefit from the phased removal of late-seral habitat include: Cooper's hawk, sharp-shinned hawk, and yellow-breasted chat.
4.7 Air Quality				
PM_{10} would be generated by slash-burning activities associated with site preparation under even-aged management. There would be little change from existing conditions.	Similar to the No Action Alternative. Although various alternative management practices would result in some change in PM_{10} generation, these changes are not expected to be substantial relative to overall PM_{10} conditions under the No Action Alternative.	Same as the Proposed Action.	Same as the No Action Alternative.	Same as the Proposed Action.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
4.8 Visual Resources				
Current CFPRs and Green Diamond's operational policies may reduce, to some degree, the visual effects of commercial forest management relative to the historical level of impact.	Implementation of the AHCP/CCAA may reduce, to some degree, the visual effects of commercial forest management relative to the historical level of impact.	Same as the Proposed Action.	Similar to the Proposed Action, with minor potential benefits associated with no-harvest riparian buffers.	Same as the Proposed Action.
4.9 Recreation				
Recreational activities would continue to occur on the ownership, subject to written entry permits. The potential for harvest-related impacts would likely be similar to current conditions.	Same as the No Action Alternative, with some potential for additional benefits to recreational experiences provided by improved riparian and fishery conditions.	Same as the Proposed Action.	Similar to the Proposed Action, with minor potential benefits associated with no-harvest riparian buffers.	Same as the Proposed Action.
4.10 Cultural Resources				
Current CFPRs contain measures for protection of cultural resources that would minimize the effects of timber harvesting on cultural resources.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.
4.11 Land Use				
Current land use on the ownership would continue in a manner consistent with local land use plans and compatible with surrounding land uses.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE ES-2
Summary of Potential Environmental Impacts Associated with Each Alternative

No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative C
4.12 Social and Economic Conditions				
Timber harvest levels under the No Action Alternative are expected to remain about the same as current conditions; therefore, job growth and local tax revenues are expected to remain similar to current conditions.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.	Same as the No Action Alternative.

CHAPTER 1

Introduction/Purpose and Need

CHAPTER 1

Introduction/Purpose and Need

This Final Environmental Impact Statement (FEIS) addresses the potential environmental effects that could result from implementing Green Diamond Resource Company's (Green Diamond) Aquatic Habitat Conservation Plan/Candidate Conservation Agreement with Assurances (AHCP/CCAA). The FEIS has been prepared in accordance with the National Environmental Policy Act (NEPA).

This FEIS comprises two volumes. Volume I contains: (1) a description of the No Action Alternative, the Proposed Action, and other action alternatives; (2) a summary description of baseline conditions; and (3) the analysis of potential environmental effects that could result from implementation of the AHCP/CCAA. It also includes the identification of the NEPA Preferred Alternative, modifications and updates to the EIS and proposed AHCP/CCAA since the publication of the Draft EIS (DEIS), and appendices containing additional information. Volume II provides a summary of major comment areas, copies of all public comments and letters received by the lead agencies, and the responses to the comments.

1.1 Background and Document Overview

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (collectively referred to as the Services) are responding to applications from Green Diamond (previously Simpson Resource Company) for an Incidental Take Permit (ITP) and Enhancement of Survival Permit (ESP), respectively, as authorized under Section 10 of the Federal Endangered Species Act (ESA). Green Diamond has initiated efforts to expand and improve its aquatic species conservation and ecosystem management program on its forestland in Humboldt and Del Norte counties in California (Figure 1.1-1). Green Diamond's recent efforts have resulted in the development of the multi-species AHCP/CCAA). The AHCP/CCAA was prepared to support applications for an ITP and ESP from the Services.

Green Diamond manages its forestlands for timber production and other purposes pursuant to California's Timberland Productivity Act, the Z'Berg-Nejedly Forest Practice Act, the Board of Forestry's implementing rules and regulations for management of private forestlands, various other State laws, and Green Diamond's internal management policies and guidelines. These internal policies and guidelines are primarily contained in the *Habitat Conservation Plan for the Northern Spotted Owl on the California Timberlands of Simpson Resource Company* (Simpson Resource Company, 1992) and Green Diamond's "Option (a)" document (Simpson, 1999) filed with the California Department of Forestry and Fire Protection.

Green Diamond is requesting authorization for the incidental take of two fish Evolutionarily Significant Units (ESUs) and one Distinct Population Segment (DPS) that are listed as threatened under the ESA. Individual fish within these ESUs and DPS exist on Green Diamond lands. These fish ESUs/DPSs are the Southern Oregon/Northern California Coast coho salmon ESU, California Coastal Chinook salmon ESU, and Northern California steelhead DPS. Green Diamond also is requesting authorization for the incidental take of

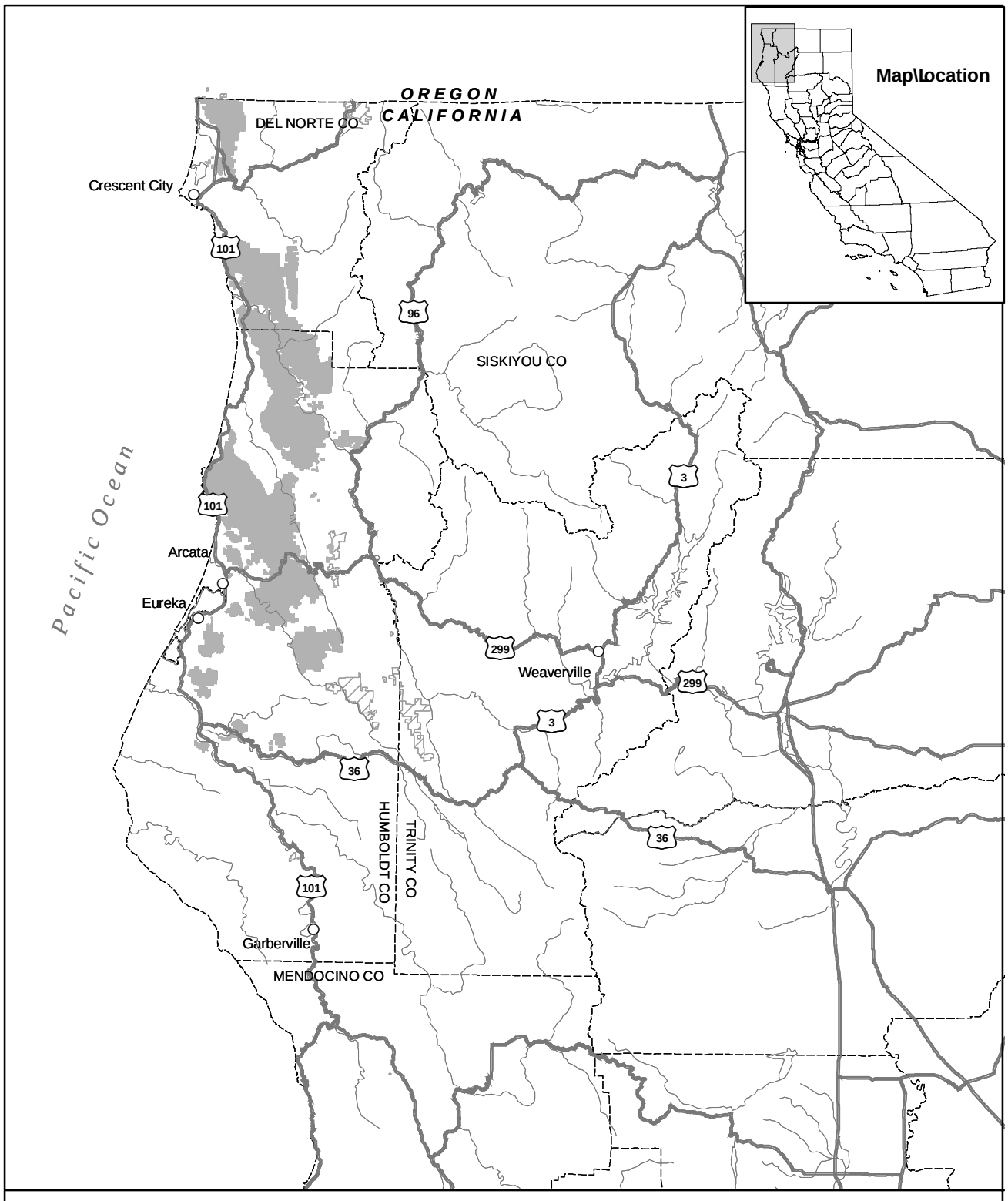

Figure 1.1-1
Green Diamond Resource Company
California Ownership

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three other fish ESUs, two fish species and two amphibian species, currently unlisted, should they become listed in the future. These unlisted ESUs/species are Chinook salmon (Southern Oregon and Northern California Coastal ESU, Upper Klamath/Trinity Rivers ESU), steelhead (Klamath Mountains Province ESU), coastal cutthroat trout, rainbow trout, southern torrent salamander, and tailed frog. Chapter 3 of the proposed AHCP/CCAA describes the ESUs/species for which Green Diamond is seeking Permit coverage. Green Diamond has proposed an AHCP/CCAA duration (Permit period) of 50 years.

The Services have determined that issuance of an ITP by NMFS and issuance of an ESP by USFWS are major Federal actions that trigger the National Environmental Policy Act (NEPA) requirement for the analysis and disclosure of the potential environmental impacts of the actions. Pursuant to NEPA, the environmental consequences of the Federal incidental take authorizations are being analyzed in this Environmental Impact Statement (EIS), with the USFWS and NMFS as co-lead Federal agencies.

1.2 Purpose and Need for the Proposed Action

The USFWS and NMFS are responding to applications from Green Diamond for: (1) an ESP pursuant to Section 10(a)(1)(A) of the Federal ESA; and (2) an ITP pursuant to Section 10(a)(1)(B) of the ESA, respectively. Pursuant to ESA Section 10(a), if NMFS finds that all ESA requirements for incidental take permit issuance are met, NMFS will issue the requested Permit. The USFWS may approve an ESP if it finds that the CCAA meets the regulatory requirements for such permits. In addition, implementing the provisions of these permits will further NMFS' and USFWS' long-term objective of ensuring long-term survival of ITP/ESP species while allowing otherwise lawful activities of the applicant to continue.

The Services' purpose and need in this action, therefore, is to respond to Green Diamond's ITP and ESP application for incidental take authorization pursuant to the AHCP/CCAA that provides protection and conservation to listed, proposed, and unlisted species and their habitats, consistent with the requirements of Section 10(a)(1)(A) and Section 10(a)(1)(B) of the ESA.

The applications request that NMFS approve Green Diamond's application and issue an ITP and that the USFWS approve Green Diamond's application and issue an ESP. The Services' approval and issuance of these Permits are the NEPA "actions" analyzed in this EIS.

1.3 Decisions to Be Made

NMFS must decide whether to issue, issue with conditions, or deny an ITP pursuant to Section 10(a)(1)(B) of the ESA. Pursuant to Section 10(a)(2)(B) the applicant is required to prepare a habitat conservation plan, and in reaching its decision to issue an ITP, NMFS must find that:

- The taking will be incidental to, and not the purpose of, the carrying out of an otherwise lawful activity
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking

- The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild
- Other measures that NMFS may require as necessary or appropriate for purposes of the conservation plan will be met and plan implementation will be assured

The USFWS must decide whether to issue, issue with conditions, or deny an ESP pursuant to Section 10(a)(1)(A) of the ESA (June 17, 1999, 64 FR 32706). The applicant for an ESP is required to prepare a CCAA and in reaching its decision to issue an ESP, the USFWS must find that:

- The take will be incidental to an otherwise lawful activity
- The CCAA complies with CCAA/ESP regulations that incorporate the Services' Candidate Conservation Agreement with Assurances policy (i.e., the benefits of the conservation measures as implemented, when combined with those benefits that would be achieved if it is assumed that conservation measures were also to be implemented on other necessary properties) would preclude or remove the need to list the covered species
- The probable direct and indirect effects of any authorized take will not appreciably reduce the likelihood of survival and recovery in the wild of any species
- Implementation of the terms of the CCAA is consistent with applicable Federal, State, and tribal laws and regulations
- Implementation of the terms of the CCAA will not conflict with any ongoing conservation programs for species covered by the Permit
- The applicant has shown capability for and commitment to implementing all of the terms of the CCAA

1.4 Action Area

As discussed in Chapter 1, the Action Area includes all commercial timberland acreage within the 11 Hydrographic Planning Areas (HPAs) on the west slopes of the Klamath Mountains and the Coast Range of California in Del Norte and Humboldt counties where Green Diamond owns lands or harvesting rights, during the period of such ownership within the Permit term. The Action Area is currently 416,532 acres, including approximately 1,866 acres of lands on which Green Diamond owns perpetual harvesting rights. The Action Area acreage will adjust during the Permit term to reflect real property transactions involving Green Diamond.[1] To account for those potential adjustments, the EIS analyzes

[1] Additional commercial timberlands that Green Diamond may acquire in the future may be added to Green Diamond's Initial Plan Area (known herein as the current Action Area), subject to Green Diamond submitting to the Services a description of the lands it intends to add, along with a summary of relevant characteristics they share with existing Action Area lands within that HPA. Up to 15 percent of the current Action Area (e.g., 62,479 acres), including areas on which Green Diamond owns perpetual harvesting rights, may be added to or deleted from the Action Area without an amendment to the proposed AHCP/CCAA. The 15 percent cap would not apply to certain categories of land transfers as specified in the proposed Implementation Agreement between Green Diamond and the Services.

possible impacts of the Proposed Action and the alternatives on all commercial timberlands within the 11 HPAs, defined as the "Primary Assessment Area." Under Alternative C, the Action Area and Primary Assessment Area contain additional areas outside the 11 HPAs that are known as "rain-on-snow" areas (see Section 2.5).

1.5 Regulatory Background

Federal authorization of incidental take is subject to several laws and regulations. Timber harvest-related activities on private lands are subject to numerous Federal and State regulations and other applicable guidelines. Key relevant State regulations and guidelines applicable to management activities on Green Diamond's lands in northern California, and those associated with issuance of an ITP and ESP by the Services, are described below. In essence, these laws and regulations, which are summarized below, establish what are "otherwise lawful activities" pursuant to which any take that is authorized under the ITP and ESP must be incidental. In addition, laws that do not directly control these issues but are related are also summarized below.

1.5.1 Federal Regulatory Provisions Relating to Approval of ITPs

1.5.1.1 Endangered Species Act

The Federal Endangered Species Act of 1973, as amended (ESA), is administered by the Secretaries of the Interior and Commerce through the USFWS and NMFS. Species listed as endangered or threatened under the ESA are provided protection as described herein.

Section 9/Section 4(d). Section 9 of the ESA prohibits the take of fish and wildlife species listed as endangered. Pursuant to Section 4(d) of the ESA, the Services may, by regulation, extend the prohibition of take to species listed as threatened. NMFS has extended the prohibition of take to the listed ESUs/DPS (50 CFR 223.203). As defined in the ESA, take includes harm or harassment as well as more directed activities such as hunting, capturing, collecting, or killing [16 USC 1532(19)]. By regulation, USFWS and NMFS have defined harm as an act that actually kills or injures fish or wildlife, and may includes significant habitat alteration that significantly impairs essential behavioral patterns, such as migrating, spawning, feeding, breeding, and sheltering (50CFR17.3, 50CFR222.102).

Section 10. Section 10(a)(1)(A) of the ESA authorizes USFWS and NMFS to authorize take of individual members of endangered and threatened species for scientific purposes or to enhance the propagation and survival of the species.

In recognition that take cannot always be avoided, Section 10(a)(1)(B) of the ESA allows USFWS and NMFS to authorize taking of endangered and threatened species by non-Federal entities that is incidental to, but not the purpose of, otherwise lawful activities. Similar provisions are found in Section 7 for actions by Federal agencies (see below). Under Section 10(a)(1)(B), such authorizations are granted through the issuance of ITPs. Applicants for such permits must submit Habitat Conservation Plans (HCPs) that specify:

- The names of the species that will be taken
- The impact(s) that will likely result from the proposed taking
- The measures the applicant will take to minimize and mitigate those impacts

- The source of funding available to implement the measures
- Procedures that will be used to respond to unforeseen circumstances
- Alternatives to the taking and the reason the alternatives were not chosen
- Any other measures considered by the Secretaries (i.e., USFWS and NMFS) as necessary or appropriate for minimizing or mitigating the impacts of the taking

The Services also approve HCPs and issue ITPs that cover unlisted species if they are in the same area as the listed species. If an ITP and HCP treat an unlisted species as if listed, additional mitigation would not be required within the area covered by the ITP and HCP upon listing the species. The 'No Surprises' regulation adopted by USFWS and NMFS, 63 FR 8859 (February 23, 1998), codified at 50 CFR 17.22 and 17.32 for USFWS and 50 CFR 222.307(g) for NMFS, also provides that, as long as the HCP is being properly implemented, the Services will not require additional conservation and mitigation measures beyond those required in the plan in the event of changed circumstances not provided for in the plan. In the event of unforeseen circumstances, the Services may require additional measures limited to modifications within the conserved habitat area or the plan's operating conservation program, but the Services will not require the commitment of additional land, water or money, or impose additional restrictions on the use of land, water or natural resources beyond the level otherwise agreed upon without the consent of the permitee. However, in the unlikely event that the permitted activity no longer meets the issuance criteria that the activity will not appreciably reduce the likelihood of survival and recovery of the species in the wild, and the Services are not able to take steps to prevent that reduction, the Services will as a last resort revoke the permit, 69 FR 71723 (December 10, 2004). Under the Proposed Action addressed in this EIS, NMFS would issue an ITP based on implementation measures contained in Green Diamond's proposed AHCP that would cover the six listed and unlisted salmon and steelhead ESUs and one listed steelhead DPSs within NMFS's jurisdiction.

Additionally, in 1999 the Services announced a joint policy that provided additional ESA assurances through issuance of ESPs to non-Federal landowners for currently unlisted species that are: (1) proposed for listing under the ESA as threatened or endangered, (2) candidates for listing, or (3) likely to become candidates or proposed in the near future. Similar to issuance of ITPs in which the applicant must submit an HCP, issuance of an ESP requires that landowners enter into a Candidate Conservation Agreement with Assurances (CCAA) that commits them to implement voluntary conservation measures for the proposed or candidate species, or species likely to become candidates or proposed in the near future. The ESP provides assurances that additional conservation measures will not be required and additional land, water, or resource use restrictions will not be imposed if the species are listed in the future. Under the Proposed Action, the USFWS would issue an ESP based on conservation measures contained in Green Diamond's proposed CCAA for two species of trout, one salamander, and one frog species in USFWS's jurisdiction. Applicants for ESPs must provide the following information:

- The common and scientific names of the species for which the applicant requests incidental take authorization
- A description of the land use or water management activity for which the applicant requests incidental take authorization

- A Candidate Conservation Agreement that complies with the requirements of the CCAA policy available from the Service

Section 7. Under Section 7 of the ESA, Federal agencies must ensure that actions they authorize, fund or carry out are not likely to jeopardize the continued existence of endangered, threatened, or proposed species or result in the destruction or adverse modification of designated critical habitat of listed species by Federal agency actions. Because issuance of an ITP or ESP is a Federal action, the Services consult with themselves to ensure ITP/ESP issuance will comply with Section 7 of the ESA. This EIS is being prepared to support possible issuance of an ITP and/or ESP, which requires compliance with ESA Section 7.

1.5.1.2 National Environmental Policy Act

The NEPA of 1969, as amended, applies to all Federal agencies and most of the activities they manage, regulate, or fund that affect the environment. It establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to assess environmental impacts, and contains "action-forcing" procedures to ensure that Federal agency decision makers take environmental factors into account.

NEPA requires the analysis and full public disclosure of the potential environmental impacts of a proposed major Federal action. The issuance of an ITP by NMFS and issuance of an ESP by USFWS, as defined in this EIS, are major Federal actions that trigger the NEPA requirement for the analysis and disclosure of the potential environmental impacts of the actions. Pursuant to NEPA, the environmental consequences of the Federal incidental take authorizations are being analyzed in this EIS, which is being prepared with the USFWS and NMFS as co-lead Federal agencies.

1.5.1.3 1996 Amendments to the Magnuson-Stevens Fishery Conservation and Management Act

The 1996 Sustainable Fisheries Act amended the Magnuson-Stevens Fishery Conservation and Management Act (the Magnuson Act) to add provisions requiring NMFS and the various fishery management councils to identify and protect essential fish habitat (EFH) for fish species managed under the Magnuson Act. EFH can include coastal areas and oceans, and it can also include rivers used by anadromous fish. The amendments require that whenever Federal or State approval is required for any activity, including a non-fishing related activity that could adversely affect EFH, a consultation similar to the consultation required under the ESA must be conducted. If it is determined that the activity would adversely affect EFH, recommendations would be made on measures that the agency can take to conserve the habitat. The Magnuson Act did not, however, place mandatory requirements on agencies for compliance with conservation measures recommended by NMFS.

Currently, among the covered species EFH has been defined only for Chinook and coho salmon.

1.5.1.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA) makes it unlawful to pursue, hunt, capture, kill, or possess or attempt to do the same to any migratory bird or part, nest, or egg of such bird listed in wildlife protection treaties between the United States and Great Britain,

Mexico, Japan, and Russia. As with the Federal ESA, the act also authorizes the Secretary of the Interior to issue permits for take. The procedures for securing such permits are found in Title 50 of the Code of Federal Regulations (CFR), together with a list of the migratory birds covered by the act. The USFWS has recently determined that an ITP issued under Section 10 of the ESA also constitutes a Special Purpose Permit under 50 CFR 21.27.

1.5.1.5 Bald Eagle and Golden Eagle Protection Act

The Bald Eagle and Golden Eagle Protection Act makes it unlawful to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest or disturb any bald or golden eagle.

1.5.2 Related Federal Laws

1.5.2.1 Clean Water Act

The Clean Water Act of 1977 (CWA) is the principal Federal legislation designed to protect the quality of the nation's waters. The purposes of the CWA include "the protection and propagation of fish, shellfish, and wildlife." The U.S. Environmental Protection Agency (EPA) is charged with implementing most of the CWA, including Section 303, which contains provisions for establishing and meeting water quality standards. The CWA provides for establishment of Total Maximum Daily Loads (TMDLs) where water bodies are not meeting established water quality standards. The CWA includes provisions for states to assume much of the implementation responsibility, which is largely the case in California. (See subsequent discussion on the Porter-Cologne Water Quality Control Act of 1969.) Many stream reaches and watersheds in the Action Area have been listed as impaired water bodies by the North Coast Regional Water Quality Control Board (RWQCB). Green Diamond's proposed AHCP/CCAA is not intended to ensure compliance with CWA or TMDL requirements. However, the species, and their associated habitats, which are the focus of this plan, are also commonly identified as a component of the set of beneficial uses CWA is designed to protect. As a result, some elements of the AHCP/CCAA will likely contribute towards the achievement of CWA identified beneficial uses.

1.5.2.2 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended, requires Federal agencies to take into account the effects of a proposed undertaking on cultural resources listed or eligible for listing on the National Register of Historic Places (NRHP). The purpose of Section 106 is to ensure that Federal agencies consult with State and local groups before non-renewable cultural resources, such as archaeological sites and historic structures, are affected. Section 106 requires Federal agencies to take into account the effects of their actions on properties that may be eligible for listing or that are listed in the NRHP for projects that they finance, permit, or own.

1.5.3 State Regulation of Timber Harvesting and Related Activities

1.5.3.1 California Forest Practice Act and Forest Practice Rules

Overview. In general, commercial timber operations on State and private land in California are governed by the Z'berg-Nejedly Forest Practice Act of 1973 (Forest Practice Act) as implemented through Forest Practice Rules (Title 14 of the California Code of Regulations [14 CCR]) promulgated by the Board of Forestry (BOF) and administered by the California

Department of Forestry and Fire Protection (CDF). Pertinent examples of California Forest Practice Rules (CFPRs) relevant to fish and wildlife habitat management under Green Diamond's proposed AHCP/CCAA include: (1) the environmental review process undertaken by CDF, with input from other agencies, that applies to review and approval of proposed commercial timber operations; (2) watercourse and lake protection zone rules; (3) special rules to protect fish, wildlife, and watersheds; (4) rules for defined special treatment areas; (5) rules specific to the requirement for maximum sustained production of high quality timber products; and (6) a methodology for assessing cumulative environmental effects. The CFPRs also incorporate significant requirements contained in other State laws, such as the Porter-Cologne Water Quality Control Act, the California Environmental Quality Act (CEQA), and the California Endangered Species Act (CESA) (see below).

Environmental Review Process. The CFPRs impose a two-tiered environmental review process on timber harvesting operations in California. The review process is a certified regulatory program that produces the functional equivalent of an Environmental Impact Report (EIR) process and documentation required under CEQA for discretionary permitting decisions by State agencies. As a certified program, it is exempt from CEQA requirements regarding preparation of initial studies, negative declarations, and EIRs. Other provisions of CEQA, however, apply to BOF decisions, such as the policy of avoiding significant adverse effects on the environment (where feasible) and the requirement to consult with responsible agencies.

The first tier of the review process entails the programmatic consideration by the BOF and CDF of environmental impacts common to timber operations and the adoption of rules (the CFPRs) to control those impacts. The second tier of review occurs when the rules are applied to individual timber operations through the preparation, review, and approval of Timber Harvesting Plans (THPs).

A THP is a three-year plan for the harvesting of commercial tree species on private and state-owned forestlands. The primary purpose of the THP is to identify the scope of the proposed timber operations, assess potential site-specific and area-specific individual and cumulative effects on the environment, and discuss all feasible mitigation measures and alternatives that will reduce or avoid potentially significant impacts. Each plan is filed with CDF and reviewed by an interdisciplinary team that, if necessary, also inspects the plan site. No harvesting can occur until the THP for the site is approved. Approval of a THP requires a determination by the Director of CDF that all significant adverse impacts, including cumulative effects, have been avoided or mitigated to a level of insignificance.

Green Diamond regularly submits proposed THPs to CDF for review by CDF and a State agency review team (comprising the RWQCB, Department of Fish and Game, and the California Geologic Service [CGS] (formerly known as the California Division of Mines and Geology [CDMG]). Additional input is received from interested State and Federal agencies, often including the California Department of Parks and Recreation, the National Park Service, USFWS, and NMFS. Green Diamond's THPs cover only small areas (generally fewer than 100 acres).

Watercourse and Lake Protection Rules. The California Watercourse and Lake Protection Zone (WLPZ) rules require buffers of specified widths along streams and other bodies of

water. They also require maintenance of specified percentages of overstory canopy and understory vegetation in the buffers. These buffers are intended to: (1) provide a vegetative filter strip that will capture and reduce sediment carried by runoff from side-slopes; (2) preserve canopy cover to maintain water temperatures; and (3) provide for filtration of organic and inorganic material and vegetation, as well as streambed and flow modification by instream woody debris. In addition, the construction, use, and maintenance of logging roads, skid trails, and landings are regulated to minimize erosion and sedimentation impacts to watercourses and to remove or prevent in-stream obstructions to unrestricted fish passage.

Special Rules for Wildlife and Sensitive Watersheds. The CFPRs also require the retention of snags, intended for wildlife purposes and for the recruitment of large woody debris (LWD) for instream habitat through retention of larger living trees near aquatic habitats. Specific habitat protection and harvesting prescriptions are established for wildlife species designated as sensitive species. In addition, wildlife needs must be considered in the cumulative effects assessment, discussed below.

If substantial evidence exists that timber operations within a planning watershed will create a reasonable potential to cause or contribute to ongoing, significant cumulative effects on resources within the watershed, the BOF may classify the planning watershed as sensitive. Subsequent to classification, the BOF may further define watershed-specific performance standards for timber operations that will avoid or mitigate new or continuing significant cumulative effects. None of the planning watersheds in Green Diamond's proposed AHCP/CCAA have been designated as sensitive watersheds by the BOF.

Further, the CFPRs stipulate that no THP can be approved if it would result in an unauthorized taking of species listed under either the Federal or State ESAs.

Special Treatment Area. The State Coastal Commission has designated a number of special treatment areas along the north coast of California, within which general development and various management activities are restricted. Approximately 280 acres of Green Diamond's proposed AHCP/CCAA coverage area lies within any of these designated areas.

The State BOF, however, has created a separate network of special treatment areas (STAs) that could limit the scope of silvicultural treatments, including the size of clearcut units, time intervals between harvest entries, and logging practices that may be employed. STAs under the CFPRs are specific locations containing one or more of the following significant resource features:

- Are within 200 feet of the watercourse transition line of Federal or State designated wild and scenic rivers
- Are within 200 feet of national, State, regional, county, or municipal park boundaries
- Are key habitat areas of Federal or State designated threatened, rare or endangered species
- Are within 200 feet of State designated scenic highways

Approximately 1,800 acres in Green Diamond's proposed AHCP/CCAA coverage area are considered STAs by virtue of being within 200 feet of State or Federal park lands.

Maximum Sustained Production of High Quality Timber Products. Pursuant to the Forest Practice Act, the BOF adopted regulations designed to achieve the goal of maximum sustained production (MSP) of high-quality timber products, while giving consideration to various other forest benefits and amenities. Each proposed timber harvest operation must demonstrate that it will contribute toward achievement of MSP. Pursuant to Section 913.11(a) (also known as "Option [a]") of the CFPRs, MSP will be achieved by:

- Producing a yield of timber products specified by the landowner, which takes into account biological and economic factors, as well as consideration of other forest values
- Balancing growth and harvest over time
- Realizing growth potential as measured by adequate site occupancy by the tree species to be managed and maintained given silvicultural methods selected by the landowner
- Maintaining good stand vigor
- Providing for adequate regeneration, as defined in the CFPRs

Cumulative Environmental Effects. The CFPRs provide that all THPs must address cumulative environmental effects, which are defined as two or more individual effects that, when considered together, are considerable or that compound or increase other environmental impacts. Under the CFPRs, the cumulative impact from several projects is the change in the environment that results from the incremental impacts of a project when added to other closely related past, present, and reasonably foreseeable future projects. The CFPRs provide that no THP can be approved unless it avoids or mitigates with feasible measures all significant environmental impacts, including cumulative impacts. Each THP is required to include a CEQA-based assessment of potential cumulative impacts and, if necessary, avoid or mitigate such impacts to a level of insignificance, and incorporate feasible mitigation measures that exceed those required by the CFPRs.

CFPRs as a Benchmark for No Action. As discussed in Section 2.1, the CFPRs are part of the No Action Alternative. The No Action Alternative also includes Green Diamond's operational policies and guidelines.

In response to a joint request made by NMFS and the California Resources Agency, an independent Scientific Review Panel found in 1999 that the CFPRs and their implementation (the forest practice rulemaking process, the rules themselves, and the THP review and approval process) do not "achieve properly functioning habitat conditions" necessary to "adequately conserve anadromous salmonids" listed under the ESA (Ligon et al., 1999). Since then the BOF has adopted "interim" rules for Class I watercourses that further strengthen the forest practice rules and the THP process. NMFS continues to find that the CFPRs do not ensure the achievement of properly functioning habitat for conservation of anadromous salmonids throughout their range in California, although forest practices operations conducted pursuant to this process in a particular area, land ownership, or region under this process may achieve such conditions.

1.5.3.2 California Environmental Quality Act

Similar to NEPA, CEQA requires State agencies with discretionary permitting authority to evaluate the environmental effects of a proposed project. If one or more significant impacts are identified, a detailed EIR must be prepared. If no significant impacts are determined or

if all of the significant impacts can be mitigated to levels less than significant, a negative declaration is prepared. CEQA also requires that a negative declaration or Draft EIR be prepared if a project has statewide, regional, or area-wide significance, including projects that would substantially affect sensitive habitats.

As noted above, the preparation, review, and approval of THPs that detail activities associated with timber harvesting on State and private lands serves as the functional equivalent of an EIR under CEQA.

1.5.3.3 Porter-Cologne Water Quality Control Act

The California Porter-Cologne Water Quality Control Act of 1969 authorizes RWQCBs to establish water quality objectives necessary for the reasonable protection of beneficial uses, including preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. The objectives are stated in basin plans. The North Coast Basin Plan, which encompasses Green Diamond's ownership, includes water quality objectives for several pollutants associated with non-point source discharges from timber operations. These include the suspended sediment load and suspended sediment discharge rate of surface waters, turbidity, and the natural receiving water temperatures of intrastate waters. The North Coast Basin Plan regulates certain practices relating to logging and related activities pursuant to the North Coast RWQCB's authority to regulate discharges of pollutants that may affect water quality. Under the CFPRs, no THP may be approved if it would result in the violation of an applicable Basin Plan provision.

As previously noted (see Clean Water Act above), the State Water Resources Control Board (SWRCB) and regional water boards implement the Federal CWA in California under the oversight of the EPA, Region IX. Direction for implementation of the CWA is provided by the Code of Federal Regulations (40 CFR) and by a variety of EPA guidance documents on specific subjects. The SWRCB and the North Coast RWQCB have the authority and responsibility to ensure compliance with the provisions of the CWA in the north coast region of California, which includes Green Diamond's northern California ownership.

1.5.3.4 Streambed Alteration

Pursuant to California Fish and Game Code sections 1600-1603, the Department of Fish and Game (CDFG) regulates the alteration of streambeds through streambed alteration agreements. Under these provisions, CDFG specifies conditions that must be followed during timber operations to protect fish and wildlife resources that could be impacted by the construction of stream crossings and related timber harvest activities.

1.5.3.5 California Endangered Species Act

The CESA is part of the California Fish and Game Code. As a guide to State agencies, Section 2053 states that, "it is the policy of the State that State agencies should not approve projects as proposed which would jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species, if there are reasonable and prudent alternatives consistent with conserving the species or its habitat which would prevent jeopardy."

The CESA also states, however, that such reasonable and prudent measures must at the same time maintain the project purpose to the greatest extent possible. CESA also prohibits take of species listed or proposed for listing as endangered or threatened and provides a number of regulatory mechanisms to authorize the incidental take of species.

1.5.4 Related State Laws

1.5.4.1 Timberland Productivity Act

The California Timberland Productivity Act of 1982 (TPA) affirms the State's interest in providing a favorable climate for long-term investment in forest resources through establishment of "timberland production zones" (TPZs). The use of lands designated as TPZ is limited to the growing and harvesting of timber and uses compatible with those activities. All of Green Diamond's lands included in the coverage area for its proposed AHCP/CCAA are zoned as TPZ.

1.6 Green Diamond Planning and Management

1.6.1 Silviculture and MSP

Green Diamond's lands that would be covered by the provisions of the proposed AHCP/CCAA are characterized by a number of unique conditions based on climate, tree species mix, geologic factors, and past harvesting and management history. The conifers of primary economic value on Green Diamond's lands are coast redwood and Douglas-fir, which require substantial direct sunlight to grow rapidly at young ages. Even-aged silvicultural techniques are used to promote propagation of these species throughout the North Coast redwood region. Although the use of uneven-aged regeneration systems can be beneficial to many shade-tolerant species, such as western hemlock and white fir, these systems generally are less suited to the economically valuable redwood and Douglas-fir which grow at maximum rates when free to grow in full sunlight (Smith, 1962; USFS, 1973; Perry, 1994). On the basis of the unique growing conditions of the region and the long-term management approach implemented by Green Diamond, Green Diamond feels the continued use of even-aged regeneration tools is necessary to support its management and business objectives, as well as to achieve the State law mandates of maximum sustained production of high quality timber products as discussed below. Appendix A provides a table outlining considerations for selecting even-aged versus uneven-aged management.

1.6.2 State Laws and Regulations

As noted above, Green Diamond operates its timberlands under multiple regulatory controls. The California Forest Practice Act mandates the achievement of maximum sustained production of high quality timber products and consideration of other significant values, including protection of wildlife, fisheries, water quality, and regional economic vitality and employment. In addition, all of Green Diamond's lands that would be covered by the ITP/ESP are designated as TPZ under California's TPA, which limits the use of TPZ lands to growing and harvesting timber and uses compatible with those activities. California's timber harvest regulations also require compliance with water quality protection measures adopted by Regional and State Water Boards under the Porter-Cologne Water Quality Control Act. Further, all timber harvesting is subject to the Federal and State

ESAs, and the CFPRs stipulate that no THP may be approved if it would result in an unauthorized taking of species listed under those acts.

1.6.3 Watershed and Landscape Plans

Although timber harvesting operations are regulated at the individual THP level, many of the productivity, resource protection, and environmental issues may be addressed on a larger landscape scale. Green Diamond has undertaken a number of watershed- and ownership-level planning efforts to protect terrestrial wildlife and aquatic habitat that meet or exceed State standard rules and regulations. These planning efforts are designed to address the State of California's mandates of: (1) enhancing timberland productivity; and (2) protecting endangered species, timber resources, and related environmental values. The planning efforts also seek to reconcile those mandates with Green Diamond's management objectives and the unique environmental and productivity conditions on Green Diamond's ownership. Green Diamond feels that even-aged management is also key to implementation of these other landscape management templates, including the Green Diamond Northern Spotted Owl HCP (see below), and achievement of maximum sustained production on Green Diamond's lands under Option (a).

Green Diamond has developed a substantive database on site-specific and regional conditions by conducting extensive data gathering and scientific research. The results of this research are incorporated in the watershed and ownership planning efforts. These various plans form the basis of Green Diamond's short- and long-term management decisions. Many of the internal policies, programs, and measures used by Green Diamond to govern planning and management on its lands are discussed below.

1.6.3.1 Northern Spotted Owl Habitat Conservation Plan

The proposed AHCP/CCAA builds on conservation provided under Green Diamond's HCP for the northern spotted owl (NSOHCP), which provides protection to the AHCP/CCAA covered species through resource management measures, such as enhanced stream protection zones and wildlife habitat retention areas. In addition, the NSOHCP also provides some benefit to 39 other terrestrial species thought to be the most sensitive to timber operations on the ownership.

1.6.3.2 Maximum Sustained Production Option (a) Document

Green Diamond manages its properties for the primary purpose of growing and harvesting commercial timber. Implicit in this goal is achievement of a sustained yield in perpetuity (i.e., the harvesting of timber at a rate commensurate with the ability of the land base to grow replacement trees). Green Diamond's "Option (a)" document is the company's blueprint for achieving maximum sustained production of high quality timber products over a 100-year planning horizon. The Option (a) document is submitted as part of Green Diamond's THPs to demonstrate compliance with the CFPR mandate that each THP demonstrate achievement of MSP. Similar to the NSOHCP, the Option (a) document is premised on the primary use of even-aged regeneration methods to meet MSP and wildlife habitat objectives given the unique conditions of Green Diamond's ownership and this region. The document also provides consideration to other significant values, including protection of wildlife, fisheries, water quality, and regional economic vitality and employment.

1.6.3.3 Road Management Policy

Green Diamond currently has approximately 4,000 miles of management roads on its ownership in northern California. These roads are used by Green Diamond for land management activities and historically by the public for various recreational activities. Roads can be sources of erosion, particularly if improperly used or maintained. Erosion problems, road maintenance costs, as well as concerns over wildlife species sensitivity, have prompted Green Diamond over the last several years to restrict hundreds of miles to motorized public use through construction and installation of gates, barricades, and earthen berms. These restrictions benefit salmonids and other aquatic species by reducing erosion and associated sediment delivery to streams. They also benefit terrestrial wildlife species that are sensitive to local human presence. In addition, Green Diamond has invested substantial economic resources in road reconstruction and maintenance that is not associated with timber harvesting plan operations. The investment is intended to minimize further any sedimentation of aquatic habitat.

1.6.3.4 Other Programs and Measures

Other programs and measures that provide a foundation for Green Diamond's proposed AHCP/CCAA are:

- A long-term stream channel monitoring program initiated in 1995 (active and ongoing)
- Stream assessments and studies of aquatic species conducted on Green Diamond property since 1993 (active and ongoing)
- The Salmon Creek Management Plan, prepared in 1993 in coordination with CDF, the CDFG, and the North Coast RWQCB (active and currently being implemented)
- The Management Strategies for the Little River Watershed, prepared in 1999 after Green Diamond acquired the Little River timberlands formerly owned by Louisiana-Pacific Corporation (active and currently being implemented)
- A cooperative effort with the Yurok Tribe fisheries staff and the Coastal Conservancy on a long-term program to restore anadromous fish habitat in 30 basins and sub-basins of the lower Klamath River (active and ongoing)
- A cooperative effort with Redwoods National Park in the upper Redwood Creek watershed to inventory roads and hillslopes and prioritize treatment areas to reduce the risk of future erosion (currently inactive, but may be resumed)
- Habitat restoration and enhancement projects completed in cooperation with restoration groups on 33 streams (active and ongoing)
- Standardized field methods to assess salmonid populations and habitat, originally developed through cooperative efforts of the Fish, Farm, and Forest Communities Forum (active and currently being implemented)
- The Redwood Creek Total Maximum Daily Load (TMDL) Implementation Plan proposed by the Redwood Creek Landowners Association (under consideration, but not currently implemented)

1.6.3.5 Structure of Green Diamond's Timberlands Operations

On December 31, 2001, Simpson Timber Company transferred its California timberlands assets to a new affiliate, Simpson Resource Company. The timberlands employees and management functions associated with those assets were transferred to Simpson Resource Company on June 30, 2002. Subsequent to release of the Draft EIS (DEIS), Simpson Resource Company changed its name to Green Diamond Resource Company, effective April 30, 2004. All references in this EIS to past or continuing operation of Green Diamond are also intended to refer to past operation of the Green Diamond timberlands when they were owned and operated by Simpson Timber Company and during that period of time when it was known as Simpson Resource Company.

1.6.4 AHCP/CCAA Planning and Development

Green Diamond submitted its application for an ITP and ESP in the context of the above-discussed regulatory controls, which, under ESA Section 10, limit, shape and authorize, the "otherwise lawful activities" to which the take for which Green Diamond seeks authorization will be incidental. Accordingly Green Diamond's AHCP/CCAA is premised on achieving and maintaining consistency with the above-discussed legal and regulatory controls as well as management objectives.

Under the Proposed Action, the Services would authorize take of species covered under the plans pursuant to ESA Section 10, but the take must be incidental to otherwise lawful activities. In the context of the ESA and this EIS, those "otherwise lawful activities" include Green Diamond's timber harvesting operations that are regulated and approved under State law. Accordingly, the Federal action does not include authorization of the harvesting itself.

According to Green Diamond, its proposed AHCP/CCAA is necessarily designed to be consistent with Green Diamond's unique management and productivity objectives that are based on Green Diamond's extensive site-specific and regional analysis, as reflected in the various internal planning templates. In addition to the ownership-wide planning processes and documents used by Green Diamond to address its company-specific operating mandates, Green Diamond must also comply with all the applicable laws and regulatory requirements discussed above, including the CFPR requirements for incorporating into THPs measures that are designed to protect aquatic species and their habitats. The CFPRs also prohibit approval of THPs that would result in the unauthorized take of a listed species. However, rather than relying solely on the THP process to determine what measures to use for protecting aquatic species and their habitats, the AHCP/CCAA process provides ownership-wide protection for aquatic species and their habitats and also addresses Green Diamond's needs of obtaining greater regulatory certainty and remaining competitive in the forest products market.

As with the other environmental and productivity concerns discussed above, Green Diamond has determined that protection of aquatic species and their habitats is best addressed at the ownership level. Accordingly, Green Diamond has proposed an AHCP/CCAA that, if approved, would add an additional planning "template" to Green Diamond's existing plans relating to forest and resource management.

Green Diamond indicates that it seeks greater regulatory certainty in the operation of its business by obtaining the ITP and ESP. Approval of these Permits would improve Green

Diamond's ability to conduct long-term forest planning and contribute to a stable business climate that supports Green Diamond's ability to remain competitive in the forest products market. Incidental take authorization based on an AHCP and a CCAA would allow greater certainty for Green Diamond's forest planning by providing assurances that, so long as Green Diamond complies with the terms of the AHCP and CCAA, the Services will not require additional conservation and mitigation measures beyond those required in the Plan in the event of changed circumstances not provided for in the Plan. In the event of unforeseen circumstances, the Services may require additional measures limited to modifications within the conserved habitat area or the Plan's operating conservation program, but the Services will not require the commitment of additional land, water or money, or impose additional restrictions on the use of land, water or natural resources beyond the level otherwise agreed upon without the consent of the permitee. However, in the unlikely event that the permitted activity no longer meets the issuance criteria that the activity will not appreciably reduce the likelihood of survival and recovery of the species in the wild, and the Services are not able to take steps to prevent that reduction, the Services will as a last resort revoke the Permit, 69 FR 71723 (December 10, 2004).

1.7 Consultation and Coordination

1.7.1 Scoping

Public scoping was conducted to identify issues and concerns pertaining to implementation of Green Diamond's proposed AHCP/CCAA and the content of this EIS. The scoping process involved solicitation of comments from the public, as well as feedback from other agencies, tribal groups, and organizations.

1.7.1.1 Dates and Times of Scoping Meetings

The Services and Green Diamond held four public scoping meetings over a two-day period on July 11 and July 12, 2000 in Eureka and Crescent City, California. Prior to these meetings, the Services published a Notice of Intent (NOI) in the Federal Register (July 11, 2000, 65 FR 42674) to advertise the Services' intent to prepare an EIS and to announce the public scoping meetings. The NOI, provided information on the background and purpose of the proposed AHCP/CCAA, requested public comment on the EIS for the AHCP/CCAA within a 30-day comment period, and provided preliminary information on the public scoping meetings. The meetings also were advertised in the local Eureka and Crescent City newspapers, as well as through mailings to members of the public who had previously expressed interest in the AHCP/CCAA.

The objectives of the meeting were to inform the public about Green Diamond's AHCP/CCAA and the associated EIS, and to solicit public comment on the scope of the EIS for the Proposed Action and possible alternatives for consideration in the EIS. During these meetings, Green Diamond outlined the proposed AHCP/CCAA and opened the floor to questions and comments. Additional public input was obtained during pre-meeting "open house" sessions that allowed the public to view poster material on the AHCP/CCAA and to visit with representatives from Green Diamond and the Services on a more informal basis.

Green Diamond also held a series of six informational meetings with cooperating agencies and local tribal groups. Meeting objectives were to inform the agencies and tribes (Yurok

Nation and Hoopa Tribe) about Green Diamond's AHCP/CCAA, solicit feedback on the AHCP/CCAA, and receive suggestions on the content of the associated EIS. Agencies in attendance were:

- State of California Resources Agency
- CDFG
- California Department of Forestry and Fire Protection (CDF)
- California Department of Mines and Geology (CDMG)
- California Department of Parks and Recreation
- SWRCB
- North Coast RWQCB
- U.S. Forest Service (USFS)
- EPA

Informational meetings were conducted using a presentation/question-and-answer format, and were hosted by Green Diamond. The meetings were held as follows: August 11, 2000 (Green Diamond offices, Eureka); August 18, 2000 (CDFG offices, Redding); August 25, 2000 (Yurok Tribal offices, Eureka); August 29, 2000 (CH2M HILL offices, Sacramento); August 30, 2000 (North Coast RWQCB offices, Santa Rosa); and September 21, 2000 (Hoopa Tribal offices). Attendees signed an attendance list with their affiliation and introduced themselves at the beginning of the meeting to the group. Attendees were informed that they should ask questions during or after the presentation as necessary.

1.7.1.2 Summary of Scoping Comments

Comments on the EIS were grouped into five broad categories: (1) suggested alternatives; (2) general comments regarding the contents of the EIS; (3) scope of the impacts analysis; (4) analysis of impacts on aquatic species; and (5) analysis of other impacts. All comments are summarized in greater detail in the Scoping Report for this EIS dated September 18, 2000 and included herein as Appendix B.

1.7.2 Coordination between the Services and Green Diamond

Extensive interaction also occurred between the Services and Green Diamond during the development of the AHCP/CCAA in policy and technical committee meetings comprised of representatives from all three organizations.

1.8 Summary of Scoping and the Public Review Process

1.8.1 Public Scoping

Following issuance of a Notice of Intent (NOI), which appeared in the *Federal Register* on July 11, 2000, the Services initiated the EIS and began the scoping process. Scoping meetings were held on July 11 and July 12, 2000 in Eureka and Crescent City, California. Attendees were given an overview of Green Diamond's proposed AHCP/CCAA and asked to present their questions, concerns, and information pertinent to development of the associated EIS. Green Diamond also held a series of six informational meetings with cooperating agencies and local tribal groups. The meetings were held on August 11, August 18, August 25, August 29, August 30, and September 21, 2000 at various locations. All comments are

summarized in greater detail in the Scoping Report for this EIS dated September 18, 2000 and included herein as Appendix B.

1.8.2 DEIS Public Review Process

A Notice of Availability (NOA) for the Draft EIS (DEIS) was published in the Federal Register by NMFS and USFWS on August 16, 2002 (67 FR 53567). The public review period was scheduled for 90 days from August 16, 2002 to November 14, 2002. Two public meetings to formally introduce Green Diamond's proposed AHCP/CCAA and the DEIS were held on September 4, 2002, in Eureka, California. Representatives from NMFS, USFWS, and Green Diamond were available to discuss the AHCP/CCAA conservation strategy and the DEIS.

Advertisements were placed in local newspapers prior to the meeting date describing when and where each public meeting would be held. The two public meetings were held at the following location:

Wednesday, September 4, 2002
1:00 – 3:00 p.m. and 5:00 – 7:00 p.m.
Red Lion Inn
1929 4th Street
Eureka, California

Subsequent to introductions and a brief history of the AHCP/CCAA and summary of the associated environmental review process by the Services, representatives from Green Diamond described the key elements of the AHCP/CCAA conservation strategy. Members of the public in attendance at the meetings were then invited to ask questions or provide comments about the AHCP/CCAA and DEIS. Attendees were also encouraged to provide written comments on the DEIS before close of the public comment period. Approximately 30 people were in attendance at both meetings.

1.8.3 Number of Comments Received

A total of 20 oral questions and comments were received from the two meetings held in Eureka. In addition, 25 comment letters were received during the 90-day public review period, comprising 1,267 separate comments addressed in this Final EIS (FEIS). Written comments, plus oral comments received at the public meetings, are included in Volume II of this FEIS. See Volume II for a description of the comments received, and the responses to comments. FEIS Volume II provides a complete listing of the individuals, agencies, and organizations that submitted comments on the AHCP/CCAA and DEIS.

1.8.4 FEIS Public Review Process

The public outreach process will continue through completion and approval of the Record of Decision (ROD) by the Services. Statements on the FEIS will be accepted by the Services considered in the decision on the Proposed Action. The FEIS is being distributed for a 30-day notification period.

1.9 Differences between the DEIS and FEIS

This section presents the key changes to the DEIS in this FEIS as summarized below. These revisions do not alter the significant conclusions in the DEIS.

- Revisions to text have been made to reflect changes in the listing of steelhead, one of the covered species, initially listed by NMFS as the "Northern California Evolutionarily Significant Unit (ESU)" but currently listed as the "Northern California Distinct Population Segment (DPS)." The DPS policy adopts criteria similar to, but somewhat different from, those in the ESU policy for determining when a group of vertebrates constitutes a DPS: the group must be discrete from other populations, and it must be significant to its taxon. A group is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors." Using the DPS policy, resident rainbow trout are considered "markedly separated" from the anadromous form and are not included in the current steelhead listing (71 FR 834).
- Refinements and clarifications have been made to Green Diamond's Operating Conservation Strategy (see AHCP/CCAA Section 6); these changes are also reflected in the FEIS.
- Additional information has been provided to explain and clarify in greater detail the basis for the cumulative effects analysis in Chapter 4 (*Environmental Consequences*) relating to geology and geomorphology (Section 4.2) and aquatic resources (Section 4.3).
- A new Section 4.13, *Summary of Cumulative Impact Analysis*, has been prepared that summarizes the overall cumulative effect to the environment as a result of implementation of the Proposed Action and the other alternatives.

1.10 NEPA Environmentally Preferred Alternative

CEQ regulations require that the Record of Decision specify "the alternative or alternatives which were considered to be environmentally preferable" (40 CFR 1505.2[b]). The environmentally preferred alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic cultural and natural resources. NEPA's Section 101 calls for Federal agencies to make decisions to achieve "conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans" (42 USC 4341[a]). Federal agencies should strive to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences. It also calls for Federal agencies to achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Based on the analysis of alternatives in the FEIS, there are many similarities in the overall effects of the alternatives on the human environment, thus making it difficult to choose any particular alternative in the FEIS as the environmentally preferred alternative. Upon further

review, the Services will identify the Environmentally Preferred Alternative in the Record of Decision as required by NEPA.

1.11 Adequacy of the EIS

Based on the standards included in NEPA for adequacy of analysis, the Services have determined that with the clarifications, corrections, and supportive information included in this FEIS and the proposed Final AHCP/CCAA, the FEIS complies with NEPA. For purposes of NEPA, the Federal lead agencies (i.e., USFWS and NMFS) are responsible for the final determination of adequacy.

CHAPTER 2

Proposed Action and Alternatives

CHAPTER 2

Proposed Action and Alternatives

NEPA requirements for alternatives analysis (40 CFR 1502.14) direct Federal agencies to consider a range of alternatives that could accomplish the agency's purpose and need and present the alternatives in comparative form to define the issues and provide a clear basis for decision makers and the public to choose among options. Five alternatives are considered in this EIS, as briefly described in Table 2-1 and described in more detail in Table 2.7-1 found at the end of this chapter. The No Action Alternative and the three action alternatives represent a reasonable range of alternatives to the Proposed Action. Additional alternatives were considered; those eliminated from detailed evaluation are summarized in Section 2.6.

As required by NEPA, this EIS compares the Proposed Action and the other three action alternatives with the No Action Alternative. The No Action Alternative is the benchmark against which the effects of all other alternatives are measured.

TABLE 2-1
Alternatives Analyzed in Detail in the Green Diamond AHCP/CCAA EIS

Title	Brief Description
No Action (No Permit/No Plan)	• Continuation of Green Diamond's existing timber harvesting and forest management practices in the Action Area under existing regulations (see Sections 2.1.1 and 2.1.2) • Continued application of existing measures for protection of fish and wildlife habitat (Section 2.1.3) • Continued implementation of measures contained in Green Diamond's NSOHCP and associated IA that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations • Continued implementation of measures designed to avoid take of other listed species; continued implementation of other measures to mitigate or avoid significant impacts to unlisted species (Sections 2.1.4 and 2.1.5)
Proposed Action	• Continuation of existing operations pursuant to existing regulations, other applicable laws, and Green Diamond's NSOHCP, as augmented by the proposed AHCP/CCAA Conservation Strategy • Incidental take coverage for two listed fish ESUs and one listed fish DPS, three unlisted fish ESUs, two unlisted fish species, and two unlisted amphibians through issuance of an ITP by NMFS and an ESP by the USFWS • AHCP/CCAA/ITP/ESP obligations for the covered species and their habitats, to include: (1) fixed and variable RMZ/EEZ widths for Class I, II, and III watercourses and implementation of other riparian management measures; (2) implementation of road management, slope stability, and ground disturbance measures; and (3) effectiveness and implementation monitoring

TABLE 2-1
Alternatives Analyzed in Detail in the Green Diamond AHCP/CCAA EIS

Title	Brief Description
Listed Species Only (Alternative A)	• Same as the Proposed Action except for no incidental take coverage for unlisted species/ESUs and, consequently, no monitoring of amphibian populations
Simplified Prescription Strategy (Alternative B)	• Continuation of existing operations pursuant to existing regulations, other applicable laws, and Green Diamond's NSOHCP, as augmented by an AHCP/CCAA conservation strategy • An AHCP/CCAA would be implemented for the same fish and wildlife species covered by the Proposed Action, and an ITP/ESP would be issued for those species. • Obligations for the covered species include fixed, no-cut riparian buffer widths for Class I and II watercourses on the fee-owned lands of the Action Area.
Expanded Species/Geographic Area (Alternative C)	• Same as Proposed Action except for conservation measures that would be applied over an expanded area (an additional 25,677 acres) which has a different hydrology (rain-on-snow hydrology) than the majority of the area that would be covered under the Proposed Action • The AHCP/ITP would provide incidental take coverage for two listed fish ESUs and one listed fish DPS, three unlisted fish ESUs, two unlisted fish species, one listed fish species, four unlisted amphibians, one unlisted reptile, and two listed bird species through issuance of ITPs by NMFS and the USFWS • Modifications to the AHCP/ITP obligations that include additional species-specific measures

2.1 No Action (No Permit/No Plan)

This alternative has been developed to evaluate the conditions, as they would occur over time with "no Federal action" or "no project" in relation to current conditions. Under the No Action Alternative, NMFS and USFWS would not issue Green Diamond an ITP or an ESP, and Green Diamond would not implement an AHCP/CCAA. As a result, Green Diamond would remain subject to the ESA's prohibitions on unauthorized take of listed species. Green Diamond would, however, continue to implement measures contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations.

Green Diamond would continue to conduct timber harvesting and related operations in the Action Area in accordance with existing State and Federal regulations as well as operational and policy management actions currently being implemented by Green Diamond. The applicable regulations that provide the framework for implementing No Action elements are described in Section 1.5.3. Activities which would continue to occur as part of the No Action Alternative pursuant to existing laws and regulations where incidental take is not authorized are described in detail as components of the No Action Alternative in

Sections 2.1.1 through 2.1.5, and include activities associated with the growing, harvesting, and transporting timber products on and off the property; conducting ancillary activities necessary to protect the property from fire, insects, disease, and vandalism; complying with various local, State, and Federal laws and regulations that assess and seek to protect environmental resources (including listed fish and wildlife species); and voluntarily conducting research on wildlife and fish species and their habitats.

2.1.1 Green Diamond's Timber Harvesting and Forest Management Activities

Descriptions of the major activities associated with Green Diamond's management of its lands under this alternative are provided below:

- Harvesting and transporting timber
- Timber stand regeneration and improvement
- Road and landing construction, reconstruction, and maintenance
- Monitoring and research activities

2.1.1.1 Harvesting and Transporting Timber

Green Diamond manages its forestlands for the primary purpose of growing and harvesting timber that subsequently will be milled to produce various commercial wood products. As specified in its "Option (a)" document, Green Diamond has implemented a schedule and rate of tree harvesting that seeks to balance timber harvesting with replacement tree growth.

Lands within Green Diamond's northern California ownership are generally managed under even-aged silvicultural prescriptions; this would continue under the No Action Alternative. These areas would be replanted with seedlings, or regenerated by seed from residual trees left on site. In accordance with the CFPRs and Green Diamond's operating guidelines, even-aged regeneration harvests must not exceed 40 acres. Harvesting of timber within even-aged units with stand age classes of 50 years or greater would be implemented under this alternative.

Historically, uneven-aged management has been focused: (1) in and around watercourse and lake protection zones and water supply areas; (2) along or around visually sensitive road and highway corridors; (3) around nest site locations of selected bird species (e.g., northern spotted owls); (4) within some demonstration units upslope of riparian and watercourse protection corridors; (5) generally near property lines where neighborhoods exist; and (6) in geologically unstable areas that are identified for special protection. Under the No Action Alternative, uneven-aged management would continue to be focused in these areas, and would be accomplished by marking and removing individual trees or small groups or clusters of trees. Cutting cycles (the number of years between two successive harvest entries into the same stand) in uneven-aged stands on Green Diamond lands under this alternative would be 10 to 50 years.

No harvesting would occur within 39 set-aside areas identified in Green Diamond's NSOHCP for purposes of promoting suitable owl habitat following harvesting in other areas. Combined, the 39 set-asides contain 13,242 acres, and range from 100 to 2,000 acres in size.

Chainsaws and feller-bunchers are currently used for all tree felling and log bucking activities, but other types of mechanical felling and bucking equipment could be used under this alternative. Where possible, log yarding on Green Diamond lands would continue to be accomplished using cable-logging systems. Tractor operations would generally be confined to stands that occur on slopes of less than 40 to 45 percent, depending on proximity to other environmentally sensitive areas (e.g., unstable slopes) and variability of terrain. Tractor operations also would be limited to dry months (May 1 through October 15), except for circumstances and locations defined in a winter operating plan. Pursuant to the CFPRs, tractor operations would not be conducted on:

- Unstable areas
- Slopes greater than 65 percent
- Slopes greater than 50 percent that have a high or extreme erosion hazard rating
- Slopes greater than 50 percent that lead without flattening to sufficiently dissipate water flow and trap sediment before reaching a watercourse or lake

Helicopters would be used within isolated (i.e., difficult to access) harvesting units to yard downed timber where road and landing access would otherwise traverse extremely steep, sensitive, or unstable topography where a high risk of road/landing failure exists. Helicopters would also be used to gain access to isolated timber stands in areas where extremely risky and difficult stream crossings exist.

Both heel-boom and wheeled front-end loaders would be used in conjunction with log yarding, sorting, and loading activities on landings. Log trucks would be used to transport logs to a mill for further processing.

2.1.1.2 Timber Stand Regeneration and Improvement

Consistent with its sustained yield objective, Green Diamond would continue to rely on non-intensive as well as intensive timber management techniques to maximize growth and yield on its lands. Current management practices for regenerating harvested stands and promoting their growth would continue to be implemented under this alternative. These practices would include a variety of activities, such as site preparation, tree planting and occasional seeding, fertilization, precommercial and commercial thinning, pruning, prescribed burning, and cone collecting. The level and degree to which these practices would be used would depend on the regeneration method for a particular harvest unit (e.g., even-aged vs. uneven-aged harvest), the amount of basal area remaining after harvesting in uneven-aged units, proximity to special treatment areas (e.g., WLPZs and nest site buffer areas), and the post-harvest existence of special elements (e.g., large trees) requiring protection.

Site Preparation. Site preparation on Green Diamond forestlands could entail broadcast burning of entire harvesting units for purposes of removing concentrations of logging slash and other debris, reducing herbaceous competition, and exposing mineral soil to provide greater planting or seeding access to the site. Elimination of larger slash and debris would also eliminate potential fuel for wildfire, thereby reducing the fire hazard during the life of the future stand. Control of existing unwanted vegetation may also be facilitated through use of contact and translocated herbicides. Use of all herbicides and adjuvants used on Green Diamond forestlands would continue to be applied consistent with the EPA

registration requirements and other applicable laws or court-ordered mandates. Harvested units are usually burned in early fall to mid-winter months after slash and/or competing vegetation has thoroughly dried and a significant amount of rain has fallen to minimize the risk of uncontrolled fires. Burning is also conducted in early spring before fuels dry excessively. Under this alternative, these practices would continue and would be implemented in accordance with local air quality regulations. Broadcast burning would be concentrated on even-aged regeneration units; brush piles could also be used in uneven-aged areas. Pursuant to Green Diamond's NSOHCP, however, burning limitations would apply adjacent to set-aside and other sensitive owl habitat retention areas (e.g., WLPZs).

Planting. As part of its plan to obtain successive crops of trees from its lands on a sustained yield basis, Green Diamond would continue to replant each even-aged harvesting unit with approximately 300 to 500 redwood and Douglas-fir seedlings per acre in the first planting season (winter) after harvesting is completed. Seedlings would be planted 10 to 12 feet apart. Many regenerated areas would contain at least 1,000 seedlings per acre two years after planting, reflecting the effects of adjacent seed fall and redwood stump sprouting. Pursuant to the CFPRs, stocking surveys would be conducted after the first and second growing season to ensure that all replanted areas have the proper number and distribution of trees. If a survey indicates that the number or distribution of trees is not adequate, the area would be replanted to achieve desired results.

For uneven-aged regeneration units where single tree and group selection are employed, interplanting of coniferous species could occur. These areas would generally be planted with tree species representative of the original stand and in numbers necessary to meet stocking requirements.

Vegetation Control and Stand Growth Enhancement. Green Diamond would continue to strive for a long-term stocking level of approximately 100 to 200 trees per acre, with a species composition similar to that previously occupying the site. In order to effect maximum growth in the shortest period of time, newly established stands may receive a variety of treatments subsequent to planting. These treatments would generally be initiated at the end of the second growing season and continue until the stand is approximately 35 years of age, and include chemical treatment of invasive and competing brush and herbaceous species, as well as precommercial and commercial thinning of overstocked stands. Depending on growth performance, stands may also be fertilized to enhance growth.

Herbicides. A list of all herbicides and adjuvants used on Green Diamond forestlands and method of application are contained in Appendix C. These products are approved for forestry use and are registered by the California Department of Pesticide Regulation (CDPR) for use in forestry. In addition, the EPA is responsible for regulating the sale, distribution and use of herbicides under the Federal Insecticide, Fungicide, and Rodenticide Act. Decisions whether to approve (register) an herbicide for sale or distribution are based on a risk/benefit standard that weighs risks to humans and the environment, considering economic, social, and ecological costs and benefits from use of the product. Herbicide application on Green Diamond lands is divided into two main categories: hand and aerial. Their use is governed by manufacturer's label specifications, the guidance provided by the EPA and the CDPR, and Green Diamond's own best management practices (BMPs). In addition, site-specific application requires (1) a written recommendation of a pest control

adviser (PCA), (2) supervision of a State-certified applicator, and (3) inspection by and reporting to the county agricultural commissioner.

Green Diamond BMPs for ground and aerial application of herbicides require:

- Notification to adjacent landowners living within 300 feet of a spray area or within 1,000 feet downstream of the treatment area prior to herbicide use.
- Routine inspections by Green Diamond personnel in addition to county agricultural inspections.
- Prohibitions against foliar treatments when wind speeds exceed 5 and 10 miles per hour for aerial and ground applications, respectively, on the spray site.
- Maintenance of an untreated buffer on designated Class I and Class II watercourses at the distance prescribed for WLPZs for ground applications, or within a 100-foot horizontal buffer zone of a Class I or II watercourse when aerially applied.
- Maintenance of an untreated 100-foot horizontal buffer zone adjacent to all flowing water when aerially applied.
- Prohibitions against helicopters carrying herbicides flying over Class I or Class II watercourses (if reasonably avoidable).

These BMPs are generally voluntary, but in some instances are attached as conditions to the spray permit.

Green Diamond currently applies herbicides to approximately one to three percent of its California ownership in any given year. This level of treatment converts to a range of 4,500 to 13,700 acres per year. Additionally, 50 to 100 miles of rights-of-way may be treated annually to control roadside vegetation. These activities would continue to occur under the No Action Alternative.

Fertilizers. Green Diamond periodically applies fertilizer to young forest stands. Treated stand ages typically vary from about 25 to 35 years old, and the fertilizer is aerially applied using helicopters. Treatment to date has been limited to nitrogen applied as urea in pill form. Application rates are nominally at 200 pounds of nitrogen per acre. Stands treated in the younger age classes may receive a second treatment seven to ten years before rotation.

Pruning and Cone Collection. Some pruning activity would continue to occur under this alternative. Cone collection activities would also continue in both even-aged and uneven-aged stands under the No Action Alternative.

Fire Prevention and Suppression. Under the No Action Alternative, fire prevention would continue to be practiced by Green Diamond when and where necessary. This would include removal of logging slash from forestlands within 100 feet of public roads, control of public access to the forest, limitation or suspension of harvesting activities during periods of high fire danger, and prescribed burning for purposes of reducing fuel loads on the forest floor.

Fire suppression activities might also be required periodically to fight fires. Depending on the location and characteristics of a particular fire, these activities would be supervised by CDF or the U.S. Forest Service as necessary and might include constructing firelines by hand or bulldozer, lighting backfires, applying aerial fire suppressants, and felling trees or snags.

2.1.1.3 Road and Landing Construction, Reconstruction, and Maintenance

New road and landing construction might involve timber felling and removal in the road or landing right-of-way. Construction and major reconstruction activities might include excavation, filling, realignment, and recontouring of roads; installation of erosion control facilities and structures; dust abatement; road surface enhancement, such as rocking; and soil stabilization.

All new roads and landings would be constructed in accordance with practices specified in the CFPRs plus additional Green Diamond operational policies and guidelines. The location, design, timing, and construction standards of new (and upgraded) roads and landings would be generally governed by the techniques described in Weaver and Hagans (1994). In accordance with the CFPRs, new roads (other than necessary crossings) and landings would be located and constructed upslope of all watercourses and outside WLPZs, except for stream crossings and unless justified on a site-specific basis in a THP. Culverts, bridges and/or occasional fords would be placed or constructed at all watercourse crossings, and would generally be designed to withstand 100-year flood events and to allow for unrestricted fish passage. Where feasible, bridges would be installed on fish-bearing streams. When a bridge installation is not feasible, a countersunk or bottomless culvert or other "fish-friendly" structure would be installed to provide for upstream and downstream fish passage. Installed culverts would not restrict the active channel flow. Construction or reconstruction of logging roads, tractor roads, and landings would not take place during the winter period, unless otherwise provided for under a winter operating plan.

Erosion control structures and facilities (e.g., ditch relief culverts and/or rolling dips) would be installed at maximum spacing intervals suggested by Weaver and Hagans (1994), as modified by Green Diamond. Maximum spacing intervals would range from 115 to 600 feet on the basis of a "two percent" stratification of road grade classes and associated erosion hazard ratings (see Section 6.2.3.6.12 of the AHCP/CCAA.) Pursuant to the CFPRs, the construction, reconstruction, maintenance, and use of roads and landings in conjunction with timber operations on steep slopes and within WLPZs would be restricted during wet weather periods and on unstable terrain. Additional restrictions could be applied on a site-specific basis prior to timber harvesting.

Road and landing construction, reconstruction, and maintenance frequently require the application of water to road and landing surfaces. Under this alternative, water would be provided by water trucks that pump water from streams, reservoirs, lakes, and ponds located on Green Diamond forestlands. Occasionally, specific locations within or adjacent to watercourses would be excavated or dammed to increase the in-channel storage area for drafting purposes. These activities would be subject to approval from CDFG pursuant to CDFG's streambed alteration regulatory program. Under the No Action Alternative, Green Diamond would continue to pump water from these sources as permitted by law. Road and landing construction, reconstruction, and maintenance may also involve the surfacing of soil roads with rock, lignin, pavement, or other surface treatments. These alternative road surface treatments would also continue as necessary under the No Action.

Historically, road and landing construction, reconstruction, and maintenance within areas outside of THP boundaries have generally occurred in an opportunistic manner to take advantage of the proximity of current THP operations and heavy equipment availability

within the local area. Some activities, on the other hand, such as control of roadside vegetation, have required preparation and implementation of long-term plans. These practices would continue under the No Action Alternative.

Currently, approximately 4,000 miles of road exist and are in active use on the Green Diamond ownership. Under the No Action Alternative, there would be a slight net increase in the total number of miles of roads over the next 50 years; the number of miles of new road construction would exceed the number of miles of roads abandoned. Green Diamond would continue its existing practice of decommissioning non-management roads, and fixing road-related sediment sources, where they are appurtenant to THPs being operated by Green Diamond. Where road decommissioning is part of the THP, the process would occur in accordance with procedures outlined in the CFPRs and techniques described in Weaver and Hagans (1994). Road and landing abandonment would include the removal of culverts and soil stabilization as necessary.

Green Diamond has estimated the volume of potential sediment associated with high- and moderate-risk sediment delivery sites (based on both the probability of delivery to watercourses and the sediment volume associated with such delivery) to be 6.4 million cubic yards. Under the No Action Alternative, fewer than 1.3 million cubic yards of sediment would be removed during the first 15 years of the term of the Permits. The estimated cost associated with treating this volume is approximately $1.0 million per year, as required by the CFPR's THP processes.

Under the No Action Alternative, Green Diamond would continue to voluntarily implement a biannual training program for equipment operators and supervisors on proper road and landing construction, upgrading, maintenance, and decommissioning practices with an emphasis on practical, effective erosion and sediment control.

Key differences between CFPR requirements and Green Diamond operational guidelines and policies, both of which will be implemented under the No Action Alternative, are summarized in Table 2.1-1 below.

TABLE 2.1-1
Standard CFPR Requirements Compared to Green Diamond Road Construction, Reconstruction, and Maintenance Guidelines, Both of Which Will Be Implemented Under the No Action Alternative

CFPR Requirements	Green Diamond Guidelines
Implementation of prescriptive road construction, reconstruction, maintenance, and decommissioning standards contained in the CFPRs for all roads appurtenant to THP project areas.	CFPR requirements plus implementation of additional best management practices (BMPs) based on techniques described in Weaver and Hagans (1994).
No method contained in the CFPRs for assessing and prioritizing low-, moderate-, and high-risk sediment delivery sites on roads.	Utilization of a formal methodology for assessing and prioritizing low-, moderate-, and high-risk sediment delivery sites on roads. Methodology is based on watershed sensitivity and basin resource issues (e.g., TMDLs), and proposed THP activity within the watershed.

TABLE 2.1-1
Standard CFPR Requirements Compared to Green Diamond Road Construction, Reconstruction, and Maintenance Guidelines, Both of Which Will Be Implemented Under the No Action Alternative

CFPR Requirements	Green Diamond Guidelines
On-site review of road and landing construction, upgrading, maintenance, and decommissioning standards and prescriptions contained in individual THPs required of equipment operators and supervisors. No other periodic training program required for equipment operators and supervisors on proper road and landing construction, upgrading, maintenance, and decommissioning practices.	CFPR requirements plus biannual informal training program for equipment operators and supervisors on proper road and landing construction, upgrading, maintenance, and decommissioning practices.
Installation of waterbreaks on logging roads at maximum spacing intervals ranging from 50 to 300 feet on the basis of a "15 percent" stratification of road grade classes and associated erosion hazard ratings.	Installation of ditch relief culverts and/or construct rolling dips on logging roads at maximum spacing intervals ranging from 115 to 600 feet on the basis of a "two percent" stratification of road grade classes and associated erosion hazard ratings.
Installation of bridges not required. Requires that drainage structures on Class I watercourses shall allow for unrestricted passage of all life stages of fish or listed aquatic species that may be present.	Installation of bridges on Class I watercourses where economically feasible; installation of a countersunk or bottomless culvert (or other fish-friendly structure) where bridge installation is not possible on Class I watercourses.
Design of drainage structures and facilities on logging roads so as to not discharge on erodible fill or other erodible material unless suitable energy dissipators are used. No minimum distance requirement from Class I or Class II watercourses indicated.	Design of ditch drains so as to effect discharge 50 to 100 feet before water enters a Class I or Class II watercourse.
Treatment of areas of bare mineral soil exceeding 800 continuous square feet exposed by timber operations within the WLPZ of Class I or II waters (or Class III waters if an ELZ or WLPZ is required). Protection measures may include seeding, mulching, or replanting, but specific treatments, seeding rates, and minimum mulching depths are not specified.	Seeding and mulching of all new road cut and fill slopes, exposed slopes associated with temporary stream crossings, and any other management-induced ground disturbance larger than 100 square feet (except hand-constructed firelines) within the WLPZ of a Class I or II watercourse at a seeding rate of 30 lbs/acre (or 20 lbs/acre if Green Diamond seed mix is used) and a mulching depth of 2 inches with 90 percent coverage.

2.1.1.4 Monitoring and Research Activities

As part of the THP process and other regulatory and management regimes, including the NSOHCP, Green Diamond conducts a number of research and monitoring activities. These include compliance and effectiveness monitoring, wildlife surveys, environmental assessments and watershed studies (e.g., in the TMDL context).

2.1.2 Green Diamond's Other Operations and Activities

In addition to forest management operations noted above, other activities would be undertaken by Green Diamond and by third parties pursuant to Green Diamond authorization (e.g., leases, easements, and licenses) under this alternative. Such activities would be consistent with the zoning of Green Diamond's lands as TPZ. Under California's Timberland Productivity Act, TPZ zoning is for growing and harvesting of timber and for designated "compatible uses." Compatible uses on the Green Diamond forestlands include:

- Commercial and non-commercial development and use of local rock pits and quarries
- Water use
- Harvesting and transportation of minor forest products
- Public recreation activities
- Watershed, fish and wildlife enhancement and monitoring
- Administrative and non-timber related use of roads, landings, and equipment fords

2.1.2.1 Rock Pits and Quarries

Under the No Action Alternative, Green Diamond would quarry rock from several rock (borrow) pit locations throughout its ownership to obtain road surfacing or filling material. These pits would typically be smaller than 2 acres. Because these pits would be excavated for purposes of road construction and maintenance associated with timber harvesting and forest management and are located more than 100 and 75 feet from Class I and Class II watercourses, respectively, they would be exempt from regulation under the Surface Mining and Reclamation Act (SMRA) as administered by the California Division of Mines and Geology.

Green Diamond would also continue extracting instream gravel from several locations throughout the ownership in compliance with permitting requirements of the CDFG.

2.1.2.2 Water Use

On-site facilities rely on water delivery from many reservoirs, lakes, and ponds located on Green Diamond forestlands. Under the No Action Alternative, Green Diamond would continue to pump water from these sources.

2.1.2.3 Minor Forest Products

Minor forest products (e.g., firewood, burls, poles, stumps, and split wood products) are currently harvested from and transported over Green Diamond lands in accordance with Green Diamond and State law permitting requirements. These products are either removed from and transported over Green Diamond lands in conjunction with active timber harvesting activities or removed from inactive landings subsequent to cessation of timber harvesting operations during non-winter operating periods. These activities would continue under this alternative.

2.1.2.4 Public Recreation

Green Diamond currently provides recreational opportunities on its forestlands to some groups and individuals, subject to a written entry permit. Entry for these activities, which include hunting, fishing, camping, picnicking, hiking, motorcycle use and target shooting, are permitted on a limited basis within specified areas. Under the No Action Alternative, Green Diamond would continue to provide these recreational opportunities subject to Green Diamond's discretion and its permitting requirements.

2.1.2.5 Voluntary Watershed, Fish and Wildlife Enhancement, and Monitoring

Under the No Action Alternative, Green Diamond may continue to conduct voluntarily, or allow the conduct of, various watershed, fish, and wildlife management activities for the

enhancement or monitoring of watershed, wildlife, and fisheries resources. Examples of activities that could be conducted include:

- Aquatic habitat enhancement (e.g., instream boulder or large woody debris placement)
- Activities associated with improving fish passage (e.g., fish ladder construction or repair, culvert replacement or improvement, blockage removal)
- Instream surveys and sampling of fish (including spawning surveys and downstream migrant trapping), aquatic habitat conditions, macroinvertebrates, and water quality

2.1.2.6 General Maintenance and Administrative Use of Road and Landings

General maintenance and administrative use of roads on the Green Diamond ownership is an ongoing, year-round activity that may occur in the absence of timber harvesting operations. Specific maintenance routines are not different from those outlined above for timber harvesting operations, except that they do not require coverage under a THP or other regulatory regime. Such general maintenance and administrative use would continue under the No Action Alternative.

2.1.3 Fish and Wildlife Habitat

This section summarizes the practices and regulatory requirements that would be implemented by Green Diamond (that have the potential to affect fish and wildlife habitat) under the No Action Alternative. Practices specific to key components and elements of fish and wildlife habitat, such as riparian habitat, large woody debris, snags, and hardwoods, are described.

2.1.3.1 Riparian Habitat

Measures that would be implemented under the No Action Alternative for riparian habitats adjacent to Class I, II, and III watercourses, plus ponds, swamps, seeps, springs, and bogs, are described in detail below, but could be modified and expanded on the basis of site-specific individual and cumulative effects analyses during THP preparation.

Class I Watercourses. Existing CFPRs require the establishment of WLPZs immediately adjacent to streams and lakes. Under the No Action Alternative, standard minimum zone widths for Class I (fish-bearing) watercourses are 150 feet, and can be increased depending on the percent slope of areas immediately upslope of these streams. Pursuant to Green Diamond's NSOHCP, Green Diamond widens WLPZs immediately adjacent to Class I watercourses wherever possible to take advantage of natural conditions.

Within a Class I WLPZ, at least 85 percent overstory canopy would be retained within 75 feet of the watercourse or lake transition line; at least 70 percent overstory canopy would be retained within the remainder of the WLPZ. The residual overstory canopy after timber harvesting would be composed of at least 25 percent of the overstory conifers existing prior to harvesting. Under No Action, this requirement would be augmented by additional measures identified in the Green Diamond NSOHCP that provide for retention of a variety of tree sizes (height and diameter) and species within WLPZs, with priority given to wildlife habitat trees. Within Class I WLPZs, at least 75 percent surface cover and undisturbed area would be retained after harvesting to act as a sediment filter strip, to dissipate raindrop

energy, and to provide wildlife habitat. In addition, where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55 percent, a special management zone would be established where the use of even-aged regeneration methods would be prohibited.

Single tree selection harvesting would be Green Diamond's preferred harvesting method within the WLPZ of Class I watercourses. Use of heavy equipment for timber felling, yarding, or site preparation would be prohibited within the WLPZ except at prepared tractor road crossings or at existing or new road crossings approved by CDF and CDFG.

The 10 largest dbh conifers (living or dead) per 330 feet of stream channel would be retained within 50 feet of Class I watercourses to provide future instream large woody debris. Green Diamond would retain a variety of tree sizes (height and diameter) and species within Class I WLPZs, with priority given to wildlife habitat trees and down woody material.

In addition to prescriptive measures, the design of site-specific measures within Class I WLPZs by Green Diamond foresters, as well as review of these measures by a multi-disciplinary review team, would be included in the No Action Alternative (see Section 1.5.3.1).

Class II Watercourses. Watercourse and lake protection measures for streams where aquatic habitat exists for non-fish aquatic species (Class II) would include minimum, variable WLPZ widths of 50 to 100 feet, depending on the adjacent hillslope gradient and associated erosion hazard rating. At least 50 percent total canopy closure would be retained subsequent to any commercial harvesting. However, at least 70 percent minimum total canopy closure would be retained post-harvest where it exists within the WLPZ prior to timber harvesting. Pursuant to Green Diamond's NSOHCP, Green Diamond would widen WLPZs immediately adjacent to Class II watercourses wherever possible to take advantage of natural conditions and on the basis of site-specific review where other special circumstances (e.g., geologic instabilities) warrant.

Existing regulations require that the residual overstory canopy after timber harvesting be composed of at least 25 percent of the overstory conifers existing prior to harvesting. This requirement would be augmented by additional measures identified in the Green Diamond NSOHCP that provide for retention of a variety of tree sizes (height and diameter) and species within WLPZs, with priority given to wildlife habitat trees. Within Class II WLPZs, at least 75 percent surface cover and undisturbed area would be retained after harvesting to act as a sediment filter strip, to dissipate raindrop energy, and to provide wildlife habitat.

Single tree selection harvesting would be Green Diamond's preferred harvesting method within the WLPZ of Class II watercourses where more than 50 percent canopy exists prior to timber operations. Use of heavy equipment for timber felling, yarding, or site preparation would be prohibited within the WLPZ except at prepared tractor road crossings or at existing or new road crossings approved by CDF and CDFG. At least two living conifers per acre, measuring at least 16 inches dbh and 50 feet tall, would be retained within 50 feet of Class II watercourses to provide future instream large woody debris.

Class III Watercourses. Protection for Class III streams where no aquatic life is present but the stream is capable of transporting sediment to a Class I or Class II watercourse would include establishing 25- to 50-foot ELZs, depending on the adjacent hillslope gradient and associated erosion hazard rating. To the extent allowed by existing regulations, timber

harvesting would still continue in ELZs, within which heavy equipment use would be limited. All trees within the Class III channel or that are needed for bank stability would be retained. Under some circumstances, WLPZs could be established for Class III watercourses in lieu of ELZs. WLPZ widths and WLPZ protection measures for Class III watercourses would be determined from a joint on-site inspection by Green Diamond foresters and the THP review team. In the event a WLPZ is designated for a Class III watercourse, at least 50 percent of the understory vegetation present before timber operations would be retained as cover subsequent to any commercial harvesting. Even-aged management would be Green Diamond's preferred regeneration method within the ELZ of Class III watercourses; these areas are replanted subsequent to harvesting.

Ponds, Swamps, Bogs, and Seeps. Ponds, swamps, bogs, and seeps would receive Class II protection as described above. Springs would also receive Class II protection provided that they contain habitat for non-fish aquatic species.

2.1.3.2 Large Woody Debris

Although existing regulations do not provide retention standards for large woody debris (LWD), LWD issues are analyzed and addressed in the individual and cumulative effects analysis in THPs. Green Diamond currently retains some existing LWD on the forest floor. Merchantable sections of some downed logs or trees are periodically subject to salvage. Stumps, on the other hand, are not removed except where clearing is required for road and landing construction, and in these cases stumps are left on-site. Where stumps are removed, they are often stock-piled for use in stream restoration work. Salvage operations not related to a THP might also occur after major storms or fires; then, high-quality old-growth logs might be salvaged. There would, however, be no salvage allowed within the WLPZ of a Class I and Class II watercourse. Outside of a Class I or Class II WLPZ, all merchantable sections of downed trees would be salvaged, unless site-specific reasons dictated otherwise. All snags that are felled (including those intentionally felled for safety) would also be salvaged. Stumps and cull sections of downed trees would not be salvaged. Under the No Action Alternative, this general salvage policy would continue to apply to all silvicultural treatments covered by a THP, except within WLPZs adjacent to Class I and Class II watercourses.

Under the No Action Alternative, some large, downed woody debris would be depleted as a result of broadcast burning of some even-aged units subsequent to timber harvesting. These units would be burned to facilitate planting and natural seeding. The frequency of broadcast burning would be relatively low; less than 40 percent of harvested even-aged areas would be burned each year. If such a depletion occurs, it would be addressed in the regular cumulative effects analysis of the THP.

2.1.3.3 Snags

Under this alternative, Green Diamond would, in general, retain all snags greater than 16 inches dbh and greater than 50 feet tall that are not merchantable and that do not pose a safety or fire hazard. Under this alternative, future recruitment of snags would occur through the retention of old-growth elements in the 39 set-aside areas, minimum overstory canopy retention standards within the WLPZ of Class I and Class II watercourses, and

retention of a variety of tree sizes and species within WLPZs as noted above. Snags would also be recruited pursuant to species-specific measures noted below for listed species.

2.1.3.4 Hardwoods

Under the No Action Alternative, Green Diamond generally would not harvest hardwoods in WLPZs. Under special circumstances, Green Diamond might remove hardwoods in WLPZs to enable conifer regeneration, enhance riparian function, establish cable corridors for timber harvesting operations, or for safety. Outside of WLPZs, Green Diamond would retain hardwoods in all uneven-aged silvicultural areas, except where they may impede the regeneration of conifers (see below). Green Diamond's tree retention standard in even-aged management units would be one to two trees per acre. When hardwoods occur in THPs, Green Diamond would retain them in range of diameter classes and would attempt to retain them in equal ratio to conifers. In hardwood dominated stands, two merchantable hardwood trees per acre would be retained in even-aged management units following timber harvesting. In all harvested areas, hardwood trees that show evidence of substantial wildlife use (i.e., whitewash, acorn granaries, old raptor nests, etc.) or that repeatedly provide a superior crop of acorns would also have priority for retention.

As has occurred in the past, Green Diamond would continue under the No Action Alternative to remove hardwoods where they impede the regeneration of conifers; removal would be subject to the retention standards noted above. Green Diamond may take measures to reduce the competitive influence of tanoak and madrone in stands where hardwood competition threatens the survival of the conifer seedlings. These species would be treated with herbicides or, sometimes by mechanical means, as noted above. Green Diamond would not use herbicides within WLPZs along Class I and Class II watercourses or within the ELZs (or WLPZs) of Class III watercourses where water is present.

2.1.4 Measures to Protect Federal and State Listed Species

Under the No Action Alternative, Green Diamond would remain subject to existing regulatory requirements and would continue to implement its existing operational practices. Green Diamond would remain subject to the prohibition on unauthorized taking of State and federally listed species as well as the provision of the CFPRs that no THP may be approved that would result in the unauthorized take of a listed species. The only exception to the applicability of the take prohibition would continue to be the northern spotted owl, which is covered by an HCP/ITP issued to Green Diamond previously and is discussed in more detail below. Further, Green Diamond would remain subject to the State law regulatory requirements to avoid or mitigate significant adverse impacts of timber harvesting on all wildlife, including species listed or proposed for listing under the Federal and State ESA. State and federally listed species known to occur on or in the vicinity of the Green Diamond ownership in northern California are the coho salmon (Southern Oregon/Northern California Coast ESU), Chinook salmon (California Coastal ESU), steelhead (Northern California DPS), American peregrine falcon, bald eagle, bank swallow, little willow flycatcher, marbled murrelet, northern spotted owl, and western snowy plover. The tidewater goby is not known to occur on the Green Diamond ownership, but can be found in lagoons locally.

2.1.4.1 Coho Salmon, Chinook Salmon, and Steelhead

The coho salmon (Southern Oregon/Northern California Coast ESU), Chinook salmon (California Coastal ESU), and steelhead (Northern California DPS) are federally listed as threatened under the Federal Endangered Species Act (ESA). The population segment of coho salmon from Punta Gorda, California to the northern border of California is listed as threatened under the California Endangered Species Act (CESA). Under the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of these species and other fish species listed (or proposed for listing under State law) in the future. Measures presently include implementation of watercourse and lake protection and other operational guidelines. Further, Green Diamond would continue to incorporate site-specific measures into THPs as necessary for the purposes of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.2 Tidewater Goby

The tidewater goby is listed as endangered under the Federal ESA, and occur primarily in shallow lagoons and lower stream reaches in the Action Area where waters are brackish to fresh and fairly slow moving. Under the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of these species. Measures presently utilized include implementation of watercourse and lake protection and other operational guidelines. Further, Green Diamond would continue to incorporate site-specific measures into THPs, as necessary, for the purposes of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.3 American Peregrine Falcon

The peregrine falcon is listed as endangered under CESA. Five peregrine falcon nest sites have been documented on or near Green Diamond lands. Under the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of this species. Green Diamond would incorporate into THPs site-specific measures, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.4 Bald Eagle

Bald eagles are listed as threatened under the Federal ESA and endangered under CESA. Two bald eagle nest sites and frequent winter use in all major drainages have been documented on Green Diamond lands. Under the No Action Alternative, Green Diamond would remain subject to the take prohibition for this species. Green Diamond would seek technical assistance from the USFWS and/or CDFG to develop and implement site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.5 Bank Swallow

The bank swallow is listed as threatened under CESA. Bank swallows have not been observed on the Green Diamond ownership. Under the No Action Alternative, however, if bank swallows were found on Green Diamond lands, Green Diamond would incorporate site-specific measures into THPs as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.6 Little Willow Flycatcher

The little willow flycatcher is listed as endangered under CESA. One willow flycatcher breeding site is known to occur in the Klamath region of Green Diamond's ownership. Under the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.4.7 Marbled Murrelet

The marbled murrelet is listed as threatened under the Federal ESA and endangered under CESA. From past surveys, the marbled murrelet is known to occur in a number of residual old-growth stands in the Klamath region and one second-growth stand with residual structure in the Little River drainage. Under the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

Approximately 1,400 acres of Green Diamond's current ownership, and an additional 3,350 acres within the adjustment area lands, are within the boundaries of a marbled murrelet critical habitat unit (CHU) (CA-03-a). Portions of adjacent lands in public ownership, such as the Redwood National and State Parks and the Headwaters Reserve, have been designated as marbled murrelet critical habitat by the USFWS. However, Green Diamond is not seeking coverage under the Permits for the harvest of trees, as described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.5, in any portion of the Action Area that has been designated as critical habitat for the marbled murrelet, as defined in 50 CFR 17.95, when the harvest of those trees would affect a "primary constituent element" of critical habitat for the marbled murrelet, as defined in 50 CFR 17.95 (adopted May 24, 1996 61 FR 26256).

2.1.4.8 Northern Spotted Owl

The northern spotted owl is listed as threatened under the Federal ESA. Since surveys for northern spotted owls were initiated on Green Diamond lands in 1989, over 200 northern spotted owl nest sites or activity centers have been identified throughout its ownership in northern California. Under the No Action Alternative, Green Diamond would continue to comply with measures contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and management operations. Pursuant to the NSOHCP, Green Diamond would continue to implement a four-point conservation program that includes (1) habitat management and nest protection, (2) a spotted owl research program, (3) establishment of set-asides and special management areas in selected habitat areas, and (4) employee/ contractor training.

Under the No Action Alternative, habitat management and nest site protection measures would be implemented primarily through the THP process. Green Diamond would use its NSOHCP to guide the development of individual THPs. Timber harvesting would be planned and implemented to: (1) protect spotted owl nest sites during the nesting and fledging season; (2) maintain suitable foraging, roosting, and nesting habitat on Green Diamond's property; and (3) accelerate the development of replacement habitat following harvesting.

Surveys for spotted owls would continue pursuant to protocols identified in the NSOHCP. Banding and monitoring of spotted owls would continue where appropriate to facilitate population estimates and to gather additional demographic information.

To protect existing owl sites in select areas for purposes of avoiding take and promoting development of suitable owl habitat following harvesting, Green Diamond would continue to not harvest timber in 39 set-aside areas. In addition, a separate "special management area" would continue to be monitored in which no take of spotted owls would be allowed.

2.1.4.9 Western Snowy Plover

The western snowy plover is listed as threatened under the Federal ESA. Western snowy plovers are known to nest on some of Green Diamond's coastal property between the Mad River and Redwood Creek, as well as one gravel bar in the Van Duzen drainage. Under the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.1.5 Measures for Other Species

Green Diamond would implement measures designed to avoid or mitigate potentially significant impacts to other species under the No Action Alternative in various ways, including implementing nest protection measures for several unlisted species considered "sensitive" by the Board of Forestry. Sensitive species include the osprey, northern goshawk, golden eagle, great blue heron, and great egret. These species-specific measures would continue to be implemented under the No Action Alternative. In addition, Green Diamond's THPs would identify significant reductions in the amount and distribution through harvesting of late-successional forest stands, as well as site-specific or general measures that would mitigate significant adverse impacts to fish and wildlife associated with these stands. These practices would be in addition to other direct and indirect general measures relating to riparian habitat, watercourse and lake protection, and snag retention. In addition, Green Diamond would remain subject to State and Federal laws, such as the Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the prohibitions on taking of certain raptors pursuant to Sections 3503.3 and 3511 of the California Fish and Game Code.

Under the No Action Alternative, THPs would also include a cumulative effects analysis that would address past and future impacts on biological resources. This analysis would include discussion on the following within the context of impacts to fish and wildlife: (1) structural diversity within streams; (2) instream and upslope downed woody debris; (3) riparian vegetation; (4) presence and recruitment of snags, dens, and nest trees; (5) presence of multi-storied tree canopies; hardwood cover; (6) presence of late seral forest characteristics and late seral continuity; and (7) presence of other special wildlife habitat elements.

Green Diamond would, as appropriate and with input from the multi-disciplinary review team, other interested agencies, and the public, incorporate into THPs other site-specific measures designed to reduce significant individual and cumulative impacts to sensitive and other species.

2.2 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting and related operations in accordance with existing State and Federal regulations, including the CFPRs, its NSOHCP, and the operational and policy management actions currently being implemented by Green Diamond. Green Diamond would also implement an Aquatic HCP/CCAA within the Action Area. Operations within the Action Area would be subject to the provisions of an ITP and ESP.[1]

NMFS would issue Green Diamond an ITP with a term of 50 years for two listed fish ESUs and one listed fish DPS (coho salmon [Southern Oregon/Northern California Coast ESU], Chinook salmon [California Coastal ESU], and steelhead [Northern California DPS]) and three unlisted fish ESUs (Chinook salmon [Southern Oregon and Northern California Coastal ESU, Upper Klamath/Trinity Rivers ESU] and steelhead [Klamath Mountains Province ESU]). The USFWS would issue Green Diamond an ESP, also with a 50-year term, covering two unlisted fish species, (coastal cutthroat and rainbow trout), and two unlisted amphibians (southern torrent salamander and tailed frog). Table 2.2-1 lists species that would receive ITP/ESP coverage under the Proposed Action.

TABLE 2.2-1
Fish and Amphibian Species That Would Be Covered Under the Proposed Action

	Listing/Sensitivity Status Within the Action Area	
Species Common Name (*Scientific Name*)	**Federal**	**State**
Fish		
Coho salmon (*Oncorhynchus kisutch*) Southern Oregon/Northern California Coast ESU	FT	ST
Steelhead trout* (anadromous) (*Oncorhynchus mykiss*) Northern California DPS	FT	None
Steelhead trout* (anadromous) (*Oncorhynchus mykiss*) Klamath Mountains Province ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha*) California Coastal ESU	FT	None
Chinook salmon (*Oncorhynchus tshawytscha*) Southern Oregon and Northern California Coastal ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha*) Upper Klamath/Trinity Rivers ESU	None	None
Coastal cutthroat trout (anadromous and resident) (*Oncorhynchus clarki clarki*)	FSS	CSC
Rainbow trout* (resident) (*Oncorhynchus mykiss*)	None	None

[1] It is anticipated that Green Diamond, CDF, and others may on occasion and on a site-specific basis propose mitigations through the THP review process that go beyond the conservation measures in the proposed AHCP/CCAA.

TABLE 2.2-1
Fish and Amphibian Species That Would Be Covered Under the Proposed Action

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	**State**
Amphibians		
Southern torrent salamander (*Rhyacotriton variegatus*)	None	CSC
Tailed frog (*Ascaphus truei*)	None	CSC

* Although both steelhead and rainbow trout are of the species *Oncorhynchus mykiss*, they are considered to be separate DPSs, This is, in part, because they exhibit markedly different behavioral patterns. For additional details regarding the differences between these species see 71 FR 834. Steelhead are under the jurisdiction of the NMFS, whereas rainbow trout are under the jurisdiction of the USFWS.

Federal
FT Federal threatened species
FSS Forest Service sensitive species

State
CSC CDFG Species of Special Concern
ST State threatened species

Existing measures employed by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's AHCP/CCAA Conservation Strategy, which includes enhanced riparian management zone (RMZ) widths, enhanced riparian protection within the RMZs, and establishment of equipment exclusion zones (EEZs) (see below). Green Diamond would also implement *ownership-wide* mitigation, management, and monitoring measures. These include:

- Implementation of an ownership-wide Road Management Plan that provides for selective and road-related fish passage enhancement (barrier removal); implementation of practices that are designed to minimize sediment discharge to Class I, II, and III streams; and decommissioning of some roads.
- Protection of unique geomorphic features, such as channel migration zones and floodplains
- Adoption of various slope stability and ground disturbance measures
- Effectiveness and compliance monitoring, plus adaptive management and structured feedback loops, subject to the available funding of the account

2.2.1 Timber Harvesting and Forest Management Activities

General forest management and timber harvesting activities noted under the No Action Alternative would continue under this alternative. The use of fertilizers and herbicides for purposes of enhancing tree growth and controlling competing brush vegetation in even-aged regeneration units and roadside areas would continue under the Proposed Action; however, they would not be covered activities under the ITP or ESP.

Under the Proposed Action, Green Diamond would implement the following additional key measures on its fee-owned lands within the Action Area that supplement the measures described under the No Action Alternative.

2.2.1.1 Harvesting and Transporting Timber

- Harvest timber within RMZs in accordance with conservation measures defined in the AHCP/CCAA, as summarized below in Section 2.2.3.1 of this EIS.
- Prohibit timber harvesting within the "inner zone" of all Class I RMZs and 2nd order or larger Class II RMZs (see Section 2.2.3.1 below) that are located below designated "steep streamside slope management zones" (SMZs) (see Sections 6.2.2.1 and 6.3.2.1 of the proposed AHCP/CCAA), except for purposes of creating cable-yarding corridors when other options are impractical. (RMZ areas located below an SMZ are referred to as RSMZs in the proposed AHCP/CCAA.) Retention of a minimum 85 percent overstory canopy would be required in Class I and 2nd order or larger Class II RSMZ "outer zones."
- Allow limited timber harvesting within the first 1,000 feet of a 1st order Class II RSMZ inner zone subject to 85 percent canopy closure retention post-harvest. A minimum 75 percent overstory canopy retention within the first 1,000 feet of a 1st order Class II RSMZ outer zone would also be required. (See Section 6.2.2.1 of the proposed AHCP/CCAA.)
- Prohibit timber harvesting within the entire RSMZ for the Coastal Klamath and Blue Creek Hydrographic Regions.
- Exclude use of heavy equipment within RMZs, with the exception of existing roads and landings, construction of spur roads to extend outside the RMZ, and stream crossings.
- Use single-tree selection as the initial silvicultural prescription within SMZs and the only prescription within headwall swales. In addition, one commercial harvesting entry would be allowed within SMZs and headwall swales, except where cable corridors are necessary to conduct intermediate treatments in adjacent stands, for the term of the Permits. All hardwoods within SMZs and headwall swales would be retained and, wherever possible, Green Diamond would provide for even spacing of unharvested conifers such that all species and size classes represented in pretreatment stands would generally be represented post harvest.
- Establish no-cut zones within the toe, and 25 feet upslope from the top of the toe of active deep-seated landslides, except for purposes of creating cable-yarding corridors when other options are impractical. Similarly establish no-cut zones upslope of the deep-seated landslide scarp so as to taper to the lateral margins of the scarp.
- Prohibit timber harvesting within the boundaries of shallow rapid landslides, and retain a minimum 70 percent overstory canopy within 50 feet above and 25 feet on the sides of shallow rapid landslides. This default prescription may be modified subsequent to a site-specific geologic review.
- Cease log hauling and landing use (including helicopter service landing areas) if such use results in runoff of waterborne sediment in amounts sufficient to cause a visible

increase in turbidity in any ditch or road surface which drains into a Class I, II, or III watercourse, regardless of the time of year.

- Allow loading and hauling of logs during the winter period (October 15 through May 14) only on roads and landings with rocked surfaces during extended dry fall periods (October 16 through November 15), if less than four inches of rainfall has accumulated from September 1. Loading and hauling will cease when cumulative rainfall reaches four inches. Loading and hauling will be permitted with early spring drying (May 1 through May 14), if no measurable rainfall has occurred within the last 5 days and no rain is forecasted by the National Weather Service for the next 5 days.
- Prohibit the use of landings on roads within RMZs during the winter period.
- Limit vehicular use on unrocked roads during the winter period to all-terrain vehicles (ATVs) only. Other vehicular use of seasonal roads would be allowed if early spring drying or an extended dry fall occurs (see above).
- Restrict water drafting and use of gravity-fed water storage systems for timber operations in accordance with procedures detailed in the AHCP/CCAA. (See Section 6.2.3.13 of the AHCP/CCAA.)

2.2.1.2 Timber Stand Regeneration and Improvement – Site Preparation

- Implement various measures contained in the AHCP/CCAA that focus on minimizing surface erosion from site preparation operations through: (1) minimization of bare soil exposure within harvest units, (2) minimization of fireline construction, (3) maintenance of a nearly continuous forest floor layer of duff and woody material, and (4) prevention of drainage failures and sediment delivery from firelines.

2.2.1.3 Road and Landing Construction, Reconstruction, and Maintenance

- Complete within five years of issuance of the Permits a prioritization of sub-watershed road work units for risk assessment that weights risk on the basis of biological, geomorphic, and road-related management criteria, as described in the AHCP/CCAA.
- Based on a priority ranking of sub-watershed road work units, identify road-related sediment sources using a two-step process of air photo analysis and field inventories, as outlined in the AHCP/CCAA.
- On the basis of the road assessment and treatment prioritization noted above, develop an implementation plan to effect (1) temporary road decommissioning; (2) permanent road decommissioning; or (3) road upgrading, as appropriate.[2]
- Implement a formalized biannual training program for equipment operators and supervisors on proper road and landing construction, upgrading, maintenance, and decommissioning practices with an emphasis on practical, effective erosion and sediment control.

[2] Green Diamond would apply road assessment and implementation plan measures to all fee-owned lands and the 1,866 acres in which it owns perpetual harvesting rights granted by Green Diamond Timber Company on June 28, 2002, within the Action Area; these measures would not be applied to other existing perpetual harvesting rights areas or any harvesting rights areas acquired over time, unless provided for in an agreement with the fee owner.

- Decommission or upgrade roads in accordance with the implementation plan during the non-winter period only, except during dry fall periods under circumstances defined in the AHCP/CCAA. Green Diamond may also upgrade roads during early spring drying periods. (See Sections 6.2.3.3 and 6.2.3.4 of the AHCP/CCAA.)
- Front-load treatment of high- and moderate-risk sediment delivery sites (beginning in the high priority road work units) by providing for an average of $2.5 million per year (which includes Green Diamond's required THP-related road work, currently estimated to be $1.0 million per year), to be adjusted for inflation in 2002 dollars for each year for the first 15 years of the Permits (for a total of $37.5 million unless the acceleration period is adjusted following revision of the estimate of sediment yield from high- and moderate-risk sediment delivery sites at the end of the first five years following issuance of the Permits. The acceleration period and monetary commitment could be adjusted (upward or downward) by up to 1.5 years and $3.75 million depending on the revised estimate of sediment yield. Under the Proposed Action, 3.1 million cubic yards of sediment would be removed during the first 15 years of the term of the Permits (compared to 1.3 million cubic yards under the No Action Alternative).
- Surface roads and landings used during the winter period to a minimum compacted depth of 12 inches of pit run rock or a combination of pit run and crushed rock.
- Install culverts with a minimum diameter of 24 inches in all stream crossings on management roads and 18 inches on logging road ditch drains.
- Inspect all mainline roads prior to September 15 of each year and perform priority repair/maintenance tasks prior to the winter period.[3]
- Maintain other management roads or roads yet to be decommissioned on a three-year rotating basis in accordance with a maintenance schedule contained in the AHCP/CCAA.[4] (See Section 6.2.3.9.4 of the AHCP/CCAA.)
- Implement a response plan as described in the AHCP/CCAA to large storm events that could result in major sediment inputs to stream channels.
- Draft water from streams, reservoirs, lakes, and ponds in accordance with various guidelines and procedures described in the AHCP/CCAA to protect covered species.
- Implement various other road/landing construction, reconstruction, and maintenance measures contained in the AHCP/CCAA, for purposes of further minimizing potential sediment delivery to the waters of Class I, II, or III streams.

2.2.1.4 Monitoring and Research Activities

Under the Proposed Action, Green Diamond would commit to continue the various watershed, fish, and wildlife management activities for the enhancement or monitoring of

[3] Green Diamond would apply routine road maintenance and inspection measures only where Green Diamond has exclusive road-use rights. Road maintenance and inspection where Green Diamond does not have exclusive road-use rights in the Action Area would be conducted in accordance with existing CFPRs and Green Diamond's management policies.

[4] Approximately 45 percent of all of Green Diamond's roads will be maintained annually following this routine maintenance schedule. The actual percentage of roads to be maintained each year will increase over time because a portion of the current road network is planned for decommissioning. In addition, as the Road Management Plan is implemented and more roads are decommissioned, the overall miles of roads that require maintenance will decrease.

watershed, wildlife, and fisheries resources described under the No Action Alternative in Section 2.1.2.5.

Under the Proposed Action, Green Diamond would also commit to the following additional monitoring and research programs:

- Annual summer temperature monitoring at selected sites throughout the Action Area
- Annual population monitoring of tailed frog larval populations in paired headwater sites of first and second order streams
- Annual sub-population monitoring of southern torrent salamanders in paired headwater sites in watersheds with and without harvesting activity
- Annual measuring and monitoring of spawning gravel permeability in selected Class I streams at selected sites
- Annual measuring and monitoring of water turbidity above and below stream crossings and permanent monitoring stations at selected sites
- Annual or periodic long-term trend monitoring of Class I channel conditions, sediment delivery from Class III watercourses, effectiveness of hillslope management measures (augmented by focused studies within designated "experimental watersheds"), road-related catastrophic sediment inputs, detailed channel and habitat conditions for selected stream reaches throughout the Action Area, LWD occurrence, and slope stability as a result of implementation of the proposed AHCP/CCAA conservation measures
- Annual summer juvenile salmonid and outmigrant trapping monitoring
- Conduct an assessment of steep streamside slope delineations within five years of approval of the Permits by the Services
- Convene a Scientific Review Panel to assess adequacy of SMZ conservation measures after the 15th winter following approval of the AHCP/CCAA by the Services
- Conduct a property-wide hillslope mass wasting assessment within 20 years for purposes of examining relationships between hillslope mass wasting processes and timber management practices

2.2.2 Other Operations and Activities

Other operations and activities noted under the No Action Alternative would continue under the Proposed Action, with the following exception. Instream gravel extraction, subject to permitting requirements of the CDFG, would continue under the Proposed Action; it would not be a covered activity under the ITP or ESP.

Under the Proposed Action, Green Diamond would implement the following additional key measures on its fee-owned lands within the Action Area that supplement the measures described under the No Action Alternative.

- Prohibit establishment of new rock quarries and borrow pits within a Class I or Class II RMZ.

- Prohibit use of an existing rock quarry or borrow pit that is within 150 feet of a Class I watercourse, within 100 feet of a 2nd order or larger Class II watercourse, or within 70 feet of a 1st order Class II watercourse (first 1,000 feet).
- Extract or haul rock from quarries so as to not cause a visible increase in turbidity in watercourses or hydrologically connected facilities which discharge into watercourses.
- Place overburden generated during development of rock quarries and borrow pits in a stable location away from watercourses and RMZs.

2.2.3 Fish and Wildlife Habitat

2.2.3.1 Riparian Habitat

Following the distinctions used in the CFPRs, riparian management measures under the Proposed Action would vary among three broad classes of streams: Class I, Class II, and Class III watercourses. Further divisions would apply within some stream classes on the basis of stream size (Class II streams) and side slopes (Class III streams). Riparian management measures would apply on fee-owned lands within the Action Area.

Class I Watercourses. Under the Proposed Action, Class I streams would include all current or historical fish-bearing streams. RMZ widths for Class I streams would be a minimum of 150 feet slope distance, as measured from the first line of perennial vegetation or from the outer channel migration zone (CMZ) or outer floodplain edge (if greater than 150 feet on one side), where applicable. Under the Proposed Action, the RMZ for Class I streams would contain two sub-zones: an inner zone and outer zone. The minimum width of the inner zone (closest to the stream) would be a variable 50 to 70 feet, depending on side slope gradient. The outer zone would be the remaining 80 to 100 feet and would extend from the outer limit of the inner zone edge. The outer zone could be extended, where applicable and necessary, to cover the entire floodplain and an additional 30 to 50 feet (depending on side slope gradient) beyond the outer edge of the floodplain.

Riparian habitat management described under the No Action Alternative would continue, unless superseded or augmented by conservation measures contained in the AHCP/CCAA. Measures superceding those described under the No Action Alternative, plus additional AHCP/CCAA conservation measures, would be as follows:

- Within the 50- to 70-foot inner zone, Green Diamond would retain at least 85 percent overstory canopy closure. Within the remainder of the RMZ (outer zone), at least 70 percent overstory canopy would be retained, except as noted below for Class I RMZs located below SMZs where 75 percent overstory canopy closure would be retained.
- If the inner zone is predominately composed of hardwoods, no conifers would be taken from the inner zone. In addition, timber harvesting within RMZs would not reduce the conifer stem density to less than 15 conifer stems per acre.
- Within the RMZ, no trees would be harvested that contribute to bank stability or are judged likely to recruit to the watercourse.[5]

[5] The distinction in retention levels between inner and outer zones of the RMZ would be reduced on increasingly steeper slopes (generally greater than 50 percent) because of the increased potential for trees to recruit at greater distances from the

- The Class I RMZ would be an EEZ, except for (1) existing roads and landings, (2) construction of new spur roads to extend operations outside the RMZ, (3) road watercourse crossings, (4) skid trail watercourse crossings, and (5) designated skid trail intrusions.

  The exception for skid trail watercourse crossings would only be applicable when the following conditions are met:

  – Construction and use of skid trail watercourse crossings within the RMZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trail watercourse crossing sites in the RMZ over establishing new skid trail watercourse crossing sites in the RMZ.

  – Skid trail watercourse crossings would not be constructed or used in the RMZ to provide access to RMZs for the purpose of their harvest.

  – Within the Class I RMZ, trees would be felled to facilitate skid trail watercourse crossing construction and use. All such felled trees would be retained as downed wood in the RMZ and would be counted towards estimated reductions in full tree equivalent (FTE) values and reductions in potential recruitment of LWD.

  – Green Diamond would submit to the Services an explanation, justification, and map of any proposed skid trail watercourse crossings as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

  The exception for skid trail intrusions would only be applicable when the following conditions are met:

  – RMZ hillslopes are less than 25 percent.

  – Construction and use of skid trails within the RMZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trails in the RMZ over construction of new skid trails in the RMZ.

  – Skid trails would not be constructed or used in the RMZ to provide access to RMZs for the purpose of their harvest.

  – Within the RMZ, only trees less than 10 inches in dbh would be felled to facilitate skid trail use. All such felled trees would be retained as downed wood in the RMZ and will be counted towards estimated reductions in FTE values and reductions in potential recruitment of LWD.

  – Green Diamond would submit to the Services an explanation, justification, and map of the proposed skid trail and use in the RMZ as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

stream. Redwoods would be preferentially harvested over other conifers, because of their ability to sprout from the remaining root system.

- During the life of the Permits, only a single harvest entry would occur into an RMZ except where cable corridors are necessary to conduct intermediate treatments in adjacent stands.
- Salvage would not occur within inner zones, on floodplains, or CMZs. Salvage would be limited to downed trees in the outer zone, and would be allowed only if the wood could not be incorporated into the bankful channel, is not contributing to bank or slope stability, or is not positioned so as to intercept sediment moving toward the stream.
- Timber harvesting would be prohibited within all Class I RMZ inner zones that are located below SMZs (i.e. RSMZs) (see Sections 6.2.2.1 and 6.3.2.1 of the proposed AHCP/CCAA), except for purposes of creating cable-yarding corridors when other options are impractical. Retention of a minimum 85 percent overstory canopy closure would be required in RSMZ outer zones. In addition, no timber harvesting would be allowed within the entire RSMZ in the Coastal Klamath and Blue Creek HPAs.
- Where features of instability are identified within the RMZ, additional site-specific conservation measures may apply (see Section 2.2.1.1, Harvesting and Transporting Timber).
- Any ground disturbance larger than 100 square feet in size caused by management activities within the RMZ (except hand-constructed firelines) would be mulched and seeded or otherwise treated to reduce the potential for sediment delivery to the stream.
- Prohibit establishment of new rock quarries and borrow pits within a Class I RMZ.
- Prohibit use of an existing rock quarry or borrow pit that is within 150 feet of a Class I watercourse.

Class II Watercourses. For purposes of the proposed AHCP/CCAA, Class II streams contain no fish, but support or provide habitat for aquatic vertebrate species. RMZ widths for Class II streams would be a minimum of 75 or 100 feet (slope distance), as measured from the first line of perennial vegetation. The 75-foot minimum buffer would apply to the first 1,000-foot segment of the smallest (1st order) Class II stream (Class II-1); the 100-foot minimum buffer would apply to the remaining portion of the small (1st order) Class II streams, as well as to larger Class II streams (2nd order or higher) (Class II-2). A preliminary assessment of Class II RMZ widths on Green Diamond fee-owned lands indicates that approximately 61 percent of the total Class II stream lengths would receive 100-foot RMZs, and 75-foot RMZs would apply on the remaining 39 percent. Under the Proposed Action, the RMZ for Class II streams, as with Class I streams, would contain an inner zone and outer zone. The minimum width of the inner zone would be a fixed 30 feet. The outer zone would be the remaining 45 or 70 feet (see above) and would extend to the edge of the floodplain from the outer limit of the inner zone edge.

- Riparian habitat management within the RMZ of Class II streams would generally be the same as for Class I streams under this alternative, with the exception that trees that are judged likely to recruit to a watercourse would not be harvested within the first 200 feet of the Class II RMZ adjacent to a Class I RMZ. Other exceptions specific to Class II RSMZs are noted below.

- The Class II RMZ would be an EEZ, except for (1) existing roads and landings, (2) construction of new spur roads to extend operations outside the RMZ, (3) road watercourse crossings, (4) skid trail watercourse crossings, and (5) designated skid trail intrusions.

  The exception for skid trail watercourse crossings would only be applicable when the following conditions are met:

  – Construction and use of skid trail watercourse crossings within the RMZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trail watercourse crossing sites in the RMZ over establishing new skid trail watercourse crossing sites in the RMZ.

  – Skid trail watercourse crossings would not be constructed or used in the RMZ to provide access to RMZs for the purpose of their harvest.

  – Within the Class II-1 RMZs, trees would be felled and harvested to facilitate skid trail watercourse crossing construction and use. All harvested trees would be counted towards estimated reductions in full tree equivalent (FTE) values and reductions in potential recruitment of LWD.

  – Within Class II-2 RMZs, trees would be felled to facilitate skid trail watercourse crossing construction and use. All such felled trees would be retained as downed wood in the RMZ and would be counted towards estimated reductions in FTE values and reductions in potential recruitment of LWD.

  – Green Diamond would submit to the Services an explanation, justification, and map of any proposed skid trail watercourse crossings as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

  The exception for skid trail intrusions would only be applicable when the following conditions are met:

  – RMZ hillslopes are less than 25 percent.

  – Construction and use of skid trails within the RMZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trails in the RMZ over construction of new skid trails in the RMZ.

  – Skid trails would not be constructed or used in the RMZ to provide access to RMZs for the purpose of their harvest.

  – Within the RMZ, only trees less than 10 inches in dbh would be felled to facilitate skid trail use. All such felled trees would be retained as downed wood in the RMZ and will be counted towards estimated reductions in FTE values and reductions in potential recruitment of LWD.

  - Green Diamond would submit to the Services an explanation, justification, and map of the proposed skid trail and use in the RMZ as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

- Timber harvesting would be prohibited within the inner zone of 2nd order or larger Class II RSMZs (see Sections 6.2.2.1 and 6.3.2.1 of the proposed AHCP/CCAA), except for purposes of creating cable-yarding corridors when other options are impractical. Retention of a minimum 85 percent overstory canopy closure would be required in 2nd order or larger Class II RSMZ outer zones.

- Timber harvesting would be allowed within the first 1,000 feet of a 1st order Class II RSMZ inner zone subject to retaining 85 percent overstory canopy closure post-harvest. Retention of a minimum 75 percent overstory canopy closure within the first 1,000 feet of a 1st order Class II RSMZ outer zone would also be required. (See Section 6.2.2.1 of the proposed AHCP/CCAA.)

- Prohibit use of an existing rock quarry or borrow pit that is within 100 feet of a 2nd order or larger Class II watercourse, or within 70 feet of a 1st order Class II watercourse (first 1,000 feet).

Class III Watercourses. Under the Proposed Action, protection of Class III streams would occur in a two-tiered system, where the tiers correspond to two slope classes. Tier A protections would generally apply where streamside gradients are less than 60 percent to 70 percent. Conversely, Tier B protections would apply where gradients are greater than 60 percent to 70 percent. (The threshold gradient percent is different for different Hydrologic Planning Area (HPA) groups (see Sections 1.3.2.3 and 6.2.1.5 of Green Diamond's proposed AHCP/CCAA and Section 3.2.4 of this EIS.)

ELZ management measures for Class III watercourses described under the No Action Alternative would be superceded, as appropriate, or augmented by the following EEZ conservation measures contained in the AHCP/CCAA:

- **Tier A:** Green Diamond would establish a 30-foot EEZ, except for (1) existing roads, (2) road watercourse crossings, and (3) skid trail watercourse crossings. The exception for skid trail watercourse crossings would only be applicable when the following conditions are met:

  - Construction and use of skid trail watercourse crossings within the Class III EEZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trail watercourse crossing sites in the Class III over establishing new skid trail watercourse crossing sites in the Class III.

  - Within Class III EEZs, trees would be felled and harvested to facilitate skid trail watercourse construction and use.

  - Green Diamond would submit to the Services an explanation, justification, and map of any proposed skid trail watercourse crossings as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

- **Tier B:** Establishment of a 50-foot EEZ (except for watercourse crossings, existing roads, and identified skid trails), within which all hardwoods, non-merchantable trees, and on-the-ground LWD would be retained. Conifers would also be retained where they contribute to maintaining bank stability or if they are acting as a control point (retaining sediment and or preventing headcutting) in the channel. A minimum average of one conifer per 50 feet of stream length within the EEZ would also be retained. Ignition of fire during site preparation would also be prohibited within the EEZ.

  The exception for skid trail watercourse crossings would only be applicable when the following conditions are met:

  – Construction and use of skid trail watercourse crossings within the Class III EEZ would occur only when construction and use of alternative routes to otherwise inaccessible areas outside of the RMZ would result in substantially greater impacts to aquatic resources. Preference would be given to utilizing existing skid trail watercourse crossing sites in the Class III over establishing new skid trail watercourse crossing sites in the Class III.

  – Within Class III EEZs, trees would be felled and harvested to facilitate skid trail watercourse construction and use.

  – Green Diamond would submit to the Services an explanation, justification, and map of any proposed skid trail watercourse crossings as part of the informational copy of the THP notice of filing (see AHCP/CCAA Section 6.2.7.2).

Ponds, Swamps, Bogs, Springs, and Seeps. Ponds, swamps, bogs, springs, and seeps that support aquatic species would also be afforded the same protection as other Class II watercourses noted above for riparian habitats.

2.2.3.2 Large Woody Debris

Under the Proposed Action, large woody debris retention, removal, and recruitment activities would be the same as those described under the No Action Alternative, but would be augmented by AHCP/CCAA conservation measures noted above for Class I and II RMZs and Class III EEZs.

2.2.3.3 Snags

General snag retention and recruitment measures under the Proposed Action would be the same as under the No Action Alternative, as augmented by additional measures contained in the AHCP/CCAA. As noted for the No Action Alternative, future recruitment of snags would occur through the retention of old-growth elements in the 39 set-aside areas, minimum overstory canopy retention standards within RMZs, and retention of a variety of tree sizes and species within RMZs. Recruitment would be enhanced under the Proposed Action through RMZ-specific measures noted above. These include the establishment of a 50- to 70-foot inner zone for Class I streams and 30-foot inner zone for Class II streams, restrictions on salvage activity, single harvest entry limitations (except where cable corridors are necessary to conduct intermediate treatments in adjacent stands), minimum conifer retention standards, and limitations on harvesting of "stream recruitment" trees.

2.2.3.4 Hardwoods

Under the Proposed Action, management of hardwood resources within the Action Area would be the same as under the No Action Alternative, except for retention of a greater number of hardwoods within SMZ areas, headwall swales, and Tier B Class III EEZs (see Section 2.2.1.1).

2.2.4 Measures to Protect Federal and State Listed Species

Under the Proposed Action, take of listed species covered under the AHCP/CCAA would be permitted provided such action is incidental to a covered activity, such as timber harvesting. Specific measures contained in the CFPRs or developed pursuant to the THP process that are designed for the purpose of avoiding take of listed species and minimizing and mitigating environmental impacts to such species and their habitats would be superseded by measures contained in the AHCP/CCAA and its accompanying ITP to minimize and mitigate the impacts of incidental take and comply with other requirements of the ESA. Green Diamond would remain subject to the take prohibition for other listed species that are not covered by the ITP but that may occur within the Action Area. For listed species not covered by the AHCP/CCAA and ITP, Green Diamond would implement measures designed to avoid take of these listed species, including continuing to adhere to measures contained in its NSOHCP and the CFPRs (e.g., for certain listed bird species, the CFPRs include nest protection and other measures designed to avoid take), and measures identified during the THP preparation and review process). If a species is also state listed under CESA, Green Diamond would not undertake any AHCP measures that would result in a violation of CESA's prohibition on unauthorized take as that term is defined under state law.

2.2.4.1 Coho Salmon, Chinook Salmon, and Steelhead

Under the Proposed Action, incidental take of these species would be authorized subject to the terms of the ITP. Green Diamond would implement AHCP/CCAA measures intended to minimize and mitigate the impacts of incidental take of these fish species. These include many of the general forest management, riparian habitat, large woody debris, and snag measures noted above, which were designed to protect or enhance habitat for salmonid fish species.

2.2.4.2 Tidewater Goby

As with the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of this species. The Services do not anticipate under the Proposed Action that Green Diamond would change any of the measures it currently implements for this species. It is anticipated that Green Diamond would incorporate into THPs site-specific measures, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.4.3 American Peregrine Falcon

Under the Proposed Action, Green Diamond would implement CFPR prescriptive protection measures specific to the species and incorporate into THPs site-specific measures, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.4.4 Bald Eagle

As with the No Action Alternative, Green Diamond would seek technical assistance from the USFWS and/or CDFG to develop and implement site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.4.5 Bank Swallow

As with the No Action Alternative, Green Diamond would incorporate into THPs site-specific measures, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.4.6 Little Willow Flycatcher

As with the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.4.7 Marbled Murrelet

Under the Proposed Action, the Services do not anticipate that Green Diamond would change any of the measures it currently implements for this species. As with the No Action Alternative, Green Diamond would seek technical assistance from the USFWS and/or CDFG to develop and implement site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts. As with the No Action Alternative, Green Diamond is not seeking coverage under the Permits for the harvest of trees, as described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.5, in any portion of the Action Area that has been designated as critical habitat for the marbled murrelet, as defined in 50 CFR 17.95, when the harvest of those trees would affect a "primary constituent element" of critical habitat for the marbled murrelet, as defined in 50 CFR 17.95 (adopted May 24, 1996 61 FR 26256).

2.2.4.8 Northern Spotted Owl

Under the Proposed Action, Green Diamond would continue to comply with measures contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations.

2.2.4.9 Western Snowy Plover

As with the No Action Alternative, Green Diamond would incorporate site-specific measures, as necessary, into THPs for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.2.5 Measures for Other Species

The ITP/ESP would provide Green Diamond authorization to incidentally take unlisted, covered fish and amphibian species (see above) that have either been proposed for listing or are considered to be sensitive because populations or habitats are thought to be declining, if those species become listed under the ESA during the term of the Permits. Under the

Proposed Action, specific measures developed pursuant to the THP process designed to mitigate or avoid significant impacts to the unlisted, covered species would be augmented by measures contained in the AHCP/CCAA and its accompanying ITP/ESP to mitigate or avoid significant impacts to these species and to minimize the impacts of incidental take in the event these species are listed in the future. The conservation strategy for unlisted, covered species relies extensively on AHCP/CCAA measures intended to minimize and mitigate the impacts of incidental take of the listed, covered species discussed above. These include many of the general forest management, riparian habitat, large woody debris, and snag measures noted above that were designed to protect or enhance habitat for listed salmonid fish species.

Under the Proposed Action, Green Diamond would continue to implement measures designed to mitigate or avoid significant impacts to other unlisted species, not covered by the AHCP/CCAA but considered "sensitive" by the Board of Forestry (osprey, northern goshawk, golden eagle, great blue heron, and great egret). Green Diamond would implement CFPRs specific to these species and incorporate site-specific measures into THPs as necessary, to avoid or mitigate potentially significant environmental effects to insignificance. In addition, Green Diamond would remain subject to State and Federal laws, such as the Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the prohibitions on taking of certain raptors pursuant to Sections 3503.3 and 3511 of the California Fish and Game Code.

2.3 Alternative A (Listed Salmonid Species Only)

Under Alternative A, Green Diamond would continue to conduct timber harvesting and related operations in the Action Area in accordance with existing State and Federal regulations, including the CFPRs and its NSOHCP, and the operational and policy management actions currently being implemented by Green Diamond. Green Diamond would also implement an AHCP within the Action Area. Operations within the Action Area would be subject to the provisions of an ITP only, meaning that there would be no coverage for unlisted species and no application for an ESP.

NMFS would issue Green Diamond an ITP with a term of 50 years for two listed fish ESUs and one listed fish DPS (coho salmon [Southern Oregon/Northern California Coast ESU], Chinook salmon [California Coastal ESU], and steelhead [Northern California DPS]). Table 2.3-1 lists species that would receive ITP coverage under Alternative A.

TABLE 2.3-1
Fish Species That Would Be Covered Under Alternative A

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	**State**
Coho salmon (*Oncorhynchus kisutch)* Southern Oregon/Northern California Coast ESU	FT	ST
Steelhead trout* (*Oncorhynchus mykiss)* Northern California DPS	FT	None

TABLE 2.3-1
Fish Species That Would Be Covered Under Alternative A

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	State
Chinook salmon (*Oncorhynchus tshawytscha)* California Coastal ESU	FT	None

* Steelhead are the anadromous life history type of the species *Oncorhynchus mykiss* and are under the jurisdiction of the NMFS.

Federal
FT Federal threatened species

State
ST State threatened species

Under Alternative A, mitigation, management, and monitoring measures would be the same as those specified for the Proposed Action, except that monitoring measures specific to amphibians would be dropped under this alternative.

2.3.1 Timber Harvesting and Forest Management Activities

General forest management and timber harvesting activities noted for the Proposed Action would be the same under this alternative, except that monitoring of tailed frog larval and southern torrent salamander populations would not occur.

2.3.2 Other Operations and Activities

Under Alternative A, other operations and activities would be the same as noted under the Proposed Action.

2.3.3 Fish and Wildlife Habitat

Conservation measures for riparian habitat, large woody debris, snags, and hardwoods described for the Proposed Action would be the same under this alternative.

2.3.4 Measures to Protect Federal and State Listed Species

Under Alternative A, take of AHCP covered listed species would be permitted provided such action is incidental to covered activities. Specific measures contained in the CFPRs or developed pursuant to the THP process that are designed for the purpose of avoiding take of the three listed fish species would be superseded by measures contained in the AHCP and its accompanying ITP to minimize and mitigate the impacts of incidental take and comply with other requirements of the ESA. Green Diamond would remain subject to the take prohibition for other listed species that are not covered by the ITP but that may occur within the Action Area. For other listed species not covered by the AHCP, Green Diamond would continue to implement measures designed to avoid unauthorized take of listed species, including nest protection and other measures designed to avoid take, measures defined in its NSOHCP, and measures identified during the THP preparation and review process. If a species is also state listed under CESA, Green Diamond would not undertake any AHCP measures that would result in a violation of CESA's prohibition on unauthorized take as that term is defined under state law.

2.3.4.1 Coho Salmon, Chinook Salmon, and Steelhead

Under Alternative A, incidental take of these species would be authorized subject to the terms of the ITP. Green Diamond would implement AHCP measures intended to minimize and mitigate the impacts of incidental take of these fish species. These include many of the general forest management, riparian habitat, large woody debris, and snag measures described for the Proposed Action, which were designed to protect or enhance habitat for salmonid fish species.

2.3.4.2 Tidewater Goby

As with the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of this species. The Services do not anticipate under Alternative A that Green Diamond would change any of the measures it currently implements for this species. It is anticipated that Green Diamond would incorporate site-specific measures into THPs, as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.4.3 American Peregrine Falcon

Under Alternative A, Green Diamond would implement CFPR prescriptive measures specific to the species and incorporate site-specific measures, developed by Green Diamond foresters and biologists or identified during the THP preparation and review process, into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.4.4 Bald Eagle

As with the No Action Alternative, Green Diamond would seek technical assistance from the USFWS and/or CDFG to develop and implement site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.4.5 Bank Swallow

As with the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.4.6 Little Willow Flycatcher

Under Alternative A, Green Diamond would incorporate site-specific measures into THPs, as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.4.7 Marbled Murrelet

The Services do not anticipate under Alternative A that Green Diamond would change any of the measures it currently implements for this species. As with the No Action Alternative, Green Diamond is not seeking coverage under the Permits for the harvest of trees, as described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.5, in any portion of the Action Area that has been designated as critical habitat for the marbled murrelet, as defined in 50 CFR 17.95, when

the harvest of those trees would affect a "primary constituent element" of critical habitat for the marbled murrelet, as defined in 50 CFR 17.95 (adopted May 24, 1996 61 FR 26256).

2.3.4.8 Northern Spotted Owl

As would be the case for both the No Action Alternative and the Proposed Action, Green Diamond would continue under Alternative A to comply with measures contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations.

2.3.4.9 Western Snowy Plover

As with the No Action Alternative, Green Diamond would implement site-specific measures as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.3.5 Measures for Other Species

In contrast to the Proposed Action, the ITP under Alternative A would not provide Green Diamond authorization to incidentally take unlisted fish and amphibian species that have either been proposed for listing or are considered to be sensitive because populations or habitats are thought to be declining, if those species become listed under the ESA during the term of the Permits. However, the AHCP conservation measures for this alternative relating to general forest management, riparian habitat, large woody debris, and snags would also benefit and mitigate or avoid significant impacts to unlisted aquatic species not covered by the ITP (e.g., the tailed frog and southern torrent salamander).

Under Alternative A, Green Diamond would continue to implement measures designed to mitigate or avoid significant impacts to other unlisted species, not covered by the AHCP but considered "sensitive" by the Board of Forestry (osprey, northern goshawk, golden eagle, great blue heron, and great egret). Green Diamond would implement CFPRs specific to these species and design THPs that incorporate site-specific measures identified during the THP preparation and review process, as necessary, to avoid or mitigate potentially significant environmental effects to insignificance. In addition, Green Diamond would remain subject to State and Federal laws, such as the Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the prohibitions on taking of certain raptors pursuant to Sections 3503.3 and 3511 of the California Fish and Game Code.

2.4 Alternative B (Simplified Prescriptions Strategy)

Under Alternative B, Green Diamond would continue to conduct timber harvesting and related operations on its property in accordance with existing State and Federal regulations, including the CFPRs, its NSOHCP, and the operational and policy management actions currently being implemented by Green Diamond. Green Diamond would also implement an AHCP/CCAA within the Action Area. Operations within the Action Area would be subject to the provisions of an ITP and ESP.

NMFS would issue Green Diamond an ITP with a term of 50 years for two listed fish ESUs and one listed fish DPS (coho salmon [Southern Oregon/Northern California Coast ESU],

Chinook salmon [California Coastal ESU], and steelhead [Northern California DPS]) and three unlisted fish ESUs (Chinook salmon [Southern Oregon and Northern California Coastal ESU, Upper Klamath/Trinity Rivers ESU] and steelhead [Klamath Mountains Province ESU]). The USFWS would issue Green Diamond an ESP, also with a 50-year term, covering two unlisted fish species (coastal cutthroat and rainbow trout), and two unlisted amphibians (southern torrent salamander and tailed frog). Table 2.4-1 lists species that would receive ITP or ESP coverage under Alternative B.

Existing measures employed by Green Diamond to protect Class I, Class II, and Class III streams would be supplemented by an AHCP/CCAA Conservation Strategy specific to this alternative, which includes fixed riparian buffer widths within which no management or timber harvesting would occur, and establishment of ELZs. Green Diamond would not implement an ownership-wide Road Management Plan or implement slope stability and ground disturbance measures, or provide protection for unique geomorphic features, such as CMZs and floodplains, other than those required by the CFPRs on a THP by THP basis. Effectiveness and compliance monitoring would not be as extensive under this alternative as for the Proposed Action, and the results of monitoring would not be used to make changes to the Operating Conservation Plan.

2.4.1 Timber Harvesting and Forest Management Activities

General forest management and timber harvesting activities noted under the No Action Alternative would continue under this alternative. Although fire suppression would continue on Green Diamond lands, it would not be a covered activity under the ITP or ESP under this alternative. Similarly, although Green Diamond would continue their use of fertilizers and herbicides, which they apply for the purposes of enhancing tree growth and controlling competing brush vegetation in even-aged regeneration units and roadside areas, this would not be a covered activity under the ITP or ESP.

TABLE 2.4-1
Fish and Amphibian Species That Would Be Covered Under Alternative B

	Listing/Sensitivity Status Within the Action Area	
Species Common Name (*Scientific Name*)	**Federal**	**State**
Fish		
Coho salmon (*Oncorhynchus kisutch)* Southern Oregon/Northern California Coast ESU	FT	ST
Steelhead trout* (anadromous) (*Oncorhynchus mykiss)* Northern California DPS	FT	None
Steelhead trout* (anadromous) (*Oncorhynchus mykiss)* Klamath Mountains Province ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha)* California Coastal ESU	FT	None
Chinook salmon (*Oncorhynchus tshawytscha)* Southern Oregon and Northern California Coastal ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha)* Upper Klamath/Trinity Rivers ESU	None	None

TABLE 2.4-1
Fish and Amphibian Species That Would Be Covered Under Alternative B

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	**State**
Coastal cutthroat trout (anadromous and resident) (*Oncorhynchus clarki clarki)*	FSS	CSC
Rainbow trout* (resident) (*Oncorhynchus mykiss*)	None	None
Amphibians		
Southern torrent salamander (*Rhyacotriton variegatus)*	None	CSC
Tailed frog (*Ascaphus truei)*	None	CSC

* Although both steelhead and rainbow trout are of the species *Oncorhynchus mykiss*, they are considered to be separate DPSs, This is, in part, because they exhibit markedly different behavioral patterns. For additional details regarding the differences between these species see 71 FR 834. Steelhead are under the jurisdiction of the NMFS, whereas rainbow trout are under the jurisdiction of the USFWS.

Federal
FT Federal threatened species
FSC Federal species of concern
FSS Forest Service sensitive species

State
CSC CDFG Species of Special Concern
ST State threatened species

Under Alternative B, Green Diamond would commit to the following additional key measures in implementing the AHCP/CCAA relative to the No Action Alternative:

- Prohibit timber harvesting within riparian buffers, except for purposes of creating cable-yarding corridors when other options are impractical
- Exclude use of heavy equipment within riparian buffers, with the exception of existing roads and stream crossings
- Prohibit use of landings within riparian buffers

2.4.2 Other Operations and Activities

Other operations and activities noted under the No Action Alternative would continue under Alternative B, with the following exception. Instream gravel extraction, subject to permitting requirements of the CDFG, would continue as under the Proposed Action; it would not be a covered activity under the ITP or ESP.

2.4.3 Fish and Wildlife Habitat

2.4.3.1 Riparian Habitat

Following the distinctions used in the CFPRs, riparian management measures under Alternative B would vary among three broad classes of streams: Class I, Class II, and Class III watercourses.

Class I Watercourses. Under Alternative B, Class I streams would include all fish-bearing streams. Riparian buffers for Class I streams would have fixed widths of 200 feet (slope distance), as measured from the first line of perennial vegetation. Under this alternative, there would be no forest management or riparian habitat management within Class I riparian buffers (with the exception of creating cable-yarding corridors when other options are impractical). Many measures described under the No Action Alternative for riparian buffer areas would consequently become inapplicable, because the CFPRs assume some level of timber harvesting within these zones. The use of heavy equipment within Class I riparian buffers would also be prohibited under this alternative, except for the use of existing roads and stream crossings for log hauling and access purposes (unless otherwise qualified by the CFPRs).

Class II Watercourses. Riparian buffers for Class II streams would have fixed widths of 130 feet (slope distance), as measured from the first line of perennial vegetation. Under this alternative, there also would be no forest management or riparian habitat management within Class II riparian buffers (with the exception of creating cable-yarding corridors when other options are impractical). Many measures described under the No Action Alternative for riparian buffer areas would again become moot, because the CFPRs assume some level of timber harvesting within these zones. The use of heavy equipment within Class II riparian buffers would also be prohibited under this alternative, except for the use of existing roads and stream crossings for log hauling and access purposes (unless otherwise qualified by the CFPRs).

Class III Watercourses. Under Alternative B, protection of Class III streams would be the same as under the No Action Alternative.

Ponds, Swamps, Bogs, Springs and Seeps. Ponds, swamps, bogs, springs, and seeps that support aquatic species would also be afforded the same protection as other Class II watercourses noted above for riparian habitats.

2.4.3.2 Large Woody Debris

Under Alternative B, large woody debris retention, removal, and recruitment activities would be the same as those described under the No Action Alternative. However, because no timber or riparian management would occur within the riparian buffers under this alternative, future recruitment of snags would be almost totally dependent on natural causes (e.g., windthrow events, landslides, and natural mortality-inducing processes within the buffer areas).

2.4.3.3 Snags

General snag retention and recruitment measures under the Proposed Action would be the same as under the No Action Alternative. However, because no timber or riparian management would occur within the riparian buffers under this alternative, future recruitment of snags would be almost totally dependent on natural mortality-inducing processes within the buffer areas.

2.4.3.4 Hardwoods

Under the Alternative B, management of hardwood resources within the Action Area would generally be the same as under the No Action Alternative.

2.4.4 Measures to Protect Federal and State Listed Species

Under Alternative B, take of AHCP/CCAA covered listed species would be permitted provided such action is incidental to covered activities. Specific measures contained in the CFPRs, other applicable laws, or developed pursuant to the THP process that are designed for the purpose of avoiding take of listed species would be superseded by measures contained in the AHCP/CCAA and its accompanying ITP. Green Diamond would remain subject to the take prohibitions for other listed species that are not covered by the ITP but that may occur within the Action Area. For other listed species not covered by the AHCP/CCAA, Green Diamond would continue to implement measures designed to avoid unauthorized take of listed species, including continuing nest protection and other measures designed to avoid take, measures defined in its NSOHCP, and measures identified during the THP preparation and review process. If a species is also state listed under CESA, Green Diamond would not undertake any AHCP measures that would result in a violation of CESA's prohibition on unauthorized take as that term is defined under state law.

2.4.4.1 Coho Salmon, Chinook Salmon, and Steelhead

Under Alternative B, incidental take of these species would be authorized subject to the terms of the ITP. Green Diamond would implement AHCP/CCAA measures intended to minimize and mitigate the impacts of incidental take of these fish species, including establishment of fixed riparian buffers and no harvesting or other management within riparian buffer areas.

2.4.4.2 Tidewater Goby

As with the No Action Alternative, Green Diamond would remain subject to the prohibition on unauthorized take of this species. The Services do not anticipate under Alternative B that Green Diamond would change any of the measures it currently implements for this species. It is anticipated that Green Diamond would incorporate site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.4.3 American Peregrine Falcon

Under Alternative B, Green Diamond would implement CFPR site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.4.4 Bald Eagle

As with the No Action Alternative, Green Diamond would seek technical assistance from the USFWS and/or CDFG to develop and implement site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.4.5 Bank Swallow

As with the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.4.6 Little Willow Flycatcher

Under Alternative B, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.4.7 Marbled Murrelet

The Services do not anticipate under Alternative B that Green Diamond would change any of the measures it currently implements for this species. As with the No Action Alternative, Green Diamond is not seeking coverage under the Permits for the harvest of trees, as described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.5, in any portion of the Action Area that has been designated as critical habitat for the marbled murrelet, as defined in 50 CFR 17.95, when the harvest of those trees would affect a "primary constituent element" of critical habitat for the marbled murrelet, as defined in 50 CFR 17.95 (adopted May 24, 1996 61 FR 26256).

2.4.4.8 Northern Spotted Owl

As would be the case for both the No Action Alternative and the Proposed Action, Green Diamond would continue under Alternative A to comply with measures contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations.

2.4.4.9 Western Snowy Plover

As with the No Action Alternative, Green Diamond would incorporate site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.4.5 Measures for Other Species

The ITP and ESP would provide Green Diamond authorization for incidental take of unlisted, covered fish and amphibian species (see above) that have either been proposed for listing or are considered to be sensitive because populations or habitats are thought to be declining, if those species become listed under the ESA during the term of the Permits. Under Alternative B, specific measures contained in the CFPRs or developed pursuant to the THP process would be augmented by measures contained in the AHCP/CCAA and its accompanying ITP and ESP. The conservation strategy for unlisted, covered species relies extensively on AHCP/CCAA measures intended to minimize and mitigate the impacts of incidental take of the listed, covered species discussed above.

Under Alternative B, Green Diamond would continue to implement measures designed to mitigate or avoid significant impacts to other unlisted species, not covered by the AHCP/CCAA but considered "sensitive" by the Board of Forestry (osprey, northern goshawk, golden eagle, great blue heron, and great egret). Green Diamond would implement CFPRs specific to these species and design THPs that incorporate site-specific measures developed by Green Diamond foresters and biologists or identified during the THP preparation and review process, as necessary, to avoid or mitigate potentially significant environmental effects to insignificance. In addition, Green Diamond would remain subject to State and Federal laws, such as the Migratory Bird Treaty Act, Bald Eagle

and Golden Eagle Protection Act, and the prohibitions on taking of certain raptors pursuant to Sections 3503.3 and 3511 of the California Fish and Game Code.

2.5 Alternative C (Expanded Geographic and Species Coverage)

Under Alternative C, Green Diamond would continue to conduct timber harvesting and related operations on its property in accordance with existing State and Federal regulations, including the CFPRs, its NSOHCP, and the operational and policy management actions currently being implemented by Green Diamond. Green Diamond would also implement an AHCP within the Action Area. An additional 25,677 acres of rain-on-snow areas within Trinity and Del Norte counties are also included in the coverage area for this alternative. Operations within these areas would be subject to the provisions of an ITP.

NMFS and the USFWS would issue Green Diamond an ITP with a term of 50 years for 16 species. The 16 covered species would consist of three listed fish ESUs, three unlisted fish ESUs, two unlisted fish species, one listed fish species, four unlisted amphibians, one unlisted reptile, and two listed bird species, as shown in Table 2.5-1.

TABLE 2.5-1
Federal and State Protective Status of Fish, Amphibian, and Reptile Species Covered Under Alternative C

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	**State**
Fish		
Coho salmon (*Oncorhynchus kisutch*) Southern Oregon/Northern California Coast ESU	FT	ST
Steelhead trout* (anadromous) (*Oncorhynchus mykiss*) Northern California ESU	FT	None
Steelhead trout* (anadromous) (*Oncorhynchus mykiss*) Klamath Mountains Province ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha*) California Coastal ESU	FT	None
Chinook salmon (*Oncorhynchus tshawytscha*) Southern Oregon and Northern California Coastal ESU	None	None
Chinook salmon (*Oncorhynchus tshawytscha*) Upper Klamath/Trinity Rivers ESU	None	None
Coastal cutthroat trout (anadromous and resident) (*Oncorhynchus clarki clarki*)	FSS	CSC
Rainbow trout* (resident) (*Oncorhynchus mykiss*)	None	None
Tidewater goby (*Eucyclogobius newberryi*)	FE	CSC
Amphibians		
Southern torrent salamander (*Rhyacotriton variegatus*)	None	CSC
Tailed frog (*Ascaphus truei*)	None	CSC
Foothill yellow-legged frog (*Rana boylii*)	FSS	CSC/CFP

TABLE 2.5-1
Federal and State Protective Status of Fish, Amphibian, and Reptile Species Covered Under Alternative C

Species Common Name (*Scientific Name*)	Listing/Sensitivity Status Within the Action Area	
	Federal	**State**
Northern red-legged frog (*Rana aurora aurora*)	FSS	CSC/CFP
Reptiles		
Western pond turtle (*Clemmys marmorata marmorata*)	FSS	CSC/CFP
Birds		
Marbled murrelet (*Brachyramphus marmoratus*)	FT	SE
Bald eagle (*Haliaeetus leucocephalus*)	FT	SE

* Although both steelhead and rainbow trout are of the species *Oncorhynchus mykiss*, they are considered to be separate DPSs, This is, in part, because they exhibit markedly different behavioral patterns. For additional details regarding the differences between these species see 71 FR 834. Steelhead are under the jurisdiction of the NMFS, whereas rainbow trout are under the jurisdiction of the USFWS.

Federal
FE Federal endangered species
FT Federal threatened species
FSS Forest Service sensitive species

State
CSC CDFG Species of Special Concern
ST State threatened species
CFP California Fully Protected Species
SC Candidate for State listing
SE State Endangered Species

Because this alternative is an expansion of the Proposed Action, the mitigation and monitoring measures described for the species covered under the Proposed Action, would also be applied under Alternative C, where applicable and practicable. The adaptive management program noted for the Proposed Action would also be included under Alternative C. Extra mitigation management and monitoring measures relating to the covered species, as well as their aquatic and semi-aquatic habitat in local and downstream drainages, would be implemented throughout the expanded coverage area as needed. Additional mitigation and management measures specific to the marbled murrelet, bald eagle, and western pond turtle would also be included, and are summarized below.

2.5.1 Timber Harvesting and Forest Management Activities

General forest management and timber harvesting activities noted for the Proposed Action would generally be the same under this alternative, except that Green Diamond would commit to the following additional key measures in implementing the AHCP relative to the Proposed Alternative.

2.5.1.1 Harvesting and Transporting Timber

Prohibit timber harvesting operations within the rain-on-snow area from November 15 through May 14, except for non-mechanized planting.

2.5.1.2 Monitoring and Research Activities

Expand the monitoring program for the three types of effectiveness monitoring projects (rapid response, response, and long-term trend) to include additional sites in the rain-on-snow area.

2.5.2 Other Operations and Activities

Under Alternative C, other operations and activities would be the same as noted under the Proposed Action.

2.5.3 Fish and Wildlife Habitat

Conservation measures for riparian habitat, large woody debris, snags, and hardwoods described for the Proposed Action would generally be the same under this alternative. Some loss of snags, however, would be anticipated under Alternative C as a result of phased harvesting of isolated timber stands of suitable marbled murrelet habitat over the term of the Permit (see Section 2.5.4.7. below).

2.5.4 Measures to Protect Federal and State Listed Species

Under Alternative C, take of AHCP-covered listed species would be permitted provided such action was incidental to covered activities. Specific measures contained in the CFPRs or developed pursuant to the THP process that are designed for the purpose of avoiding take of listed species and minimizing and mitigating environmental impacts to such species and their habitats would be superseded by measures contained in the AHCP and its accompanying ITP to minimize and mitigate the impacts of incidental take and comply with other requirements of the ESA. Green Diamond would remain subject to the take prohibition for other listed species that are not covered by the ITP but that may occur within the coverage area for this alternative. For other listed species not covered by the AHCP, Green Diamond would continue to implement measures designed to avoid unauthorized take of listed species, including nest protection and other measures designed to avoid take, measures defined in its NSOHCP, and measures identified during the THP preparation and review process. If a species is also state listed under CESA, Green Diamond would not undertake any AHCP measures that would result in a violation of CESA's prohibition on unauthorized take as that term is defined under state law.

2.5.4.1 Coho Salmon, Chinook Salmon, and Steelhead

Under Alternative C, incidental take of these species would be authorized subject to the terms of the ITP. Green Diamond would implement AHCP measures intended to minimize and mitigate the impacts of incidental take of these fish species. These include many of the general forest management, riparian habitat, large woody debris, and snag measures described for the Proposed Action, which were designed to protect or enhance habitat for salmonid fish species.

2.5.4.2 Tidewater Goby

Under Alternative C, incidental take of the tidewater goby would be authorized subject to the terms of the ITP. Green Diamond would implement AHCP measures intended to minimize and mitigate the impacts of incidental take of this fish species. These include

many of the general forest management, riparian habitat, and large woody debris described for the Proposed Action, which were designed to protect or enhance habitat for salmonid fish species.

2.5.4.3 American Peregrine Falcon

Under Alternative C, Green Diamond would implement prescriptive measures specific to the species as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.5.4.4 Bald Eagle

Under Alternative C, mitigation and management measures designed to avoid take would be superseded by species-specific measures contained in the AHCP under this alternative designed to minimize and mitigate the impacts of take and comply with other ESA requirements, to include the following:

- Within proposed THP harvesting units, survey for bald eagle nests and establish 30- to 40-acre nest site management zones within which management prescriptions would be jointly developed by Green Diamond and USFWS representatives on a site-specific basis

Insofar as the bald eagle is also a State-listed species under CESA, Green Diamond would not undertake any AHCP measures that are likely to take this species unless it also receives incidental take authorization under State law.

2.5.4.5 Bank Swallow

As with the No Action Alternative, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.5.4.6 Little Willow Flycatcher

Under Alternative C, Green Diamond would incorporate site-specific measures into THPs, as necessary, for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.5.4.7 Marbled Murrelet

Under Alternative C, specific measures designed to avoid take of the marbled murrelet would be superseded by species-specific measures contained in the AHCP under this alternative designed to minimize and mitigate the impacts of take and comply with other ESA requirements, to include the following:

- Retention and protection over a 50-year period of timber stands identified as suitable for murrelet nesting located adjacent to large blocks of high value murrelet habitat on public lands
- Phased harvest of other isolated timber stands, with harvest occurring first in stands with the lowest potential value for murrelets and provisions for extended phasing of harvests in stands with the highest potential value for murrelets
- Seasonal restrictions on timber operations in and adjacent to murrelet stands

- Designation of no-cut and operational buffers to avoid take of murrelets on adjacent lands
- Thinning of overstocked stands in neighboring Redwood National Park (RNP) to accelerate development of buffer habitat and potential murrelet nesting habitat on public lands
- Development of a corvid management program to reduce predation pressure on nesting murrelets in Redwood National and State Parks
- Funding for murrelet research

Potential significant adverse impacts to the marbled murrelet would also be further reduced through implementation of the general forest management and riparian habitat measures described for the Proposed Action and carried forward under this alternative, which were designed to protect or enhance habitat for salmonid fish species.

Insofar as the murrelet is also a State-listed species under CESA, Green Diamond would not undertake any AHCP measures that are likely to take this species unless it also receives incidental take authorization under State law.

2.5.4.8 Northern Spotted Owl

Under Alternative C, Green Diamond would continue to comply with measures summarized under the No Action Alternative and contained in its NSOHCP and associated Implementation Agreement that provide for the legal incidental take of northern spotted owls in connection with timber harvesting and forest management operations.

2.5.4.9 Western Snowy Plover

As with the No Action Alternative, Green Diamond would incorporate site-specific measures as necessary for the purpose of avoiding unauthorized take and mitigating or avoiding significant environmental impacts.

2.5.5 Measures for Other Species

The ITP would provide Green Diamond incidental take authorization for unlisted, covered fish, amphibian, and reptile species (see above) that have either been proposed for listing or are considered to be sensitive because populations or habitats are thought to be declining, if those species become listed under the ESA during the term of the Permits. Under Alternative C, specific measures contained in the CFPRs or developed pursuant to the THP process that are designed to mitigate or avoid significant impacts to the unlisted, covered species would be augmented by measures contained in the AHCP and its accompanying ITP to mitigate or avoid significant impacts to these species and to minimize and mitigate the impacts of incidental take in the event these species are listed in the future. The conservation strategy for unlisted, covered species relies extensively on AHCP measures intended to minimize and mitigate the impacts of incidental take of the listed, covered species discussed for the Proposed Action. These include many of the general forest management, riparian habitat, large woody debris, and snag measures noted under the Proposed Action that were designed to protect or enhance habitat for listed salmonid fish species.

Under Alternative C, one additional species-specific mitigation/management measure would be implemented for the western pond turtle: Green Diamond will avoid road building in meadows and open areas in upland habitats, near suitable aquatic habitat for pond turtles.

Under Alternative C, Green Diamond would continue to mitigate or avoid significant impacts to other unlisted species, not covered by the AHCP but considered "sensitive" by the Board of Forestry (osprey, northern goshawk, golden eagle, great blue heron, and great egret). Green Diamond would implement CFPRs specific to these species and design THPs that incorporate site-specific measures developed by Green Diamond foresters and biologists or identified during the THP preparation and review process as necessary to avoid or mitigate potentially significant environmental effects to insignificance. In addition, Green Diamond would remain subject to State and Federal laws, such as the Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and the prohibitions on taking of certain raptors pursuant to Sections 3503.3 and 3511 of the California Fish and Game Code.

2.6 Alternatives Considered but Dismissed from Further Consideration

Other alternatives were considered by the Services but not carried forward for detailed analysis during preparation of this EIS. The alternatives considered but not carried forward are: (1) broad application of generic management prescriptions; (2) ITP coverage for terrestrial species (in addition to those considered in Alternative C above) and aquatic and riparian species; (3) alternative Permit terms; and (4) application of Pacific Lumber Company Habitat Conservation Plan prescriptive elements. These alternatives were not selected for detailed analysis because they do not meet the Services' purposes and needs or the applicant's objectives, or they are beyond the scope of the EIS.

2.6.1 Generic Management Prescriptions

In addition to the alternatives carried forward for detailed analysis, the Services considered approaches that would adopt numerous "generic" management prescriptions that have been applied on a regional basis in other conservation efforts, often on federally managed lands. These management prescriptions are discussed below in the context of two applications: (1) silvicultural applications; and (2) existing application of Federal forest policies on private lands.

2.6.1.1 Silvicultural Applications

By definition, generic prescriptions do not take into account site-specific conditions. They are systematically applied regardless of the actual existence of a biological concern (or the cause of that concern), or the likely effectiveness of the prescription in a given area. Further, the burden imposed by the prescription can be greater than what is required to address targeted biological concerns or to mitigate the actual taking of listed species by the landowner. Generic management prescriptions often include blanket restrictions on certain silvicultural practices (for example, no clearcutting), and/or percent limits on harvesting within a set time period. All of these approaches are typically applied systematically across the landscape.

These types of prescriptions are not carried forward for detailed analysis as separate alternatives because they are not consistent with Green Diamond's management and productivity objectives, which are based on the unique growing conditions of the North Coast redwood region and on Green Diamond's ownership-wide and watershed-level approach to managing its timberlands. On the basis of the unique growing conditions of the local area and the long-term management approach implemented by Green Diamond, the continued use of even-aged regeneration tools are necessary to support Green Diamond's management and business objectives. Even-aged management is also key to implementation of other ownership-wide management templates, including Green Diamond's NSOHCP and achievement of maximum sustained production on Green Diamond's lands under the MSP Option (a) document.

Such generic prescriptions would also be inconsistent with Green Diamond's existing harvesting and management framework reflected in documents reviewed and approved pursuant to State statutes (see Sections 1.5 and 1.6). Further, absent the need to operate within this context, transitioning to another silvicultural regime, such as uneven-aged management, within the proposed timeframe of the ITP/ESP is impractical, infeasible and uneconomic because of numerous logistical and operational constraints, such as:

- **Reconfiguration and relocation of Green Diamond's entire road and skid trail network**—Uneven-aged management systems require placement and concentration of roads, skid trails corridors, and landings along the mid- and lower slope reaches within a watershed. (Even-aged management concentrates roads, yarding corridors, and landings on mid- and upper slope reaches.) Such an undertaking is impractical within the proposed timeframe of the ITP/ESP. Also, skid trails are generally wider than cable corridors for even-aged systems, and landings are generally larger to accommodate ground yarding of logs by skidders and bulldozers.
- **Species redistribution**—The conifers of primary economic value on Green Diamond's lands are coast redwood and Douglas-fir, which require substantial direct sunlight to grow rapidly at young ages. Even-aged silvicultural techniques are used to promote propagation of these species throughout the North Coast redwood region. Although the use of uneven-aged regeneration systems can be beneficial to many shade-tolerant species, such as western hemlock and white fir, these systems generally are less suited to the economically valuable redwood and Douglas-fir which grow at maximum rates when free to grow in full sunlight (Smith, 1962; USFS, 1973; Perry, 1994).
- **Product specialization**—Less opportunity exists to "manage" and promote individual tree diameter growth of selected species under uneven-aged management. Because diameter and species mix from harvested stands is more unpredictable under uneven-aged management, general product manufacturing and marketing is also more opportunistic in nature. The manufacture of the high-quality wood products that is the foundation of Green Diamond's current niche within the marketplace relies on a consistent redwood/Douglas-fir species mix within a narrowly defined diameter range that is difficult to "plan" for over the long-term under an uneven-aged management scenario.

Pursuant to Federal Council of Environmental Quality guidelines, alternatives are to be reasonable, practical and feasible. Therefore, transitioning to another silvicultural regime, such as uneven-aged management, should not be carried forward for detailed analysis.

2.6.1.2 Application of Federal Forest Management Measures to Private Lands, Including the Green Diamond Ownership

Applying forest management measures used for Federal lands to the lands owned by Green Diamond was considered but eliminated from further consideration in this EIS. Measures for managing Federal forest lands are designed for lands that are subject to the operating guidelines and principles of Federal land management agencies, such as the U.S. Forest Service and the Bureau of Land Management, and take into consideration the management and operational issues and mandates pertinent to those Federal land managers. Such considerations in managing Federal lands often emphasize recreational use and other passive and limited actions rather than commercial operations. For this reason, the Federal management measures are not directly pertinent to privately owned lands or the uses of those private lands (in this case, timber harvesting operations by Green Diamond).

For example, the Northwest Forest Plan (NWFP) was developed for the U.S. Forest Service and Bureau of Land Management to address management objectives in lands in western Washington, Oregon, and northern California. In those areas covered by the NWFP, management prescriptions include interim fixed-width 300-foot, 150-foot, and 100-foot riparian no-cut buffers along either side of Class I, Class II, and Class III streams, respectively. (Riparian buffer widths and harvesting prescriptions may be adjusted on the basis of completed watershed analyses.) NWFP standards were developed to provide a wide range of benefits to many unlisted and listed species under Federal multiple-use management principles.

NWFP standards and other available information were considered in developing Green Diamond's proposed AHCP/CCAA, and Green Diamond considers it unlikely that it would adopt more restrictive NWFP-like standards not already reflected in the Proposed Action or other action alternatives, based on economic operational considerations, its management objectives, and the number of species considered in the design of the NWFP standards for which Green Diamond is not seeking authorization for incidental take (e.g., the grizzly bear, Vaux's swift, and long-legged myotis).

As a result of the different management objectives of Federal agencies and Green Diamond, use of the Federal forest management measures on Green Diamond's lands would affect existing operations to the extent that areas currently available for timber harvesting would be precluded from approved operations. Approximately 94 percent of the timber resource that sustains Simpson Timber Company's California mills in Korbel, Orick, and Brainard originates from Green Diamond Resource Company lands within the Action Area. The large reductions in harvestable acreage that would result from implementing Federal land management policies for forest lands could limit Green Diamond's ability to harvest minimum amounts of timber to the extent that Simpson Timber Company mills would not be sustained. Because Simpson Timber Company is the largest purchaser of Green Diamond Resource Company timber, the large reductions in harvestable acreage that likely would occur from implementing Federal land management policies would adversely affect Simpson Timber Company's ability to compete in the redwood and Douglas-fir market.

Application of Federal forest management measures to Green Diamond's ownership could limit Green Diamond's competitive market position and potentially constrain continued regional economic vitality. Green Diamond employs more than 265 workers in Humboldt and Del Norte counties, and mills dependent on Green Diamond timber in the region employ approximately 410 people. By constraining Green Diamond's existing operations to an extent that limits its regional competitiveness, implementing the management prescriptions designed for Federal lands could result in layoffs and contribute to regional unemployment.

2.6.2 Extensive Terrestrial Species Coverage

In addition to the species covered in the Proposed Action, the Services considered covering a large number of terrestrial species that are often associated with upland habitats during portions of their life histories (e.g., peregrine falcon and bank swallow). The Services did not carry this approach forward as an alternative for several reasons. Identifying terrestrial species as additional Permit species in an HCP/CCAA would require developing species-specific, upland prescriptions. These would be in addition to those developed for the northern spotted owl in Green Diamond's NSOHCP and would extend beyond the riparian focus of the proposed AHCP/CCAA and the other action alternatives, and are therefore beyond the scope of this EIS. The marbled murrelet and bald eagle were included as covered species under Alternative C in this EIS because of the species' habitat requirements; survey results on Green Diamond lands and nearby parks suggest overlap with aquatic and riparian ecosystems (see Section 3.6.3).

2.6.3 Different Permit Term

As discussed in Section 2.2, Proposed Action, the Federal action assessed in this EIS is the issuance of an ITP by NMFS and the issuance of an ESP by the USFWS to Green Diamond. The ITP would cover three listed fish ESUs and three unlisted fish ESUs. The USFWS action would cover one unlisted fish and two unlisted amphibians. The term of both Permits would be 50 years. This Permit term was selected because it generally corresponds to the rotation age of timber stands on the Green Diamond ownership.

A different Permit term for the ITP/ESP assessed in this EIS (other than 50 years) was considered but not carried forward. Both a shorter term (to 25 years) and a longer term (to 75 years) were considered. A 25-year Permit would not allow adequate time for the conservation measures to be implemented and assessed for effectiveness. Specifically, a shortened Permit term would not allow for appropriate application and interpretation of site-specific prescriptions using the adaptive management and monitoring provisions of the proposed AHCP/CCAA. Conversely, if the Permit term was 75 years, the data used to assess possible modifications to prescriptive measures would be outdated or invalid and, therefore, inadequate to rely on for decisions made so far into the future.

2.6.4 Pacific Lumber Company Habitat Conservation Plan Prescriptions

The Services considered application of the prescriptive elements and overall approach required by the Pacific Lumber Company (PALCO) HCP, which PALCO is currently implementing on a portion of its commercial timberlands immediately adjacent to Green Diamond's southern holdings. The Services, however, did not carry this approach forward

for several reasons. The PALCO HCP was developed absent significant information describing the status of their proposed HCP covered lands and the relative risk to the species present on their lands if subjected to their proposed forest management activities. As a result, the PALCO HCP's operational restrictions (e.g., riparian buffer widths, etc.) were based on information collected from and representative of other areas, often outside the redwood region. To address this issue, the PALCO HCP incorporates reasonable, though conservative, interim operational restrictions, based on the best available science at that time, combined with requirements to collect extensive site-specific watershed information. This information, collected through a combination of required individual watershed analyses and monitoring, can then be used to refine the HCP's operational restrictions to more accurately reflect the potential for PALCO's covered activities to affect their HCP covered species. In contrast, Green Diamond has been studying the aquatic resources on its ownership for more than a decade and has extensive, site-specific knowledge about many of its environmental resources. This site-specific information allows for the opportunity to develop prescriptive measures specific to the varying environmental conditions on their ownership and demonstrates that there are enough environmental differences between their property and the PALCO HCP covered lands that different prescriptive elements are warranted. As an example, Green Diamond's research has shown there are significant differences in the presence of some of their proposed covered species relative to the distribution of these same species on PALCO HCP covered lands. In addition, the existence of site-specific information regarding Green Diamond's proposed covered lands does not necessitate the same level of data collection as required by the PALCO HCP watershed analyses and monitoring programs. Hence, it is reasonable to expect that Green Diamond's monitoring programs and research efforts would be significantly different and tailored to their landscape and information needs. Finally, although Green Diamond and PALCO both conduct commercial timber harvest activities, they conduct these activities under significantly different internal operational constraints born of unique financial, logistical, and philosophical characteristics. For these reasons, application of the PALCO HCP requirements was not considered to be a feasible alternative.

2.7 Comparison of Alternatives

Table 2.7-1 presents the five alternatives considered in detail in a comparative format. The table summarizes the differences in key management measures under each of the alternatives. In general, the comparison is geared toward how the key management measures of each alternative are similar to or different from the provisions of the other alternatives. Many management activities will not differ by alternative (e.g., recreation), and are therefore not included in Table 2.7-1.

A comparison of the effects of each of the alternatives is presented in the Executive Summary section at the beginning of this EIS (Table ES-1).

2.8 Environmentally Preferred Alternative

CEQ regulations require that the Record of Decision specify "the alternative or alternatives which were considered to be environmentally preferable" (40 CFR 1505.2[b]). The environmentally preferred alternative is the alternative that will promote the national

environmental policy as expressed in NEPA's Section 101. Ordinarily this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic cultural and natural resources. NEPA's Section 101 calls for Federal agencies to make decisions to achieve "conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans" (42 USC 4341[a]). Federal agencies should strive to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences. It also calls for Federal agencies to achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Based on the analysis of alternatives in the FEIS, there are many similarities in the overall effects of the action alternatives on the human environment, thus making it difficult to choose any particular alternative in the FEIS as the environmentally preferred alternative. Upon further review, the Services will identify the Environmentally Preferred Alternative in the Record of Decision as required by NEPA.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Federal ESA Compliance for Covered Species				
Federal ITP/ESP not issued. Subject to take prohibition of listed species, except the northern spotted owl under Green Diamond's 1992 NSOHCP.	Federal ITP/ESP issued. Implementation of an Aquatic HCP/CCAA.	Federal ITPs only issued. Implementation of an Aquatic HCP.	Same as Proposed Action.	Federal ITP only issued. Implementation of an Aquatic HCP.
Covered Species				
N/A	Three listed fish ESUs, three unlisted fish ESUs, two unlisted fish species, and two unlisted amphibians.	Three listed fish ESUs only.	Same as Proposed Action.	Three listed fish ESUs, three unlisted fish ESUs, two unlisted fish species, one listed fish species, four unlisted amphibians, one unlisted reptile, and two listed bird species.
General Timber Harvesting and Forest Management Activities				
Harvesting and management as per the CFPRs and other applicable law, Green Diamond's NSOHCP, and Green Diamond operational policies and guidelines (with technical assistance from the Services, as appropriate).	Same as No Action, plus additional measures contained in the proposed AHCP/CCAA.	Same as No Action, plus additional measures contained in an AHCP.	Same as No Action, plus additional measures contained in an AHCP/CCAA.	Same as Proposed Action.
(Harvesting and Transporting Timber)				
Harvest scheduling pursuant to Green Diamond's "Option A" document.	Same as No Action.	Same as No Action.	Same as No Action.	Same as No Action, except would include specific conservation measures for marbled murrelet and bald eagle habitat.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Harvesting limited to single-tree selection within WLPZs.	Same as No Action, except CFPRs augmented by additional measures for RMZs and cable corridors would be allowed where necessary to conduct intermediate treatments in adjacent stands. See Riparian Habitat below for additional information.	Same as Proposed Action.	No harvesting within riparian buffers.	Same as Proposed Action.
Only uneven-aged management allowed within special management zones for steep inner gorge areas immediately upslope of Class I WLPZs.	Only single-tree selection and one commercial harvesting entry for the term of the Permits within headwall swales, deep-seated landslides, and "steep streamside slope management zones" (SMZs) immediately upslope of Class I and Class II RMZs, except where cable corridors are necessary to conduct intermediate treatments in adjacent stands. Within the SMZ, retain all hardwoods and leave conifer trees evenly distributed across the landscape where feasible. No-cut zones within the toe, and 25 feet upslope from the top of the toe of deep-seated landslides, except for purposes of creating cable-yarding corridors when other options are impractical. Similarly no-cut zones upslope of deep-seated landslide scarps so as to taper to the lateral margins of the scarp.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Log loading and hauling from October 15 to May 1 limited to roads with "stable operating surfaces."	Loading and hauling of logs from October 15 through May 14 limited to roads with rocked surfaces, except during dry fall and early spring periods under circumstances defined in the AHCP/CCAA. Use of landings within RMZs also not permitted during this period.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action, plus timber harvesting operations within the additional rain-on-snow areas are not allowed from November 15 through May 14 except for purposes of non-mechanized tree planting.
Use of roads during the winter period (October 15-May 1) not allowed where saturated soil conditions exist, where a stable logging road, landing, or skid trail does not exist, or when visibly turbid water from road/landing/skid trail surfaces may reach a watercourse or lake.	Same as No Action, except use of roads, landings, and skid trails additionally not allowed at any time of the year if such use results in runoff of waterborne sediment in amounts sufficient to cause a visible increase in turbidity in any ditch or road surface which drains into a Class I, II, or III water-course. Limit vehicular use on unrocked roads during the winter period (October 15 – May 15) to ATVs only.	Same as Proposed Action.	Same as No Action	Same as Proposed Action.
Harvesting on unstable slopes (defined by CFPRs), inner gorge areas and slope greater than 65 percent would not occur without review by a licensed geologist or certified engineering geologist.	Unstable slope harvesting by default conservation measures for steep streamside slopes, headwall swales, and shallow—deep seated landslides, unless reviewed by a licensed geologist or certified engineering geologist.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
(Timber Stand Regeneration and Improvement)				
Site preparation activities pursuant to the CFPRs; incorporation of a site preparation addendum required with THPs. Other activities include tree planting, vegetation control and stand growth enhancement, pruning and cone collection, and fire prevention and suppression.	Same as No Action, plus implementation of various additional measures to minimize surface erosion from site preparation through minimization of bare soil exposure within harvest units, minimization of fireline construction, maintenance of a continuous forest floor layer of duff and woody material, and prevention of drainage failures and sediment delivery from firelines.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
(Road and Landing Construction, Reconstruction, and Maintenance)				
Construction, reconstruction, and maintenance activities pursuant to the CFPRs, implementation of best management practices (BMPs) based on techniques described in Weaver and Hagans(1994), and other Green Diamond operational policies and guidelines.	Same as No Action, plus implementation of additional measures (noted below) contained in Green Diamond's ownership-wide Road Management Plan.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Does not require road inventory.	Requires inventory of Green Diamond's road network every five years to ensure that management roads that are no longer needed for log transport or administrative access are changed to decommission status.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Provides for risk assessment methodology to identify and prioritize treatment of road-related sediment sources based on watershed sensitivity and basin resource issues (e.g. TMDLs), and proposed THP activity within the watershed. Currently, the approximate cost of roadwork for priority sites under the THP process is estimated at $1 million.	Provides for risk assessment methodology to identify and prioritize treatment of road-related sediment sources over the entire ownership based on a process described in the AHCP/CCAA that utilizes results of aerial photos and field inventories. Requires subsequent development of an implementation plan to effect temporary or permanent road decommissioning, or road upgrading, as appropriate. Front load treatment of high- and moderate-risk sediment delivery sites (beginning in the high priority road work units) by providing for an average of $2.5 million per year (approximately $1.5 million in addition to the No Action) for the first 15 years (for a total of $37.5 million) (The acceleration period would be adjusted following revision of the estimate of sediment yield from high- and moderate-risk sediment delivery sites at the end of the first five years following issuance of the Permits. The acceleration period and monetary commitment could be adjusted (upward or downward) by up to 1.5 years and $3.75 million depending on the revised estimate of sediment yield.) Provides for treatment of all high- and moderate-risk sediment delivery sites by the end of the term of the Permits.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Pursuant to the CFPRs, road inspection and maintenance generally limited to THP operating areas and access roads.	Requires inspection and priority repair or maintenance of all mainline roads throughout the ownership once a year prior to the winter period.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Does not require maintenance of other management roads or roads yet to be decommissioned outside of THP operating areas.	Requires maintenance of other management roads or roads yet to be decommissioned throughout the ownership on a 3-year rotating basis in accordance with a schedule contained in the AHCP/CCAA.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Does not require a response plan to large storm events that could result in major sediment inputs to stream channels.	Requires a response plan to large storm events that could result in major sediment inputs to stream channels.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Requires installation of ditch relief culverts or construction of rolling dips at maximum spacing intervals ranging from 115 to 600 feet on the basis of “2 percent” stratifications of road gradient and associated soil erodibility ratings.	Same as No Action.	Same as No Action.	Same as No Action.	Same as No Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Requires general treatment of roads and landings to prevent waterborne transport of sediment and concentration of runoff during the winter period.	Requires surfacing of roads and landings used during the winter period to a minimum compacted depth of 12 inches of pit run rock or a combination of pit run and crushed rock.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Requires installation of bridges on Class I watercourses where economically feasible; requires installation of countersunk or bottomless culverts that accommodate a 100-year flood flow where bridge installation is not possible.	Requires installation of culverts with a minimum diameter of 24 inches for Class I streams and 18 inches for logging road ditch drains. Requires design of all new stream crossing culverts to handle a 100-year return interval flow event and to minimize water diversion potential.	Same as No Action.	Same as No Action.	Same as No Action.
Permanent culverts on Class II watercourse crossings or logging road ditch drains must accommodate a 100-year flood flow.	Requires installation of culverts with a minimum diameter of 24 inches for Class II streams and 18 inches for logging road ditch drains. Requires design of all new stream crossing culverts to handle a 100-year return interval flow event and to minimize water diversion potential.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Requires seeding and mulching of (1) new road cut and fill slopes, (2) exposed slopes associated with temporary stream crossings, or (3) within the RMZ of Class I or II watercourses and Class III EEZs at a seeding rate of 30 lbs/acre and a mulching depth of 2 inches with 90 percent surface coverage.	Same as No Action.	Same as No Action.	Same as No Action.	Same as No Action.
Road construction on unstable slopes would require review by a licensed geologist or certified engineering geologist.	Road construction on steep streamside slopes, headwall swales, and shallow–deep seated landslides would not occur without licensed geologist or certified engineering geologist review.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Monitoring and Research				
Compliance and effectiveness monitoring, wildlife studies, environmental assessments, and watershed studies pursuant to existing regulations and Green Diamond's NSOHCP.	Same as No Action, plus various additional short- and long-term effectiveness monitoring programs as described in the AHCP/CCAA. Provides for adaptive management and structured feedback loops.	Same as Proposed Action, except that species-specific monitoring and research is limited to fish species only and does not include unlisted amphibians (tailed frog and southern torrent salamander).	Same as No Action.	Same as Proposed Action, plus establishes additional monitoring sites within rain-on-snow areas.
Riparian Habitat				
Management pursuant to the CFPRs and other applicable law, Green Diamond's NSOHCP, and Green Diamond operational policies and guidelines.	Same as No Action, plus additional measures contained in the proposed AHCP/CCAA. Some measures would supersede CFPRs.	Same as No Action, plus additional measures contained in an AHCP. Some measures would supersede CFPRs.	Same as No Action, plus additional measures contained in an AHCP/CCAA. Some measures would supersede CFPRs.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
(Riparian Zone Widths, Zone Stratifications, Buffer Areas)				
Class I WLPZ: at least 150 feet Class II WLPZ: 50-100 feet Class III ELZ: 25-50 feet Class III WLPZ designation possible under some circumstances.	Class I RMZ[a]: at least 150 feet Class II-1 RMZ[b]: at least 75 feet Class II-2 RMZ[c]: at least 100 feet Class III (Tier A) EEZ[d]: 30 feet Class III (Tier B) EEZ[e]: 50 feet	Same as Proposed Action.	Class I riparian buffer: 200 feet Class II riparian buffer: 130 feet Class III ELZ: 25-50 feet	Same as Proposed Action.
Class I Inner Zone: 75 feet Class I Outer Zone: 75 feet	Class I Inner Zone: 50-70 feet Class I Outer Zone: 80-100 feet Class II Inner Zone: 30 feet Class II Outer Zone: 45-70 feet	Same as Proposed Action.	No inner/outer zone stratification within the riparian buffer.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Plus: 25-50 foot special operating zone adjacent to (upslope) of a Class I WLPZs where even-aged management occurs; special management zone upslope of a Class I WLPZ inner gorge where slopes exceed 55 percent.	Establishes steep streamside slope management zones (SMZs) upslope of the RMZs along Class I and II watercourses where steep streamside slopes have been identified.	Same as Proposed Action	No special operating zone adjacent to the riparian buffer.	Same as Proposed Action.
(Class I Retention and Operational/Silvicultural Restrictions)				
75 percent surface cover and undisturbed area; single-tree selection; no use of heavy equipment except at prepared tractor and road crossings. Retention and protection of understory and mid-canopy trees within the 25-50 foot special operating zone; even-aged management prohibited in Class I special management zone where slopes exceed 55 percent.	Same as No Action, except SMZ protections supersede No Action restrictions within special operating/management zones. In addition: prohibit timber harvesting within RMZ “inner zones” that are located below designated SMZs, except for purposes of creating cable-yarding corridors when other options are impractical. In addition, no timber harvesting within the entire RMZ below an SMZ in the Coastal Klamath and Blue Creek HPAs; post-harvest conifer stem density of at least 15 stems per acre; greater than 16 inches dbh; no harvesting of trees likely to recruit to the watercourse; only a single harvest entry (except where cable corridors are necessary to conduct intermediate treatments in adjacent stands) within the life of the Permits.	Same as Proposed Action.	No harvesting or management within Class I riparian buffers.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Inner Zone: at least 85 percent overstory canopy post-harvest; at least 25 percent of pre-harvest conifers; 10 largest dbh conifers per 330 feet of stream channel within first 50-foot width of zone; no salvage permitted.	Inner Zone: at least 85 percent overstory canopy closure post-harvest; no conifer removal if zone is predominately composed of hardwoods; no salvage permitted.	Same as Proposed Action.	No harvesting or management within Class I riparian buffers.	Same as Proposed Action.
Outer Zone: at least 70 percent overstory canopy post-harvest; no salvage permitted.	Outer Zone: at least 70 percent overstory canopy closure post-harvest; salvage permitted but limited to downed trees if they cannot be incorporated into the bankful channel, not contributing to bank/slope stability, or not intercepting sediment.	Same as Proposed Action.	No harvesting or management within Class I riparian buffers.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
(Class II Retention and Operational/Silvicultural Restrictions)				
75 percent surface cover and undisturbed area; single-tree selection only where more than 50 percent total canopy exists pre-harvest; no use of heavy equipment except at prepared tractor and road crossings. At least 70 percent minimum total canopy closure required where it exists within the WLPZ prior to timber harvesting.	Same as No Action, except SMZ protections supersede No Action restrictions within special operating/management zones. In addition: prohibit timber harvesting within RMZ "inner zones" that are located below designated SMZs, except for purposes of creating cable-yarding corridors when other options are impractical. In addition, no timber harvesting within the entire RMZ below an SMZ in the Coastal Klamath and Blue Creek HPAs; no harvesting of trees likely to recruit to the watercourse within the first 200 feet adjacent to a Class I RMZ; only a single harvest entry (except where cable corridors are necessary to conduct intermediate treatments in adjacent stands) within the life of the Permits.	Same as Proposed Action.	No harvesting or management within Class II riparian buffers.	Same as Proposed Action.
50 percent to 70 percent total canopy closure (understory plus overstory) post-harvest; at least two living conifers per acre post-harvest measuring at least 16 inches dbh and 50 feet tall within 50 feet of the watercourse.	Inner Zone: at least 85 percent overstory canopy closure post-harvest; no salvage permitted. Outer Zone: at least 70 percent overstory canopy closure post-harvest; salvage permitted but limited to downed trees if they cannot be incorporated into the bankful channel, not contributing to bank/slope stability, or not intercepting sediment.	Same as Proposed Action.	No harvesting or management within Class II riparian buffers.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
(Class III Retention and Operational/Silvicultural Restrictions)				
Heavy equipment use limited; even-aged management allowed; retention of 50 percent of pre-harvest understory vegetation in the event a WLPZ is designated; retention of all trees within the Class III channel or that are needed for bank stability.	Same as No Action. Possible Class III WLPZ designation superseded by the following: Tier A (< 60-70 percent slopes): retention of all LWD on the ground; fire ignition during site preparation prohibited. Tier B: (> 60-70 percent slopes): all hardwoods and non-merchantable trees retained; conifers retained that contribute to bank stability or that act as a control point in the channel; post-harvest retention of at least one conifer per 50 feet of stream length; fire ignition during site preparation prohibited.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.
Large Woody Debris				
LWD sources: see Riparian Habitat above.	LWD sources: see Riparian Habitat above.	LWD sources: see Riparian Habitat above.	LWD sources: see Riparian Habitat above.	LWD sources: see Riparian Habitat above.
Site Preparation and Burning in Riparian Buffers				
Prohibits mechanical site preparation in Class I or Class II WLPZs by wheeled or tracked equipment.	Prohibits mechanical site preparation in Class I or Class II RMZs by wheeled or tracked equipment.	Same as Proposed Action.	Prohibits mechanical site preparation in Class I and Class II riparian buffers by wheeled or tracked equipment.	Same as Proposed Action.
Prohibits fire ignition within Class I or II WLPZs, as well as Class III ELZs.	Prohibits fire ignition within Class I or II RMZs, as well as Class III EEZs.	Same as Proposed Action.	Prohibits fire ignition within Class I or II riparian buffers, as well as Class III ELZs.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Snags				
Retains all snags greater than 16 inches dbh and 50 feet tall that do not pose a safety or fire hazard. Future recruitment would occur through retention of old-growth elements in the 39 NSO set asides areas, minimum overstory canopy and conifer tree stem retention noted above within WLPZs, and natural mortality elsewhere throughout the Action Area.	Retains all snags greater than 16 inches dbh and 50 feet tall that do not pose a safety or fire hazard. Future recruitment would occur through retention of old-growth elements in the 39 NSO set asides areas, minimum overstory canopy and conifer tree stem retention noted above within RMZs and Tier B Class III EEZs, and natural mortality elsewhere throughout the Action Area.	Same as Proposed Action.	Retains all snags greater than 16 inches dbh and 50 feet tall that do not pose a safety or fire hazard. Future recruitment would occur through retention of old-growth elements in the 39 NSO set asides areas, and natural mortality within riparian buffers and elsewhere throughout the ownership.	Same as Proposed Action, except for implementation of species-specific conservation measures for the marbled murrelet.
Hardwoods				
In general, retains all hardwoods in uneven-aged areas, except where removal would enable conifer regeneration, enhance riparian function, establish cable corridors, or for safety. One to two trees per acre would be retained in even-aged management units. Hardwood removal also subject to other retention standards noted above.	Same as No Action, except also requires retaining all hardwoods within SMZs.	Same as Proposed Action.	Same as No Action.	Same as Proposed Action.

TABLE 2.7-1
Description of Alternatives

No Action (No AHCP/No Permit)	Proposed Action (Green Diamond AHCP/CCAA)	Alternative A (Listed Species Only)	Alternative B (Simplified Prescriptions)	Alternative C (Expanded Species and Geographical Coverage)
Listed Species				
Subject to take prohibition for all listed species; incidental take allowed for the spotted owl pursuant to previous authorization.	Allows take of covered species, provided incidental to a covered activity, through implementation of general forest management, riparian habitat, large woody debris, and snag measures noted above. Subject to take prohibition for other listed species.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action. Incidental take of the marbled murrelet and bald eagle authorized pursuant to implementation of additional conservation measures specific to these species.
Unlisted Species				
Avoids and minimizes significant impacts to unlisted species.	Provides assurances for covered, unlisted species that have either been proposed for listing or are considered to be sensitive. Allows take of these species (provided incidental to a covered activity) in the event they become listed in the future through implementation of the general forest management, riparian habitat, large woody debris, and snag measures noted above. Avoids and minimizes significant impacts to unlisted species that are not covered. (Same as No Action for these species.)	Same as No Action.	Same as Proposed Action.	Same as Proposed Action, plus requires implementation of species-specific conservation measures for the western pond turtle.

[a] Includes floodplains and channel migration zones (CMZs).
[b] Would apply to the first 1,000-foot segment of the smallest (first order) Class II stream.
[c] Would apply to remaining portions of first order Class streams, as well as to larger Class II streams (second order and higher).
[d] Where streamside slope gradients are less than 60 percent to 70 percent.
[e] Where streamside slope gradients are greater than 60 percent to 70 percent.

CHAPTER 3

Affected Environment

CHAPTER 3

Affected Environment

3.1 Introduction

This chapter describes the affected environment for resources potentially affected by implementing the Proposed Action and the alternatives. The affected environment is referred to in this EIS as the Primary Assessment Area, which is the focus of the impacts analysis presented in Chapter 4. The Primary Assessment Area includes the commercial timberlands within those portions of 11 HPAs on the west slopes of the Klamath Mountains and the Coast Range in California where Green Diamond operates or could operate in the future.[1] Green Diamond currently owns and operates on 416,532 acres within the 11 HPAs, but could expand within the 11 HPAs by approximately 267,142 acres. Green Diamond lands, therefore, represent approximately 61 percent of the 683,674 acres comprising the Primary Assessment Area. As discussed in greater detail in Sections 5 and 7 of Green Diamond's proposed AHCP/CCAA, general habitat and relevant environmental conditions, as well as the potential impacts to the covered species, are sufficiently similar across the Primary Assessment Area to support the application of conservation measures contained in the proposed AHCP/CCAA on any lands on which Green Diamond operates within the 11 HPAs during the term of the Permits. For purposes of analysis, site-specific information on Green Diamond-owned lands has been extrapolated to other commercial timberlands within the Primary Assessment Area.

In addition to the Primary Assessment Area lands analyzed in this EIS, the regional setting is described to provide an overall context for the analysis of the Primary Assessment Area in Chapter 4. The regional setting addresses those portions of the 11 HPAs that include the Primary Assessment Area as well as areas that are not part of the Primary Assessment Area.

An additional 25,677 acres of rain-on-snow areas within Trinity and Del Norte counties, outside of the 11 HPAs are described in this chapter to provide the setting for Alternative C (Expanded Species and Geographic Coverage). The impacts of the 25,677 acres included as part of Alternative C are presented in Chapter 4.

The following resource categories were selected for detailed analysis in the EIS.

- Section 3.2 – Geology, Geomorphology, and Mineral Resources
- Section 3.3 – Hydrology and Water Quality
- Section 3.4 – Aquatic Resources
- Section 3.5 – Vegetation/Plant Species of Concern
- Section 3.6 – Terrestrial Habitat/Wildlife Species of Concern
- Section 3.7 – Air Quality
- Section 3.8 – Visual Resources
- Section 3.9 – Recreational Resources
- Section 3.10 – Cultural Resources

[1] This includes all commercial timberlands, with the exception of lands owned by Pacific Lumber Company, within the 11 HPAs.

- Section 3.11 – Land Use
- Section 3.12 – Social and Economic Conditions

Because no differences in noise effects are expected as a result of issuing the proposed incidental take permit, noise issues do not warrant further analysis.

3.2 Geology, Geomorphology, and Mineral Resources

3.2.1 Introduction

North coastal California includes some of the most rapidly eroding areas in the United States. Streams draining the area, such as the Eel River, have some of the highest suspended sediment loads per unit area recorded in the world (Judson and Ritter, 1964). One fundamental reason for this occurrence is the unstable geology of the Coast Range (California Department of Water Resources (CDWR, 1982). A basic knowledge of the geology and geomorphology of the region is essential to understanding the environmental condition of the area. The following sections provide a description of the geology and geomorphology found within the Primary Assessment Area. The information presented below is intended to provide a broad overview of how geologic characteristics such as bedrock composition, bedrock structure, and tectonic uplift relate to topography, hillslope mass wasting, and erosion in the region.

3.2.2 Regional Geology

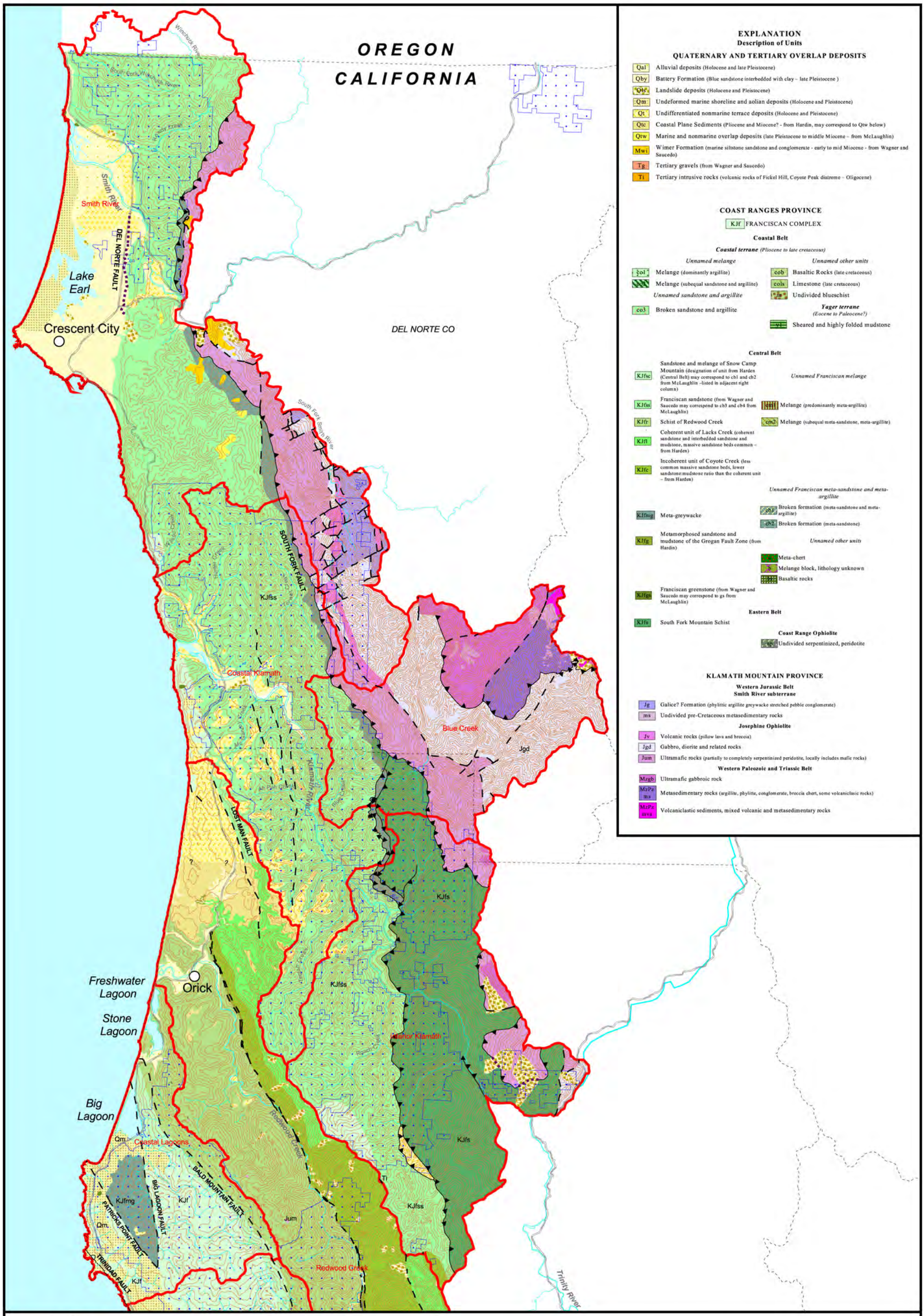
The Primary Assessment Area is located mostly within California's Coast Ranges geologic province. The eastern margin of the northern part of the Primary Assessment Area is within the Klamath Mountains geologic province (Figure 3.2-1). These provinces include a complex of various geologic terranes that collectively are within the convergent margin of the North American plate. Within the individual provinces and terranes, geomorphic conditions vary widely.

On a regional scale, the bedrock in the Primary Assessment Area is a composite of accreted oceanic rocks and pre- and post-accretionary plutonic rocks that are overlain in places by younger depositional strata. Locally, the bedrock can vary greatly, ranging from deeply weathered sandstone and mudstone, to metasedimentary rock, greenstone, and ultramafic bedrock.

The geologic structure of the region generally is dominated by a series of north to northwest trending faults. The faults correspond to topographic highs (such as the South Fork Mountain Fault) and topographic lows (such as the Grogan Fault). Numerous northwest-trending anticlines and synclines are associated with the faulting and also contribute to the shape of the landscape.

The extensive uplift of the region is well known. The height of the mountains and the high elevation of bedrock that is composed of marine sediments and ultramafic ophiolite sequences are the most obvious indicators of this uplift.

Accretion, deformation, and uplift of the region is ongoing today, as interactions continue between the Gorda, Pacific, and North American tectonic plates along the continental margin. Slip rates along the major thrust faults in the area is on the order of several millimeters per year (California Geological Service [CGS]).



EXPLANATION

Description of Units

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

- Qal — Alluvial deposits (Holocene and late Pleistocene)
- Qby — Battery Formation (Blue sandstone interbedded with clay – late Pleistocene)
- Qls — Landslide deposits (Holocene and Pleistocene)
- Qm — Undeformed marine shoreline and aolian deposits (Holocene and Pleistocene)
- Qt — Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)
- Qtc — Coastal Plane Sediments (Pliocene and Miocene? - from Hardin, may correspond to Qtw below)
- Qtw — Marine and nonmarine overlap deposits (late Pleistocene to middle Miocene – from McLaughlin)
- Mwi — Wimer Formation (marine siltstone sandstone and conglomerate - early to mid Miocene - from Wagner and Saucedo)
- Tg — Tertiary gravels (from Wagner and Saucedo)
- Ti — Tertiary intrusive rocks (volcanic rocks of Fickel Hill, Coyote Peak diatreme – Oligocene)

COAST RANGES PROVINCE

KJf FRANCISCAN COMPLEX

Coastal Belt

Coastal terrane *(Pliocene to late cretaceous)*

Unnamed melange

- col — Melange (dominantly argillite)
- Melange (subequal sandstone and argillite)

Unnamed sandstone and argillite

- co3 — Broken sandstone and argillite

Unnamed other units

- cob — Basaltic Rocks (late cretaceous)
- cols — Limestone (late cretaceous)
- Undivided blueschist

Yager terrane *(Eocene to Paleocene?)*

- Sheared and highly folded mudstone

Central Belt

- KJfsc — Sandstone and melange of Snow Camp Mountain (designation of unit from Harden (Central Belt) may correspond to cb1 and cb2 from McLaughlin –listed in adjacent right column)
- KJfss — Franciscan sandstone (from Wagner and Saucedo may correspond to cb3 and cb4 from McLaughlin)
- KJfr — Schist of Redwood Creek
- KJfl — Coherent unit of Lacks Creek (coherent sandstone and interbedded sandstone and mudstone, massive sandstone beds common – from Harden)
- KJfc — Incoherent unit of Coyote Creek (less common massive sandstone beds, lower sandstone:mudstone ratio than the coherent unit – from Harden)
- KJfmg — Meta-greywacke
- KJfg — Metamorphosed sandstone and mudstone of the Grogan Fault Zone (from Hardin)
- KJfgs — Franciscan greenstone (from Wagner and Saucedo may correspond to gs from McLaughlin)

Unnamed Franciscan melange

- Melange (predominantly meta-argillite)
- cm2 — Melange (subequal meta-sandstone, meta-argillite)

Unnamed Franciscan meta-sandstone and meta-argillite

- cb1 — Broken formation (meta-sandstone and meta-argillite)
- cb2 — Broken formation (meta-sandstone)

Unnamed other units

- Meta-chert
- b — Melange block, lithology unknown
- Basaltic rocks

Eastern Belt

- KJfs — South Fork Mountain Schist

Coast Range Ophiolite

- sp — Undivided serpentinized, peridotite

KLAMATH MOUNTAIN PROVINCE

Western Jurassic Belt
Smith River subterrane

- Jg — Galice? Formation (phyllitic argillite greywacke stretched pebble conglomerate)
- ms — Undivided pre-Cretaceous metasedimentary rocks

Josephine Ophiolite

- Jv — Volcanic rocks (pillow lava and breccia)
- Jgd — Gabbro, diorite and related rocks
- Jum — Ultramafic rocks (partially to completely serpentinized peridotite, locally includes mafic rocks)

Western Paleozoic and Triassic Belt

- Mzgb — Ultramafic gabbroic rock
- MzPz ms — Metasedimentary rocks (argillite, phylitte, conglomerate, breccia chert, some volcaniclastic rocks)
- MzPz mvs — Volcaniclastic sediments, mixed volcanic and metasedimentary rocks

Base Map Features

- Hydrographic Planning Areas
- City
- Major Roads
- County Line
- Rivers
- Green Diamond Ownership
- Contours (200 foot Intervals)

Faults

- Thrust Fault
- Fault (Dashed where approximate, dotted where concealed and queried (?) where uncertain).

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5 0 5 Miles

SCALE IS APPROXIMATE

Figure 3.2-1
Geology of the Green Diamond Hydrographic Planning Areas (Page 1 of 3)

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- Ti — Tertiary intrusive rocks (volcanic rocks of Fickel Hill, Coyote Peak diatreme – Oligocene)

COAST RANGES PROVINCE

KJf FRANCISCAN COMPLEX

Coastal Belt

Coastal terrane *(Pliocene to late cretaceous)*

Unnamed melange

- ool — Melange (dominantly argillite)
- Melange (subequal sandstone and argillite)

Unnamed sandstone and argillite

- co3 — Broken sandstone and argillite

Unnamed other units

- cob — Basaltic Rocks (late cretaceous)
- cols — Limestone (late cretaceous)
- Undivided blueschist

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Unnamed Franciscan meta-sandstone and meta-argillite

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- cb1 — Broken formation (meta-sandstone and meta-argillite)
- cb2 — Broken formation (meta-sandstone)
- KJfg — Metamorphosed sandstone and mudstone of the Grogan Fault Zone (from Hardin)

Unnamed other units

- c — Meta-chert
- b — Melange block, lithology unknown
- Basaltic rocks
- KJfgs — Franciscan greenstone (from Wagner and Saucedo may correspond to gs from McLaughlin)

Eastern Belt

- KJfc — South Fork Mountain Schist

Coast Range Ophiolite

- sp — Undivided serpentinized, peridotite

KLAMATH MOUNTAIN PROVINCE

Western Jurassic Belt
Smith River subterrane

- Jg — Galice? Formation (phyllitic argillite greywacke stretched pebble conglomerate)
- ms — Undivided pre-Cretaceous metasedimentary rocks

Josephine Ophiolite

- Jv — Volcanic rocks (pillow lava and breccia)
- Jgd — Gabbro, diorite and related rocks
- Jum — Ultramafic rocks (partially to completely serpentinized peridotite, locally includes mafic rocks)

Western Paleozoic and Triassic Belt

- Mzgb — Ultramafic gabbroic rock
- MzPz ms — Metasedimentary rocks (argillite, phyllite, conglomerate, breccia chert, some volcaniclastic rocks)
- MzPz mvs — Volcaniclastic sediments, mixed volcanic and metasedimentary rocks

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5 0 5 Miles

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Figure 3.2-1
Geology of the Green Diamond Hydrographic Planning Areas (Page 2 of 3)

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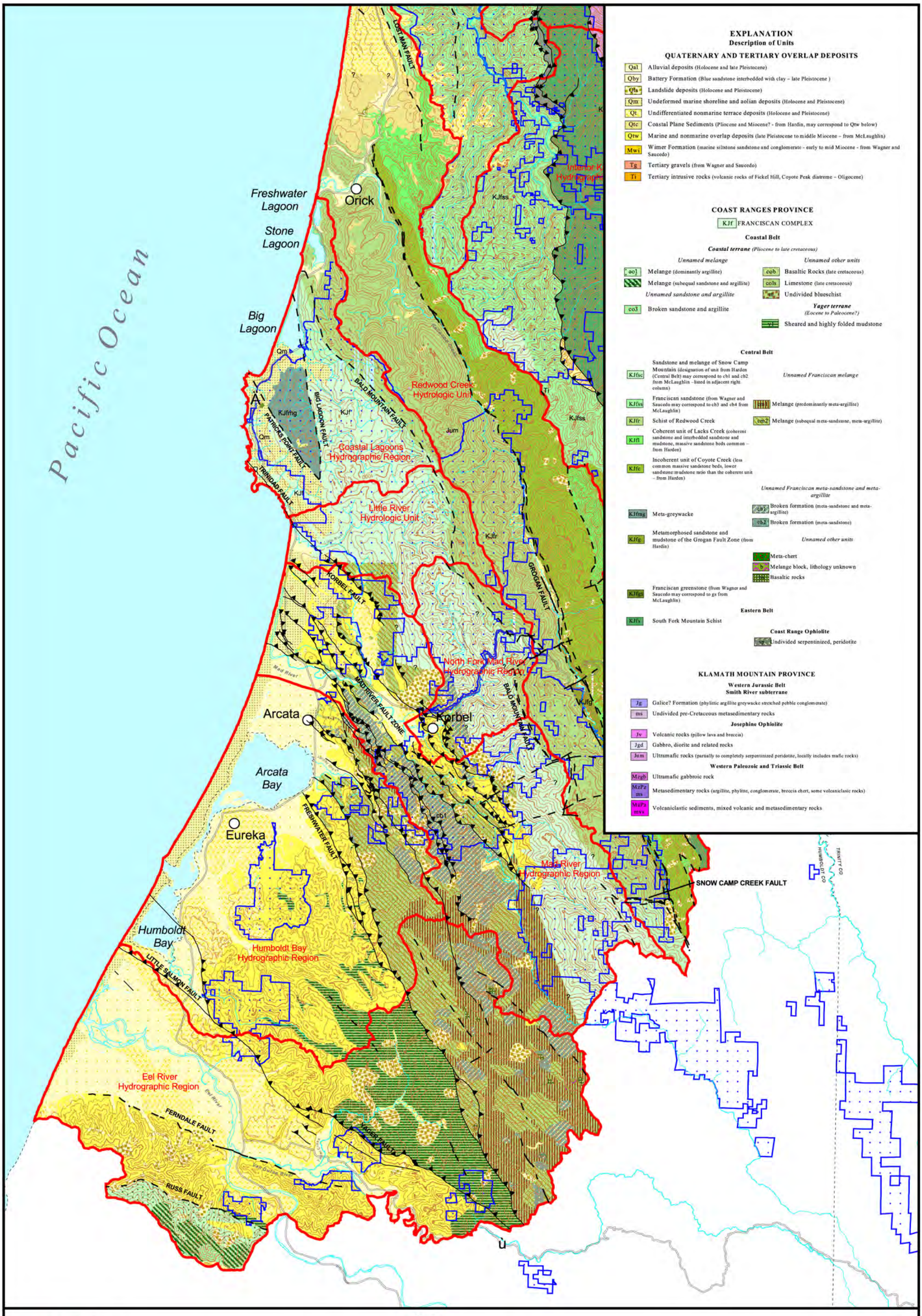

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Unnamed other units

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5 0 5 Miles

SCALE IS APPROXIMATE

Figure 3.2-1
Geology of the Green Diamond Hydrographic Planning Areas (Page 3 of 3)

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The geology of the Klamath Mountains and Coast Ranges geologic provinces is described in greater detail in the sections below.

3.2.2.1 Klamath Mountain Province

At present, five major terranes of the Klamath Mountains are recognized, and several of these are subdivided into two or more geologic units. Each terrane is bordered by major faults that represent lines or sutures where plate fragments are joined (Harden, 1998).

A brief description of the rocks and terranes of the Klamath Mountains Province that underlie the Primary Assessment Area follows.

Western Jurassic Belt. The rocks of the Western Jurassic Belt underlie the eastern margin of the Primary Assessment Area. This belt represents the youngest accreted terranes within the Klamath Mountains Province. This belt includes the rock units of the Smith River subterrane (Galice Formation) as well as rocks that may be correlative with the Josephine Ophiolite.

- **Galice Formation.** The Galice Formation represents a long belt of metasedimentary rocks formed during the Jurassic period approximately 150 million years ago. The rocks of the Galice formation include marine slate (mildly slatey to phyllitic argillite), partially serpentinized peridotite, metagraywacke, stretched pebble conglomerate, and greenstone and metavolcanic Western Jurassic Belt breccia.
- **Josephine Ophiolite**. The Josephine Ophiolite represents a remnant of oceanic basement rocks that originated from a fragment of an oceanic plate that was thrust onto the North American continent during the Jurassic period. The rocks of the Josephine Ophiolite include, gabbro, pyroxinite, pillow basalt, serpentinite, and sequences of ultramafic rocks.

The Western Jurassic Belt also contains small pockets of intruded dioritic rocks that may be located within the Primary Assessment Area. To the west, the rocks of the Western Jurassic Belt are separated from the rocks of the Coast Ranges by a major fault (the South Fork Mountain Thrust fault).

Western Paleozoic and Triassic Belt. This belt is located to the east of the Western Jurassic Belt and has been subdivided into at least three separate geologic terranes. However, only one terrane (Rattlesnake Creek) occurs within the Primary Assessment Area.

- **Rattlesnake Creek Terrane.** The Rattlesnake Creek Terrane includes oceanic ultramafic rocks (i.e., gabbro), and metasedimentary rocks (i.e., argillite, phylitte, conglomerate and metachert) and vocaniclastic sediments and mixed volcanic and metasedimentary rocks.

In addition, the Western Paleozoic and Triassic Belt contains extensive intrusions of post-accretionary dioritic and pre-accretionary ultramafic-gabbroic plutonic rocks. However, it is uncertain if any of these materials occur within the Primary Assessment Area. The Western Paleozoic and Triassic Belt is primarily located along the eastern margin of the Smith River Hydrographic Unit and is separated from the Western Jurassic Belt by a complex network of thrust faults.

3.2.2.2 Coast Range Province

The majority of the Primary Assessment Area (greater than 80 percent) is located within the Coast Range Province (Figure 3.2-1). The rocks of the Coast Range represent oceanic crust that was accreted to the continent beginning in the mid-Jurassic period (approximately 140 million years ago). Similar to the Klamath Mountains Province, the assemblages of the Coast Range terranes are fault bounded and exhibit a sequential east to west accretionary pattern.

A brief description of the Coast Range terranes and associated rocks that underlie the Primary Assessment Area is presented below.

The Franciscan Complex. The Franciscan Complex includes three major belts (Eastern, Central, and Coastal). Cashman et al. (1995) and McLaughlin et al. (2000) describe the rocks of these belts and the geologic terranes in further detail. In general, the most abundant types of rock units found within these terranes consist of layered and interlayered sequences of marine sandstone (i.e., greywacke sandstone), schist, mélange, mudstone, shale, and other common rock types such as serpentinite, chert, and conglomerate, basalt and Coast Range ophiolitic rocks.

Because the Franciscan Complex includes rock units that vary greatly in lithology, structural style, and degree of metamorphism, the rocks in the complex are also described as belonging to a specific textural zone (Blake et al., 1967). It should be noted that some of the older geologic maps used to compile Figure 3.2-1 did not differentiate the various units and textural zones. Thus, unless a unit is specifically called out on the map, the textural zones listed below may be included in the areas mapped as Franciscan Complex (KJf) and Franciscan Complex Sandstone (KJfss).

The textural zones of the Franciscan Complex include the following:

- **Franciscan Mélange.** The Franciscan Mélange consists of discontinuous, resistant blocks of graywacke sandstone, chert, greenstone, and high-grade metamorphic rock in an intensely sheared, blue-gray shaley matrix. The texture of the unit may be related to mixing by either tectonic or sedimentary (mudslide) processes (Jordan, 1978).
- **Unmetamorphosed Franciscan Complex – Textural Zone 1.** Textural Zone 1 consists of fine-to coarse-grained graywacke sandstone with interbeds of siltstone, shale, and minor conglomerate. The rocks are olive to gray-green when fresh and weather to tan or gray-brown. Exposures are well-lithified and massive to thickly bedded. Subordinate rock types include chert, pillow basalt, and greenstone.
- **Semi-Metamorphosed Franciscan Complex – Textural Zone 2**. Textural Zone 2 consists of semi-schistose, lawsonite bearing graywacke sandstone and siltstone, similar to the rocks in Textural Zone 1. Platy foliation, visible in hand specimen, has developed, but original bedding is still present.
- **Undifferentiated Franciscan Complex**. Undifferentiated Franciscan Complex is mapped where the Franciscan has not been subdivided. It consists predominantly of fine- to coarse-grained dark gray to green graywacke sandstone and dark-gray shale. Subordinate amounts of red or green chert, conglomerate, pillow basalt, greenstone, and pods of serpentinized ultramafic rocks also occur within this unit.

- **South Fork Mountain Schist – Textural Zone 3.** The South Fork Mountain Schist is metamorphosed and sheared to the point where original bedding is no longer evident. The unit forms a sinuous belt of schistose metasedimentary and metavolcanic rocks next to the South Fork Fault, the unit's eastern boundary.

Overlap Assemblage. Sedimentary deposits that formed in a variety of marine to non-marine environments overlie the late Cenozoic to late Mesozoic accreted terranes of the Franciscan Complex. These deposits (the Late Cenozoic post-accretionary Overlap Assemblage) are partly similar in age to the Franciscan basement rocks. However, the rocks are considerably less deformed, unmetamorphosed, and less lithified than the rocks of the Franciscan Complex (McLaughlin et al., 2000).

The primary rock units that occur in the overlap assemblage within the Primary Assessment Area are represented by the formations of the Wildcat Group and, to a lesser extent, the Bear River beds (Figure 3.2-1). In general, the Wildcat Group consists predominantly of a sequence of weakly to moderately well lithified marine sandstone, siltstone, mudstone, and non-marine sandstones and conglomerates. The Wildcat Group overlies older basement rocks of the Franciscan Complex and middle rocks that have been assigned to the Bear River beds (interbedded siltstone, sandstone) (McLaughlin et al., 2000).

Other Quaternary and Tertiary Overlap Deposits. This section describes rocks that may occur within both the Klamath and Coast Range Provinces. These rocks include units of unconsolidated or weakly consolidated materials such as terrace deposits, alluvial and colluvial materials, coastal sediments, and unusual occurrences of post accretionary intrusive rocks (e.g., Coyote Peak diatreme).

- **Weathered Bedrock, Colluvium, and Soils**. An overlying mantle of weathered bedrock and colluvial deposits is ubiquitous in the Primary Assessment Area. Typically, the deposits are poorly consolidated, loose, and moderately to well drained. The material is usually thickest toward the axes of swales and drainages and thinnest on the steeper side slopes where it has been shed off by erosion and shallow landsliding. The composition and thickness of the colluvial deposits and associated soils is variable and is related to the makeup and slope gradient of the underlying bedrock.

  Thicker colluvium and soils typically reside in areas with gentle slopes where the bedrock is usually less indurated. Steeper slopes are generally covered by only a thin mantle (typically less than 3 feet thick) of colluvium. These slopes are usually underlain by hard, well-cemented materials (e.g., sandstone and siltstone), and the contact between the bedrock and colluvium is often sharp. The sharp contact is often accompanied by a permeability contrast between the two units that allows a seasonal perched water table to develop. The thin soil cover is a product of the inherent low rate of bedrock weathering and the steepness of the slope (which facilitates the shedding off of the unconsolidated surface material). The thin nature of the colluvial deposits overlying hard bedrock on the steeper slopes plays an important role in the style and distribution of shallow landslides and the potential effects of timber management.

- **Modern Alluvium.** Scattered concentrations of modern alluvium occur along stream beds and inner and upper floodplains throughout the Primary Assessment Area. The alluvial materials include boulders in creek bottoms, sand, pebbles and cobbly gravel in inner floodplains, and fine sand and silt loam in overbank deposits.

- **Stream Terrace Deposits**. Deposits of moderately to intensely weathered alluvium are scattered throughout the Primary Assessment Area. Mapable units have been noted in prominent terrace surfaces adjacent to Redwood Creek and remnants of former terrace deposits have been mapped on gently sloping hillslopes near Redwood Creek (Harden et al., 1981). Late Quaternary fluvial terraces are found along well developed major rivers such as the Mad, Eel, and Van Duzen rivers.
- **Coastal Plain Sediments.** Unconsolidated to weakly consolidated silts, sands, and gravels associated with minor amounts of organic-rich mud are located within the Primary Assessment Area along the coastal plain.
- **Landslide Deposits.** A number of landslide deposits and scars have been mapped within the Primary Assessment Area (Harden et al., 1981). Many of the more prominent landslides may be correlated to terranes underlain by fault zones and specific rock units (e.g., the Incoherent Unit of Coyote Creek in the Franciscan Complex).
- **Tertiary Intrusive Rocks.** The Central Belt of the Franciscan Complex contains limited occurrences of (alkalic) intrusive volcanic rocks of unusual mineralogical composition. These intrusive bodies correspond in age to the Oligocene epoch (approximately 35 million years before) and occur at two localities northeast of Arcata. One of these localities, known as the Coyote Peak diatreme, is located within the boundaries of the Primary Assessment Area.

3.2.2.3 Seismic Hazards, Faults, and Structural Relationships

Northern coastal California and the adjacent offshore area constitute one of the most seismically active areas in the State (Cashman et al., 1995). This entire area of northwest coastal California is subject to earthquakes on several onshore faults and falls within the Cascadia subduction zone, an area thought to be capable of great (magnitude 8 to 9) earthquakes (CDMG, 1996). The high level of tectonic activity in the region is also attributed to the proximity of the Mendocino triple junction (McKenzie and Morgan, 1969), an offshore boundary (located south of the Primary Assessment Area) which separates three major crustal plates and is the northern terminus of the San Andreas Fault (Figure 3.2-1).

Several moderately active crustal faults (e.g., the Little Salmon, Mad River, Trinidad, and Fickle Hill faults) are located near or within portions of the Primary Assessment Area. Faults that show evidence of recent (Quaternary) movement, and those faults that form the boundaries that separate the major belts, terranes, and subterranes of the Klamath Mountains and Coast Range Provinces are described below.

Although most of the faults strike northwest, they exhibit a range of orientations from shallowly dipping to vertical, and also represent different deformational episodes (Monsen et al., 1980, 1982). In addition, the orientations of the region's faults and geologic terranes often mark contacts between distinctly different rock units that, inturn, strongly influence area topography and drainage patterns. The faults that exhibit evidence of recent activity may also delineate potential geologic hazard zones (i.e., the occurrence of high ground accelerations resulting from earthquakes on nearby faults may directly or indirectly result in slope failures).

The following faults show no evidence of movement during the Quaternary period:

- **South Fork Fault.** The South Fork Fault (Irwin, 1974), a major east-dipping fault, separates and thrusts the rocks of the Klamath Mountains over the rocks of the Eastern Franciscan Belt of the Coast Range Province. Serpentinite, and a zone of tectonically mixed rocks have been mapped in areas (e.g., in the Redwood Creek basin) immediately above the South Fork Fault (Young, 1978).
- **Indian Field Ridge Fault.** The surface trace of the Indian Field Ridge Fault is found to the west of the South Fork Fault and is marked in places by narrow zone of unmetamorphosed pervasively sheared rocks (Cashman et al., 1995).
- **Grogan Mountain Fault Zone.** The steep northeast dipping Grogan Mountain Fault Zone delineates the channel of Redwood Creek. The zone is defined by an area of metamorphosed and pervasively sheared rocks and separates units of sandstone that mark distinct contrasts in surface topography (e.g., Incoherent Unit of Coyote Creek and Coherent Unit of Lacks Creek).
- **Bald Mountain Fault.** The Bald Mountain Fault lies to the west of the Grogan Fault and separates unmetamorphosed sandstone and mélange units to the west from the metamorphosed units (schists) of the Grogan Fault zone to the east (Strand, 1962).
- **Snow Camp Creek Fault.** The Snow Camp Creek Fault is the only major east-west trending fault in the Primary Assessment Area. The fault is located just south of Pardee Creek in the Redwood Creek basin and separates (Redwood Creek) schist units on the south from Franciscan sandstone and mélange units to the north (Harden et al., 1981).

The following faults exhibit evidence of recent movement and may be active:

- **Patricks Point Fault.** The Patricks Point Fault is a northeast-dipping thrust fault located below the prominent raised marine terrace cut into the Falor and Franciscan rocks at Patricks Point. The terraces are interpreted to record fault bend folding of the hanging wall of a deeply buried thrust above the fault. The length of the inclined segment of the Patricks Point terrace is about 2 kilometers (km). The fault bend fold model predicts this length should correspond with the total accrued slip on the buried fault (i.e., about 2.4 centimeters per year) (Carver and Burke, 1989).
- **Mad River Fault Zone.** The Mad River Fault Zone is a major zone of complex southwest-verging thrust faults located in the vicinity of the Mad River northeast of Arcata Bay. There are five principle faults in the Mad River Fault Zone including the Trinidad, Blue Lake, McKinleyville, Mad River, Fickle Hill, and numerous minor thrustfaults (e.g., Korbel and Falor Faults). The faults of this zone have been shown to displace strata in the late Pleistocene to Holocene Age (less than 2 million years) and are thus active (McLaughlin et al., 2000).
- **Freshwater Fault.** The Freshwater Fault is an east-dipping, high-angle reverse fault that decreases in dip to the north. Movement on this fault was thought to have preceded Wildcat deposition (Ogle, 1953), but recent studies show it to offset the Wildcat, suggesting late Cenozoic reactivation (Woodward-Clyde Consultants, 1980).

- **Little Salmon Creek and Yager Faults.** The Little Salmon Creek Fault is a moderately low-dipping southwest thrust fault located in the central Eel River basin south of Eureka. The fault zone cuts the surface and displaces Holocene (recent) Age strata. The nearby Yager Fault is interpreted to root in the same zone of thrusting as the Little Salmon Creek Fault (McLaughlin et al., 2000). Data on slip rate and estimates on earthquake recurrence intervals indicate that the Little Salmon Fault is active and capable of generating large earthquakes.
- **Russ and False Cape Fault Zones.** The Russ Fault Zone juxtaposes Miocene and younger strata (less than 24 million years) of the Eel River forearc basin (i.e., overlap assemblage) with coeval and older strata of the underlying accretionary complex. The distribution of surface and subsurface earthquakes strongly suggest that the Russ Fault is active at shallow depths (McLaughlin et al., 2000).

3.2.3 Geomorphology

3.2.3.1 Landform Development

The topography of the Primary Assessment Area is highly variable and consists of landforms ranging from steep terrane with deeply incised narrow drainages, to rolling landscape with less deeply incised drainage networks. As noted, the region has experienced high rates of Neogene uplift, deformation, and accompanying channel down cutting. Parallel to these processes, the area has experienced relatively high denudation rates and the upper reaches of many drainages have been sculpted over geologic time by repeated shallow landslides. At present, landslides are common throughout the Primary Assessment Area and continue to be a major force shaping the modern landscape.

In addition to hillslope mass wasting and erosional processes, a dominant factor controlling the variation in topography is the underlying rock mass and associated geologic structure. According to McLaughlin et al. (2000), rock masses larger than a few hundred meters in diameter tend to develop topographic forms related to the erosional and slope-stability properties of the constituent materials. These properties may be controlled by many factors, such as the structural state of the rock mass and orientation of layering. Rates of tectonic uplift may also play a role in the development of topographic form. However, geodetic work indicates that these rates tend to vary gradually and impact broad regional areas, rather than more localized areas (e.g., subunits of specific rock terranes located within individual HPAs) (McLaughlin et al., 2000).

The spatial variation in dominant rock units or geologic groups in the HPAs is evident in the expression of the local topography. In addition, the contact between the rock units and overlying soil is gradational and varies according to rock unit and topography. The major rock types and associated soils and landforms that may be found in the Primary Assessment Area follow:

- Well indurated sandstone rock masses weather to granular (sandy and silty) soil that is stable enough to form steep slopes. The stability and homogeneity of such soils and rock masses tend to result in steep, sharp-crested topography dissected by a regularly spaced array of straight, well-incised sidehill drainages (McLaughlin et al., 2000).

- Units containing unconsolidated and poorly indurated sandstone rock masses rapidly weather when disturbed and are highly unstable. These units tend to form a thick cover of sandy and silty soils, support only gentle hillslopes and poorly incised sidehill drainages, and crests tend to be rounded (Bond. J, NMFS, pers. comm.).
- Highly folded broken formations that also include zones of clayey sheared argillitic rock generally correspond to steep topography with generally sharp crests and well-incised but irregular sidehill drainages (McLaughlin et al., 2000).
- Units containing mélange with subequal amounts of sandstone and argillite or units that are predominantly made up of argillitic sequences that are highly folded and variably sheared generally have irregular, gently to moderately sloping topography that lacks a well-incised system of sidehill drainages (McLaughlin et al., 2000). Mélange areas typically support grassland prairie zones, which are susceptible to gully erosion, especially where overgrazing has increased runoff and road construction has disturbed the natural drainage channels. Although commercial timber grows on land underlain by mélange, many such areas were converted to grassland after timber harvesting and have not produced new timber growth (CDWR, 1982).
- Clayey rock masses, especially where sheared, weather to clayey soil materials. These clayey soils and bedrock are so weak that they can support only gentle hillslopes and poorly incised sidehill drainages, and crests tend to be rounded (Kelsey et al., 1995; McLaughlin et al., 2000).
- Well-indurated rock masses associated with the terranes of the Klamath Mountains Province result in very steep, sharp-crested topography. These units are typically overlain by thin soils and are dissected by straight, well-incised sidehill drainages.

3.2.3.2 Soils

The following section provides a brief description of the main soils types (series) in the Primary Assessment Area and is intended to supplement the geologic and geomorphologic descriptions presented above by providing additional background on how different soil series may relate to hillslope mass wasting and erosion in the region.

Soil is the product of the action of the climate and living organisms upon the parent material, as conditioned by time and relief. The interrelationships among the factors of soil formation are complex, and the effect of any one factor cannot be isolated and identified with certainty. Soils also have many characteristics that affect their behavior and response to various land uses. Specific physical and chemical properties such as permeability, susceptibility to erosion, and other features such as location of the water table, depth to bedrock, underlying geology, and slope influence how certain soils will react to various land management practices.

A soil survey is an inventory and evaluation of the characteristics and properties of soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. The descriptions presented in this section are based on U.S. Department of Agriculture, Soil Conservation Service (SCS) soil surveys conducted in 1921, and CDF Soil and Vegetation Survey maps published in 1975. The information provided in the CDF soil-vegetation association maps is based on aerial photographs with

limited ground truthing. Because much of the soil information in the Primary Assessment Area is out of date or incomplete, more comprehensive and up-to-date soil survey work is currently being conducted by the Natural Resource Conservation Service (NRCS), the successor to the SCS. However, this work is ongoing and the most recent NRCS soil survey data is not available at this time.

Area geology, along with the influence of climate, vegetation, and topography, resulted in the formation and distribution of a large number of different soil series within the Primary Assessment Area. This section, however, only presents descriptions of those soil series that have the largest aerial coverage in the Primary Assessment Area. Information on other less dominant soil series in the Primary Assessment Area is not provided due to the smaller total acreage covered by the series, discontinuity in area the soils cover, or incomplete soil information.

Six predominant soils series within the Primary Assessment Area are Hugo, Masterson, Melbourne, Larabee, Josephine, and Atwell. The remaining soils include those soils that are either unmapped or cover smaller discontinuous sections of the Primary Assessment Area.

The soils classification descriptions provided by NRCS and other agencies further define soils series descriptions according to physical and chemical properties including factors such as the following:

- Parent material the soil is derived from
- Texture
- Organic matter content
- Moisture retention characteristics
- Color
- Depth
- The type of terrane (slope) where the soil is found
- The soil's surface erosion hazard rating

A summary of the physical and chemical characteristics of the predominant soils series in the Primary Assessment Area is presented below.

Hugo. Hugo soils are gray-brown at the surface, pale brown at the subsurface, and are 30 to 60 inches deep. The Hugo series consists of deep, well drained soils that formed in material weathered from sandstone, shale, schist, and conglomerate. Hugo soils are on uplands and occur on strongly dissected mountains with sharp, narrow ridges, and deep V-shaped drainages and have slopes of 9 to 75 percent. They range from near sea level to 4,000 feet elevation (NRCS, 1998). They range in texture from loam to clay loam. Surface erosion hazard is moderate to high (University of California, 1979). Hugo soils are associated with Melbourne soil and they are found throughout the Primary Assessment Area.

Masterson. According to the NRCS, Masterson soils are located on rolling to steep slopes at elevations of about 5,000 to 6,500 feet. However, Masterson soils are located at lower elevations in the Primary Assessment Area. The soils are dark brown at surface changing to yellow brown closer to bedrock. They formed in residuum weathered from mica schist and their depth to bedrock ranges from 20 to 40 inches (usually 30 to 40 inches). The amount of coarse fragments increases with increasing depth below a depth of 10 inches and average

35 percent to 55 percent of the volume. (NRCS, 1998). Masterson soils are most abundantly found in the Redwood Creek and Interior Klamath HPAs.

Melbourne. Melbourne soils are on foothills, hillsides, and ridge tops at elevations of 200 to about 1,200 feet. Slopes are zero percent to 65 percent. The soil formed in residuum colluvium from siltstone and fine-grained sandstone (NRCS, 1998). Melbourne soils are brown at the surface, dark brown in the subsurface, 30 to 60 inches deep, and are classified as loam to clay loam. Surface erosion hazard is moderate on slopes less than 50 percent (University of California, 1979). Melbourne soils are associated with Hugo soils and they are found throughout the Primary Assessment Area.

Larabee. Larabee soils occur on moderately steep to steep, well dissected uplands under forest vegetation at elevations up to 2,000 feet. Larabee soil is typically deep, well drained, and fine grained, with a high silt content throughout the profile. Larabee soil is derived from soft sedimentary rocks of the California north coast range and is found mostly within the Mad River, Humboldt Bay, and Eel River HPAs.

Josephine. The Josephine series consists of deep, well drained soils (gravelly loam) that formed in moderately fine textured colluvium and residuum weathered from sedimentary, metamorphosed sedimentary, and volcanic rocks. Josephine soils are on broad ridge tops, toeslopes, footslopes, and side slopes of mountains. Elevations are 200 to 5,500 in California. Slope gradients dominantly are 35 percent to 60 percent but range from 2 percent to 75 percent. Josephine soils can be found to a depth of 59 inches and range from dark brown at surface to brown, reddish brown and yellowish brown at depth (NRCS, 2000).

Atwell. Atwell soils are important because they are extremely erodible (University of California, 1979). These soils formed in colluvium from sheared graywacke sandstone and shale. Atwell soils occur in mountainous terrane at elevations up to 3,000 feet. They occupy concave to irregular, unstable slopes in areas of high drainage density. Soil slips, landslides, seeps, and springs are common in Atwell soils. Slope gradients are from 15 percent to 50 percent and colors vary from grayish brown, to dark grayish brown and olive brown to light yellowish brown (NRCS, 2001). Atwell soils are known to occur in association with the Mad River Fault Zone and the Grogan Fault (Redwood Creek), and they likely occur in other localities of the Primary Assessment Area as well.

3.2.3.3 Landslide Classification and Landslide Prone Terrain

Many types of hillslope mass wasting occur within the Coast Range and Klamath Mountain Provinces. As previously mentioned, landslides are common throughout the Primary Assessment Area. Intense and prolonged rainfall events combined with area geology, geomorphology, and timber harvesting activities often result in conditions that are highly susceptible to excessive erosion and landslides, especially when high antecedent groundwater conditions exist. Types of landslides in the Primary Assessment Area are described below based on the classifications in Crunden and Varnes (1996) and CDMG (1997) with modifications to suit the conditions present in the area.

Shallow-Seated Landslides. Shallow-seated landslides are generally confined to the overlying mantle of colluvium and weathered bedrock, although in some instance may involve competent bedrock as well. Most shallow landslides are rapid events and commonly leave a bare unvegetated scar after failure.

- **Debris Slides.** Debris slides are characterized by a process whereby unconsolidated rock, colluvium, and soil have failed rapidly along a relatively shallow failure plane. In most instances the depth of failure is less than 10 feet. In some instances, however, a debris slide may extend deeper and incorporate some of the underlying competent bedrock. Debris slides often form steep, unvegetated scars in the head region and irregular, hummocky deposits in the toe region. Slide debris often overrides the ground surface near the toe. Debris slides may exist individually or coalesce to form a larger landslide complex. Slides often continue to move for several years following initial failure. Most natural debris slides are triggered by elevated pore water pressures resulting from high intensity and/or long duration rainfall or from being undercut by stream erosion. The occurrence of high ground accelerations resulting from earthquakes on nearby faults may also result in shallow slope failures either directly or indirectly by reducing soil strength and altering the groundwater regime. In many managed watersheds, a common cause of debris slides is thick, over-steepened road fill associated with old roads, skid trails, and landings.

- **Debris Flows/Torrents.** Debris flows and debris torrents are characterized by long stretches of bare soil and generally unstable channel banks that have been scoured by the rapid movement of debris. Failure typically begins as a debris slide but quickly mobilizes into a flow or torrent as material liquefies, traveling rapidly downslope. These landslides occur most commonly on very steep slopes at or near the axis of small swales or stream channels. As a debris flow/torrent moves through first and second order channels, the volume of material may increase to a much greater size than the initial failure. It is not unheard of for a large debris torrent to deliver more than 10,000 cubic yards of sediment to a stream channel.

- **Channel Bank Failures.** Channel bank failures are defined as small shallow debris slides that occur along the banks of stream channels. Such failures are a result of undercutting of the stream bank by stream incision or stream widening. Large channel bank failures that extend far up an adjacent hillslope may become difficult to distinguish from debris slides. Because such failures are relatively common along streams they have been classified separately from the other failures.

- **Rock Falls.** Rock falls are characterized by catastrophic failure of relatively steep rock slopes or cliffs along a surface where little or no shear displacement takes place. Generally rock debris accumulates at the toe of the slope. Rock falls are relatively uncommon in the Primary Assessment Area.

Deep-Seated Landslides. Deep-seated landslides typically have a basal slip plane that extends into bedrock. Most deep-seated failures move incrementally; catastrophic failure is relatively rare. Active slides are typically vegetated with trees and/or grass.

- **Translational/Rotational Rock Slides.** Translational/rotational rockslides are characterized by movement of a relatively intact slide mass with a failure plane that is relatively deep when compared to that of a debris slide. The slide plane typically extends below the colluvial layer into the underlying and more competent bedrock. The slides often have a distinct toe at the base of the hillside and undercutting of the toe of the slope by streams plays a key role in their long-term stability. Translational/rotational rock slides are identified by a broad arcuate headscarp and a series of mid-slope benches on what is otherwise moderately to steeply sloping terrane. Sag ponds, hummocky

topography, and springs and patches of wet ground may be present. Commonly the landslide consists of several smaller slide blocks that coalesced together to form the larger landslide complex. Lateral scarps between the individual landslide blocks are often poorly defined, in part due to the low rate and/or infrequent movement of the slide mass. Differential movement between individual slide blocks is common. Where slide movement is most active, drainage networks and stream channels are shallow and generally poorly to moderately defined. Movement is most apparent in the upper portion of the hillside and less apparent near the toe. Steep main scarps, secondary internal slide scarps, and toe slopes may be subject to debris sliding.

- **Earthflows.** Earthflows are characterized by a relatively large semi-viscous and highly plastic mass resulting in a slow flowage of saturated earth. Most earthflows are composed of a heterogeneous mixture of fine-grained soils and rock. Earthflows may range from less than 1 acre to hundreds of acres. The depth of failure is varied but typically greater than 15 feet and the degree of activity is varied - many earthflows are dormant while others exhibit seasonal creep in response to high rainfall. Rapid movement of such failures is rare. Ground displacement is generally slight, and catastrophic failure of the slope is unlikely. Slide materials erode relatively easily, resulting in gullying and irregular drainage patterns and may be reactivated in response to removal of toe support, high rainfall events, and possibly by large seismic events. Because of the seasonal movement associated with some of these slides, earthflow areas are often unable to support timber stands. Small earthflows may be influenced by poor road drainage across the toe of the slide.

Landslide-Prone Terrains. Both deep and shallow landslides occur within the Primary Assessment Area, with shallow landslides most common on slopes steeper than 60 percent to 70 percent. In general, steep streamside slopes, inner gorge slopes, steep headwall swales, and breaks-in-slopes have been identified as areas with greater potential for producing shallow landslides compared to adjacent slopes. Landslides are also more frequent in areas of convergent slope form where surface and ground waters tend to concentrate and where colluvial soils tend to be thickest.

The most prevalent landslide-prone terrains in the Primary Assessment Area are:

- **Steep Streamside Slopes.** Steep streamside slopes are defined as steep slopes located immediately adjacent to a stream channel, and generally formed, over time, by coalescing scars from shallow landsliding and stream erosion. These slopes typically exceed 65 percent gradient where stream incision has undercut the toe of the slope, and descend directly to streams without intervening topographic benches. Preliminary landslide inventories in the Primary Assessment Area indicate that roughly 60 percent to 90 percent of all shallow landslides initiate on steep streamside slopes. All steep streamside slopes show evidence of modern landslide processes (less than 50 years old) when slopes are examined on a sub-basin level.

- **Inner Gorges.** An inner gorge is a subset of steep streamside slopes where a more-or-less distinct break-in-slope separates steeper "inner gorge" slopes below the break-in-slope from lower gradient slopes above the break. The steep streamside slopes classification includes inner gorge slopes as well as those steep slopes where a distinct break-in-slope is absent.

- **Headwall Swales.** Many shallow landslides occur within headwall swales upstream of Class III watercourses, where convergent topography forces both the accumulation of thick soils and the concentration of shallow subsurface runoff along the axis of the valleys. Headwall swales are defined as areas of narrow, steep, convergent topography (swales or hollows) located at the heads of Class III watercourses (i.e. an unchanneled swale extending upstream of a watercourse) that have been sculpted over geologic time by repeated debris slide and debris flow events. The sideslopes leading into the swale are typically greater than 70 percent. Slopes are often smooth to slightly irregular, unbroken by benches. Swales often have an inverted teardrop or spoon shaped appearance. Seasonal seeps, springs and wet areas may exist within the axis of the swale toward the base. The soil and colluvium depth is often much deeper within the axis of the swale than on the adjoining side slopes. The surface expression of the swale may be distinct to subdued. The width of headwall swales is highly variable ranging between 30 and 100 feet.

3.2.4 Geology, Topography, and Geomorphology of the HPAs and Rain-on-Snow Areas

This section provides a brief description of the geology, topography, and geomorphology of the 11 HPAs. This general information is provided because more detailed and specific information on the individual HPAs is not available at this time. Green Diamond is in the process of conducting a Hillslope Mass Wasting Assessment and Landslide Inventory on its fee-owned lands within the Primary Assessment Area. The assessment is currently scoped as a 5-year effort and the resulting data will be used to fill in the gaps on site geology and hillslope mass wasting within the individual HPAs. HPAs encompassing complete drainage areas are referred to as "hydrologic units," whereas those encompassing partial or multiple watersheds are referred to as "hydrographic areas."

3.2.4.1 Smith River Hydrographic Region

The Smith River Hydrographic Region is approximately 182,000 acres. Bedrock underlying the hydrographic region predominantly consists of Central Belt Franciscan Complex rock with areas of Klamath Mountains bedrock along the eastern margin of the region. Faults in the region include the inactive South Fork Fault, which separates the Franciscan bedrock from the Klamath Mountains bedrock, and a complex network of thrust faults within the Klamath Mountains geology.

Scattered, poorly consolidated remnants of Miocene marine sandstone, siltstone, and conglomerate deposits (Wimer Formation) overlie the Franciscan bedrock on ridges, approximately 5 miles inland and at elevations of 1,200 to 1,600 feet above mean sea level (ASL). There are also remnants of continental deposits of sandstone and conglomerate, of similar age, on ridges at slightly higher elevations, near the Wimer Formation deposits. The coastal section of the hydrographic unit is dominated by the Smith River Plain, an elevated marine terrace where an abrasion platform of Franciscan rocks is almost entirely covered with a blanket of marine siltstone, shale and unconsolidated sands of Pliocene and Pleistocene age (Battery Formation). Pleistocene to Holocene river terrace deposits, flood plain deposits, and dune sands also cover large portions of the Smith River Plain. Unconsolidated Pleistocene to Holocene river terrace and flood plain deposits can also be found at various locations along stream and river channels (Ristau, 1979; Davenport, 1982-84; Wagner and Saucedo, 1987) within the unit.

Within this HPA, Central Belt Franciscan bedrock composed of Undifferentiated Franciscan Sandstone underlies Green Diamond's northern and southwestern ownership and Klamath Mountains bedrock composed of serpentinite, gabbro, metavolcanics, and metasedimentary rocks underlies the southeastern ownership (Figure 3.2-1).

The topography of the Smith River Hydrographic Region is highly variable, but, in general, is relatively steep and sharp-featured compared to other HPAs. Pleistocene and Holocene landslide deposits cover portions of the Franciscan bedrock at numerous locations. Published landslide maps indicate that both shallow and deep-seated landslides exist throughout this HPA with debris slides and disrupted ground present on many of the steeper slopes (CDMG, 1999). The inherently weak serpentinite of the Klamath Mountains bedrock is also particularly prone to landslide processes, but this geologic unit is only a small portion of the Primary Assessment Area in this hydrographic region.

3.2.4.2 Coastal Klamath River Hydrographic Region

The Coastal Klamath River Hydrographic Region is approximately 108,000 acres. The area is predominantly underlain by Central Belt Franciscan Complex bedrock with Klamath Mountains bedrock underlying a narrow strip along the eastern margin of the unit. The Central Belt Franciscan Complex is generally described as meta-sandstone. Klamath Mountains bedrock in the HPA is composed of Josephine Ophiolite intrusive and extrusive volcanics, which includes partially to completely serpentinized ultramafic rocks, gabbro, diorite, pillow lava and breccia. The inactive South Fork Fault separates the Franciscan rocks from the older rocks of the Klamath Mountains geologic province (Figure 3.2-1).

The topography of the Coastal Klamath Hydrographic Region is highly variable, but in general is relatively steep and sharp featured. Landslide processes in the unit are dominated by shallow debris slides and debris flows, based on Green Diamond's preliminary landslide inventory data from this area. These landslides tend to be prevalent on steep streamside slopes along Class I and Class II watercourses and to a lesser extent in the headwall areas of Class III watercourses. Sediment delivered to watercourses from shallow landslides is considered a significant portion of the sediment budget for this hydrologic unit. Deep-seated landslides are relatively uncommon within this unit, although they do exist, as is indicated by CDMG-published landslide maps and Green Diamond's preliminary landslide inventory data. The inherently weak serpentinite of the Klamath Mountains bedrock is particularly prone to landslide processes, but this geologic unit comprises only a small portion of the Primary Assessment Area in this HPA.

3.2.4.3 Blue Creek Hydrologic Unit

The Blue Creek Hydrologic Unit is approximately 80,000 acres. The majority of the Blue Creek Hydrologic Unit (i.e., the central and eastern areas of the unit) is underlain by Klamath Mountains bedrock. The bedrock in the remaining sections of the unit (i.e., the southwest area of the unit) primarily consists of Franciscan Complex rocks (Figure 3.2-1). The inactive South Fork Mountain Fault separates the Coast Ranges Province from the Klamath Mountains Province.

The Primary Assessment Area within the Blue Creek Hydrologic Unit is primarily underlain by Franciscan Complex rocks. From east to west, bedrock within the hydrologic unit consists of small patches of partially to completely serpentinized ultramafic bedrock of the

Josephine Ophiolite, the South Fork Mountain Schist unit of the Franciscan Eastern Belt and the meta-sandstone and mudstone of the Franciscan Central Belt.

The topography of the Blue Creek Hydrologic Unit is generally characterized by steep to very steep terrane, and is similar to the steeper topography within the Coastal Klamath HPA. Elevations and slope gradients increase toward the east of the unit due to higher concentrations of massively bedded Franciscan Complex sandstone, and the occurrence of the more resistant metasedimentary and ultramafic rocks of the Klamath Mountains.

Specific data on landsliding in this hydrologic unit is unavailable at this time. However, based on an analysis of existing geologic maps, it appears that landslide processes in this hydrologic unit are dominated by shallow debris slides and debris flows in the Klamath terranes, and there is a potential for deep-seated landslides within Coast Range terranes.

3.2.4.4 Interior Klamath River Hydrographic Region

The Interior Klamath River Hydrographic Region is approximately 128,000 acres. Bedrock in the region is primarily composed of the Coast Ranges Franciscan Complex, with Klamath Mountains bedrock present in limited areas at the eastern margin of the region. The inactive Coast Ranges Fault separates Franciscan Complex Central Belt sandstone from Franciscan Complex Eastern Belt South Fork Mountain Schist, and the inactive South Fork Fault separates the Coast Ranges Province from the Klamath Mountains Province geology.

Most of the Primary Assessment Area within this HPA is underlain by the Franciscan Complex bedrock. The bedrock in this HPA is roughly divided between Central Belt sandstone and Eastern Belt South Fork Mountain Schist. Central Belt meta-graywacke is also located in smaller areas of the HPA, and limited areas of the eastern margin of the region are underlain by Klamath Mountains volcanics and metavolcanics.

Specific data on landsliding in this hydrographic region is unavailable at this time. However, based on an analysis of existing geologic maps, it appears that landslide processes in this hydrographic region are dominated by shallow debris slides and debris flows in the Klamath terranes, and there is a potential for deep-seated landslides within Coast Range terranes.

3.2.4.5 Redwood Creek Hydrologic Unit

Substantial geologic mapping and research has been done in the Redwood Creek area (Nolan et al., 1995). As a result, the geology, landform development, and hillslope mass wasting characteristics of this hydrologic unit are probably the best understood of all of the HPAs that make up the Primary Assessment Area.

The Redwood Creek Hydrologic Unit is approximately 188,000 acres. The Redwood Creek Hydrologic Unit is located entirely within the Coast Ranges geomorphic province. Most of the Primary Assessment Area in this unit is underlain by the Redwood Creek Schist. Much smaller sections of the Primary Assessment Area, located to the east and southeast, are underlain by the Incoherent Unit of Coyote Creek, and the Coherent Unit of Lacks Creek. A small section located at the southern tip of the hydrologic unit is underlain by the Sandstone and Mélange of Snow Camp Mountain. Coastal plain and marine terrace sediments are located in the northern coastal area of the unit. These sediments are mainly composed of

unconsolidated to slightly consolidated sands, silts, and gravels, and may be as much as 300 feet thick.

Each of the major bedrock units in the Redwood Creek Hydrologic Unit is set apart from one another by a series of major northwest trending faults. The most notable of the faults found in this unit is the Grogan fault, which defines the channel of Redwood Creek and separates the Redwood Creek Schist from the Incoherent Unit of Coyote Creek. Other notable faults are the Indian Field Ridge Fault, which separates the Incoherent Unit of Coyote Creek from the Coherent Unit of Lacks Creek, and the Snow Camp Creek Fault, located at the southern tip of the hydrologic unit, which separates Redwood Creek Schist from the Sandstone and Mélange of Snow Camp Mountain.

Many hillslopes in the Redwood Creek basin are unstable and highly susceptible to mass-movement failure because of the steepness of the terrane and the low shear strength of much of the underlying saprolite and residual soil. (This is especially true in the Incoherent Unit of Coyote Creek, although shallow landslides also exist in the unit). According to Colman (1973), at least 36 percent of the basin shows landforms that are the result of active mass movements or that are suggestive of former mass-movement failures. Complex associations of rotational slumping, translation, and earthflows are the most visually obvious forms of mass movement in the Redwood Creek basin. Some have clearly defined margins, but many gradually merge with less active areas of soil creep. On many earthflows, grass, grass-bracken-fern, and grass-oak prairie vegetation dominate in marked contrast to the mature coniferous forest or cutover land on more stable slopes.

Several lithologies occur within the Redwood Creek Schist and the geomorphic expression of the different schist units is variable. Slopes underlain by the Redwood Creek Schist have gently convex profiles and side-slope gradients commonly range from 20 percent to 40 percent. Both the Redwood Creek Schist and the South Fork Mountain Schist exhibit knobby topography in areas where greenstone units of tectonic blocks are included in the schist. Shallow, incised streams are a typical drainage feature of schist slopes (Cashman et al., 1995). In addition, some evidence of deep-seated, slow moving, landslide deposits have been identified in road cut exposures in the schist units (Cashman et al., 1995).

The sandstone and mudstone of the Coherent Unit of Lacks Creek have a distinct geomorphic expression. Sharp ridges, steep slopes, and narrow V-shaped tributary canyons are characteristic of the landscape developed on these relatively resistant rocks. Slopes have straight to gently concave profiles, and slope gradients commonly range from 30 percent to 50 percent. In the Coherent Unit, streamside debris slides and debris avalanches are common in the inner gorges of tributaries (Cashman et al., 1995). In contrast to the steep terrane of the Coherent Unit, the bedrock of the Incoherent Unit of Coyote Creek forms a subdued rolling landscape having less deeply incised drainage networks and few high points and knobs formed by resistant rock types. Earthflows are preferentially developed in this unit, as are streamside debris slides along inner gorges.

Rocks in the Grogan Fault Zone that are intermediate in texture and degree of metamorphism between the Redwood Creek Schist and the sandstone and mudstone units. The geomorphic expression of this unit is similar to that of the Incoherent Unit of Coyote Creek, and streamside debris slides are concentrated along linear zones of sheared rocks parallel to the Grogan Fault (Harden et al., 1981).

The landscape developed on the Sandstone and Mélange unit of Snow Camp Mountain is generally more hummocky than other hillslopes in the Redwood Creek Hydrologic Unit. However, parts of the Snow Camp Mountain unit are underlain by massive sandstone and display steep slopes, prominent ridges, and V-shaped valleys, in contrast to the more rolling hummocky hillslopes underlain by mélange. Tectonic blocks of greenstone and chert form prominent knobs and summits (Cashman et al., 1995). As in the Coherent Unit of Lacks Creek, streamside debris slides and debris avalanches are common in the inner gorges of tributaries and in the steeper areas of the unit underlain by massive sandstone.

3.2.4.6 Coastal Lagoon Hydrographic Region

The Coastal Lagoons Hydrographic Region is approximately 54,000 acres. Bedrock in the region includes the Redwood Creek Schist, the Sandstone and Mélange of Snow Camp Mountain, and Undifferentiated Central Belt Franciscan Mélange, the Patrick's Point meta-graywacke unit, and younger marine and non-marine terrace deposits near the coastline.

These geologic units are generally structurally bounded by northwest trending thrust faults and high angle faults. Broad northwest trending anticlines and synclines are also mapped within the hydrographic region.

The topography of the hydrographic region is moderately steep, except in the younger terrace deposits and in the area of the lagoons near the coastline. Preliminary Green Diamond landslide inventory results indicate that both shallow and deep-seated landslides exist throughout the Coastal Lagoons hydrographic region.

3.2.4.7 Little River Hydrologic Unit

The Little River Hydrologic Unit is located within a coastal watershed with a drainage area of approximately 30,000 acres. From east to west, the bedrock of the unit is composed of Redwood Creek Schist (along the eastern margin), Sandstone and Mélange of the Snow Camp Mountain, and Undifferentiated Central Belt Franciscan Bedrock. Quaternary deposits are found near the mouth of the watershed located at Moonstone Beach (several miles south of Trinidad, California). The Snow Camp Mountain geologic unit is composed of hard, intensely folded graywacke sandstone and siltstone that grades into sheared mélange. The Redwood Creek Schist is mostly composed of hard, fine-grained quartz-mica schist, which includes or grades locally into bodies of semi-schist, slate, meta-conglomerate, and meta-chert (Kilbourne, 1983-85; Harden et al., 1981). The Undifferentiated Central Belt is composed of sandstone and mudstone. The Quaternary deposits are composed of poorly consolidated interbedded clays, silts, sands, and gravels.

Marine terrace deposits of late Pleistocene and Holocene Age cover bedrock surfaces on wave-cut benches, within about 3 miles of the coastline, and up to 500 feet ASL, near the mouth of Little River. The terrace deposits are composed of unconsolidated to slightly consolidated silts, sands, and gravels, including old dune sands. Holocene alluvium and flood plain deposits cover the valley floor, nearly one-mile wide, in the area downstream from Crannell (Ristau, 1979; Kelley, 1984).

The inactive Bald Mountain Fault is located between the Snow Camp Mountain and Redwood Creek Schist geologic units and the active Trinidad Fault separates these relatively young strata from the adjacent Franciscan Mélange.

The hydrologic unit is generally characterized by moderate- to high-relief hillslopes, except for the area from the Crannell town site to the mouth of the river at Moonstone Beach. Published landslide maps and Green Diamond's preliminary landslide data indicate that both shallow and deep-seated landslides exist throughout this HPA. The Franciscan mélange is particularly susceptible to earth flows, and the younger, sandy bedrock, which is susceptible to slumping and rotational slide movement, is relatively highly erodible.

3.2.4.8 Mad River Hydrographic Region

The Mad River Hydrographic Region is approximately 120,000 acres. Bedrock within the Mad River Hydrographic Region is composed mostly of Central Belt Franciscan Complex and Quaternary – Tertiary Overlap deposits juxtaposed by the Mad River thrust fault system. The Primary Assessment Area within this hydrographic region is composed of the three major geologic units mentioned above.

Topography in the region is relatively steep and mountainous, but fairly extensive lowlands are present from the mouth of the river and upstream to the Mad River Fish Hatchery, near the town of Blue Lake.

Central Belt Franciscan Complex is composed of broken formation (schist, greywacke sandstone, shale, conglomerate, chert, pillow basalt, and greenstone) and mélange (primarily composed of discontinuous bodies of hard greywacke sandstone, chert, greenstone and pillow basalt in a weak, pervasively sheared claystone matrix). However, mapping of the units has not been systematic and consistent in all parts of the watershed. In much of the area, the Franciscan units have not been separately identified, and the rock is simply mapped as Undifferentiated Franciscan.

Quaternary – Tertiary Overlap deposits include the Falor Formation, which is generally described as poorly cemented clay, silty clay, and pebbly sandstone and fine-grained sandstone with pebbly stringers (James, 1982). The Falor Formation is correlated to the upper section of the Wildcat Group (James, 1982). Other Quaternary – Tertiary Overlap deposits include marine terraces, fluvial terraces, dune deposits, and Holocene alluvium and beach deposits.

Pleistocene to Holocene marine terrace deposits cover the bedrock surfaces on wave-cut benches within about two miles of the coastline, and up to 260 feet above sea level. These deposits are composed of slightly consolidated silts, sands and gravels, which have been uplifted and offset by subsequent fault movements (Kelley 1984; Kelsey and Carver 1988). These deposits cover the bedrock at various locations adjacent to the present stream and river channels, but at higher levels than the active channel deposits. As many as six separate terrace levels have been identified at some locations, with progressively older terrace deposits at correspondingly higher levels. These deposits are composed of unconsolidated, poorly sorted sands, gravels, and boulder conglomerates. Fluvial terrace deposits are most extensive adjacent to Lindsay Creek in the Fieldbrook area and adjacent to the Mad River at Blue Lake and Butler Valley (Kelley, 1984; James, 1982; Kilbourne, 1983-85).

Ancient dune sand deposits, of Pleistocene to Holocene age, overlie the bedrock up to 4 miles from the present coastline, and up to 620 feet ASL. These deposits are composed of unconsolidated fine to course grained sand (Kelley, 1984). The ancient dune sands may be part of the Hookton Formation located south of the area covered in this study. These materials are extremely erodible where they are exposed, and they are subject to slumping where slopes are undercut.

Holocene alluvium, flood plain deposits, and beach deposits are present in active stream and river channels, in valley bottoms, and on the coastal plain. They are composed of poorly sorted, unconsolidated mixtures of boulders, gravel, sand, silt, and clay (James, 1982; Kelley, 1984; Kilbourne, 1983-85; Ristau, 1979). These deposits are reworked by meandering and shifting stream channels, especially during the infrequent large flood events. The sediment progressively migrates downstream, with new material being added at multiple points along the channels by erosion and landslide movement. Some of that new material is transported out to sea or removed by gravel mining.

Pleistocene to Holocene marine terrace deposits cover the bedrock surfaces on wave-cut benches within about 2 miles of the coastline, and up to 260 feet ASL. These deposits are composed of slightly consolidated silts, sands, and gravels, which have been uplifted and offset by subsequent fault movements (Kelley, 1984; Kelsey and Carver, 1988).

Published landslide maps indicate that both shallow and deep-seated landslides exist throughout this HPA. Deep-seated rotational/translantional landslides and earthflows are common in the Franciscan Mélange. Younger bedrock in the Primary Assessment Area is generally described as poorly consolidated, uncemented, interbedded sands, silts, clays, and gravels. These materials are extremely erodible, and they are very susceptible to slumping and rotational slide movement.

3.2.4.9 North Fork Mad River Hydrologic Unit

The North Fork Mad River Hydrologic Unit is approximately 31,000 acres. Bedrock within the North Fork Mad River Hydrologic Unit is composed mostly of Central Belt Franciscan Complex with Quaternary – Tertiary Overlap deposits in the southwest section of the unit juxtaposed by the Mad River thrust fault system.

From east to west, the Franciscan bedrock within the Primary Assessment Area is Redwood Creek Schist along the east margin, Sandstone and Mélange of Snow Camp Mountain and Undifferentiated Franciscan Complex rocks, also identified as Broken Formation rock on the west side of the Undifferentiated Franciscan (McLaughlin et al., 2000) and Quaternary – Tertiary Overlap deposits (Figure 3.2-1). The northwest-trending, northeast-dipping Bald Mountain Fault separates rocks of the Redwood Creek Schist and the Snow Camp Mountain unit in the east portion of the watershed.

The topography of the unit is relatively steep and mountainous, similar to the rest of the Mad River watershed. Similar to the other Mad River hydrographic areas, both shallow and deep-seated landslides exist throughout this HPA. Deep-seated rotational/translational landslides and earthflows are common in the Franciscan mélange. Younger bedrock in the Primary Assessment Area is generally described as poorly consolidated, uncemented, interbedded sands, silts, clays, and gravels. These materials are extremely erodible, and they are very susceptible to slumping and rotational slide movement.

3.2.4.10 Humboldt Bay Hydrographic Region

The Humboldt Bay Hydrographic Region is approximately 139,000 acres. The Humboldt Bay Hydrographic Region includes Quaternary – Tertiary overlap deposits and Quaternary age alluvium, with Yager Terrane near the southern boundary of the region and Central Belt Franciscan Complex bedrock under the eastern quarter of the region.

The bedrock in this region includes both Quaternary – Tertiary overlap deposits and the Central Belt Franciscan mélange. The overlap deposits within the Primary Assessment Area include the Wildcat Group, which is composed of moderately consolidated, poorly cemented, weak siltstone, claystone, and fine sandstone, as well as the Falor Formation. These strata were deposited on an erosional surface of Franciscan and Yager Formation rocks, and they have been subsequently eroded, faulted, folded, and partly covered with younger sedimentary rocks. The Central Belt Franciscan Mélange is described as a weak, pervasively sheared claystone matrix, which encloses various-sized blocks of hard sandstone, greenstone, metavolcanic rock, serpentinite, chert, and schist. Some of the different lithologic blocks in the mélange are large enough to be mapped separately at a large enough scale.

The Fickle Hill Fault (part of the Mad River Fault zone), the Freshwater Fault, and the Little Salmon Fault are the three main faults within the Humboldt Bay region. They have north-northwest to northwest alignments and northeast dips. The Little Salmon Fault and the Table Bluff Anticline define the topographic high at the southwest boundary of the hydrographic region, and the Freshwater Fault separates the Central Belt Franciscan Complex from the younger rock formations in the central portion of the region.

Topography within the Quaternary – Tertiary overlap deposits is well dissected and of relatively low relief. The Wildcat Group and younger rocks in most of the Humboldt Bay Hydrographic Region are highly erodible, and fragments of the rock readily breakdown in the streambeds to sand, silt, and clay.

Published landslide maps indicate that both shallow- and deep-seated landslides exist within this HPA.

3.2.4.11 Eel River Hydrographic Region

The Eel River Hydrographic Region is approximately 205,000 acres and contains Quaternary-Tertiary overlap deposits and Quaternary age alluvium with Coastal Belt Franciscan Complex bedrock near the southern boundary of the region and Yager Terrane and Central Belt Franciscan bedrock under the eastern third of the region. Coastal Belt Franciscan bedrock underlies a very small portion of the Primary Assessment Area at the south end of the hydrographic region (Figure 3.2-1).

The geologic structure of the area follows the northwest trend of regional geologic structure. The Little Salmon Fault, which is known to be presently active, passes through the Eel River Hydrographic Region. The Freshwater Fault juxtaposes the Yager Terrane and Central Belt Franciscan bedrock and the Ferndale Fault defines the trace of the Van Duzen River at its confluence with the Eel River.

Topography within the Quaternary – Tertiary overlap deposits is highly variable and includes some steep slope segments. Published landslide maps indicate that both shallow and deep-seated landslides exist within this HPA.

3.2.4.12 Rain-on-Snow Areas Located Outside of the HPAs

Green Diamond ownership in the rain-on-snow areas outside the HPAs are shown on Figure 3.2-1. The following information is based on geologic maps published by CDMG (Strand, 1962; Redding, Sheet, and Wagner and Sucedo, 1987; Weed Sheet).

The ownership located to the northeast of the Primary Assessment Area along the Oregon-California border, is in a watershed that drains into the Middle Fork of the Smith River. This tract is predominantly underlain by Galice Formation bedrock of the Western Jurassic Belt of the Klamath Mountains Province. Galice Formation bedrock is composed of slate, partially serpentinized peridotite, meta-graywacke, and stretched pebble conglomerate. Along the western margin of this tract is metavolcanic bedrock of the Western Jurassic Belt. Elevations in this area range from approximately 3,000 feet to 4,000 feet. Topography is relatively steep and well dissected.

The ownership located east of Minor Creek and Redwood Creek near U.S. Highway 299 is predominantly underlain by the South Fork Mountain Schist geologic unit with areas of undifferentiated Central Belt Franciscan Complex bedrock and possibly limited occurrences of partially serpentinized ultra mafic bedrock. Elevations in the area range from 2,500 feet to 4,500 feet. Topography is variably steep and the drainage pattern appears to be structurally controlled (trellised).

The ownership located to the east of Pilot Creek and adjacent to the Mad River Hydrographic Region is in a watershed which drains to the Trinity River. This tract is predominantly underlain by the South Fork Mountain Schist geologic unit with areas of Upper Jurassic Age marine bedrock, Mesozoic granitic bedrock, and Cenozoic non-marine clastic bedrock. This area is included in the Franciscan Complex bedrock of the Coast Range Province. Elevations in the area range from approximately 2,000 feet to 5,000 feet. Topography is variably steep and the drainage pattern appears to be trellised.

Although no landslides were mapped on the geologic maps used to compile these descriptions, based on the mountainous terrane in these areas, it is reasonable to assume that there is the potential for both shallow and deep-seated landslides.

3.2.5 Mineral Resources

The description presented below is intended to provide a general overview of the known occurrences of commercial mineral resources and operating rock products facilities in the general vicinity of the Primary Assessment Area. Even though mineral resources and rock products of economic importance occur within the vicinity of Primary Assessment Area, extraction and processing of these resources would not be affected by the Proposed Action or the other alternatives. Green Diamond's rock pits are generally fewer that 2 acres in size; are located more than 100 and 75 feet from Class I and II streams, respectively; and are exempt from Surface Mining and Reclamation Act (SMRA) regulations. Therefore, a comprehensive assessment of the mineral resources and their extraction, processing, and use in the Primary Assessment Area was not undertaken for this EIS, and the information provided below is based on a survey of available literature only.

Currently, no commercial base metal (e.g., lead, zinc, copper) or precious metal (e.g., gold, silver) mineral production occurs in Del Norte or Humboldt counties, or on Green Diamond lands; however, commercial deposits of nickel and cobalt are in the vicinity of the Primary Assessment Area in Del Norte County. In 1977, a proposal for mining nickel and cobalt was submitted by Cal-Nickel Corporation. The company proposed mining of laterite deposits on Gasquet Mountain between the North Fork of the Smith River and Hardscrabble Creek (Institute for River Ecosystems at Humboldt State University, 1997). Because of economic considerations, the project is on hold, as are permitting and environmental issues (pers. com., Jay Sarina, Planning Division, County of Del Norte).

Historically, gold mining played an important role in the early economy of Del Norte and Humboldt counties (Ogle, 1953). Gold mining included numerous prospects of both placer and lode deposits. In addition to gold, other base and precious metals mined or prospected in the region include copper, chormite, manganese, zinc, and silver (CDMG Minefile Database, 2001). Manganese and copper were historically produced from the Franciscan Coastal Belt rocks and possibly from the Yager Formation (USFWS and CDF, 1998).

Historical mining activity in the Primary Assessment Area also includes sand, gravel, and rock mining, with sand and gravel constituting the main non-fuel mineral resource (Ogle, 1953; Logan, 1947; Strand, 1962; Youngs and Kohler-Antablin, 1966; CDMG Minefile Database, 2001). These sources also identify historical stone production near the Primary Assessment Area, including rock and some small limestone bodies. Sand and gravel deposits occur along the current river and stream channels of the Primary Assessment Area. Additional sand and gravel is found in the Quaternary-Tertiary Wildcat Formation and the Hookton Formation. Building stone is and has historically been quarried from the Yager Formation and the Franciscan Coastal and Central Belt rocks. Limestone, presumably from the mélange of the Franciscan Central Belt rocks, was historically mined for Portland grade cement (Ogle, 1953; Strand, 1962).

Commercial deposits of sand, gravel, and stone exist in the vicinity of the Primary Assessment Area (CDMG Minefile Database, 2001). The geological formations that host these deposits are widespread in both Humboldt and Del Norte counties. At present, the CDMG Minefile Database lists 51 mining operations (rock quarries, sand and gravel operations, and borrow pits) in Humboldt County and 16 mining operations in Del Norte County (CDMG SMRA Eligible List as of 07/30/2001).

Green Diamond operates numerous rock quarries (borrow pits) within the Primary Assessment Area. These mining operations are used to supply surfacing or fill material for purposes of road construction and maintenance associated with timber harvesting and forest management. The pits are generally smaller than 2 acres in size and are located more than 100 and 75 feet from Class I and Class II watercourses, respectively. Because of their location and purpose (i.e., road construction and maintenance associated with timber harvesting and forest management), they are exempt from regulation under the Surface Mining and Reclamation Act of 1975 (SMARA) as administered by the State Mining and Geology Board. Two valid State of California permits for rock mining within the Primary Assessment Area are presently held by Mercer-Fraser.

Hydrocarbon resources (natural gas) exist near the southern border of the Primary Assessment Area. Currently, gas is produced in commercial quantities from an area known as the Tompkins Hill gas field. The Tompkins Hill field is located in the Eel River sedimentary basin; records indicate this basin has produced gas since 1937 (McLean, 1993). The gas comes from the sandstones of the Rio Dell Formation of the Wildcat Group. Production records for 1998 list gas production at Tompkins Hill at roughly 1.3 million cubic feet (DOGGR, 1998). Other gas fields in the area include the Table Bluff and Grizzly Bluff fields. However, both of these fields are listed by the Department of Conservation, Division of Oil, Gas, and Geothermal Resources as abandoned (DOGGR, 2001).

3.3 Hydrology and Water Quality

3.3.1 Introduction

This section provides descriptions of the watersheds within the HPAs, estuarine conditions for coastal areas, and baseline hydrology and water quality summaries. Watersheds may be wholly included in or split among several HPAs.

Logging, mining, road building, and grazing over the course of the last 100 years, combined with the local existence of steep slopes, unstable geologic formations, and seasonally intense precipitation, have produced runoff and erosion concerns for portions of the Primary Assessment Area. The north coast of California receives some of the heaviest precipitation in the state in the form of rain, snow, or both, depending on elevation.

Enhanced runoff, erosion, sedimentation, suspended sediments, and temperature are the chief water quality concerns of these coastal drainages. Some stream reaches and watersheds have been listed as impaired waterbodies by the RWQCB, and as such are subject to development of TMDLs. TMDLs will provide guidance for regulating suspended sediment concentrations or loads within certain project watersheds.

3.3.2 Watershed Characteristics

The regional geology, HPAs, and rivers in the vicinity of the Primary Assessment Area are shown on Figure 3.2-1 (Section 3.2, Geology, Geomorphology, and Mineral Resources). Key characteristics of these watersheds and HPAs are summarized in Table 3.3-1. Information specific to Green Diamond fee-owned lands within each HPA is also presented that typifies much of the remainder of the Primary Assessment Area for which detailed information is unavailable.

Currently, Green Diamond's fee-owned lands within the Primary Assessment Area contain more than 2,500 miles of Class I and II streams, 86 percent of which are Class II watercourses. In addition, Green Diamond's fee-owned lands contain about 4,000 miles of road within the HPAs, 85 percent of which are categorized as "seasonal."

TABLE 3.3-1
HPA Characteristics

HPA	HPA Acreage	Green Diamond Acreage Within HPA	Green Diamond Percentage	Green Diamond Road Miles	Class I Stream Miles	Class II Stream Miles	Class I and II Stream Miles
Smith River Hydrographic Region	181,999	44,177	24.3	422	65	287	352
Coastal Klamath Hydrographic Region	108,150	88,760	82.16	862	84	546	631
Blue Creek Hydrologic Unit	80,303	15,393	19.2	140	21	93	114
Interior Klamath Hydrographic Region	128,006	66,139	51.7	547	25	217	242
Redwood Creek Hydrologic Unit	188,335	33,038	17.5	290	30	158	187
Coastal Lagoons Hydrographic Region	53,592	39,981	74.6	394	31	237	268
Little River Hydrologic Unit	29,703	26,041	87.7	307	20	150	170
Mad River Hydrographic Region	119,686	49,376	41.3	433	42	256	298
North Fork Mad River Hydrologic Unit	31,416	28,209	89.8	297	18	152	169
Humboldt Bay Hydrographic Region	138,719	17,484	12.6	205	15	60	75
Eel River Hydrographic Region	205,160	7,933	3.9	98	3	38	41
Total	**1,265,069**	**416,532**	**32.9**	**3,996**	**355**	**2,192**	**2,547**

The HPA areas are part of nine contiguous coastal drainage basins that encompass approximately 13.7 million acres in northwestern California and southern Oregon. The size of the Primary Assessment Area and Green Diamond's fee ownership relative to the coastal basins directly correlates to the potential influence of Green Diamond's timber operations on these basins. Some of the HPAs represent a small proportion of the total area in the coastal basins of which they are a part, while others encompass the entire basin. Green Diamond's fee ownership in the largest coastal basins (Klamath, Smith, and Eel Rivers) is concentrated in HPAs near the coast and is very small relative to total basin size, limiting the influence of Green Diamond's operations on these watersheds. Upstream factors including dams, water diversions, development, and other commercial land uses (e.g., agriculture and non-Green Diamond timber management activities) further reduce the relative impact of Green Diamond's operations on these drainages. Some of the smaller coastal basins, in contrast, are largely owned by Green Diamond, and Green Diamond's management activities may be the main human-caused influence within these drainages.

3.3.3 Climate

The climate of the HPAs is highly variable, dependent on elevation and slope, but is generally representative of the cool, rainy climate of the coastal area of northern California. The general climatic conditions influence the hydrology of the HPAs and associated watersheds and are summarized by HPA below.

Additional Green Diamond areas to be evaluated as part of Alternative C are described as rain-on-snow areas and are generally higher in elevation than most of the HPA areas described below. The rain-on-snow Green Diamond lands range in elevation from 2,400 feet to 5,000 feet. Precipitation in these areas occurs mostly as snow at elevations above 3,500 feet and ranges from 60 inches to 70 inches per year.

3.3.3.1 Smith River Hydrographic Region

This hydrographic region is located in one of the wettest areas of California. Average annual rainfall varies from about 60 inches at Point St. George to more than 125 inches at higher inland areas. The precipitation is orographic in nature, increases with elevation, and is usually greater on the windward (southwest) slopes. About 75 percent of the precipitation occurs between November 1 and March 31 (90 percent between October 1 and April 30). Average annual snowfall in the unit ranges from 28 inches at elevations of 1,700 feet ASL (Elk Valley) to 126 inches at 2,420 feet ASL (Monumental).

The climate in this area is primarily influenced by marine air masses and cold air drainage from higher elevations. Occasionally, the climate is influenced by drier air masses associated with east winds.

3.3.3.2 Coastal Klamath Hydrographic Region

The large size of the Klamath basin and its geographic differences results in a wide range of climatic conditions. For the entire basin, the weather can be generalized as having dry summers with hot daytime temperatures and wet winters with low to moderate temperatures. Peak air temperatures occur during July with a monthly average maximum of 18.3°C for the coast and 35°C inland. Precipitation is seasonal, with approximately 90 percent falling between October and March. Annual amounts vary from 20 inches to more than 80 inches, depending on location. High intensity rainfall occurs December through February and may cause flooding at times. Snow occurs at higher elevations and some areas receive up to 80 inches annually.

3.3.3.3 Blue Creek Hydrologic Unit

Precipitation in the Blue Creek headwaters averages 100 inches annually, 75 percent of which falls between November and March (Helley and LaMarche, 1973, as cited in Voight and Gale, 1998). Air temperatures in the region are mainly affected by the coastal marine climate, with daily high temperatures ranging from 4.4 - 21.1°C annually. During the summer the climate is moderated by coastal fog, which reduces solar radiation and contributes moisture by fog drip.

3.3.3.4 Interior Klamath Hydrographic Region

The large size of the Klamath basin and its geographic differences result in a wide range of climatic conditions. In the interior (e.g., South Fork Trinity sub-basin), the climate is

generalized by hot, dry summers and cool, wet winters. The average annual precipitation for the South Fork Trinity sub-basin is 30 to 60 inches, depending on altitude and distance from the Pacific Ocean. Most precipitation falls between November and March, with negligible amounts in localized areas between June and September. Snow is a major component of the annual precipitation in higher elevations.

3.3.3.5 Redwood Creek Hydrologic Unit

Precipitation in the Redwood Creek basin is highly seasonal, with 90 percent occurring between October and April. The annual average for the basin is almost 80 inches, with more than 90 inches occurring in localized areas. December is usually the wettest month with about 17 percent of the annual total.

3.3.3.6 Coastal Lagoons Hydrographic Region

A coastal weather pattern is typical for the lagoons. Summers are mild in temperature with a marine fog layer commonly occurring; winters are cooler. The average annual rainfall is 40 to 60 inches, with heavier amounts falling in the more inland areas. Most of the precipitation falls between October and April.

3.3.3.7 Little River Hydrologic Unit

The Little River drainage has a weather pattern similar to most northern California coastal watersheds, typically with wet winters and dry summers. At least 80 percent of the precipitation occurs between November and April. The coastal area receives about 50 inches annually, whereas interior parts of the watershed receive over 80 inches annually. Most of the precipitation falls as rain, although snowfall occurs at the higher elevations. Coastal marine fog is common during the summer months.

3.3.3.8 Mad River Hydrographic Region

In the Mad River basin, 75 percent of the annual precipitation occurs between November and March. Annual precipitation levels range from around 40 inches at the coast to greater than 70 inches in the central basin. The basin average is approximately 63 inches. In the upper basin, snow averages 23 inches annually and usually occurs above 3,000 feet, but snow levels may occasionally drop to as low as 1,000 feet ASL.

3.3.3.9 North Fork Mad River Hydrologic Unit

The average daily air temperature in the North Fork Mad River Hydrologic Unit ranges from a high of 16.7°C during August to a low of 4.4°C in January. The average annual precipitation in the hydrologic unit ranges from 60 to 80 inches, with rainfall increasing inland. Most precipitation occurs between October and May. Snow usually occurs above 3,000 feet ASL, but snow levels may occasionally drop to as low as 1,000 ASL.

3.3.3.10 Humboldt Bay Hydrographic Region

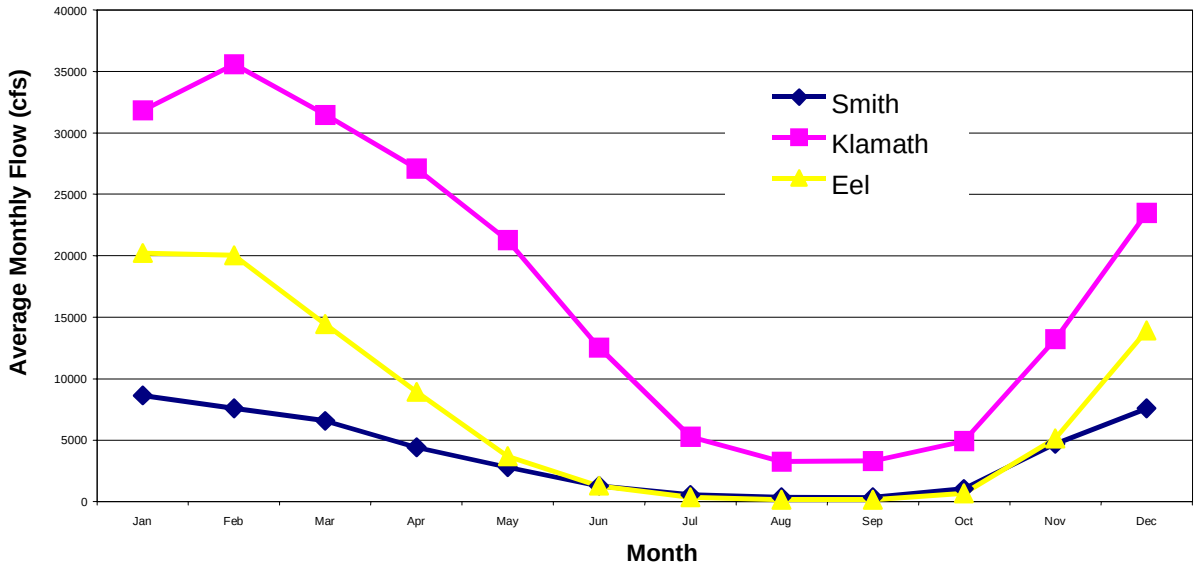
The watersheds that drain into Humboldt Bay are influenced by the coastal weather patterns of northern California. Typically, the majority of precipitation falls as rain between November and April with snowfall occurring sporadically at higher elevations. Coastal areas around Eureka receive about 35 to 40 inches of rain annually, whereas inland areas of the basin may receive 60 inches or more per year. During the summer the climate is moderated by coastal fog, which reduces solar radiation and contributes moisture by fog drip.

3.3.3.11 Eel River Hydrographic Region

Like the majority of northern California, climate in the Eel River basin is characterized by wet winters and dry summers. Nearly 80 percent of the annual precipitation falls between November and April. The average annual precipitation varies from less than 40 inches in the Eel River Plain and Round Valley to more than 110 inches in the Bull Creek headwaters. The average annual precipitation for the entire Eel River basin is about 60 inches. Fog drip during the summer months is a source of precipitation not included in annual totals. The dense, often persistent, band of marine fog usually extends 20 to 30 miles inland. Measurements in the Bear River Ridge revealed fog drip accumulations of 12 inches in open areas and 8.5 inches under forest canopy.

3.3.4 Baseline Hydrologic Data

Peak flows in the northern coastal watersheds usually occur during winter storms in January. The Eel, Smith, and Klamath Rivers had mean peak daily flows of 395,000 cubic feet per second (cfs), 75,500 cfs, and 397,000 cfs, respectively, for January flows during 1974 and 1975 storms. The typical annual pattern of flows for these rivers is shown on Figure 3.3-1. Note that the streams are markedly seasonal with extended low flow periods during the summer and fall. These rivers are the major project drainages and are shown as examples of typical seasonal flow patterns.



Period of Record: Smith 10/01/1931 to 9/30/1999
Klamath 10/01/1910 to 9/30/1926, 10/01/1950 to 10/29/1995, 10/01/1997 to 9/30/1999
Eel 10/01/1910 to 9/30/1914, 10/01/1916 to 9/30/1999

FIGURE 3.3-1
Average Monthly Flows of Project Rivers

3.3.5 Water Quality

Most surface waters in the Primary Assessment Area have not been sampled for water quality, but key constituents of concern (temperature, suspended sediment, turbidity) have been analyzed from a number of locations. Values generally meet or exceed minimum RWQCB Basin Standards, although some of the streams are listed as impaired under Section 303(d) of the CWA. (Green Diamond's proposed AHCP/CCAA is not intended to

address Federal CWA/TMDL requirements.) The list of waterbody impairments is shown in Table 3.3-2. The causes for impairment in these streams vary, but include such factors as:

- Nonpoint-source erosion/siltation
- Rangeland
- Silviculture
- Loss of riparian vegetation
- Logging roads
- Streambank destabilization
- Erosion/siltation

TABLE 3.3-2
Waterbody Impairment and Beneficial Uses for Impaired Water Bodies in Primary Assessment Area Watersheds

Watershed	Listed Impairment	Existing Beneficial Uses[a]
Klamath River	Temperature, nutrients, dissolved oxygen	MUN, AGR, GWR, FRSH, NAV, REC1, REC2, COMM, WARM, COLD, MIGR, SPWN, EST, AQUA
Redwood Creek[b]	Sediment	MUN, AGR, IND, REC1, REC2, COMM, COLD, WILD, RARE, MIGR, SPWN, SHELL, EST
Mad River	Sediment, turbidity	MUN, AGR, IND, PROC, POW, REC1, REC2, COMM, WARM, COLD, WILD, RARE, MIGR, SPWN, EST, AQUA
Eel River	Sediment, temperature	MUN, AGR, IND, GWR, NAV, POW, REC1, REC2, COMM, WARM, COLD, WILD, RARE, MIGR, SPWN, EST, AQUA
Van Duzen River	Sediment	MUN, AGR, IND, REC1, REC2, COMM, COLD, WILD, RARE, MIGR, SPWN, AQUA
Freshwater Creek	Sediment	MUN, COMM, EST
Elk River	Sediment	MUN, COMM, EST

[a] Beneficial use codes are MUN municipal and domestic, AGR agricultural, IND industrial, PROC industrial process, GWR groundwater recharge, FRSH freshwater replenishment, NAV navigational, POW hydropower generation, REC1 body contact recreation, REC2 non-contact recreation, COMM commercial and sport fishing, WARM warm freshwater habitat, COLD cold freshwater habitat, WILD wildlife habitat, RARE threatened or endangered species, MIGR migration of aquatic organisms, SPWN fish spawning, SHELL shellfish, EST estuarine habitat, AQUA aquaculture.

[b] Planning and restoration for Redwood Creek will be with the National Park Restoration Plan.

General characteristics of Primary Assessment Area streams can be derived from U.S. Geological Survey (USGS) stream monitoring records for the major rivers. Table 3.3-3 shows mean daily ranges of temperature, turbidity, and conductivity for the Smith, Klamath, and Eel Rivers near their mouths.

TABLE 3.3-3
Range of Mean Daily Water Quality Values for Three Primary Assessment Area Rivers

Parameter	Klamath River Near Klamath	Smith River at Crescent City	Eel River at Scotia
Daily mean temperature range (°C)	4 - 27.5	3 - 21.5	5 - 23.5
Daily mean turbidity range (NTU)	0 - 95	0.2 - 12	0 - 380
Daily mean conductivity range (µmhos/cm)	95 - 250	63 - 159	90 - 351
Period of record	1,973 - 1,995	1,973 - 1,993	1,973 - 1,995

Source: USGS stream monitoring records.

The records of high turbidity and low conductivity were all found in winter months during days of high runoff. High temperatures in late summer were all during low flow periods.

In addition to the long-term records from the lower elevation gaging stations, water temperature monitoring has been conducted since 1994 in the various HPAs. As of the end of the year 2000, more than 400 temperature profiles have been recorded at 111 Class I (fishbearing) stream sites and 210 profiles at 70 sites in Class II streams with the following objectives:

- Document the highest 7DMAVG (the average of all temperatures recorded over a 7-day period) and daily fluctuations for each site.
- Determine seasonal maximum water temperatures.
- Identify stream reaches with temperatures that may exceed the thresholds of any of the covered species.

In addition to documentation of average stream temperatures and species-specific temperature thresholds, relationships were developed between temperature and drainage area as a means of accounting for the natural variation in water temperatures. These regression relationships yielded confidence limits of temperature based on drainage basin area. Individual values greater than those limits were viewed as possible locations of temperature exceedances for aquatic species of concern. Summary descriptions of temperatures relative to exceedance thresholds for specified aquatic species of concern are provided below for purposes of defining temperature variability between lower and upper watershed reaches within each HPA. A complete description of the temperature monitoring program, that includes site locations, summarized data, and appropriate temperature thresholds for salmonids can be found in Appendix C-5 of the proposed AHCP/CCAA. Monitoring data on suspended sediments and turbidity are not available for watershed reaches in each HPA.

3.3.5.1 Smith River Hydrographic Region

Summer water temperatures within the Smith River Hydrographic Region have been below the recommended NMFS Maximum Weekly Average Temperature (MWAT) threshold value for juvenile coho of 17.4°C (NMFS, 1997) at every monitored location throughout 6 years of temperature monitoring. The average 7DMAVG for all 61 Class I temperature profiles recorded since 1994 was 14.4°C. The highest recorded 7DMAVG value was 17.3°C in lower Goose Creek in 1997. Water temperature does not appear to be a limiting factor for salmonids in the Smith River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 94 of the 113 recorded profiles (83 percent). The highest 7DMAVG recorded was 17.3°C and the average 7DMAVG for all summer temperature profiles was 13.6°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Smith River Hydrographic Region at most sites and most years of monitoring.

3.3.5.2 Coastal Klamath Hydrographic Region

Summer water temperatures within the Coastal Klamath Hydrographic Region have been above the recommended NMFS threshold value for juvenile coho of 17.4°C in only two of the 67 recorded Class I temperature profiles. 7DMAVG values of 17.4°C and 17.6°C were recorded in lower Turwar Creek in 1994 and 1997, respectively. The average 7DMAVG for all 67 Class I temperature profiles recorded since 1994 was 15.0°C. Water temperature does not appear to be a limiting factor for salmonids in the Coastal Klamath Hydrographic Region.

Maximum temperatures at the monitoring sites (Class I and II streams) have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 53 of the 75 recorded profiles (71 percent). The highest 7DMAVG recorded in headwater streams was 17.6°C and the average 7DMAVG for all headwater summer temperature profiles was 14.8°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Coastal Klamath Hydrographic Region at most sites and most years of monitoring.

3.3.5.3 Blue Creek Hydrologic Unit

Summer water temperatures within the Blue Creek Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in only one of the 23 recorded Class I temperature profiles. A 7DMAVG values of 18°C was recorded in Blue Creek in 1997. The average 7DMAVG for all 23 Class I temperature profiles recorded since 1994 was 15.1°C. Water temperature does not appear to be a limiting factor for salmonids in the Blue Creek Hydrologic Unit.

Maximum temperatures at the headwaters monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 19 of the 28 recorded profiles (68 percent). The highest 7DMAVG recorded in headwater streams was 18°C and the average 7DMAVG for all summer temperature profiles was 15.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Blue Creek Hydrologic Unit at most sites and most years of monitoring.

3.3.5.4 Interior Klamath Hydrographic Region

Summer water temperatures within the Interior Klamath Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in only three of the 23 recorded Class I temperature profiles. The average 7DMAVG for all Class I temperature profiles recorded since 1994 was 14.8°C. Water temperature does not appear to be a limiting factor for salmonids in Interior Klamath Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 20 of the 30 recorded profiles (67 percent). The highest 7DMAVG recorded in headwater streams was 20.1°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.6°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Interior Klamath Hydrographic Region at most sites and most years of monitoring.

3.3.5.5 Redwood Creek Hydrologic Unit

Summer water temperatures within the Redwood Creek Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in 4 of the 15 recorded Class I temperature profiles. A 7DMAVG value of 22°C was recorded in Redwood Creek at Panther in 2000. The other occurrences of 7DMAVG temperatures above 17.4°C have also been in the mainstem of Redwood Creek and lower Coyote Creek. The average 7DMAVG for all Class I temperature profiles recorded since 1994 was 15.7°C. Summer water temperature may be a limiting factor for salmonids in Redwood Creek itself, while temperatures in tributaries to Redwood Creek appear to remain relatively cool through the summer.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 29 of the 37 recorded profiles (78 percent). The highest 7DMAVG recorded in all streams was 22°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.7°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Redwood Creek Hydrologic Unit at most sites and most years of monitoring.

3.3.5.6 Coastal Lagoons Hydrographic Region

Summer water temperatures within the Coastal Lagoons Hydrographic Region have been below the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C at all Class I sites throughout 6 years of temperature monitoring. The highest recorded 7DMAVG value was 16.1°C in lower Maple Creek in 2000. The average 7DMAVG for all 43 Class I temperature profiles recorded since 1994 was 14.4°C. Water temperature does not appear to be a limiting factor for salmonids in the Coastal Lagoons Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 61 of the 65 recorded profiles. The highest 7DMAVG recorded in all streams was 16.5°C, and the average 7DMAVG for all summer temperature profiles was 14.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Coastal Lagoons Hydrographic Region.

3.3.5.7 Little River Hydrologic Unit

Summer water temperatures within the Little River Hydrologic Unit have been at the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C twice throughout 6 years of temperature monitoring. A 7DMAVG value of 17.4°C was recorded in the lower Little River in 1996 and 2000. The average 7DMAVG for all 44 Class I temperature profiles recorded since 1994 was 14.9°C. Water temperature does not appear to be a limiting factor for salmonids in the Little River Hydrologic Unit.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 58 of the 72 recorded profiles (81 percent). The highest 7DMAVG recorded in headwater streams was 17.4°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Little River Hydrologic Unit at most sites and most years of monitoring.

3.3.5.8 Mad River Hydrographic Region

Summer water temperatures within the Mad River Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C eight times at three sites: middle Canon Creek in 2000, and lower Canon Creek between 1996 and 2000, and Boulder Creek in 1997 and 1998. The highest recorded 7DMAVG was 18.8°C in lower Canon Creek in 1997. The average 7DMAVG for all 37 Class I temperature profiles recorded since 1994 was 16.1°C. Summer water temperature may be a limiting factor for salmonids in portions of the Mad River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 68 of the 90 recorded profiles (76 percent). The highest 7DMAVG recorded in all streams was 18.8°C, and the average 7DMAVG for all headwater summer temperature profiles was 12.9°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Mad River Hydrographic Region at most sites and most years of monitoring.

3.3.5.9 North Fork Mad River Hydrologic Unit

Summer water temperatures within the North Fork Mad River Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in one reach, the lower North Fork Mad River, in every year it was monitored (1994-2000), with 7DMAVG values ranging from 17.7°C in 1994 to 19.7°C in 1996. The average 7DMAVG for all 39 Class I temperature profiles recorded since 1994 was 15.3°C. Temperatures at all other sites in this HPA have been below the recommended NMFS threshold for juvenile coho except for site 1a on the North Fork Mad River in 1998. Summer water temperatures may be a limiting factor for salmonids in the lower mainstem North Fork Mad River, but do not appear to be limiting in the upper North Fork Mad River or tributaries to it.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 39 of the 52 recorded profiles (75 percent). The highest 7DMAVG recorded in streams was 19.7°C, and the average 7DMAVG for all summer temperature profiles was 14.8°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the North Fork Mad River Hydrologic Unit at most sites and most years of monitoring.

3.3.5.10 Humboldt Bay Hydrographic Region

Summer water temperatures within the Humboldt Bay Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C twice at lower Salmon Creek throughout 6 years of monitoring. The recorded 7DMAVG values at the site were 18.1°C in 1997 and 17.4°C in 1998. The average 7DMAVG for all 35 Class I temperature profiles recorded since 1994 was 14.7°C. Summer water temperatures do not appear to be a limiting factor for salmonids in the Humboldt Bay Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 28 of the 35 recorded profiles (80 percent). The highest 7DMAVG

recorded in Class I streams was 18.1°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.7°C. No Class II sites have been monitored to date. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Humboldt Bay Hydrographic Region at most sites and most years of monitoring.

3.3.5.11 Eel River Hydrographic Region

Summer water temperatures within the Eel River Hydrographic Region have been below the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C at every site throughout 6 years of monitoring. The highest recorded 7DMAVG value was 16.6°C in Stevens Creek in 2000. The average 7DMAVG for all 12 Class I temperature profiles recorded since 1994 was 14.7°C. Summer water temperatures do not appear to be a limiting factor for salmonids in the Eel River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in all but two of the 12 recorded profiles. The highest 7DMAVG recorded in Class I streams was 16.6°C, and the average 7DMAVG for all summer temperature profiles was 14.7°C. No Class II sites have been monitored to date. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Eel River Hydrographic Region for most sites and years of monitoring.

3.4 Aquatic Resources

3.4.1 Introduction

This section describes fisheries and other aquatic resources occurring within the Primary Assessment Area and the additional 25,677 rain-on-snow acres under Alternative C that could potentially be affected by approval of the proposed Permits (Proposed Action), other action alternatives, or the No Action Alternative. Discussions focus on eight fish, four amphibian, and one reptile species occurring or potentially occurring within these areas that would be covered by one or more of the action alternatives. The distribution, status, life history and habitat requirements, and factors affecting populations of these 13 species are discussed in the following text.

This section also describes current, known aquatic habitat conditions within the Primary Assessment Area for each of the 11 HPAs previously described in Sections 3.2 and 3.3. In addition, this section summarizes general ecological implications of land management activities on aquatic habitat that have influenced, or could potentially influence, the affected environment. These descriptions are presented to inform the reader of general cause-effect relationships, and to develop the basis for assessing potential project effects on aquatic habitat and the covered species in Chapter 4, Environmental Consequences, of this document.

3.4.2 Covered Species

3.4.2.1 Background

Table 3.4-1 lists the common and scientific names of the eight fish species, four amphibian species, and one reptile species covered under the various action alternatives, and their status under the Federal and State ESAs. The designation in Table 3.4-1 of individual ESUs/DPSs of steelhead and coho and Chinook salmon as individual species is consistent with language in the Federal ESA. An ESU must be substantially reproductively isolated from other conspecific population units, and it must contribute substantially to ecological/genetic diversity of the biological species as a whole. The DPS policy adopts criteria similar to, but somewhat different from, those in the ESU policy for determining when a group of vertebrates constitutes a DPS: the group must be discrete from other populations, and it must be significant to its taxon. A group is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors." Using the DPS policy, resident rainbow trout are considered "markedly separated" from the anadromous form and are not included in the current steelhead listing (71 FR 834). Measures to minimize and mitigate the potential impacts of incidental take on the covered species are evaluated in Chapter 4, Environmental Consequences. These measures focus on assessing, conserving, and monitoring the populations and habitats of the species covered under the various alternatives. The mitigation measures, supporting analysis, and related authorizations also provide the basis for Green Diamond to comply with any requirements of the CFPRs relating to the ESA and the covered species.

3.4.2.2 General Information

Distribution. The 13 fish, amphibian, and reptile species discussed in this section occupy a wide range of stream reaches based on their specific habitat requirements and biological adaptations. Because of this diversity, they are dependent on a variety of stream habitats. Some larger streams may be used by all of the species, while smaller tributaries may be used by all, some, one, or none of the species. In general, Chinook salmon are distributed from the coast to low-elevation streams a short distance inland. Coho salmon venture farther inland to higher elevations than Chinook salmon. Steelhead, rainbow trout, and coastal cutthroat trout are distributed from the coast to higher-elevation areas farther inland than either Chinook or coho salmon.

The tidewater goby is found in estuarine environments and rarely ventures far upstream into fresh water.

Many of the amphibian and reptile species are found at relatively low elevations; however, tailed frogs are generally found at higher elevations and farther inland from the coast than the fish species. Torrent salamanders are found at even higher elevations than tailed frogs.

TABLE 3.4-1
Federal and State Protective Status of Fish, Amphibian, and Reptile Species Covered Under the Action Alternatives

Species Common Name	Scientific Name	Coverage	Federal Status	State Status
Fish				
Southern Oregon/Northern California Coasts coho salmon ESU	*Oncorhynchus kisutch*	P,A,B,C	FT[a]	ST
Klamath Mountains Province steelhead ESU	*Oncorhynchus mykiss*	P,B,C	None[b]	None
Northern California steelhead DPS	*Oncorhynchus mykiss*	P,A,B,C	FT[b]	None
California Coastal Chinook salmon ESU	*Oncorhynchus tshawytscha*	P,A,B,C	FT[c]	None
Southern Oregon and Northern California Coastal Chinook salmon ESU	*Oncorhynchus tshawytscha*	P,B,C	None[c]	None
Upper Klamath-Trinity Rivers Chinook salmon ESU	*Oncorhynchus tshawytscha*	P,B,C	None[c]	None
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	P,B,C	FSS[d]	CSC
Rainbow trout [e]	*Oncorhynchus mykiss*	P,B,C	None	None
Tidewater Goby	*Eucyclogoloius newbenyi*	C	FE	CSC
Amphibians				
Southern torrent salamander	*Rhyacotriton variegatus*	P,B,C	None	CSC
Tailed frog	*Ascaphus truei*	P,B,C	None	CSC
Foothill yellow-legged frog	*Rana boylii*	C	FSS	CSC/CFP
Northern red-legged frog	*Rana aurora aurora*	C	FSS	CSC/CFP
Reptiles				
Western pond turtle	*Clemmys marmorata marmorata*	C	FSS	CSC/CFP

Coverage
P Proposed Action: Aquatic HCP/CCA
A Alternative A: Listed Species Only
B Alternative B: Simplified Prescriptions Strategy
C Alternative C: Expanded Species and Geographic Coverage

Federal Status
FE Federal endangered species
FT Federal threatened species
FSS Forest Service sensitive species

State Status
ST State of California threatened species
CSC CDFG Species of Special Concern
CFP California Fully Protected Species

[a] The Southern Oregon/Northern California Coasts coho salmon ESU was listed as threatened on May 6, 1997, and critical habitat was designated on May 5, 1999.

[b] The Klamath Mountains Province steelhead ESU did not warrant listing as of April 4, 2001. The Northern California steelhead DPS was listed as threatened on June 7, 2000, and critical habitat was proposed on December 10, 2004. Steelhead are the anadromous life history type of *Oncorhynchus mykiss* and are under the jurisdiction of the NMFS.January 5, 2006 (71 FR 834). Critical habitat for the Northern California steelhead ESU was designated on September 2, 2005 (70 FR 52488

[c] The California Coastal Chinook salmon ESU was listed as threatened September 16, 1999, and critical habitat was proposed on December 10, 2004. The Southern Oregon and Northern California Coastal Chinook salmon ESU did not warrant listing as of September 16, 1999. The Upper Klamath-Trinity Rivers Chinook salmon ESU did not warrant listing as of March 9, 1998.

[d] The NMFS determined that the Southern Oregon/California Coasts coastal cutthroat trout ESU did not warrant listing as of April 5, 1999. This species is now under the jurisdiction of the USFWS and a review of the status of this species is being conducted.

[e] Rainbow trout are the resident life history type of *Oncorhynchus mykiss* and are under the jurisdiction of the USFWS. Using the DPS policy, resident rainbow trout are considered "markedly separated" from the anadromous form and are not included in the current listing for steelhead (71 FR 834).

Status of Populations. Table 3.4-1 summarizes the status of the covered species for each of the action alternatives. The California Coastal Chinook salmon ESU, Southern Oregon/Northern California Coasts (SONCC) coho salmon ESU, and Northern California steelhead DPS are federally listed threatened species. Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. The NMFS determined that Federal listing was not warranted for the Klamath Mountains Province steelhead ESU (April 4, 2001, 66 FR 17845), the Southern Oregon and Northern California Coastal Chinook salmon ESU (September 16, 1999, 64 FR 50394), and the Upper Klamath-Trinity Rivers Chinook salmon ESU (March 9, 1998, 63 FR 11482). Cutthroat trout are now under the jurisdiction of the USFWS and undergoing a status review. Rainbow trout are the resident life history type of *Oncorhynchus mykiss* and are also under the jurisdiction of the USFWS and not included in the current steelhead DPS listings; this species is currently unlisted.

The tidewater goby is a federally listed endangered species. Southern torrent salamander, tailed frog, foothill yellow-legged frog, northern red-legged frog, and Western pond turtle have been designated as Federal species of concern by the USFWS.

Life History and Habitat Requirements. General life history and habitat requirements for the 13 fish, amphibian, and reptile species discussed in this section are provided below.

Fish. The eight fish species covered under the Proposed Action are members of the family Salmonidae and exhibit varying levels of anadromy. Anadromous fish rear in freshwater for varying lengths of time, migrate to the ocean where they grow and mature, then return to freshwater to spawn and complete their life cycle. Chinook and coho salmon are exclusively anadromous; all individuals migrate from freshwater streams to the ocean and return to spawn. Steelhead are the anadromous life form of rainbow trout. Cutthroat trout primarily exist as resident populations, but limited anadromy does occur. Coho and Chinook salmon die after spawning, while steelhead, rainbow trout, and coastal cutthroat trout may survive to spawn more than once. Key life history and habitat requirements of coho salmon, steelhead/rainbow trout, Chinook salmon, and coastal cutthroat trout are summarized in Table 3.4-2 and discussed below under the individual species' descriptions.

The anadromous (steelhead) and resident (rainbow trout) forms of *O. mykiss* are genetically indistinguishable, and the life history and habitat requirements of resident rainbow trout are similar to those of steelhead while in the freshwater phase.

Amphibians and Reptiles. Key life history and habitat requirements of the two amphibian species (southern torrent salamander and tailed frog) covered under the Proposed Action are summarized in Table 3.4-3 and discussed below under the individual species' descriptions. Amphibians breed in water and feed on land, in shrubs, or in trees. They occupy wetland, pond, riverine, and stream habitats as primary breeding areas. The general life history and habitat requirements of the additional amphibian species and the single reptile species that are only covered under Alternative C are summarized below under the individual species' descriptions.

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout
(from Table 3-1 of Green Diamond's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Spawning period (anadromous populations)	September to March, concentrated from January to February depending on rainfall and stream discharge	September to March depending on time of entry	September to January, concentrated from November to January depending on rainfall and stream discharge	December to May depending on time of entry
Spawning period (resident populations)	Not Applicable	September to April	Not Applicable	Spring or early summer
Spawning habitat				
Redd sites	Pool tails or slightly upstream	Pool tails, upper sections of watershed	Pool tails or slightly upstream	Pools tails with protective cover nearby
Water depth	0.2 to 0.5 m	0.1 to 1.5 m	0.5 to 7 m	0.1 to 1 m
Water velocity	0.3 To 0.5 m/sec	0.2 to 1.6 m/sec	0.2 to 1.9 m/sec	0.1 to 1 m/sec
Substrate size	1.3 to 15 cm	0.6 to 12.7 cm	1.3 to 15 cm	0.6 to 10.2 cm
Temperature	5.6°C to 13.3°C	5°C to 15°C	5.6°C to 13.9°C	5°C to 15°C
Incubation period	36 to 100 days depending on water temperature	19 to 80 days depending on water temperature	30 to 159 days depending on water temperature	40 to 50 days depending on water temperature

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout
(from Table 3-1 of Green Diamond's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Rearing habitat	Mix of pools and riffles with abundant instream and overhead cover Fry seek shallow water along stream margins, backwaters, and side channels Summer parr found mainly in pools Overwintering juveniles seek shelter from high flows in side channels, backwaters, under large boulders and woody debris Summer weekly average temperatures (MWAT) below 17.4°C	Fry tend to school and seek shallow water along stream margins Larger fry and juveniles maintain territories in pool and run habitat Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)	Fry seek cover in shallow water along channel margins or in low-velocity channel bottoms Overwintering juveniles seek shelter under large boulders and woody debris, and in side channels or other low-velocity refugia Fry young-of-the-year and yearling smolts also use estuarine habitat Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)	Fry seek low-velocity shallow water in stream margins, backwater pools, and side channels Large coho fry can force cutthroat fry into riffles Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)
Outmigration (for anadromous populations)	Juveniles usually remain in freshwater for 1 year Smolts outmigrate from late March to early June	Freshwater residence varies from 1 to 4 years, but 1 to 2 years is predominant in the Project Area	Downstream migration begins immediately after emergence (Late February to June) Estuarine residence varies, probably 1 to 6 weeks depending on conditions	Anadromous cutthroat smolt outmigrate at 1 to 6 years of age depending on estuarine conditions

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout
(from Table 3-1 of Green Diamond's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Other factors	Coho spawn after spending 1 to 2 years at sea; in California, most coho spawn at 3 years of age, with some males spawning at age 2 (jacks) All coho die after spawning	Steelhead spawn after 1 to 4 years at sea Adult steelhead may spawn more than once Summer-run steelhead are able to use habitat not accessible to fall/winter-run salmonids Anadromous (steelhead) and resident (rainbow trout) populations occur in the Action Area	Chinook spawn at 2 to 7 years of age; in California, 2- to 4-year-olds are most common Some males (jacks) spawn at age 1 or 2 All Chinook die after spawning	Resident and anadromous cutthroat use similar spawning habitat Non-migratory cutthroat live in isolated headwater tributaries Spawning tends to occur in 1st and 2nd order streams and isolated headwaters Cutthroat trout may spawn more than once

TABLE 3.4-3
Key Life History and Habitat Requirements of Southern Torrent Salamander and Tailed Frog
(from Table 3-2 of Green Diamond's proposed AHCP/CCAA)

Characteristic Habitat Requirements	Southern Torrent Salamander	Tailed Frog
General	Cold clear streams with a loose gravel substrate Areas with water seeping through moss-covered gravel Splash zones of waterfalls Uppermost portions of streams and headwater seeps	Cold clear streams with a boulder, cobble, or gravel substrate Upper portions of streams but overlapping upper extent of fish-bearing reaches
Adults	Interstices within gravel in streams and under objects along stream edges and in splash zone Usually remain within 1 m of flowing water	Streams and upland habitats along streambanks
Larvae	Interstices within gravel in streams	Attach selves to rocky substrates, primarily in riffles
Breeding period	Spring or early summer	Spring and fall
Metamorphosis of young	Probably 2 to 3 years	1 to 2 years (data specific to the Project Area)
Forage	Terrestrial and aquatic invertebrates	Terrestrial and aquatic invertebrates Tadpoles feed on diatoms
Other factors	Can persist in streams with subsurface flow during the dry summer season Generally are believed to have low dispersal capabilities	Predation by fish may limit distribution within lower sections of stream

Factors Affecting Populations. Water quality is an important habitat component for all fish species. Important water quality parameters for the covered salmonids and other fish species are temperature, sediment, and pollutants (Groot and Margolis, 1991; Rieman and McIntyre, 1993). Temperature affects fish growth, food supply, and the length of time required for egg incubation. Each life stage has preferred and optimal ranges of water temperature, with species' ranges often similar or overlapping. Activities that affect water temperature include those that reduce stream shading.

Stream sediment also is an important aspect of water quality. Too much sediment can result in stream-bottom embeddedness, which potentially limits the flow of well-oxygenated water among streambed gravels and cobbles. Reduced flow of well-oxygenated water through the stream bottom can affect egg incubation and survival, and the production of benthic invertebrates (insects), which are important fish foods (Groot and Margolis, 1991; Rieman and McIntyre, 1993).

Two other important factors can affect fish populations. These are the quantity and quality of physical habitat available and preferred by various species during different life stages, and the ability to access and use those habitats at different times of the year. Considerations include instream habitat characteristics, such as water depth and velocity, substrate, and the nature and complexity of overhead, shoreline, and bottom cover. Natural or artificial barriers that limit or prevent access to suitable habitat for spawning, rearing, migrations, and overwintering can adversely affect fish populations.

These same factors also directly or indirectly affect populations of the amphibian and reptile species covered under the various alternatives. In addition, since most species in this group breed exclusively in water, adjacent upland conditions have less of an impact on breeding habitat than riparian conditions. Additional information on each of the covered fish, amphibian, and reptile species is provided in the following text.

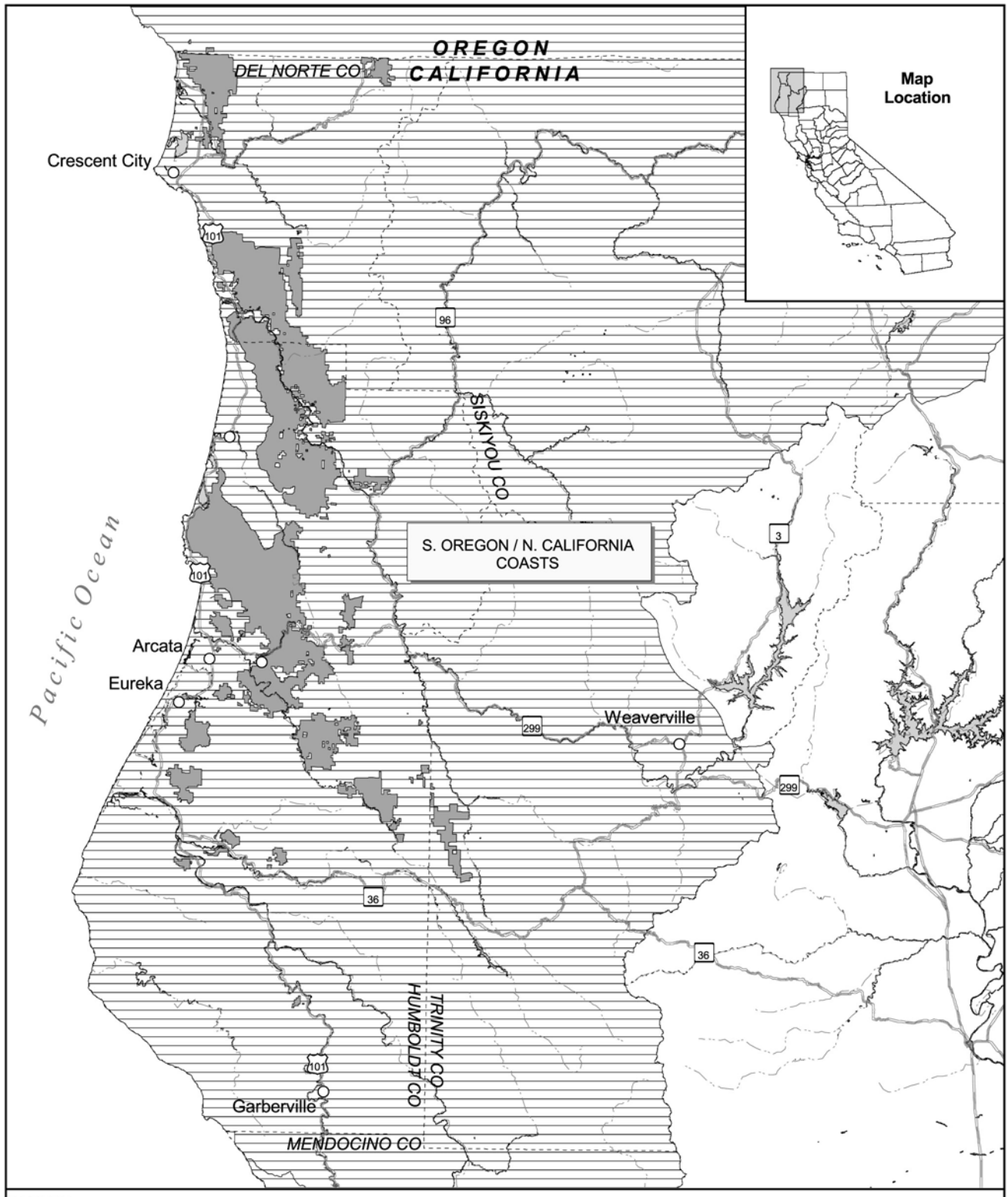
3.4.2.3 Coho Salmon: Southern Oregon/Northern California Coasts ESU

Distribution. Globally, coho salmon spawn in coastal watersheds in both Asia and North America. In Asia, they are distributed from Hokkaido, Japan to the Anadyr River in the former U.S.S.R. (Moyle, 1976; Hassler, 1987). In North America, coho salmon are distributed from Point Hope, Alaska south to the northern edge of Monterey Bay (Moyle, 1976). Along the North American coast, coho salmon are most abundant between southern Oregon and southeast Alaska. In California, coho salmon are the second most abundant of the five species of Pacific salmon. They are found in numerous coastal drainages from the Oregon/California border south to Waddell Creek and the San Lorenzo River in Santa Cruz County (Sandercock, 1991).

Status of Populations. NMFS published a proposed rule to list coho salmon as threatened in California and Oregon (July 25, 1995, 60 FR 38011). NMFS listed the SONCC coho salmon ESU as threatened (May 6, 1997, 62 FR 24588), and designated critical habitat for the SONCC coho salmon ESU (May 5, 1999, 64 FR 24049). This ESU extends from Cape Blanco, Oregon to Punta Gorda, California and overlaps the Primary Assessment Area. Critical habitat for the SONCC coho salmon ESU includes all river reaches accessible to listed coho salmon between Cape Blanco, Oregon and Punta Gorda, California, but excludes areas above specific dams or above longstanding, naturally impassable barriers. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and river reaches (including off-channel habitats). The location of coho salmon ESUs in the vicinity of the Green Diamond ownership is shown on Figure 3.4-1.

The State of California listed Central California coastal coho salmon on December 31, 1995 (CDFG, 2001). The State listed this species as endangered for waters south of San Francisco Bay only, which is south of the Primary Assessment Area. The State of California recently revised the listing status for coho salmon, listing the population segment south of Punta Gorda (including coho south of San Francisco Bay) as endangered and the population segment north of Punta Gorda to the northern California border as threatened.

Life History and Habitat Requirements. Coho salmon typically exhibit a relatively simple, 3-year life history pattern. Adults begin freshwater spawning migrations in late summer and fall, spawn from September to March, concentrated in January and February, then die. Eggs incubate in gravels of spawning redds for about 1.5 to 4 months before hatching as alevins. Alevins soon emerge from the gravel as young juveniles and begin active feeding.



LEGEND

ESU COHO STATUS

- THREATENED

- GREEN DIAMOND OWNERSHIP
- COUNTY BORDER
- RIVERS
- LAKES
- MAJOR ROADS
- CITIES

N

10 0 10 Miles

SCALE IS APPROXIMATE

Figure 3.4-1
COHO ESU LOCATIONS AND STATUS

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Juveniles feed and grow in freshwater for up to 15 months before migrating to the ocean the following spring as 1+ age smolts. Juvenile coho salmon can rear for additional years in freshwater and outmigrate as 2+ or 3+ age smolts. Previous research found that all coho salmon in California outmigrate as 1+ smolts (Shapolov and Taft, 1954). In British Colombia and further north, coho salmon age 2+, and even age 3+ smolts are common (Sandercock, 1991). Recently, age 2+ coho outmigrants have been documented in Prairie Creek, California (Bell, 2001). Coho salmon generally rear for 2 years in the ocean before returning to their natal stream to spawn as 3-year old fish. A few may return to spawn after only 1 year in the ocean and are referred to as "jacks." Table 3.4-2 summarizes key life history and habitat requirements for coho salmon.

Factors Affecting Populations. NMFS has identified numerous human-caused and natural factors it believes have contributed to declines of coho salmon (July 25, 1995, 60 FR 38011). Threats to the SONCC coho salmon ESU are numerous and varied. Several human-caused factors, including habitat degradation, harvest, and artificial propagation, exacerbate the adverse effects of natural environmental variability caused by drought, floods, and poor ocean conditions. NMFS reported the major activities responsible for the decline of coho salmon in Oregon and California are logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (May 6, 1997, 62 FR 24588). Of recent note, poor water quality conditions in the Klamath River system in 2002 resulted heightened physiological stress on returning adult salmon, resulting in a significant disease induced die-off estimated at 344 wild adult coho salmon, 629 steelhead trout, and 33,527 adult Chinook salmon (Guillen 2002, 2003). Since this time poor water quality has also been implicated in increasing juvenile susceptability to native pathogens and is thought to be the cause significant juvenile outmigrant mortalities as well.

3.4.2.4 Chinook Salmon: California Coastal ESU, Southern Oregon and Northern California Coastal ESU, and Upper Klamath-Trinity Rivers ESU

Distribution. Native spawning populations of Chinook salmon are distributed along the Asian coast from Hokkaido, Japan, to the Anadyr River, and along the North American coast from central California to Kotzebue, Alaska (Moyle, 1976; Allen and Hassler, 1986; Healey, 1991). Chinook salmon spawning may occur from near tidewater in coastal watersheds to over 3,200 km upstream in headwaters of the Yukon River (Major et al., 1978).

Status of Populations. NMFS listed the California Coastal Chinook salmon ESU, which includes fall- and spring-run fish, as threatened (September 16, 1999, 64 FR 50394), and has proposed critical habitat for this ESU (December 10, 2004, 69 FR 71880). The California Coastal Chinook salmon ESU includes Chinook salmon populations from Redwood Creek in Humboldt County to the Russian River in Sonoma County, and, as such, overlaps the southern portion of the Primary Assessment Area. Proposed critical habitat for this ESU includes numerous river reaches and estuarine areas from Redwood Creek to the Russian River. These reaches and areas were identified through a process that considered historic and current utilization, current habitat quality, unique watershed and reach characteristics, the potential for restoration of degraded habitat, and the coextensive economic impacts associated with designation.

On September 16, 1999, NMFS determined that listing the SONCC Chinook salmon ESU was not warranted (64 FR 50394). The SONCC Chinook salmon ESU extends from Cape Blanco, Oregon to the Lower Klamath River (inclusive) and, as such, overlaps the northern portion of the Primary Assessment Area. The SONCC Chinook salmon ESU does not include Chinook salmon populations in the Klamath River Basin upstream from the confluence of the Klamath and Trinity Rivers. Chinook salmon populations upstream of these rivers' confluence comprise the Upper Klamath-Trinity Rivers ESU, which overlaps the eastern portion of the Primary Assessment Area. NMFS determined on March 9, 1998, that listing the Upper Klamath-Trinity Rivers ESU was not warranted (63 FR 11482). The location of Chinook salmon ESUs in the vicinity of the Green Diamond ownership is shown on Figure 3.4-2.

Life History and Habitat Requirements. Chinook salmon, like other salmon species, have complex life history characteristics and habitat needs because they are anadromous. Chinook salmon migrate extreme distances to spawn in the lower 48 states. The Primary Assessment Area only contains portions of rivers that are used for spawning and juvenile rearing by this species. Therefore, the following discussion of Chinook salmon only addresses those life history aspects.

Adult Chinook enter streams in the Primary Assessment Area from August through January. Spawning occurs in areas with clean large gravels, small cobbles, and sufficient flow to oxygenate eggs buried within the substrate. Spawning typically occurs in the fall, usually within 2 to 3 weeks after the fish reach their natal spawning grounds. Eggs incubate during the winter, then hatch from February through May. Fry remain in the gravel for about one month before emerging. Downstream migration begins immediately after emergence (late February to June). Estuarine residence varies from approximately 1 to 6 weeks, depending on conditions, before individuals move to the open ocean where they feed and rear (Moyle, 1976). Table 3.4-2 summarizes key life history and habitat requirements for Chinook salmon.

Factors Affecting Populations. Because of their complex life history and range of habitat requirements, salmon can be subjected to a wide variety of environmental conditions (both natural and influenced by man) that affect their populations. These include conditions in the ocean, along freshwater migration corridors, and on their spawning grounds. Factors commonly associated with impacted salmon populations include genetic introgression from hatchery fish, ocean habitat conditions, suitability of spawning substrate (clean gravels and cobbles), water temperature, instream flows, and over-fishing.

Although several factors are likely to have improved conditions for Chinook salmon in the California Coastal and SONCC Chinook salmon ESUs, habitat alterations in the coastal river drainages have contributed to the reduction in abundance and distribution of Chinook salmon in these ESUs. Examples of habitat alterations affecting Chinook salmon include: water withdrawal, conveyance, storage, and flood control (resulting in insufficient flows, stranding, juvenile entrainment, and increased stream temperatures); and logging and agriculture (resulting in loss of large woody debris, sedimentation, loss of riparian vegetation, and habitat simplification) (Spence et al., 1996; Myers et al., 1998; NMFS, 1998). Of recent note, poor water quality conditions in the Klamath River system in 2002 resulted heightened physiological stress on returning adult salmon, resulting in a significant disease

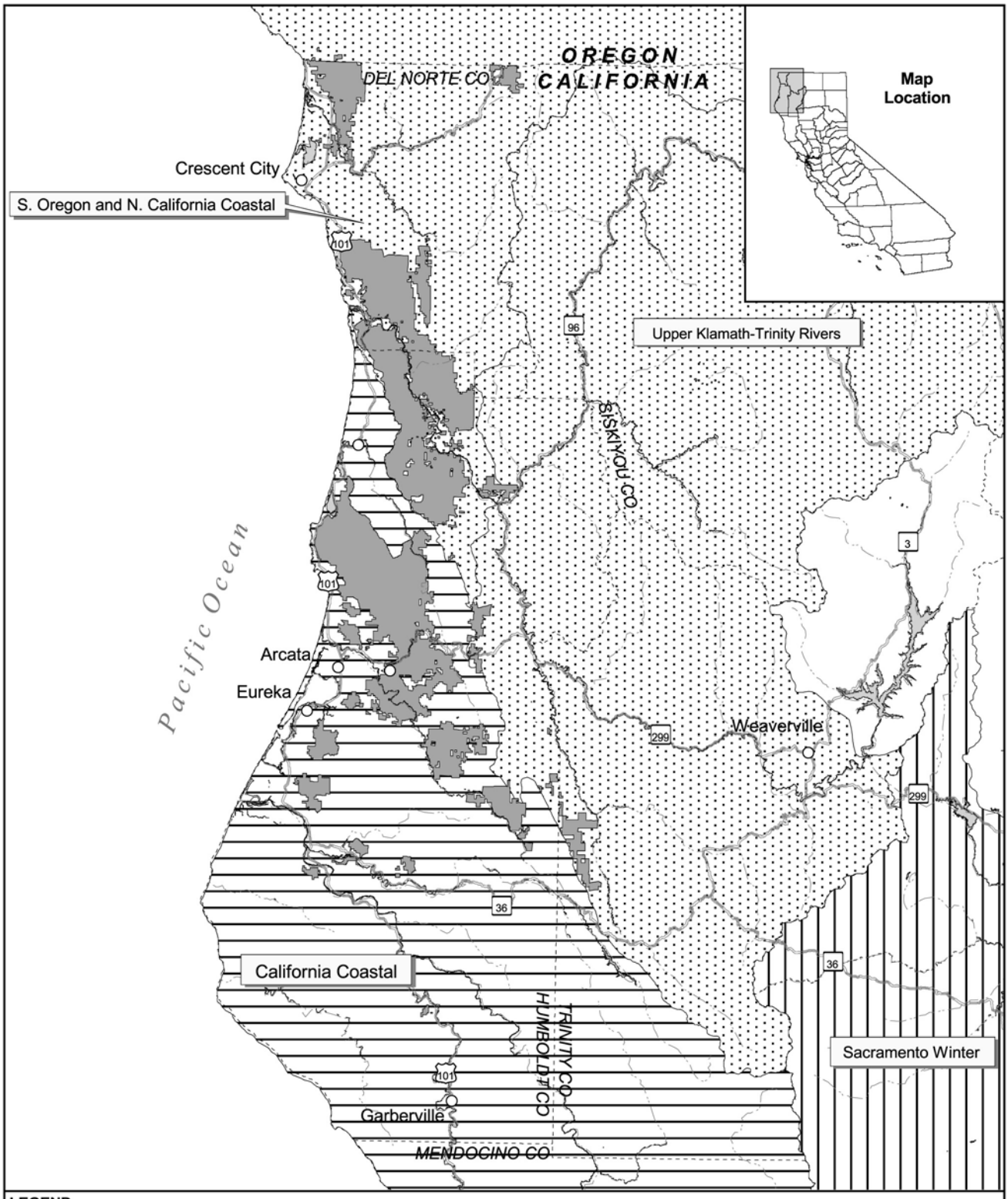

Figure 3.4-2
CHINOOK ESU LOCATIONS AND STATUS

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induced die-off estimated at 344 wild adult coho salmon, 629 steelhead trout, and 33,527 adult Chinook salmon (Guillen 2002, 2003). Since this time poor water quality has also been implicated in increasing juvenile susceptability to native pathogens and is thought to be the cause significant juvenile outmigrant mortalities as well.

3.4.2.5 Coastal Cutthroat Trout

Distribution. Coastal cutthroat trout are found in coastal drainages from the Eel River in northern California (Dewitt, 1954) to Prince William Sound in Alaska (Trotter, 1989). The inland limits of coastal cutthroat trout distribution are most likely the Fraser River in British Columbia and Celilo Falls on the Columbia River (Crawford, 1979; Trotter, 1989).

Status of Populations. NMFS determined that listing was not warranted for the Southern Oregon/California Coasts coastal cutthroat trout ESU (April 5, 1999, 64 FR 16397). This species is now formally under the jurisdiction of the USFWS. The USFWS is currently reviewing the status of cutthroat trout. Coastal cutthroat trout are a CDFG species of special concern and a USFS sensitive species (CDFG, 2001). All populations of coastal cutthroat trout in California are considered by some biologists to be at a moderate risk of extinction (Nehlsen et al., 1991).

Life History and Habitat Requirements. Coastal cutthroat trout can exhibit resident freshwater and anadromous life history forms, as indicated in the summary of key life history characteristics (Table 3.4-2). Resident populations spawn in the spring or early summer, with young fish emerging from the gravels from late spring through summer. Adults and juveniles use stream riffles and pool habitat for feeding and cover, respectively, and primarily pools and deep water habitat during winter. The resident form feeds primarily on aquatic insects, as opposed to the piscivorous (fish-eating) anadromous form (Wydoski and Whitney, 1979).

Anadromous coastal cutthroat trout exhibit a much different and more complex life history pattern than residents, because of their movements between freshwater and saltwater systems. The anadromous form spawns in smaller headwater streams and tributaries of coastal rivers to which they have access (Wydoski and Whitney, 1979). Spawning occurs primarily from late December to February, and young emerge from the gravels about mid-May. They remain in their natal streams for about a year before moving downstream to larger streams where they can live for 1 to 6 years. The anadromous form is quite piscivorous while rearing in freshwater (Behnke, 1992). Most outmigration to the ocean occurs from April through June (Wydoski and Whitney, 1979).

The life history and habitat requirements of coastal cutthroat while in saltwater are relatively unknown (Wydoski and Whitney, 1979). They do not appear to migrate to the open ocean, but instead use bays, estuaries, and the coastline where they feed on crustaceans and fish (Behnke, 1992).

Factors Affecting Populations. Behnke (1992) states that numbers of coastal cutthroat trout have drastically declined in many areas because of environmental alterations (mainly logging practices that result in increased sedimentation, reduced cover, and increased stream temperatures) and hybridization with non-native trout species. The NMFS and USFWS joint proposed rule for coastal cutthroat trout (April 5, 1999, 64 FR 16397) states that the present or threatened destruction, modification, or curtailment of its habitat or range;

overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; inadequacy of existing regulatory mechanisms; and other natural or manmade barriers affecting its continued existence are the principle factors for decline across the range of coastal cutthroat trout.

3.4.2.6 Steelhead (Northern California DPS and Klamath Mountains Province ESU) and Resident Rainbow Trout

Distribution. Coastal rainbow trout are widely distributed from the Kuskokwin River in western Alaska to Baja California (Moyle, 1976; Behnke, 1992). Steelhead (the anadromous form) occur throughout the range of coastal rainbow trout except in the northern and southern extremities (Behnke, 1992). The present southern limit of steelhead distribution is Malibu Creek, California.

Status of Populations. Rainbow trout, the resident form, are under the jurisdiction of the USFWS and are currently unlisted. NMFS published a proposed rule to list steelhead in the Klamath Mountains Province ESU as threatened (March 16, 1995, 60 FR, 14253). NMFS subsequently determined that listing was not warranted for this ESU (March 19, 1998, 63 FR 13347). However, NMFS reproposed the Klamath Mountains Province steelhead ESU for listing as a threatened species because of concerns over specific risk factors (February 12, 2001, 66 FR 9808). It was subsequently determined that listing of the Klamath Mountains Province steelhead ESU was not warranted (April 4, 2001, 66 FR 17845). The Klamath Mountains Province steelhead ESU includes steelhead from the Elk River in Oregon to the Klamath and Trinity Rivers in California, inclusive, overlapping the Primary Assessment Area.

NMFS listed the Northern California steelhead as a threatened species on June, 7, 2000, (65 FR 36074) and reaffirmed its threatened status and converted its ESU designation a DPS on Jan 5, 2006 (71 FR 834). The Northern California steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in California coastal river basins from Redwood Creek southward to, but not including, the Russian River. This DPS also includes two artificial propagation programs: the Yager Creek Hatchery and the North Fork Gualala River Hatchery. Critical Habitat for Northern California steelhead was designated on September 2, 2005, (70 FR 52488) and includes numerous river reaches and estuarine areas from Redwood Creek south to, but not including, the Russian River. These reaches and areas were identified through a process that considered historic and current utilization, current habitat quality, unique watershed and reach characteristics, the potential for restoration of degraded habitat, and the coextensive economic impacts associated with designation. The Northern California steelhead DPS and its associated critical habitat overlap the Primary Assessment Area. The location of steelhead ESUs/DPSs in the vicinity of the Green Diamond ownership is shown on Figure 3.4-3.

Summer-run steelhead from the Klamath Mountains Province ESU and the Northern California DPS are on CDFG's list of species of special concern (CDFG, 2001). Currently, all runs of steelhead within this species' southern limits (Malibu Creek, Santa Clara River, Ventura River, and Santa Ynez River) are considered at a high risk of extinction by many fisheries biologists (Nehlsen et al., 1991).

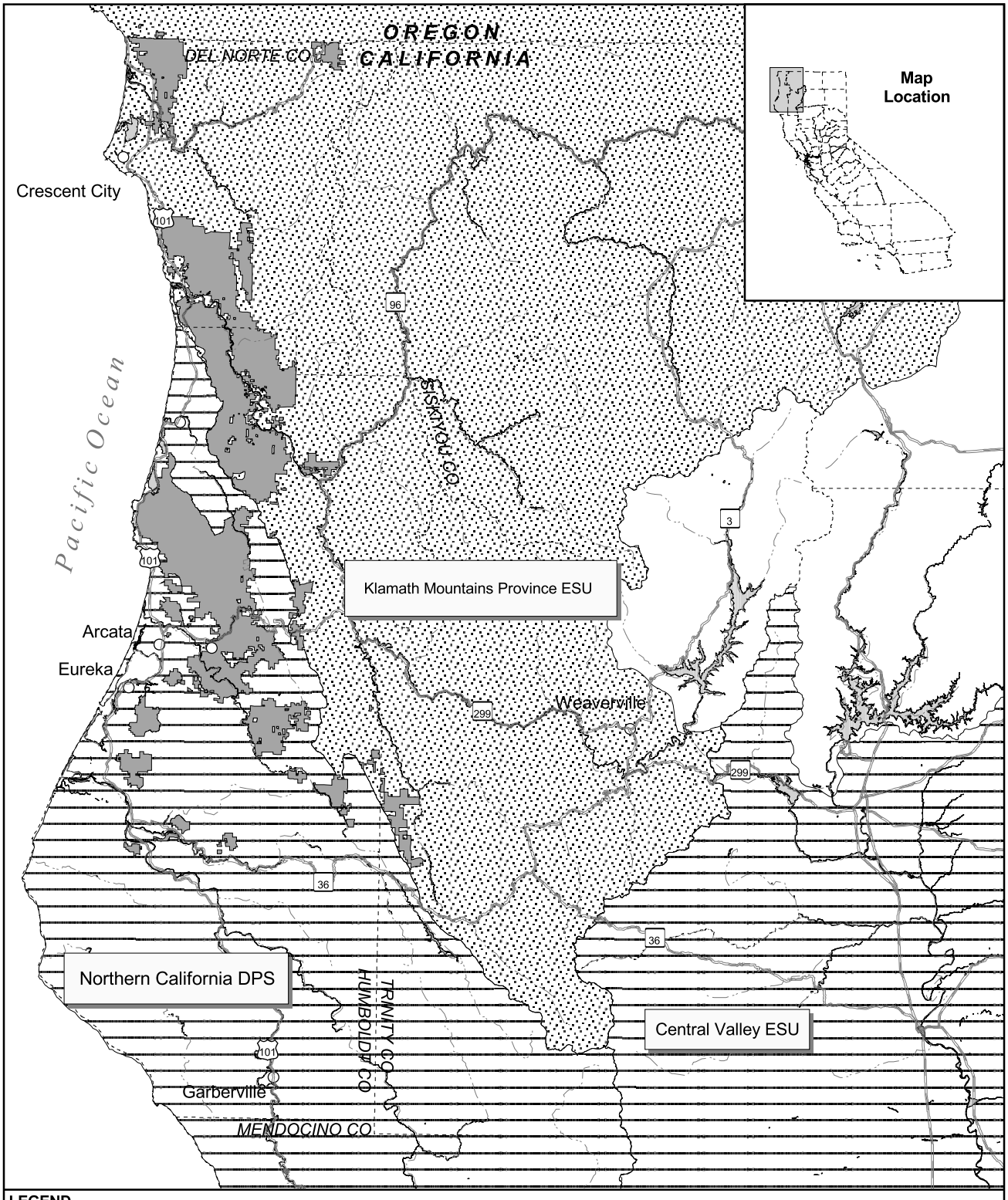

Figure 3.4-3
STEELHEAD ESU\DPS
LOCATIONS AND STATUS

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Life History and Habitat Requirements. Rainbow trout can exhibit resident freshwater and anadromous life history forms, as indicated in the summary of key life history characteristics in Table 3.4-2. Resident populations spawn from late summer through spring, with young fish emerging from the gravels in the spring and early summer. Steelhead (the anadromous form) generally rear for 2 years in freshwater before migrating to the ocean, where they typically spend two years before returning to freshwater to spawn. However, some individuals may spend 1 to 4 years at sea before reaching sexual maturity. Although steelhead are anadromous, they display different life history strategies than salmon. The most significant difference is that some steelhead survive spawning, return to the ocean for 1 or more years, then return to spawn again. Salmon only spawn once, then die.

Steelhead consist of two reproductive types, based on (1) sexual maturity at the time they enter rivers for spawning, and (2) duration of their spawning migration (Busby et al., 1996). Stream-maturing steelhead are sexually immature when they enter freshwater rivers and require several months to mature and spawn. These fish are known as summer steelhead. The other type are ocean-maturing fish, which enter rivers sexually mature and spawn shortly after entering freshwater. These steelhead are referred to as winter steelhead.

Summer run steelhead are able to use habitat not accessible to fall/winter-run salmonids (Busby et al., 1996). Summer steelhead enter freshwater between May and October. Winter steelhead enter freshwater between November and April. Steelhead in the Primary Assessment Area spawn from September to March, depending on the time of entry. Redds are constructed in areas of coarse gravel and cobbles. Fry emergence occurs in late spring. Freshwater residence varies from 1 to 4 years, but 1 to 2 years is predominant in the Primary Assessment Area. Rearing steelhead tend to inhabit riffles and higher gradient habitats. Densities of juvenile steelhead in streams are greatest where there are good amounts of instream cover (Stoltz and Schnell, 1991).

The anadromous (steelhead) and resident (rainbow trout) forms are genetically indistinguishable, and the life history and habitat requirements of resident rainbow trout are similar to those of steelhead while in the freshwater phase (with the possible exception of estuary and some mainstem habitats). Table 3.4-2 summarizes key life history and habitat requirements for steelhead and rainbow trout.

Factors Affecting Populations. NMFS concluded that all of the factors identified in Section 4(a)(1) of the ESA have played a role in the decline of steelhead. Destruction and modification of habitat, overutilization for recreational purposes, and natural and human-caused effects are listed as the primary reasons for the decline of west coast steelhead populations (March 16, 1995, 60 FR 14253).

Steelhead populations have declined in abundance over the past several decades because of natural and human factors. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Loss of habitat complexity also has contributed to steelhead declines. Sedimentation from land use activities is a primary cause of habitat degradation in the range of west coast steelhead (Busby et al., 1996).

Steelhead support an important recreational fishery. During times of decreased habitat availability (for example, during summer low flows when fish are concentrated), the impacts of recreational fishing on native anadromous stocks may increase. Incidental harvest mortality in mixed-stock sport and commercial fisheries may exceed 30 percent of listed populations. In addition, introduced non-native species and habitat modifications have led to increased predator populations in numerous river systems, and increased the level of predation on steelhead (Busby et al., 1996).

NMFS identified several factors they considered to have contributed to the decline of the Northern California steelhead DPS. These factors include impacts from historic flooding, predation, water diversions and extraction, minor habitat blockages, poaching, timber harvest, agriculture, and mining. These human-induced impacts in the freshwater ecosystem have likely reduced the species' resiliency to natural factors for decline, such as drought and poor ocean conditions (February 11, 2001, 65 FR 6960). Of recent note, poor water quality conditions in the Klamath River system in 2002 resulted heightened physiological stress on returning adult salmon, resulting in a significant disease induced die-off estimated at 344 wild adult coho salmon, 629 steelhead trout, and 33,527 adult Chinook salmon (Guillen 2002, 2003). Since this time poor water quality has also been implicated in increasing juvenile susceptability to native pathogens and is thought to be the cause significant juvenile outmigrant mortalities as well.

3.4.2.7 Tidewater Goby

Distribution. The tidewater goby is endemic to California and discontinuously distributed along the coast from Agua Hedionda Lagoon, in San Diego County, north to the mouth of the Smith River in Del Norte County (Moyle et al., 1995).

Status of Populations. The tidewater goby has been extirpated from nearly 50 percent of the lagoons within its historic range and faces threats indicating that this downward trend is likely to continue. The tidewater goby was listed as endangered under the Federal ESA in 1994 (March 7, 1994, 59 FR 5494).

Life History and Habitat Requirements. The tidewater goby is found in shallow lagoons and lower stream reaches where waters are brackish to fresh and fairly slow moving. They avoid areas of strong current and wave action. Although its closest relatives are marine species, the tidewater goby lacks a marine life history phase. All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts-per-thousand. This species occurs in loose aggregations on the substrate in shallow water less than 3 feet deep. Eggs are deposited in vertical burrows excavated in clean, coarse sand. Larval gobies are found midwater around vegetation until they become benthic and begin feeding on small invertebrates and insect larvae.

Factors Affecting Populations. Coastal development projects that result in the loss of critical saltmarsh habitat are currently the major factor adversely affecting the tidewater goby (December 11, 1992, 57 FR 58770). Other factors contributing to the decline of the population include predation by exotic species and drought conditions combined with human-induced water reductions.

3.4.2.8 Southern Torrent Salamander

Distribution. The southern torrent salamander is one of four species in the genus *Rhyacotriton* and is the most southerly ranging. It is the only species of this genus that occurs in California. Southern torrent salamanders occur within the coastal conifer forest belt of northern California and southern Oregon, specifically from southern Mendocino County, California through the Coast Ranges, to the Little Nestucca River and the Grande Ronde Valley in Polk, Tillamook, and Yamhill Counties (Good and Wake, 1992). In California, this species is found in the coastal forests of northwestern California south to Mendocino County (Anderson, 1968). Bury and Corn (1988a) believed that these salamanders are distributed as isolated, discrete populations, especially in heavily managed or drier forests.

Status of Populations. On June 6, 2000, USFWS announced that, after review, the southern torrent salamander did not warrant listing as endangered or threatened. However, USFWS recommended that the species remain on the Federal species of concern list.

The southern torrent salamander was a candidate for State listing as a threatened species. However, the California Fish and Game Commission ruled that this petition was not warranted and that CDFG should continue to consider the species as a species of special concern.

Life History and Habitat Requirements. Southern torrent salamanders have very specific habitat requirements of cold, shallow, flowing headwaters in humid coniferous forests (Nussbaum and Tait, 1977; Nussbaum et al., 1983; Diller and Wallace, 1996; Welsh and Lind, 1996). They are found most frequently in seeps, springs, and intermittent streams (Welsh, 1993) or in shallow water seeping through moss-covered gravel (Nussbaum et al., 1983). They appear to avoid open deep-water channels (Stebbins, 1985; Welsh, 1993). Adults are semiaquatic and are found next to larvae in streams, or under rocks or debris in saturated streamside habitats; larvae are aquatic and usually occur in loose gravel in streambeds (Nussbaum and Tait, 1977; Nussbaum et al., 1983). Southern torrent salamanders rarely move far from moist areas as they are very sensitive to dessication. Riparian areas are thought to be important to the species for foraging (Corn and Bury, 1989) and for courtship and reproduction (Nussbaum et al., 1983). Shade and high surface water availability are needed for movement within riparian areas. Table 3.4-3 summarizes key life history and habitat requirements for this species.

Factors Affecting Populations. The petition to list the southern torrent salamander cited habitat fragmentation, population declines, and inhibited dispersal capability throughout the species' range as significant threats to the species. Evidence indicates that timber harvesting and road building can negatively affect habitat for the southern torrent salamander. Direct effects of these activities include disturbance of substrate and killing of individual salamanders. Indirect effects include sedimentation of substrate used by the salamanders, increases in water temperatures to lethal levels, potential loss of permanent water flow, and potential increases in predator populations. The species' long lifespan may enable it to persist in marginal habitats until conditions improve. Southern torrent salamanders may also be able to burrow vertically in the substrate to find moist, cool conditions.

3.4.2.9 Tailed Frog

Distribution. The tailed frog is the only member of the genus *Ascaphus*. It is endemic to the Pacific Northwest and is widely distributed from northwestern California to British Columbia and western Montana (Nussbaum et al., 1983). Tailed frogs are found at elevations from sea level to near timber line throughout the coastal mountains from British Columbia south to Mendocino County and in the inland mountains of southeast Washington, Idaho, and Montana (Metter, 1968). In California, they occur from sea level to 6,500 feet elevation, mostly at sites receiving more than 40 inches of precipitation annually in Siskiyou, Del Norte, Trinity, Shasta, Tehama, Humboldt, Mendocino, and possibly Sonoma Counties (Bury, 1968). Throughout much of its range the species is distributed as disjunct populations (Metter, 1968). Bury and Corn (1988a) believed that isolated, discrete populations most likely occurred in drier forests and heavily managed lands.

Status of Populations. It currently is a Federal species of concern and a CDFG species of special concern.

Life History and Habitat Requirements. Tailed frogs are found in and along small, swift, permanent, mountain streams with rocky substrates and low water temperatures buffered by dense vegetation (Nussbaum et al., 1983; Reichel and Flath, 1995; Daugherty and Sheldon, 1982). Streams supporting tailed frogs primarily occur in mature (Aubry and Hall, 1991) or old-growth coniferous forests (Bury, 1983; Bury and Corn, 1988a). More tailed frogs were observed in older Douglas fir-dominated, mixed conifer/hardwood forests near cold, clear, fast-flowing streams than in younger forests with the same type streams (Welsh, 1990). In the Coast Range of western Oregon, Corn and Bury (1989) found tailed frogs were more common in dense, moist, and young and mature forests, and absent from recent clearcuts. Tailed frogs tend to avoid wetlands, marshes, ponds, lakes, and slow, sandy-bottom streams (Daugherty and Sheldon, 1982). Table 3.4-3 summarizes key life history and habitat requirements of tailed frogs.

Factors Affecting Populations. Tailed frogs were considered rare for many years, but are now known to occur in high densities in suitable habitats (Nussbaum et al., 1983). Bury and Corn (1988a) and Welsh (1990) believed that long-term, range-wide reductions or extinctions of tailed frogs were likely caused by local extirpations, increased population fragmentation, habitat loss, restricted gene flow, and limited recolonization of streams when habitats are re-established. Although the survival of tailed frogs may depend on protection of cool flowing streams and adjacent forest habitats (Bury and Corn, 1988b), timber harvesting is not incompatible with such protection (Welsh, 1990). Bury and Corn (1988a) recommended establishing protection zones for tailed frogs by retaining deciduous and small (cull) trees around streams while felling merchantable timber away from the streams.

3.4.2.10 Foothill Yellow-Legged Frog

Distribution. The foothill yellow-legged frog is found west of the Oregon Cascades and south to Baja California, Mexico. Historically, this species was known to occur in most Pacific drainages from the Santiam River system in Oregon to the San Gabriel River system in Los Angeles County, California (Jennings and Hayes, 1994). In California, the foothill yellow-legged frog was historically distributed throughout the foothills of most drainages from the Oregon border to the San Gabriel River. This species is currently found throughout the northern and central Coast Ranges and Sierra Nevada foothills (Jennings and Hayes, 1994).

Status of Populations. The foothill yellow-legged frog has become absent from many locations where it was historically present in the Sierra Nevada foothills and southern portions of its range. The species is still abundant in many drainages in northwestern California and appears to still be distributed throughout its historic range. Jennings and Hayes (1994) described this species as endangered in central and southern California south of the Salinas River; threatened in the west slope drainages of the Sierra Nevada and southern Cascade Mountains east of the Sacramento and San Joaquin Rivers; and of special concern in the Coast Ranges north of the Salinas River. The foothill yellow-legged frog is considered a species of special concern and is fully protected by the State of California. This species also is a Federal species of concern and is considered a sensitive species by the USFS.

Life History and Habitat Requirements. This species is typically associated with valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow habitat types (Zeiner et al., 1988). Foothill yellow-legged frogs are closely confined to the vicinity of permanent streams (Leonard et al., 1993) and intermittent streams (Hayes and Jennings, 1988). Shallow streams with a rocky substrate (at least cobble size) are preferred (Hayes and Jennings, 1988). Within streams with these characteristics, foothill yellow-legged frogs prefer riffles to other stream habitats (Hayes and Jennings, 1988). Foothill yellow-legged frogs appear to prefer streams with partial shading, often avoiding streams with very high (i.e., greater than 90 percent) or very low (i.e., less than 2 percent) stream shading (Hayes and Jennings, 1988). Females attach eggs to cobbles and boulders in shallow water where the eggs survive better than those laid in narrower and deeper channels. Kupferberg (1996) reported that most breeding sites were used repeatedly from year to year.

Factors Affecting Populations. The reduction in this species' distribution has been attributed primarily to dam building and flood control, mining, farming and canal building, urbanization (Jennings, 1988), and the introduction of aquatic predators (i.e., various fishes and bullfrogs) (Jennings and Hayes, 1994).

3.4.2.11 Northern Red-Legged Frog

Distribution. The northern red-legged frog is found in California, Oregon, Washington, and Canada (Nussbaum et al., 1983; Leonard et al., 1993). In California, this subspecies of red-legged frog is found west of the Cascade crest and as far south as Humboldt County. Northern red-legged frog and populations intermediate between northern and California red-legged frogs extend from Marin County north to the California/Oregon border (Jennings and Hayes, 1994).

Status of Populations. Declines in northern red-legged frog populations have been reported in British Columbia, Washington, and Oregon (Jennings and Hayes, 1994). Sufficient information has not yet been collected in California to assess overall population trends (Jennings and Hayes, 1994). The northern red-legged frog is considered a species of special concern and is fully protected by the State of California. This species also is a Federal species of concern and is considered a sensitive species by the USFS.

Life History and Habitat Requirements. Most red-legged frogs are found in moist or wet forest areas and riparian habitats below 2,800 feet (Nussbaum et al, 1983), but they have been reported up to 4,680 feet (Leonard et al., 1993). During the non-breeding season, the

red-legged frog is highly terrestrial and can be found up to 1,000 feet from water (Nussbaum et al., 1983). The red-legged frog feeds almost exclusively on land, along the water's margin, and in the vegetation (Licht, 1986), but it typically breeds in marshes, bogs, ponds, lakes, and slow-moving streams with dense streamside vegetation (Stebbins, 1972; Leonard et al., 1993). Studies by Aubry and Hall (1991) and Corn and Bury (1989) have shown the highest abundance in mature forest, with lower numbers in old-growth forest, young forest, and clearcuts. In addition, Aubry and Hall (1991) found positive correlations between red-legged frog abundance and the density of broadleaf trees and percent cover of mid-canopy broadleaf trees.

Factors Affecting Populations. Little information is available concerning the causes for the observed decline of this subspecies, but bullfrog and exotic predatory fish introductions, pesticides, herbicides, coastal development, and timber harvesting have been implicated as contributing factors (Blaustein et al., 1995; Jennings and Hayes, 1994).

3.4.2.12 Western Pond Turtle

Distribution. The western pond turtle historically ranged nearly continuously in most Pacific drainages from Klickitat County, Washington to northern Baja California, Mexico, chiefly west of the Sierra-Cascade crest (Jennings and Hayes, 1994). In California, this species was historically present in most Pacific slope drainages between the Oregon and Mexican borders (Jennings and Hayes, 1994).

Status of Populations. Jennings and Hayes (1994) consider the western pond turtle to be threatened in California and endangered from the Salinas River south along the coast and inland from the Mokelumne River southward. Although the western pond turtle appears to still occur in most areas where it was reported historically, some populations are showing little or no recruitment. Substantial declines in western pond turtle numbers have been reported outside of California (see Jennings and Hayes, 1994). The western pond turtle is considered a species of special concern and is fully protected by the State of California. This species also is considered a Federal species of concern and a sensitive species by the USFS.

Life History and Habitat Requirements. The western pond turtle has been described as an aquatic habitat generalist (Holland, 1991), but within the aquatic habitats used by the turtle, its distribution may vary seasonally and locally. The western pond turtle requires some slack-or slow-water aquatic habitat and inhabits a wide variety of fresh or brackish, permanent or intermittent water bodies. It typically occurs in marshes, lakes, ponds, brackish waters, slow-moving streams and rivers with adjacent vegetation mats, partially submerged logs, boulders, mudflats, and undercut banks and rootwads to serve as either basking or cover habitat (Blaustein et al, 1995). Habitats that lack these refugia are typically avoided by the turtle (Holland, 1994). Aquatic over-wintering sites are found along undercut banks and in soft mud of ponds (Holland, 1994). Western pond turtles can be sensitive to human disturbance, which can affect basking and nesting (Blaustein et al., 1995).

Western pond turtles use terrestrial habitats for nesting and hibernation (Holland, 1994). Mating occurs in April and May, and females move away from watercourses from June through August and migrate upslope to excavate nests up to 1,640 feet from the water's edge (Rathbun et al., 1992). Females are very sensitive to disturbance during this time and may return to the watercourse if disturbed (Holland, 1994). Time spent in terrestrial habitats

is variable, varying from locations in southern California where turtles have remained for two to three months to locations in Oregon where turtles have remained at overwintering sites for up to eight months. Overwintering sites generally have been located on slopes less than 35° in duff composed of conifer or broadleaf material (Holland, 1994). Hatchlings may overwinter in nest sites (Rathbun et al., 1992).

Factors Affecting Populations. Agricultural activities, urbanization, flood control, water diversion projects, and introduced predatory fish have contributed to population declines (Jennings and Hayes, 1994). Bullfrogs prey on hatchling and juvenile turtles and bass are known to prey on the smallest juveniles (Jennings and Hayes, 1994). Protection of suitable nesting habitat associated with existing populations and reduction in mortality of the younger age groups of turtles have been recommended to reverse the declining trend observed in western pond turtle populations (Jennings and Hayes, 1994).

3.4.3 Other Aquatic Resources

Other representative groups of aquatic resources present within the Primary Assessment Area and the additional 25,677 rain-on-snow acres under Alternative C besides the fish, amphibian, and reptile covered species described above include the following:

- Other native fish species such as lamprey, sturgeon, suckers, smelt, sculpins, and minnows
- Non-native (introduced) salmonids such as brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and hatchery-reared rainbow trout (*Oncorhynchus mykiss*)
- Non-native, non-salmonids such as sunfishes and bass
- A variety of aquatic invertebrates such as insects, crustaceans, clams, and snails

Numerous interactions can occur among these representative groups under existing conditions. Introduced salmonids can adversely affect some species of native salmonids by competing for space or food, or in some cases by preying on smaller life stages of native salmonids. For example, brook trout and brown trout can potentially compete for food and space with some life stages of native salmonids, and larger brown trout tend to be highly piscivorous in their diet. Native fishes, such as sculpin, provide a food source for native salmonids and introduced salmonids. All native aquatic species, including aquatic invertebrates, which are a major food source for most fish during all or parts of their lives, benefit from the same broad conditions that benefit the covered species. These conditions include cool, clean water and access to complex, diverse habitat.

3.4.4 Aquatic Habitat Conditions

This section provides descriptions of aquatic habitat conditions within the 11 HPAs previously discussed in Sections 3.2, Geology, Geomorphology, and Mineral Resources, and Section 3.3, Hydrology and Water Quality. These descriptions have been summarized from available information on the affected environment presented in Section 4 of Green Diamond's proposed AHCP/CCAA. HPAs encompassing complete drainage areas are referred to as "hydrologic units," whereas those encompassing partial or multiple watersheds are referred to as "hydrographic areas."

In general, the region encompassed by the 11 HPAs is characterized by the following:

- The steep and rugged terrane of the Coast Ranges and Klamath Mountains
- Geologic formations that range in age from pre-Jurassic to Recent and are marked by extensive folds and fault lines
- Several highly unstable geologic formations, including the Franciscan, Wildcat, and Falor formations
- Seasonally intense precipitation
- More than a century of logging, mining, road building, and grazing

Combined, these factors have altered stream conditions and increased hillslope erosion in most coastal watersheds. As a result of excess sedimentation and/or potential temperature concerns in several inland areas, the Klamath River, Redwood Creek, Mad River, Eel River, and Van Duzen River watersheds are included on the Section 303(d) list of impaired watersheds developed by the U.S. EPA and SWRCB (see Table 3.3-2 for a listing of 303(d) listed watersheds and pollutants).

Current habitat conditions and status of AHCP/CCAA covered aquatic species vary by HPA. Water temperatures in the HPAs are described in Section 3.3. Where data are available, current aquatic habitat conditions and status of AHCP/CCAA aquatic species are summarized below for the individual HPAs and the additional rain-on-snow areas outside of the HPAs that would be covered under Alternative C. Occurrence of covered species within the 11 HPAs for all project alternatives is summarized in Table 3.4-4.

3.4.4.1 Smith River Hydrographic Region

Channel and Estuary Conditions. Channel and habitat typing assessments have been conducted on 58 streams throughout the Primary Assessment Area. Four streams were examined within the Smith River Hydrographic Region: Wilson Creek, Dominie Creek, Rowdy Creek, and the South Fork Winchuck River (see Appendix C-1 of the AHCP/CCAA). Partitioning of habitat into pools, riffles, and runs showed a high percentage of riffles on Dominie Creek (51 percent) and the S.F. Winchuck River (41 percent), and a relatively even distribution of habitat types in the other two creeks. Dominie Creek had high levels of pool tailout embeddedness and shallow pool depths, while the other three creeks had low to moderate embeddedness and moderate to deep pools. Canopy density was relatively low on Rowdy Creek (63 percent) and higher on Wilson Creek, Dominie Creek, and S.F.Winchuck River (79 percent to 94 percent). The species composition of the riparian canopy was predominantly deciduous on all streams. Large woody debris (LWD) was not the dominant structural shelter component in any reach within the Smith River Hydrographic Region. Rowdy Creek and S.F. Winchuck River had only 5.6 percent and 6.4 percent LWD as shelter in pools, while Dominie Creek had 18.2 percent and Wilson Creek had 21.8 percent. Long-term channel monitoring is ongoing in two locations within the Smith River Hydrographic Region. Monitoring began on the South Fork Winchuck in 1996 and on Wilson Creek in 1998. No conclusions can be drawn at this point from the monitoring.

TABLE 3.4-4
Occurrence of Species Covered Under Project Alternatives in Hydrographic Planning Areas

Species	Smith River	Coastal Klamath	Blue Creek	Interior Klamath	Redwood Creek	Coastal Lagoons	Little River	Mad River	NF Mad River	Humboldt Bay	Eel River
Fish											
Chinook salmon	K	K	K	K	K	K	K	K	K	K	K
Coho salmon	K	K	K	K	K	K	K	K	K	K	K
Steelhead	K	K	K	K	K	K	K	K	K	K	K
Rainbow trout	K	K	K	K	K	K	K	K	K	K	K
Cutthroat trout	K	K	K	K	K	K	K	K	K	K	K
Tidewater goby	K	P	N	N	P	K			N	K	P
Amphibians and Reptiles											
Tailed frog	K	K	K	K	K	K	K	K	K	K	K
Southern torrent salamander	K	K	K	K	K	K	K	K	K		K
Foothill yellow-legged frog	K	K	K	K	K	K	K	K	K	K	K
Northern red-legged frog	K	K	K	K	K	K	K	K	K	K	K
Western pond turtle	P	K	K	K	K	P	K	K	K	P	P

K Known
P Presumed
N Does not occur
blank unknown

An LWD inventory was conducted in 20 streams throughout the Primary Assessment Area in 1994 and 1995, including four streams within the Smith River Hydrographic Region: Rowdy Creek, Dominie Creek, South Fork Winchuck River, and Wilson Creek (see Appendix C-2 of the AHCP/CCAA). There was a moderate level of both inchannel and recruitment zone LWD, but the size of the in-channel LWD was predominantly small (less than 2 foot diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Smith River Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The Winchuck River estuary has been impacted by a reduction of habitat through channelization for livestock grazing. The mouth of the Winchuck River regularly bars over during the summer to form an enclosed estuary. This estuary is occupied by juvenile Chinook salmon and coastal cutthroat trout during the summer months. The estuary habitat for rearing salmonids is limited because of both a lack of depth and LWD for protective cover and avian predator avoidance. Efforts are underway by the Oregon Department of Fish and Wildlife to enhance the rearing habitat in the Winchuck River estuary.

The lower channel and estuary of the Smith River has been altered and simplified by agriculture, livestock grazing, gravel mining, and urban development. The loss of secondary channels, sloughs, backwaters, and LWD has reduced the amount and complexity of salmonid rearing habitat. The Smith River mouth generally remains open and fails to bar over to form an enclosed estuary.

The lower section of the Wilson Creek watershed lacks an estuary. The creek runs directly into a semi-protected section of coastline where wave action at the creek's entrance is cushioned by exposed rocks. Flow in the lower channel is intermittent during the summer, thus out-migrating salmonid smolts have a discrete window in which to leave the watershed.

Species Status. The Smith River Hydrographic Region is in the Southern Oregon and Northern California Coastal ESU for Chinook salmon, which NMFS determined does not warrant listing (September 16, 1999, 64 FR 50394). Juvenile Chinook production is thought to be increasing in the Winchuck River. The Smith River has the only known spring-run Chinook population in the Northern California Coastal Chinook ESU. Chinook are well distributed in smaller coastal streams in the SONCC Chinook salmon ESU, and recent increases in abundance have been noted in these smaller coastal streams (September 16, 1994, 64 FR 50394).

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Smith River Hydrographic Region. Current abundance in the California portion of this ESU is thought to be less than 6 percent of the abundance in the 1940s (Weitkamp et al., 1995). The SONCC coho salmon ESU was listed as threatened under the ESA on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Spawner surveys and outmigrant trapping on Mill Creek, tributary to the Smith River, indicate that Mill Creek supports an abundant coho run (Howard, unpubl. data). Recent surveys of coho salmon conducted by Green Diamond (both spawner/carcass and juvenile counts) in the South Fork Winchuck River and Wilson Creek indicate that runs

in both streams are low and variable. The annual estimate of juvenile coho salmon in Wilson Creek has varied widely from less than 20 to nearly 1,400 juveniles during the 1995-2000 period. Coho estimates in the South Fork Winchuck River have been much lower than those in Wilson Creek over the same period (see Appendix C-7 of the AHCP/CCAA).

The Smith River Hydrographic Region is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing as of April 4, 2001 (66 FR 17845). Steelhead populations in the Winchuck River were assessed as "Healthy" by the Oregon Department of Fish and Wildlife (ODFW)/CDFG (Nickelson et al., 1992). Smith River fall-run steelhead were considered "Healthy" by ODFW/CDFG but summer-run fish were considered at high risk of extinction by Nehlsen et al. (1991) and as depressed by the USFS (from Busby et al., 1994). Annual juvenile steelhead population estimates at Wilson Creek and the South Fork Winchuck River are highly variable, ranging from a few hundred to more than 3,000 during the 1995-2000 period (see Appendix C-7 of the AHCP/CCAA).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout populations in southern Oregon and northern California are thought to be widely distributed in many small populations, with the exception of the Rogue and Smith Rivers, which support large and healthy populations (Johnson et al., 1999).

The Smith River is considered California's most important producer of coastal cutthroat trout. Cutthroat trout abundance trends in the Smith River increased 1 percent to 5 percent annually from 1982 to 1998 (Johnson et al., 1999). In addition, smolt abundance in Mill Creek (tributary to the Smith River) has increased during years 1994 though 1997 (Howard and Albro, 1997). Habitat in the Smith River estuary has been substantially degraded and cutthroat trout populations in the estuary are very low compared to historical estimates (Gerstung, 1997). Smolt counts in the Winchuck River from 1996 to 1998 show high variation, but the numbers trapped are encouraging, showing increases from 1,400 to 2,800 during this time period (Johnson et al., 1999). Cutthroat trout population estimates in the South Fork Winchuck have remained relatively stable at approximately 400 to 500 juveniles during the 1996 to 2000 period. No cutthroat were observed in Wilson Creek in 1997 and 1999 and estimates have ranged from less than 20 to approximately 160 in other years (see Appendix C-7 of the AHCP/CCAA).

Green Diamond conducted presence/absence surveys for tailed frogs in this HPA as part of a sampling of 72 streams throughout the entire Action Area to estimate the proportion of streams that supported populations of tailed frogs (Diller and Wallace 1999). In the Smith River Hydrographic Region, eight of eight (100 percent) streams sampled as part of presence/absence surveys had tailed frogs. In addition, populations of tailed frogs were confirmed in 27 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and the large number of streams known to support the species, tailed frogs streams in the Smith River Hydrographic Region appear to be in excellent condition.

Green Diamond conducted presence/absence surveys for southern torrent salamanders in this HPA as part of a sampling of 71 streams throughout the entire Action Area to estimate the proportion of streams that supported populations of southern torrent salamanders (Diller and Wallace 1996). In the Smith River HPA, seven of seven (100 percent) streams

sampled as part of presence/absence surveys had torrent salamanders. In addition, populations of torrent salamanders were confirmed in 68 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Smith River Hydrographic Region appear to be in excellent condition.

3.4.4.2 Coastal Klamath Hydrographic Region

Channel and Estuary Conditions. Twenty-two creeks were examined within the Coastal Klamath Hydrographic Region, 6 by Green Diamond personnel and 16 by the Yurok Tribal Fisheries Program (YTFP) (see Appendix C-1 of the AHCP/CCAA). Canopy closure was relatively high (from 76 to 97 percent) in the 22 creeks assessed with the exception of Terwer and East Fork Terwer Creek, which were recovering from an extremely hot wildfire in 1988 and had canopy closure of 36 percent and 71 percent, respectively. The riparian canopy was primarily deciduous (from 73 percent to 97 percent) along all the creeks assessed. The percentage of LWD as the dominant structural shelter component in pools varied widely within the Coastal Klamath Hydrographic Region from a low of 6.8 percent in East Fork Terwer Creek to a high of 55.1 percent in East Fork Hunter Creek. The average value for the 22 creeks was 26.3 percent. Partitioning of habitat into pools, riffles, and runs showed a high percentage of riffles on Bear Creek (58 percent) and South Fork Ah Pah Creek (46 percent). Of the 22 assessed creeks, 17 had sections of dry channel, ranging from 1 to 86 percent of the total length surveyed. Mynot, Hunter, EF Hunter, Hoppaw, and Main Stem Ah Pah Creeks, all had over 24 percent of their total length in dry channel, and were the highest among the 22 creeks surveyed. Omagar Creek had 23 percent of the total length in culverts.

Fourteen of the 22 creeks assessed had high pool tailout embeddedness values (60 percent or more of pool tailouts reported as at least 50 percent embedded). Fourteen of the 22 creeks had predominantly (greater than 50 percent) shallow (less than 2 feet) pools.

Long-term channel monitoring is ongoing at four locations within the Coastal Klamath Hydrographic Region: two sites on Hunter Creek, and one site each on Hoppaw Creek and Tectah Creek. Monitoring began in 1996 on one site in Hunter Creek and in 1997 at the other three sites. No conclusions can be drawn at this point from the monitoring.

A LWD inventory was conducted during 1994 and 1995 in five streams within the Coastal Klamath Hydrographic Region: Hunter Creek, Terwer Creek, the North and South Forks of Ah Pah Creek, and Ah Pah Creek (see Appendix C-2 of the AHCP/CCAA). The mainstem and North and South Forks of Ah Pah Creek had some of the highest amounts of LWD of all the creeks surveyed in the Primary Assessment Area. Overall, there was a moderate level of both in-channel and recruitment zone LWD, but the size of the in-channel LWD was predominantly small (1 to 2 feet in diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Coastal Klamath Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

Like most northcoast watersheds, the Klamath River estuary has been impacted by human activities. The lower channel has lost some its wetland habitat to residential development. The estuary has been degraded by excessive sedimentation from the upper basin. The lower channel was also extensively cleared of snags and large woody debris at the turn of the century for commercial gillnetting and navigational purposes. Water diversions from the upper Klamath and Trinity Rivers affect the water quality of the estuary during summer months and probably contribute to the occasionally high water temperatures. Even with a large volume of flow, the Klamath River mouth periodically bars over and backfloods the lower river for several miles.

Species Status. Like the Smith River Hydrographic Region, the Coastal Klamath Hydrographic Region is in the SONCC ESU for Chinook, which NMFS has determined does not warrant listing (September 16, 1999, 64 FR 50394). Within this ESU, Chinook are well distributed in smaller coastal streams, and recent increases in abundance have been noted in these smaller coastal streams (September 16, 1999, 64 FR 50394). Chinook escapement in the Klamath Basin is greatly reduced from historic estimates and current escapement levels are dependent on hatchery production (Voight and Gale, 1998).

Coho populations are depressed throughout the SONCC ESU for coho salmon, which includes the Coastal Klamath Hydrographic Region. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Coho runs in the Klamath Basin are greatly diminished from historical estimates and are largely hatchery supported today, although small wild runs exist in some tributaries (Weitkamp et al., 1995). Juvenile coho were present in 8 of 12 tributaries sampled by the YTFP within the Coastal Klamath Hydrographic Region in 1996, but were generally scarce and narrowly distributed within these tributaries (Voight and Gale, 1998). The ratio of wild fish to hatchery fish spawning naturally in these tributaries is unknown.

The Coastal Klamath Hydrographic Region is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing (April 4, 2001, 66 FR 17845). Specific information on steelhead in the Coastal Klamath Hydrographic Region is limited. YTFP sampling found juvenile steelhead to be well distributed in Coastal Klamath tributaries (100 percent presence, n=12 tributaries sampled), but no estimates of abundance were made (Voight and Gale, 1998). Steelhead populations in the Klamath River as a whole are significant, (summer/fall-run size of 110,000 fish, winter-run size of 20,000 fish) but believed to be largely hatchery supported (Busby et al., 1994).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Short-term trends indicate increases in adult cutthroat trout abundance in the lower Klamath River and its tributaries (Johnson et al., 1999). The YTFP found juvenile coastal cutthroat trout to be well distributed and relatively abundant in Coastal Klamath Hydrographic Region tributaries (present in 10 of 12 tributaries sampled). However, the dominance and abundance of (presumably) resident cutthroat in areas above barriers to anadromy could mask declines in anadromous sea-run coastal cutthroat trout populations (Voight and Gale, 1998).

In the Coastal Klamath Hydrographic Region, 16 of 17 (94.1 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition,

populations of tailed frogs were confirmed in 26 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, tailed frogs streams in the Coastal Klamath Hydrographic Region seem to be in excellent condition.

In the Coastal Klamath Hydrographic Region, 15 of 16 (93.8 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 81 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Coastal Klamath Hydrographic Region appear to be in excellent condition.

3.4.4.3 Blue Creek Hydrologic Unit

Channel and Estuary Conditions. Green Diamond has not conducted any channel and habitat typing assessment in the Blue Creek Hydrologic Unit. The YTFP has conducted channel and habitat typing on four streams in the Blue Creek Hydrologic Unit: mainstem Blue Creek, West Fork Blue Creek, Potato Patch Creek, and Slide Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density was high on West Fork Blue Creek (87 percent) and Potato Patch Creek (95 percent), but low on main stem Blue Creek and Slide Creek (42 percent and 38 percent, respectively). The riparian canopy was predominantly deciduous, ranging from 66 to 91 percent in three of the four creeks. Riparian canopy was predominantly conifers on Slide Creek. LWD was a very small component of structural shelter in pools, with values varying from 1.5 to 6 percent in the surveyed creeks. Partitioning of habitat into pools, riffles, and runs showed a high (49 percent) percentage of riffles on West Fork Blue Creek and mainly flatwater and pools on the other three creeks.

Blue Creek and Slide Creek had low levels of pool tailout embeddedness, while more than 55 percent of pool tailouts in West Fork Blue and Potato Patch Creeks were at least 50 percent embedded. Blue Creek had predominantly deep pools (greater than 4 feet), while pools in the other three creeks were mostly less than 3 feet deep. No long-term channel monitoring have been conducted by Green Diamond in this HPA.

An LWD inventory was conducted during 1994 and 1995 in one stream within the Blue Creek Hydrologic Unit (see Appendix C-2 of the AHCP/CCAA). The number of instream LWD pieces per 100 feet of channel in West Fork Blue Creek (3.2) was somewhat greater than in other streams with similar watershed areas in the Primary Assessment Area.

Species Status. The Blue Creek Hydrologic Unit is in the SONCC ESU for Chinook salmon, which NMFS has determined does not warrant listing (September 16, 1999, 64 FR 50394). Blue Creek Chinook salmon populations have been monitored by the USFWS (1988 to 1992) and are currently monitored by the YTFP. Chinook escapement in the Klamath Basin is greatly reduced from historic estimates, but Blue Creek has a significant Chinook population that showed variable but overall increasing trends in both adult escapement and juvenile outmigrant abundance from 1988 to 1996. (Gale et al., 1998). Compared with other non-hatchery enhanced tributaries with similar drainage areas, Blue Creek Chinook are thought to be a significant component of the wild Chinook run in the Klamath Basin (Gale et al., 1998).

Coho populations are depressed throughout the SONCC ESU for coho salmon, which includes the Blue Creek Hydrologic Unit. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. The Blue Creek Hydrologic Unit is somewhat unique in that it supports a significant population of native coho salmon with no evidence of hatchery produced fish in a river system otherwise characterized by heavy hatchery production and planting within many tributaries (Weitkamp et al., 1995, Gale et al., 1998). Estimates and trends in spawner escapements are hampered by low numbers of spawners and the difficulty in enumerating adult coho salmon, especially during high flow/poor visibility conditions. Qualitative snorkeling surveys indicate that portions of the Blue Creek Hydrologic Unit (especially the Crescent City Fork) have ideal spawning and rearing habitat for coho, and juvenile coho were observed utilizing this habitat in high densities (Gale et al., 1998).

The Blue Creek Hydrologic Unit is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing (April 4, 2001, 66 FR 17845). The Blue Creek Hydrologic Unit has ideal habitat for steelhead, and is thought to contain a large population of winter-run steelhead as well as a small number of summer-run steelhead. Snorkel surveys found juvenile steelhead to be abundant and well distributed throughout Blue Creek (Gale et al., 1998).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Short-term trends indicate increases in adult cutthroat trout abundance in the lower Klamath River and its tributaries (Johnson et al., 1999). The YTFP reports that Blue Creek supports a small population of coastal cutthroat trout (Gale et al., 1998).

In the Blue Creek Hydrologic Unit, two of three (66.7 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in seven other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. This HPA is very similar to the Coastal Klamath Hydrographic Region, which appears to have excellent habitat for tailed frogs.

In the Blue Creek Hydrologic Unit, four of four (100 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 32 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. This HPA is very similar to the Coastal Klamath Hydrographic Region, which appears to have excellent habitat for torrent salamanders.

3.4.4.4 Interior Klamath Hydrographic Region

Channel and Estuary Conditions. Green Diamond has not conducted any channel and habitat typing assessments in the Interior Klamath Hydrographic Region. The YTFP has conducted channel and habitat typing on 11 streams in the Interior Klamath Hydrographic Region: Johnson, Pecwan, East Fork Pecwan, Mettah, South Fork Mettah, Roach, a tributary to Roach, Morek, Cappel, Tully, and Robbers Creeks (see Appendix C-1 of the AHCP/CCAA). Canopy density ranged from 74 percent to 94 percent in the creeks surveyed. The riparian canopy was

predominantly deciduous in all 11 creeks. Morek and Cappel Creeks had the greatest amount of conifer canopy (34 and 41 percent, respectively). The percent of LWD as a component of structural shelter in pools ranged from 1.7 percent in Pecwan Creek to 19.9 percent in South Fork Mettah Creek. The average value was 9.2 percent. Partitioning of habitat into pools, riffles, and flatwater showed that pools and flatwater comprised more than 70 percent of the total length in all ten creeks surveyed. Six streams had sections of dry channel, ranging from 1 percent in Robbers Creek to 13 percent in Johnson and Morek Creeks.

Ten of the streams assessed had high levels of pool tailout embeddedness (greater than 75 percent of pools at least 50 percent embedded). Tully Creek was the one exception. At least 50 percent of the pools in six creeks were greater than 2 feet deep, while Johnson, Mettah, South Fork Mettah, and the Roach Creek tributary Creeks exhibited mainly shallow pools (less than 2 feet deep). No long-term channel monitoring or LWD surveys have been conducted by Green Diamond in this HPA.

Species Status. The Interior Klamath Hydrographic Region is in the SONCC Chinook salmon ESU, which NMFS determined does not warrant listing as of September 1999 (64 FR 50394). Specific information on Chinook salmon in the Interior Klamath Hydrographic Region is limited. Chinook escapement in the Klamath Basin is greatly reduced from historic estimates and current escapement levels are dependent on hatchery production (Voight and Gale, 1998). Portions of this HPA also overlap with the Upper Klamath-Trinity Rivers ESU Chinook salmon, which NMFS has also determined does not warrant listing (63 FR 11482).

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Interior Klamath Hydrographic Region. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Specific information on coho salmon in the Interior Klamath Hydrographic Region is limited. Recent sampling (1996) by the YTFP observed low numbers of juvenile coho in two of three tributaries that have historically been reported to have coho (Voight and Gale, 1998).

The Interior Klamath Hydrographic Region is within the Klamath Mountains Province steelhead ESU for steelhead, which NMFS determined does not warrant listing as of April 4, 2001 (66 FR 17845). Attempts to assess the population status of steelhead in this ESU are hampered by a lack of biological information. In general, there has been a replacement of naturally produced fish with hatchery fish, and downward trends in abundance in most populations (Busby et al., 1994). Specific steelhead population abundance estimates for streams within the Interior Klamath Hydrographic Region are generally non-existent. YTFP sampling (1996) found juvenile steelhead are well-distributed in Interior Klamath tributaries (100 percent presence, n=4 tributaries sampled), but no estimates of abundance were made (Voight and Gale, 1998).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Specific information on coastal cutthroat trout populations in the Interior Klamath Hydrographic Region is almost non-existent. The YTFP found coastal cutthroat in one of four Interior Klamath Hydrographic Region tributaries surveyed in 1996 (Gale et al., 1998). Gerstung (1997) suggests that coastal cutthroat trout typically do not occur above Mettah Creek.

In the Interior Klamath Hydrographic Region, seven of 11 (63.6 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in five other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this moderate rate of occurrence and relatively small number of streams known to support the species, tailed frogs streams in the Interior Klamath Hydrographic Region appear to be in moderate condition.

In the Interior Klamath Hydrographic Region, 10 of 11 (90.9 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 56 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Interior Klamath Hydrographic Region appear to be in excellent condition.

3.4.4.5 Redwood Creek Hydrologic Unit

Channel and Estuary Conditions. No channel or habitat typing assessments, long-term channel monitoring or LWD surveys have been conducted by Green Diamond in this HPA. After the flood of 1964, which inundated the town of Orick with five feet of water, the U.S. Army Corps of Engineers (Corps) constructed a levee from Prairie Creek to the ocean. During low summer flows, the north and south sloughs of the estuary become isolated and anoxic. The lower three miles of Redwood Creek also are devoid of riparian vegetation and LWD because the Corps requires that the levee's channel be clear of debris, that may lessen its transport capacity.

Species Status. The Redwood Creek Hydrologic Unit is the northernmost boundary of the California Coastal ESU for Chinook salmon, which was listed as threatened under the ESA on September 16, 1999 (64 FR 50394). Low abundance levels, sporadic occurrence in some river systems, and negative long term trends in abundance were cited in the decision to list the California Coastal Chinook salmon ESU as threatened (September 16, 1999, 64 FR 50394). Specific information on Chinook in the Redwood Creek Hydrologic Unit is limited. Nehlsen et al. (1991) characterized fall-run Chinook in Redwood Creek as at "moderate risk of extinction," and a reanalysis by Higgins et al. (1992) resulted in an upgrade in status to "stocks of special concern."

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Redwood Creek Hydrologic Unit. Current coho salmon abundance in the California portion of this ESU is thought to be less than 6 percent of their abundance in the 1940s (Weitkamp et al., 1995). The SONCC coho ESU has been listed as threatened under the ESA as of May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005.

The Redwood Creek Hydrologic Unit is the northern boundary of the Northern California DPS for steelhead, which was listed as threatened on January 5, 2006 (71 FR 834). Steelhead abundance data is very limited for this DPS, but available data indicates that winter-run steelhead populations declined significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then. Nehlsen et al. (1991) identified summer

steelhead in Redwood Creek as "at risk of extinction." NMFS found that for the populations of steelhead within this DPS only the small summer steelhead population within the Mad River, which has had large supplemental production from hatchery sources, and Prairie Creek winter steelhead have shown recent trends of increasing abundance (June 7, 2001, 65 FR 36074). Prairie Creek is a tributary to Redwood Creek and as such is within the Redwood Creek Hydrologic Unit.

Redwood Creek historically supported a large population of anadromous coastal cutthroat trout. The current population is thought to be very depressed compared to historical estimates, but relatively stable (Gerstung, 1997). Severe alteration of the estuary environment and habitat degradation from logging in the 1950s and 1960s, compounded by the 1964 flood, are believed to be largely responsible for the depressed cutthroat trout population in Redwood Creek (Gerstung, 1997). This species is now under the jurisdiction of the USFWS and is undergoing a status review.

In the Redwood Creek Hydrologic Unit, six of six (100 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 11 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. The high rate of occurrence and significant number of other streams known to support the species suggest that tailed frogs streams in the Redwood Hydrologic Unit are in good condition.

In the Redwood Creek Hydrologic Unit, five of six (83.3 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 61 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. The high rate of occurrence and large number of other streams known to support the species suggest that torrent salamander streams in the Redwood Creek Hydrologic Unit are in good condition.

3.4.4.6 Coastal Lagoons Hydrographic Region

Channel and Estuary Conditions. No channel or habitat typing assessments or LWD surveys have been conducted by Green Diamond in this HPA. Long-term channel monitoring is ongoing in two locations within the Coastal Lagoons Hydrographic Region - Maple Creek and Beach Creek. Monitoring began on both reaches in 1998. No conclusions can be drawn at this point from the monitoring.

Stone Lagoon is approximately 500 acres in size and is where salmonids from McDonald Creek generally rear to maturity. Because the lagoon only opens to the ocean occasionally, salmonids have limited opportunities to pass between the two water bodies. However, the brackish lagoon is highly productive and supports a diverse aquatic ecosystem.

Species Status. Specific information on anadromous salmonids in the Coastal Lagoons Hydrographic Region is limited. Population sizes are probably small and potentially non-existent in some years, as Big and Stone Lagoons are only open to the ocean for short time periods in winter and early spring, limiting the ability of anadromous fishes to migrate between the ocean and the lagoons.

The Coastal Lagoons Hydrographic Region is within the California Coastal Chinook salmon ESU, which was listed as threatened under the Federal ESA as of September 16, 1999 (64 FR 50394). This HPA is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. The Coastal Lagoons Hydrographic Region is within the Northern California steelhead DPS, which was listed as threatened on January 5, 2006 (71 FR 834). Coastal cutthroat are now under the jurisdiction of the USFWS and are undergoing a status review.

As many as 1,200 coho salmon and 3,000 steelhead may have occurred in Maple Creek, a tributary to Big Lagoon, as late as the 1960s (USFWS, 1967). Recent spawning surveys conducted by Green Diamond personnel during 1998 and 1999 have observed only a small number of redds, indicating limited spawning by salmonids in Maple, North Fork Maple, and Pitcher Creeks (see Appendix C-9 of the AHCP/CCAA). Big Lagoon is believed to support a "fair" population of coastal cutthroat trout (Gerstung, 1997). Green Diamond fisheries personnel observed high numbers of large coastal cutthroat in lower Maple Creek in 1999. Stone Lagoon had low numbers of cutthroat prior to heavy stocking of yearling fish in 1990 through 1994. Spawning escapement in McDonald Creek increased dramatically in the years following the stocking, but conditions in McDonald Creek are degraded and limit natural production (Gerstung, 1997).

Properties in the Coastal Lagoons Hydrographic Region were acquired by Green Diamond in 1998 after presence/absence surveys for tailed frogs had been completed. As a result, there is no estimate of the proportion of streams that support tailed frogs in this HPA. However, populations of tailed frogs have been confirmed in 22 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Green Diamond. Given the significant number of streams known to support the species, tailed frogs streams in the Coastal Lagoon Hydrographic Region are likely to be in good condition.

Populations of torrent salamanders have been confirmed in 47 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Green Diamond. Given the significant number of streams known to support the species, torrent salamander streams in the Coastal Lagoon Hydrographic Region are likely to be in good condition.

3.4.4.7 Little River Hydrologic Unit

Channel and Estuary Conditions. Channel and habitat typing assessments in the Little River Hydrologic Unit were conducted by Louisiana-Pacific Corporation fisheries personnel in 1994. Four streams were surveyed: the mainstem Little River, Upper and Lower South Fork Little River, and Railroad Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density in the Little River Hydrologic Unit was high, ranging from 91 percent to 99 percent in the three streams surveyed. The species composition of the riparian canopy was predominantly deciduous on all streams. LWD was the dominant structural shelter component in pools and ranged from 17.3 percent to 38.5 percent. Partitioning of habitat into pools, riffles, and runs showed a high percentage of pools (45 percent to 56 percent) on all four streams surveyed.

Pool tailout embeddedness values were moderate, mainly in the 26 percent to 50 percent range. Pool depths were predominantly 3 feet or less on Railroad Creek and the South Fork Little River, while half of the mainstem Little River pool depths were greater than 3 feet. No long-term channel monitoring has been conducted by Green Diamond in this HPA.

An LWD inventory was conducted during 1994 and 1995 in the same four streams in which channel and habitat type assessments were conducted. The instream LWD piece counts per 100 feet of channel were relatively high for the watershed size in Railroad Creek, and the Upper and Lower South Fork Little River, ranging from 5.1 to 8.1 pieces per 100 feet. LWD in the mainstem Little River was also more numerous than other streams in the Primary Assessment Area with similar watershed sizes (see Appendix C-2 of the AHCP/CCAA).

The Little River estuary has been impacted to a certain degree by human activities. Livestock grazing has denuded some of the riparian zone along the lower channel, accelerating the erosion of streambanks. In spite of this, the Little River has more estuarine habitat than many local streams of its size, and surveys have indicated utilization of the estuary by juvenile Chinook salmon (LP, 1986, CDFG, 1986). Although the Little River watershed is relatively small, its mouth rarely, if ever, bars over during the summer to form an enclosed lagoon.

Species Status. The Little River Chinook population is depressed compared to historical estimates, but recent trends show a relatively stable population. Green Diamond personnel have observed small numbers of live adult and carcasses of spawned out Chinook salmon, as well as redds, during spawning surveys conducted within the Little River during 1998 through 2000. Other tributaries to Little River (Upper South Fork and Lower South Fork Little River) had lower numbers of spawning Chinook salmon observed during those surveys The Little River is considered one of the best local salmonid streams, with healthy genetic stocks, sufficient returns to seed the system, and good salmonid habitat (Weseloh and Farro, pers. comm.). The Little River Hydrologic Unit is within the California Coastal Chinook salmon ESU, which was listed as threatened under the Federal ESA as of September 16, 1999 (64 FR 50394).

The Little River coho population is depressed compared to historical estimates, but appears to be relatively stable over the last decade. Recent data indicates high numbers and densities of juvenile coho from the 1998-1999 brood year. Spawning surveys conducted by Green Diamond personnel have resulted in observations of live adults, and carcasses of spawned-out coho salmon, as well as coho redds, within Little River during 1998 through 2000, and the lower South Fork Little River from 1998 to 1999 (see Appendix C-9 of the AHCP/CCAA). Coho salmon dominated the out-migrant smolt estimates in the Lower South Fork Little River and Carson Creek in 2000, exceeding 1,600 and 1,800 smolts respectively (see Appendix C-8 of the AHCP/CCAA). As noted previously, the Little River is considered one of the best local salmonid streams, with healthy genetic stocks, sufficient returns to seed the system, and good salmonid habitat. This HPA is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005.

The Little River Hydrologic Unit is within the Northern California DPS for steelhead, which was listed as threatened on January 5, 2006 (71 FR 834). Steelhead abundance data are limited for this DPS, but available data indicate that winter-run populations declined

significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then (Busby et al., 1996). Specific information on steelhead populations in the Little River Hydrologic Unit indicates that the Little River has been and remains an excellent system for steelhead production, although current abundance is depressed compared to historical estimates. Outmigrant trapping in 1994 captured approximately 10,000 steelhead parr and 1,100 smolts (Shaw and Jackson, 1994). The ability of steelhead to use spawning and rearing habitat upstream of other salmonids in the Little River contributes to their success in this HPA (Weseloh and Farro, pers. comm.).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout populations in southern Oregon and northern California are thought to be widely distributed in many small populations, with the exception of the Rogue and Smith Rivers, which support large and healthy populations (Johnson et al., 1999). Specific information on coastal cutthroat trout populations in the Little River Hydrologic Unit are limited to recent estimates and observations; historical information for comparison is lacking. Outmigrant trapping in the mainstem Little River in 1994 captured 403 coastal cutthroat trout, ranging in size from 50 to 275 mm, with the bulk around 150 mm (Shaw and Jackson, 1994).

Properties in the Little River Hydrologic Unit were acquired by Green Diamond in 1998 after presence/absence surveys for tailed frogs had been completed. As a result, there is no estimate of the proportion of streams that support tailed frogs in this HPA. However, populations of tailed frogs have been confirmed in 15 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Green Diamond. Given the significant number of streams known to support the species, tailed frogs streams in the Little River Hydrologic Unit are likely to be in good condition.

Populations of torrent salamanders have been confirmed in 18 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Green Diamond. Given the significant number of streams known to support the species, torrent salamanders streams in the Little River Hydrologic Unit are likely to be in good condition.

3.4.4.8 Mad River Hydrographic Region

Channel and Estuary Conditions. Channel and habitat typing assessment was conducted in 1994/1995 in three streams in the Mad River Hydrographic Region: Lindsay Creek, Dry Creek, and Cañon Creek (see Appendix C-1 of the AHCP/CCAA). Lindsay Creek and Cañon Creek had average canopy closures of approximately 80 percent, while Dry Creek had a canopy closure of 92 percent. This canopy was composed of 75 percent to 85 percent deciduous trees. The percentage of LWD as shelter in pools ranged from 14 percent in Dry Creek to 27 percent in Lindsay Creek. Partitioning of habitat into pools, riffles, and runs showed a high (47 percent and 50 percent, respectively) percentage of pools in both Lindsay and Cañon Creeks, a feature indicative of good salmonid habitat. Dry Creek was predominantly (67 percent) riffles.

Pool tailout embeddedness was moderate in Cañon Creek and Dry Creek and high in Lindsay Creek, with 82 percent of the pools having embeddedness values of 50 percent or greater. Pool depths in Dry Creek were almost all less than 2 feet, while Canon and Lindsay Creek pool depths were predominantly between 2 and 4 feet, with 17.6 and 15.6 percent of pools greater than 4 feet deep in Cañon Creek and Lindsay Creek, respectively.

Long-term channel monitoring is ongoing in one location within the Mad River Hydrographic Region. Monitoring began on the Cañon Creek in 1995. No conclusions can be drawn at this point from the monitoring.

There was a low level of both in-channel and recruitment zone LWD in Dry Creek and Cañon Creek, and a moderate level of LWD in Lindsay Creek (see Appendix C-2 of the AHCP/CCAA). The size of the inchannel LWD was predominantly small (less than 2 foot diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The LWD survey results may be misleading for Lindsay Creek, where most of the LWD is keyed into the banks, so that it is measured as small diameter and length, yet it affords the shelter and pool forming advantage of larger LWD. In Cañon Creek and Dry Creek, the lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Mad River Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The Mad River estuary has been severely impacted by human settlement, beginning with the draining and diking of wetlands for agricultural use. The Arcata Bottoms (once the Mad River floodplain) has been extensively developed for livestock grazing and residential purposes. In addition, to prevent regular flooding of this area, a meander in the lower Mad River was cut off by excavation of a new channel segment in 1862. The lower channel was cleared of LWD jams to facilitate the transport of logs in the late 1800s. Since then, the unrestricted removal of logs by firewood cutters in the lower reaches has inhibited re-establishment of LWD in this area. Gravel extraction occurs at numerous locations below the Mad River Hatchery and has been an important commercial activity for some time, removing approximately 15.5 million cubic yards of gravel between 1952 and 1992. The Humboldt Bay Municipal Water District, which provides water to communities and industry around Humboldt Bay, pumps its water from wells in the lower Mad River, just above the Highway 299 Bridge. This history of development has resulted in channelization of the lower 10 miles of the Mad River.

Species Status. The Mad River Hydrographic Region is within the California Coastal Chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Low abundance levels, sporadic occurrence in some river systems, and negative long term trends in abundance in this ESU were cited in the decision to list this ESU as threatened (September 16, 1999, 64 FR 50394). Nehlsen et al. (1991) identified Mad River fall-run Chinook as at moderate risk of extinction. Abundance trends have declined in the Mad River Basin over the long term, but show signs of increasing in recent years (64 FR 50405). Spawning surveys have been conducted annually on Canon Creek from 1995 through 2000. Compared to other species, large numbers of Chinook adults, redds, and carcasses have been observed during all years surveyed (see Appendix C-9 of the AHCP/CCAA).

Mad River Hatchery coho salmon stocks are not considered part of the SONCC coho salmon ESU, as they have included transplants from outside the area (Weitkamp et al., 1995). Coho salmon in the Mad River Hydrographic Region are within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Coho salmon are fairly well-distributed within the lower portion of this HPA, but almost no information on total abundance or proportion of naturally spawning hatchery fish is available. Spawning surveys have been conducted annually on Canon Creek from 1995 through 2000. Very few coho adults, redds, and carcasses have been observed in any year (see Appendix C-9 of the AHCP/CCAA). Juvenile summer population estimates for coho salmon ranged from 43 to 919 juveniles during the 1995-2000 period (see Appendix C-7 of the AHCP/CCAA).

Summer steelhead abundance in the Mad River has been monitored from 1982 to the present, revealing unexpectedly high abundance in 1994 through 1996, with a sharp downward trend in more recent years (see Appendix C-10 of the AHCP/CCAA). Information on fall-run and winter-run steelhead is lacking. The genetic effects of the Mad River Hatchery steelhead releases on the native winter steelhead population is a source of concern in this HPA (Busby et al., 1996). However, the hatchery program was terminated in 2004 so that potential genetic risks associated with propagation of this non-DPS stock will decline in the future. The Mad River Hydrographic Region is within the Northern California steelhead DPS, which was listed as threatened on January 5, 2006 (71 FR 834).

Cutthroat trout are only occasionally observed in the lower main stem Mad River, but are abundant in some lower Mad River tributaries, including Lindsay, Widow White, and Mill Creeks (Gerstung, 1997). Coastal cutthroat trout have not been observed above the confluence North Fork Mad River. This species is now under the jurisdiction of the USFWS and is undergoing a status review.

In the Mad River Hydrographic Region, 7 of 12 (58.3 percent) streams sampled as part of presence/absence surveys had tailed frogs, primarily in the lower portion of the drainage (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 17 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations, only one observation was in the upper portion of the HPA. Given this moderate rate of occurrence and somewhat limited number of streams known to support the species, tailed frog streams in the Mad River Hydrographic Region appear to be in moderate condition. However, other tailed frog studies (e.g., headwaters monitoring and life history studies) in this HPA indicate that, depending on the localized geology, some streams provide excellent habitat for tailed frogs while others completely lack habitat for the species.

In the Mad River Hydrographic Region, 8 of 12 (66.7 percent) streams sampled as part of presence/absence survey had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 54 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given the moderate rate of occurrence, torrent salamander streams in the lower portion of the Mad River Hydrographic Region appear to be in relatively poor condition. However, other torrent salamander studies (e.g., headwaters monitoring and life history studies) and the relatively large number of streams known to support the species in this HPA indicate that, depending on the localized geology, some streams provide excellent habitat for torrent salamanders while others completely lack habitat for the species.

3.4.4.9 North Fork Mad River Hydrologic Unit

Channel and Estuary Conditions. Channel and habitat typing assessments were performed on two creeks within the North Fork Mad River Hydrologic Unit: North Fork Mad River and Long Prairie Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density was 73 percent on the North Fork Mad River and 95 percent on Long Prairie Creek. Deciduous trees accounted for about 90 percent of the canopy on both creeks. LWD as structural shelter in pools was low in both creeks – 12.1 percent and 10.4 percent in the North Fork and Long Prairie Creek, respectively. Partitioning of habitat into pools, riffles, and runs showed a high percentage (47 percent) of riffles on Long Prairie Creek, and a high percentage (42 percent) of pools on the North Fork Mad River. The North Fork had 10 percent of its total length in dry channel.

Pool tailout embeddedness was high on the North Fork and low on Long Prairie Creek. Pool depths showed the opposite pattern. In the North Fork, over 50 percent of the pools were greater than 3 feet deep, while in Long Prairie Creek, less than 16 percent of the pools were greater than 3 feet deep. The differences in pool depth undoubtedly reflect the much larger size of the North Fork Mad River.

Long-term channel monitoring is ongoing at one location within the North Fork Mad River Hydrologic Unit. Monitoring began on the North Fork Mad River in 1997. An abbreviated version of the complete monitoring protocol is being used. No conclusions can be drawn at this point from the monitoring.

The North Fork Mad River had approximately one piece of in-channel LWD per 100 feet of channel, while Long Prairie Creek averaged 2.2 pieces per 100 feet. The size of the in-channel LWD present was predominantly small (less than 2 feet diameter), reflecting the alder-dominant riparian zones prevalent throughout the area (see Appendix C-2 of the AHCP/CCAA). The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the North Fork Mad River Hydrologic Unit would benefit from increased abundance of large diameter and length LWD.

Species Status. Nehlsen et al. (1991) identified Mad River fall-run Chinook salmon as at moderate risk of extinction. The North Fork Mad River Hydrologic Unit is within the California Coastal Chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Abundance trends have declined in the Mad River Basin as a whole over the long term, but show signs of increasing in recent years (September 16, 1999, 64 FR 50394). A natural barrier to Chinook and coho salmon migration occurs at roughly river mile (RM) 4 in the North Fork Mad River, severely limiting the spawning and rearing area available to Chinook in this HPA. Spawner surveys in this HPA indicate highly variable returns of winter-run Chinook to the North Fork Mad River and its tributaries below the barrier.

The North Fork Mad River Hydrologic Unit is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Spawner surveys and juvenile population estimates below the barrier also indicate low numbers of coho returns in this HPA (see Appendices C-7 and C-9 of the AHCP/CCAA).

Steelhead are able to pass the natural barrier mentioned previously for Chinook and coho salmon and therefore can use more of the North Fork drainage than other anadromous salmonids. The genetic effects of the Mad River Hatchery steelhead releases on the native winter steelhead population are a source of concern in the Mad River Basin (Busby et al., 1996). However, the hatchery program was terminated in 2004 so that potential genetic risks associated with propagation of this non-DPS stock will decline in the future. The extent of hatchery fish spawning naturally in the North Fork Mad River HPA is unknown. The North Fork Mad River Hydrographic Unit is within the Northern California steelhead DPS, which was listed as threatened on January 5, 2006 (71 FR 834).

Coastal cutthroat are now under the jurisdiction of the USFWS and are undergoing a status review. Little is known about coastal cutthroat trout in the North Fork Mad River Hydrologic Unit. The natural barrier to anadromy on the main stem North Fork Mad implies that cutthroat trout in most of this HPA (above the barrier) are resident fish.

In the North Fork Mad River Hydrologic Unit, six of seven (85.7 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 28 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and the large number of streams known to support the species, tailed frogs streams in the North Fork Mad River Hydrologic Unit seem to be in excellent condition.

In the North Fork Mad River Hydrologic Unit, six of seven (85.7 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 80 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, torrent salamanders streams in the North Fork Mad River Hydrologic Unit seem to be in excellent condition.

3.4.4.10 Humboldt Bay Hydrographic Region

Channel and Estuary Conditions. Channel and habitat typing assessments were conducted on four streams within the Humboldt Bay Hydrographic Region in 1995. Salmon Creek was assessed by Green Diamond personnel and Ryan Creek and two unnamed tributaries to Ryan Creek were assessed by the California Conservation Corps (see Appendix C-1 of the AHCP/CCAA). Canopy closure was high on all four creeks, ranging from 88 percent in Salmon Creek to 94 percent in Ryan Creek. The riparian canopy was predominantly deciduous on Salmon Creek and Ryan Creek (83 and 68 percent). This variable was not recorded on the two tributaries to Ryan Creek. The percentage of LWD as shelter in pools was 27.5 percent in Salmon Creek, and 17, 40, and 49 percent, respectively, in the two tributaries to Ryan Creek and the Ryan Creek mainstem. These are some of the higher values in Primary Assessment Area streams.

Partitioning of habitat into pools, riffles, and runs showed a moderately high percentage (44 percent) of pools on Salmon Creek and a high percentage of pools on Ryan Creek and the two assessed tributaries (65, 81, and 61 percent, respectively).

Pool tailout embeddedness was very high in all four creeks, probably because of the dominant substrate materials in these creeks. Pool depths were mainly 1 to 3 feet, with

18 percent greater than 4 feet in Salmon Creek. The assessed creeks in the Humboldt Bay Hydrographic Region had a high level of canopy closure and LWD as shelter, but very fine substrate was predominant, leading to high embeddedness values, shallow pools, and low overall shelter ratings. Long-term channel monitoring is ongoing in one location within the Humboldt Bay Hydrographic Region. Monitoring began on Salmon Creek in 1996. No conclusions can be drawn at this point from the monitoring.

Generalizations about LWD in the Humboldt Bay Hydrographic Region are difficult to make as only one creek in the region was surveyed (see Appendix C-2 of the AHCP/CCAA). Salmon Creek had an average of 4.0 pieces of in-channel LWD per 100 feet, one of the highest densities among the streams surveyed. The size of the in-channel LWD was predominantly small (less than 2 ft diameter), reflecting the alder-dominant riparian zones prevalent throughout the area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote the formation of pools. Stream health in the Humboldt Bay Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The estuaries of Humboldt Bay's watersheds have been vastly altered over the past century. Residential and agricultural development associated with the early harvesting of timber from the slopes surrounding Humboldt Bay greatly impacted watershed estuaries. Extensive areas of highly productive wetlands were converted to pasture and residential land through a complex series of dikes, tide gates, and levees. The lower section of Salmon Creek was channelized to maximize the amount of available pasture land. The tide gate on Salmon Creek has been suspected as being impassable by adult and juvenile salmonids on a wide range of flows. Recently, a section of the lower channel (now a National Wildlife Refuge) was reconstructed to its natural meander and the tide gate was modified to improve fish passage.

Species Status. The Humboldt Bay Hydrographic Region is within the California Coastal Chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Drainages within the Humboldt Bay Hydrographic Region are typically small, with no large rivers, which are typically preferred by Chinook salmon. Chinook populations within this HPA are thought to be low, and while historical estimates are not available for comparison, the small size of the Humboldt Bay drainages makes it unlikely that this HPA was ever a significant producer of Chinook salmon.

The Humboldt Bay Hydrographic Region is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Coho salmon have been documented in almost all of the drainages feeding Humboldt Bay. Information on coho abundance in these creeks is limited, but as with the ESU as a whole, current numbers are almost certainly depressed relative to historical estimates (Weitkamp et al., 1995).

The Humboldt Bay Hydrographic Region is within the Northern California DPS for steelhead, which was listed as threatened on January 5, 2006 (71 FR 834). Steelhead abundance data are limited for this ESU, but available data indicate that winter-run populations declined significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then (Busby et al., 1996).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Gerstung (1997) reports that low numbers of coastal cutthroat have been reported in most tributaries where other salmonids are present, while much higher numbers have been observed in tributaries or headwaters of tributaries where no other salmonids are present. Current populations are thought to be depressed relative to historic levels (Gerstung, 1997).

In the Humboldt Bay Hydrographic Region, only two streams were sampled as part of presence/absence surveys and tailed frogs were found in one of them (Diller and Wallace, 1999). In addition, tailed frogs have only been found in 3 other streams throughout the HPA as the result of incidental observations. However, much of this HPA is located within young unconsolidated geologic formations, which have been shown to have a strong negative influence on tailed frog occurrence as a result of a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1999). Most streams in the Humboldt Bay Hydrographic Region are likely not suitable for tailed frogs and have no potential to become suitable outside of a geologic timeframe.

In the Humboldt Bay Hydrographic Region, only three streams were sampled as part of presence/absence surveys and no torrent salamanders were found in any of them (Diller and Wallace, 1996). In addition, torrent salamanders have only been found in three other streams throughout the HPA as the result of incidental observations. However, as noted above for tailed frogs, much of this HPA is located within young unconsolidated geologic formations. These formations have been shown to have a strong negative influence on torrent salamander occurrence due to a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1996).

3.4.4.11 Eel River Hydrographic Region

Channel and Estuary Conditions. Channel and habitat typing assessments have not been conducted by Green Diamond personnel within the Eel River Hydrographic Region. The CDFG has conducted channel and habitat typing assessments on four streams within the Eel River Hydrographic Region. Wilson Creek and Stevens Creek were both assessed in 1991, and Howe Creek and West Fork Howe Creek were assessed in 1998 (see Appendix C-1 of the AHCP/CCAA).

Canopy closure was moderate in the four creeks surveyed, ranging from 57 percent in Howe Creek to 86 percent in West Fork Howe Creek. The existing canopy was mainly deciduous in all four creeks (71 to 95 percent deciduous). The percentage of LWD as the dominant structural shelter component in pools varied widely within the Eel River Hydrographic Region from zero percent in West Fork Howe Creek to a high of 48 percent in Stevens Creek. The average value for the four creeks was 15.5 percent.

Partitioning the streams into pools, riffles, and runs showed a high percentage of riffles on Wilson Creek (86 percent), Howe Creek (65 percent), and West Fork Howe Creek (74 percent). Only Stevens Creek had more than 10 percent of its total length composed of pool habitat (26 percent pools).

Howe, West Fork Howe, and Wilson Creeks all had high pool tailout embeddedness values as well as mainly shallow (less than 2 feet) pools. Stevens Creek had low pool tailout embeddedness and 57 percent of its pools were greater than 2 feet in depth. Stevens Creek

contains significantly better salmonid habitat than the other three creeks assessed in the Eel River Hydrographic Region.

Green Diamond has not conducted any LWD inventories within the Eel River Hydrographic Region, and no long-term channel monitoring reaches have been established in the Eel River Hydrographic Region.

The lower Eel River has lost valuable fisheries habitat through human activities. Wetlands, secondary channels, and sloughs have been impacted through extensive diking and channelization. The original floodplain is now used for residential and agricultural purposes, mainly grazing of dairy cattle. Sediment deposits transported from upstream areas have turned once deep pools into shallow runs, which offer marginal habitat for juvenile salmonids. The lower channel was also cleared of LWD jams for navigational purposes.

Species Status. Peak index counts and carcass surveys for Chinook salmon in two tributaries to the Eel River have shown precipitous long-term declines since the 1960s, with recent increases in one tributary. Similar monitoring for Chinook salmon in other tributaries conducted since the late 1980s have also shown steep declines. Spring-run Chinook salmon in the upper Eel River are possibly extinct, representing a significant loss of life history diversity in this ESU as a whole (64 FR 50405). The Eel River Hydrographic Region is within the California Coastal Chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394).

The Eel River Hydrographic Region is within the SONCC coho salmon ESU which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon north of Punta Gorda were listed as threatened under CESA on March 30, 2005. Coho salmon abundance in the Eel River, as within the rest of the SONCC coho ESU, is depressed (Weitkamp et al., 1995). The abundance of introduced Sacramento pike minnow in the Eel River is a cause for concern.

Nehlsen et al. (1991) identified summer steelhead in the Eel River as at risk of extinction, although the Little Van Duzen River winter steelhead stock was identified as stable in further analysis by Higgins et al. (1992). Counts at Eel River dams in the 1930s and 1940s averaged 4,400 adult steelhead annually at Cape Horn Dam and 19,000 adult steelhead annually at the Benbow Dam. Recent counts at Cape Horn Dam average 115 adults, of which only 30 are native fish. In addition to these declining trends, the abundance of the introduced Sacramento pike minnow and sedimentation are some of the main concerns cited for steelhead in the Eel River (Busby et al., 1996). The Eel River Hydrographic Region is within the Northern California DPS for steelhead, which was listed as threatened on January 5, 2006 (71 FR 834).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout are found in one tributary to the lower Eel (Strongs Creek), one tributary to the Van Duzen (Fox Creek), and a few small streams which flow into the Salt River Slough (Gerstung, 1997). No Primary Assessment Area lands exist in the drainages of these tributaries.

In the Eel River Hydrographic Region, only two streams were sampled as part of presence/absence surveys and no tailed frogs were found in either of them (Diller and Wallace, 1999). In addition, no tailed frogs have been found in other streams throughout the

HPA as the result of incidental observations. However, much of this HPA is located within young unconsolidated geologic formations, which have been shown to have a strong negative influence on tailed frog occurrence due to a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1999). Most streams in the Eel River Hydrographic Region are likely not suitable for tailed frogs and have no potential to become suitable outside a geologic timeframe.

In the Eel River Hydrographic Region, only one stream was sampled as part of presence/absence surveys and no torrent salamanders were found (Diller and Wallace, 1996). In addition, no torrent salamanders have been found in other streams throughout the HPA as the result of incidental observations. However, as described above for tailed frogs, much of this HPA is located within young unconsolidated geologic formations. These formations have been shown to have a strong negative influence on torrent salamander occurrence as a result of a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1996).

3.4.4.12 Rain-on-Snow Areas

The rain-on-snow areas are generally located at elevations above 2,500 feet. Channel and habitat typing assessments have not been conducted in the three rain-on-snow units outside of the 11 HPAs, with the exception of one survey on Elk Creek within the northernmost block. Consequently there is limited information on channel and habitat conditions within these areas.

Green Diamond has conducted surveys of anadromous salmonids within the three rain-on-snow units. The Elk Creek system within the northernmost block (Moore Tract) contains all four salmonids (coho, Chinook, steelhead, and cutthroat trout). The lower portions of tributaries that extend into the Green Diamond ownership in the South Fork Trinity River basin (University Hill Tract) have limited anadromy access, mostly steelhead. Chinook and coho are to be found mostly downstream of the Green Diamond ownership within this same watershed area. It is unknown if salmonids occur within the Supply Creek Tract, although it is known that they are distributed downstream of this third ownership block.

Green Diamond has conducted studies of tailed frogs and southern torrent salamanders to determine their distribution, relative abundance and habitat associations throughout the ownership. These amphibian species have been found at several sites in the rain-on-snow areas.

Little information is available about presence and distribution of the other fish, amphibian, and reptile species covered under Alternative C in the rain-on-snow areas.

3.4.5 Ecological Implications of Land Management Activities on Aquatic and Riparian Habitat, Fish, and Amphibians

3.4.5.1 Background

Understanding the ecological implications of planned land use activities and management commitments on aquatic ecosystems provides a basis for analyzing potential effects of the Proposed Action, other action alternatives, and the No Action Alternative. All land use

practices within the Primary Assessment Area and the additional 25,677 rain-on-snow acres under Alternative C could affect aquatic ecosystems to varying degrees. Depending on how land use practices are implemented, their effects could be either adverse or beneficial. Ecological implications and cause-effect relationships associated with past and current land use practices provide a basis for understanding the existing environment and for predicting effects on species and habitat conditions under the alternatives.

These cause-effect relationships generally are well documented in the literature and are considered by most biologists to be relatively common scientific knowledge. The ecological implications and cause-effect relationships are therefore summarized in the following text. A detailed discussion of the potential effects of timber management on covered species and their habitats is also contained in Appendix E of the AHCP/CCAA. Most of the cause-effect relationships apply directly to fish, especially salmonids, and their habitat. However, because the amphibian and reptile species being addressed in this document also depend on functioning aquatic habitat and cool, clean water, the cause-effect relationships described below are applicable to all species covered under the Proposed Action and other alternatives.

3.4.5.2 Historical Management of Aquatic and Riparian Habitat

Prior to 1950, forest harvesting and other timber-related uses along streams and rivers differed little from upslope harvesting: forests were used from the ridge to the stream's edge (Gregory, 1997). Some practices, such as dragging logs and using splash dams to create artificial floods, directly or indirectly delivered sediment to streams, lakes, and estuaries; removed forest canopies and warmed water temperatures; altered forest habitats and reduced future sources of wood inputs; and simplified and narrowed floodplains. On Federal land, production of timber commodities was the primary goal prior to the Multiple Use-Sustained Yield Act of 1960, the National Wilderness Act, and the Wild and Scenic Rivers Act. Prior to 1960, riparian management was not consistently practiced across Federal lands, and no particular protection was identified for riparian areas. Mining for gold and coal on timbered lands also significantly altered rivers and floodplains (Oliver et al., 1994). In addition, there was little or no attempt to restrict grazing in the open range or the effects of water-based recreation.

Prior to the 1930s, grazing and timber harvesting became regulated where public concern for preventing siltation into irrigation reservoirs was raised. Stream channels were straightened to prevent stream bank erosion and control floods (Oliver et al., 1994). For years, standard forest practice was to remove structures from stream channels to improve conveyance. One result of controlled flooding was that roads increasingly encroached on channels and floodplains, often constricting the channel's ability to interact with the floodplains (McIntosh et al., 1994). After 1950, the public and resource managers increasingly expressed concerns over effects of land uses on streams and anadromous salmonids.

There is wide agreement that historical land use practices prior to 1973 adversely affected the structure and productivity of aquatic ecosystems (Elmore and Beschta, 1987; MBTSG, 1998). In 1973, however, passage of the Z'Berg-Nejedly Forest Practices Act by the State Legislature created a framework and multi-disciplinary review process to ensure consideration of riparian and aquatic resource values in the development of timber harvesting plans on State and private lands. The State Board of Forestry, created by the Act,

has responsibility for development of forest practice rules (CFPRs), as necessary and appropriate, to protect riparian and aquatic resources. The CFPRs are administered by the California Department of Forestry and Fire Protection. Pertinent examples of CFPRs relevant to fish and wildlife habitat management include: (1) watercourse and lake protection zone rules; (2) special rules to protect fish, wildlife, and watersheds; and (3) rules for defined special treatment areas. (See Section 1.2.2, State Requirements.)

3.4.5.3 Forested Landscapes: Functions and Disturbances

Ecological Functions. The aquatic habitat of greatest interest in the Primary Assessment Area and the additional 25,677 rain-on-snow acres under Alternative C is that which supports, or could potentially support, the eight fish, four amphibian, and one reptile species described above and covered under the various action alternatives. Habitat conditions and requirements important to the survival of these species are numerous, but primarily can be summarized in terms of water quality and the quality and quantity of physical stream habitat available.

Water quality encompasses many attributes, but principally refers to sediment loads and sedimentation within a stream, water temperature and dissolved oxygen levels, and concentrations of nutrients and pollutants. Sedimentation is important because, if it is high, it can embed and reduce the amount of interstitial spaces within the stream substrate. This, in turn, has the potential to limit the production of aquatic insects (food source), suitable spawning areas, and cover areas for fry (salmonids) and larvae (amphibians). Temperature is important because the covered species prefer cool-water conditions and cannot tolerate elevated water temperatures, particularly for extended periods. Nutrients are important in food production, although extreme levels can have some of the same adverse effects on aquatic organisms as pollutants.

Habitat quality (and quantity) primarily refers to the complexity of the stream system and stream flow. Habitat complexity is defined by the type and amount of spawning, rearing, foraging, resting, and overwintering habitat, as well as habitat available for protection from predators. Flows often strongly influence the quantity of habitat available diurnally, seasonally, and among years, and dictate the magnitude and effects of extreme events such as high-flow (scouring) and low-flow (drought) conditions.

Riparian (and potentially upland) areas of forest ecosystems greatly influence both the water and physical habitat attributes of streams and rivers. The degree of influence, whether negative or positive, is generally related to the amount and type of vegetation present and the amount of disturbance from land management activities that occur. Vegetation functions to provide LWD to the stream, canopy closure, bank stabilization, sediment trapping, nutrient inputs (leaf litter and dissolved materials), microclimate, and flow regime modifications. Riparian areas also can act as buffers that prevent or attenuate stream inputs of management-related materials like fine sediment or chemicals applied during forest management. More specific details on these functions are provided in the following sections.

Landscape Disturbances. Ecological functions and processes of forest stands vary as species composition and stand structure change during successional development. Disturbances that alter or interfere with these successional changes have the potential to degrade, reset, or

redirect the trend of their ecological functions. Current forested landscapes reflect the effects of climate, topography, and past ecological disturbances.

The primary natural disturbances affecting plant communities are fire, grazing and browsing by ungulates, insect outbreaks and disease epidemics, windthrow, flooding, and erosion (hillslope mass wasting and surface erosion). Most of these processes are altered by human activities. Disturbance, interacting with climate and topography, produces landscape heterogeneity.

Natural and human disturbances have long-term influences on the appearance and composition of forests and the ecological services they provide (Waring and Schlesinger, 1985). Natural disturbance regimes generally provide beneficial ranges of ecological responses, and are required to create and maintain sustainable ecosystems and associated habitats and ecological processes (Everett et al., 1994; Johnson et al., 1994). The historical or natural range of variability is useful for establishing the limits of acceptable change for ecosystem components and processes (Morgan et al., 1994).

Disturbances that do not emulate historical events and disturbance scales, or replace elements required by the ecosystem, can be destructive (Everett et al., 1994). Disturbances caused by timber harvesting can be qualitatively and quantitatively different from natural disturbances; for example, there is no natural analog to disturbances created from road building. Compared to riparian areas with sustained commercial timber harvesting, disturbance patterns in no-cut riparian buffers are more likely to approximate the temporal patterns of natural processes. Repeated harvest activities shift the timing of disturbances from episodic (pulse) events to chronic (press) events.

3.4.5.4 Land Management Activities and Ecological Implications

The following land management activities are commonly associated with timberlands. These activities can potentially impact aquatic habitat, and have been identified in Biological Opinions on Federal land management actions for several listed native salmonids. The activities are silviculture and forest management; road construction, reconstruction, and maintenance; fire management; and recreation and fishing. Because roads are an integral part of forest management activities, the effects of road construction, reconstruction, and maintenance are discussed along with the effects of forest management. Effects of fire management and recreational activities that may affect the quantity and quality of aquatic habitat are discussed briefly following the discussion of forest management.

Spence et al. (1996) described the effects of human activities on watershed processes, salmonids, and their habitats. Chamberlain et al. (1991) summarized four effects of forest management that may modify the hydrologic and geomorphic processes and channel formations that determine the quantity and quality of salmonid habitat. They are:

- Alterations in the hydrologic cycle with potential increases in peak flows or occurrences of channel-forming flows from increased snow-melt or runoff, resulting in increased bed scour and bank erosion
- Increases in sediment supplies from surface erosion, hillslope mass wasting, and bank erosion, leading to channel aggradation, loss of pool volume, and degradation of spawning gravels

- Destabilization of streambanks due to removal of riparian vegetation, physical breakdown, or channel aggradation, resulting in increased sediment supplies and leading to a loss of channel formations that promote a diversity of habitat types
- Loss or reduction of LWD by direct removal, debris torrents, or management practices that convert riparian corridors to younger stands of predominantly hardwoods, contributing to reduced sediment storage sites, and reduced pool numbers and volumes

There has been less research on the potential effects of timber harvesting on amphibian species, but most of the potential effects on salmonids and their habitat are believed to also affect the cool-water adapted stream amphibians. In general, timber harvesting activities have the potential to affect aquatic species (i.e., fish and amphibians) through alteration of one or all of the following processes: hydrologic cycle, sediment inputs and transport, LWD recruitment and distribution, thermal regimes, and nutrient inputs. These and related issues are discussed below under the following headings: effects on the hydrologic cycle, effects on erosion and sedimentation, effects on water quality, and effects on physical habitat.

Effects of Forest Management on the Hydrologic Cycle. The basic components of the hydrologic cycle are precipitation, infiltration, evaporation, transpiration, storage, and runoff. In the coastal areas of northern California, where annual precipitation is highly seasonal, the timing, quantity, and quality of rain and snow fall has great influence on salmonid life histories. Thus, the interactions of timber harvest activities with the hydrologic cycle are important.

Snow Accumulation and Melt. Coastal watersheds of northern California receive most of their precipitation as rain. However, some watersheds in the Primary Assessment Area have upper sections within the transition zone between rain and snow. Along hillslopes in these upper watersheds, the forest canopy intercepts snowfall, redistributes the snow, shades the snowpack, and acts as a windbreak. In these transient areas the snow is generally wet and sticks to the forest canopy longer than colder, drier snow. In transitional areas, snow usually reaches the ground in clumps under trees or as snow melt so that snow pack in forested areas tends to vary in distribution and depth compared to logged hillslopes (Berris and Harr, 1987).

Snow melt from hillslopes in coastal watersheds is usually the result of warmer rainfall or latent heat in air moisture rather than from solar radiation. Snow packs in transitional areas may accumulate and melt several times during the wet season. When the forest canopy has been removed, more of the snow pack is directly exposed to rainfall, warm air, and direct sunlight. Harr (1986) reported there was more heat available to melt snow in a clear-cut stand than in an old-growth Douglas-fir stand during a rain storm with a 2-year recurrence interval. Plot studies in paired watersheds (logged and unlogged) have shown increases in peak streamflow after rain-on-snow events in the logged areas (Harr and McCorison, 1979; Christner and Harr, 1982).

Evapotranspiration and Infiltration. The timber management activities of clearcutting, shelterwood cutting, and precommercial thinning all reduce or eliminate significant amounts of leaves and stems. The surface area of this vegetation normally intercepts precipitation for short-term storage that is either evaporated or released as drip. The loss of forest vegetation also reduces the amount of water extracted from the soil by root systems via evapotranspiration and increases soil moisture and piezometric head. These effects have

been demonstrated following harvest of second growth redwood forest (Keppeler and Brown, 1998). These factors may lead to increases in soil water content and in surface runoff. Some studies have reported increases in water yield from logged watersheds (Hibbert, 1967; Harr et al., 1979). These increases were most evident in the start of the fall/winter wet season when rain quickly filled soil pore spaces in the logged areas and then ran off as surface flow (Harr et al., 1979). Differences were less apparent later in the rainy season since soil under mature canopies also becomes saturated, and runoff from logged and unlogged areas became nearly similar (Hibbert, 1967; Harr et al., 1979).

Soil Structure. The soil structure of forested hillslopes regulates the downslope movement of water through the soils and into watersheds. On forested hillslopes the infiltration capacity of the soils usually exceeds rainfall or snowmelt intensities so that all water is absorbed by these soils and transported to stream channels through subsurface pathways (Dyrness, 1969; Harr, 1977). Timber harvest activities that disturb the soil can reduce the infiltration capacity of soils and alter the process of subsurface water movement.

When logging activities compact or disturb surface soils the infiltration capacity is reduced, possibly increasing surface runoff, peak stream flows, and sediment inputs. The compacted surfaces of logging roads and landings are impermeable and water runs off them quickly. Inboard ditches along logging roads not only collect and concentrate surface runoff, but also intercept subsurface flow and bring it to the surface (Furniss et al., 1991). Some studies have shown that forest roads increase peak flows and sediment inputs to small watersheds when as little as 2.5 to 3.9 percent of the watershed is composed of road surfaces (Harr et al., 1975; Cederholm et al., 1981; King and Tennyson, 1984). Conversely, other studies have shown that road construction and some logging activities may have no significant effect on storm runoff (Wright et al., 1990; Johnson and Beschta, 1980).

Effects of Forest Management on Erosion and Sedimentation. Sedimentation is the end result of the erosion of soils in upland and riparian areas that are transported to streams. Erosion is the detachment and movement of soil or rock by water, wind, ice, or gravity (Brady, 1974). Hillslope erosion, sediment delivery, and sediment transport are all naturally occurring processes. The amount and rate of sediment introduced to watersheds is a function of many parameters, including the geology of hillslopes, dominant soil types, climatic conditions, and the occurrence of catastrophic events (floods, fires, earthquakes, or volcanic eruptions).

Timber harvesting and other land use activities can influence upslope erosional processes and how watersheds process sediments. It is important to realize that erosion and sediment transport are "normal" processes and that stream channels are dynamic systems that are constantly changing and adjusting to a variety of inputs. However, timber management activities and road construction, reconstruction, and maintenance, plus exposed soils in the road prism, can accelerate erosion and increase the potential for sediment delivery to streams. The following sections describe the potential impacts that forest management activities, particularly associated with roads, may have on sediment deposition and sediment processing in a watershed.

Sediment Deposition. Eroded materials delivered to streams and deposited on the streambed affect aquatic habitat. The construction, maintenance, and use of forest roads have been indicated as primary sources of sediment impacts in managed watersheds (USFWS, 1998a;

Packer, 1967). Increased levels of fine sediment in streambed gravels have been associated with decreased salmonid embryo survival (Cederholm et al., 1981; Tappel and Bjornn, 1983) and the quality of juvenile rearing habitat (Bjornn et al., 1977). Fine sediment fills the interstitial spaces among gravels and, if severe, can suffocate incubating fish eggs by blocking the flow of water and oxygen to the eggs. Juvenile fish, particularly newly hatched individuals, use interstitial spaces as refugia from high water velocities and predators (Rieman and McIntyre, 1993). Land management that minimizes erosion and sediment delivery to streams addresses this well-documented sensitivity (Chapman, 1988).

Two erosional processes, surface erosion and hillslope mass wasting (landslides and debris flows), are of principal importance on forest hillslopes (Swanston, 1991). Surface erosion in forested watersheds occurs principally through the action of water on the soil surface. Hillslope mass wasting occurs when the force of gravity exceeds the resistive forces that hold the soil on the hillslope, causing mass movement of the soil as a unit. Hillslope mass wasting usually occurs when water accumulates on steep slopes.

Surface Erosion. A common source of sediment input to watersheds is surface erosion. Surface erosion can be a major contributor of sediment in areas where soils are composed of granite or highly fractured marine sedimentary rocks (Furniss et al., 1991). Surface erosion is a two-part process in which particles are first detached and then transported downslope. The two hydrologic processes that transport surface erosion are channelized erosion by constricted flows (rilling and gullying) and sheet erosion in which soil movement is non-channelized (rolling and sliding) (Swanston, 1991). Surface erosion by rainsplash and sheetwash processes from roads (including cut slopes), stream crossings, landings, skid trails, and ditches may all contribute to substantial increases in surface erosion and increased delivery of sediments into stream channels (Reid and Dunne, 1984; Luce and Black, 1999).

Surface erosion occurs on nearly all roads, but the timing and volume of sediment delivery to streams varies with the location and design of the road, ditches, and stream crossings. The delivery rate of road-related sediment to streams is highest where (1) ditches or culverts drain directly to streams, and (2) the distance between the stream and nearby road is insufficient to filter the sediment-laden water (Ketcheson and Megahan, 1996; Megahan and Ketcheson, 1996). Erosion may also occur in association with culvert failures and diversions because of culvert blockages (Piehl et al., 1988; Furniss et al., 1991). Road erosion rates are highest during the first one or two years following road construction, then normally decrease to less than half as much in successive years (Megahan, 1974; WFPB, 1995). Irrespective of their age, roads that receive heavy traffic produce substantially more sediment than low-use or closed roads (Reid and Dunne, 1984; Bilby et al., 1989).

In the past 25 years, studies and reports have shown that road construction for timber harvesting can increase erosion rates within a watershed (Haupt, 1959; Gibbons and Salo, 1973; Beschta, 1978; Cederholm et al., 1981; Reid and Dunne, 1984; Swanson et al., 1987; Furniss et al., 1991). Roads affect watersheds by modifying natural drainage patterns and by accelerating erosion and sedimentation, thereby altering channel stability and morphology. If proper construction techniques and maintenance practices are not followed, sediment increases following road construction can be severe and long-lasting. Gibbons and Salo (1973) concluded that the sediment contribution per unit area from forest roads is usually greater than that contributed from all other timber harvesting activities combined. Recently,

techniques have been developed to improve the construction and maintenance of forest roads that minimize erosion and sedimentation (Weaver and Hagans, 1994).

Yarding and skidding activities can also affect the rate of surface erosion. Heavy equipment compacts soils, decreasing infiltration and percolation rates and increasing surface water (Lewis, 1998). The pattern of yarding and skidding can alter drainage paths and redirect water onto areas that may be more likely to erode than naturally evolved channels. Where vegetation and duff are removed, the underlying soils become vulnerable to surface erosion. Burning can also increase erodibility by creating bare ground. The effect of burning on surface erosion depends primarily on the temperature of the burn, soil cover, and soil and vegetation types (Lewis, 1998).

Hillslope Mass Wasting. In steep mountainous terrane, hillslope mass wasting is a major type of hillslope erosion and sediment source in watersheds (Sidle et al., 1985; Swanston, 1991). The frequency and magnitude of hillslope mass wasting is governed by hillslope gradient, level of soil saturation, composition of dominant soil and rock types, degree of weathering, type and level of management activities, and occurrence of climatic or geologic events. Hillslope mass wasting movements are usually episodic events and tend to contribute significant quantities of sediment and organic debris to stream channels over time intervals ranging from minutes to decades (Swanston, 1991). The resultant sediment and organic debris may have a profound effect on a stream channel including large increases in coarse and fine sediments, shifts of existing bed-load, and increases in woody debris that can lead to partial or complete blockages. In extreme situations, debris torrents may scour the existing bed-load of hundreds of meters of stream channel down to bedrock.

Hillslope mass wasting is a naturally occurring watershed process that can be accelerated by human activities. The occurrence of hillslope mass wasting after logging is closely linked to the type and intensity of harvest practices (Rood, 1984; Swanson, 1987). Hillslope mass wasting on logged hillslopes generally result from soil disturbances, increased water content in soils, and decreased root strength of decaying stumps. Numerous studies have reported increases of hillslope mass wasting due to clearcutting ranging from two to 31 times original rates, with an average of 6.6 (Rood, 1984; Ice, 1985; Howes, 1987; Swanson et al., 1987).

Forest road systems and their associated stream crossings in steep coastal watersheds are a major cause of hillslope mass wasting. Cederholm et al. (1981) reported that in Washington's Clearwater watershed, 60 percent of road related sediment production was from associated hillslope failures and that road surfaces accounted for 18 percent to 26 percent of the sediment production. Roads can lead to increases in the frequency and severity of all types of hillslope mass wasting. Studies in the western Cascades of Oregon by Sidle et al. (1985) reported that hillslope mass wasting associated with forest roads occurred 30 to more than 300 times more often than in undisturbed watersheds. Increases in hillslope failures due to roads are affected by variables such as hillslope gradient, soil type, soil saturation, bedrock type and structure, management levels, and road placement. However, the literature suggests that road placement is the single most important factor because it affects how much the other variables will contribute to slope failures (Anderson, 1971; Larse, 1971; Swanston, 1971; Swanston and Swanson, 1976; Weaver and Hagans, 1994).

Techniques are available to identify hillslopes susceptible to hillslope mass wasting by the use of aerial photography and engineering analysis (Swanson et al., 1987). These measures

may be useful in identifying areas where management activities should be avoided or at least conducted in a manner to minimize soil disturbance. Once mass movements have occurred, measures to correct erosion are expensive, time consuming, and rarely successful (Chamberlain et al., 1991).

Sediment Processing. Sediment processing in watersheds consists of the detachment and entrainment of sediment particles by flowing water, sediment transport, and sediment deposition. Once sediment has been delivered to the stream channel its movement through the watershed is governed by numerous factors. These include particle size and shape, amounts of sediment, hydraulic characteristics (frequency and magnitude of elevated flows, size of watershed, and channel gradient), and the occurrence of structures that provide complexity and roughness to channels (boulders, LWD, bedrock, or riparian vegetation).

Sediment is transported as either suspended sediment or as bedload. Suspended sediment consists of fine particles (less than 0.1 mm in diameter) that are entrained in the water column by the turbulence of flowing water. Suspended particles may be transported during a wide range of stream flows. Bedload transport occurs during storms when elevated stream discharge disrupts the armouring layer of the bed, which causes the bed material (particles greater than 1.0 mm in diameter) to roll, slide, or saltate downstream. The downstream transport of bedload is dependent on the magnitude of the stream discharge, channel gradient, and size of bedload particles (Leopold et al., 1964). The flows that initiate transport and sorting of bed material are often referred to as "channel forming flows," have a recurrence interval of approximately 2 to 3 years, and also are the flows responsible for changes in channel morphology.

Timber harvest activities affect sediment processing by increasing sediment supplies, altering the timing and frequency of peak flows, and by changing the channel structure through the reductions of important sediment storage sites provided by LWD (Chamberlain et al., 1991). Additional erosion may occur when stream banks are destabilized and the channel moves laterally and scours bank material (Scrivener, 1988).

Increased sediment delivery to stream channels affects bedload transport mechanisms, channel formations, and aquatic habitats. Increases in bedload can result in increased storage of sediment, which may lead to decreases in the number and depth of pools, a widening of the channel, and destabilization of stream banks (Everest et al., 1987). The effects of increased sediment can be short lived or persistent, depending on the amount and duration of the sediment source. Using a bedload and transport and routing model, O'Conner and PWA (2001) reported that a period of decades is required for gravel size material to be transported from the upper Freshwater Creek watershed to the lower watershed. Sand-size material is probably routed from source areas to lower Freshwater Creek over a period of about a decade. Hartman et al. (1987) reported that on Carnation Creek sudden pulses of fine sediment tended to be processed within several years, provided the watershed was not overloaded with sediment and that the erosional sources were healed. However, a channel subjected to continuous and persistent increases of sediment may become braided at low flows with much discharge occurring as sub-surface flow, and as a wide shallow channel at high flows that has a reduced capacity to transport elevated discharges. Continuous inputs of fine sediments also may infiltrate deeply into the channel bed and can persist for many years (Swanston, 1991).

Effects of Forest Management on Water Quality. Primarily, four aspects of water quality can be affected by forest management activities:

- Sedimentation
- Water temperature
- Dissolved oxygen levels
- Contaminant levels

Sedimentation. The amount of sediment deposition in a stream depends on the availability of sediment through erosion, and the rate of sediment delivery to the stream. Generally, the amount of sediment created from timber management activities is related to the amount of bare and compacted soils that are exposed to rainfall and runoff. Slope steepness, slope storage capacity, and proximity to stream channels determine the rate of sediment delivery (Quigley and Arbelbide, 1997). Activities such as skidding and yarding can compact soils because of the machinery used, especially at landings. Skidding generally causes more ground disturbance than cable or helicopter yarding. However, cable yarding on steep slopes also may result in soil disturbances because the ends of trees may drag on the ground, scarring and exposing soil.

Logging activities of timber harvesting, site preparation, and road construction may increase the amount of suspended sediment within a watershed. The amounts vary seasonally, but logging activities can alter the amount, timing, and duration of suspended sediments. Most studies have shown that roads are the main sources of suspended sediment associated with timber management activities (Anderson, 1971; Cederholm et al., 1981; Furniss et al., 1991; Swanston, 1991). The effect of roads on sediment inputs were described above.

Laboratory studies have revealed the negative effects of suspended sediment on developing salmonid eggs and embryos, yet results from field experiments have been less conclusive (Everest et al., 1987). Newcombe and MacDonald (1991) provided an extensive review of more than 70 studies that attempted to document the effects of suspended sediment on aquatic organisms. Their conclusion is that there is little agreement on the environmental effects of suspended sediment as a function of concentration and duration of exposure (Newcombe and MacDonald, 1991).

Water Temperature. All life stages of the covered species noted above require relatively cold to cool water. Suitable stream temperatures are maintained through a variety of mechanisms. In general, surface water temperatures are related to local air temperatures, except where influenced by groundwater. The primary factors affecting air temperature are elevation, aspect, latitude, humidity, wind, and sunlight. Stream temperatures also are affected by stream gradient, stream flow, and water source (groundwater, snowmelt, or rain). Tree removal generally reduces shade and humidity, and increases wind velocities and stream flow. A reduction in tree density and canopy closure in areas adjacent to streams might also affect stream temperature by allowing changes in microclimate variables, including increased air temperature, lower humidity, increased wind speed, and increased ground temperatures. Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel input morphology such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998).

The principal source of heat for small mountain streams is solar radiation striking the surface of the stream (Brown, 1969). Flow can be affected if the removal of large areas of vegetation reduces the amount of surface water infiltration into the soil because of compaction (Chatwin et al., 1994). Although reduced infiltration is not directly related to temperature, the amount of groundwater reaching a stream over time can be affected. The temperature of groundwater is usually close to the average annual ambient air temperature of a region.

Water temperature increases resulting from timber harvesting are greatest during the low-flow periods in summer and early fall. During low flow, groundwater comprises most of the stream flow because input from other sources such as snowmelt has declined. Also, the travel time for water through a given stream reach is longer (because velocities decrease with decreasing flow), exposing the water to more solar radiation. Reductions in canopy cover because of timber harvesting could worsen this condition (Beschta et al., 1987).

Reductions in canopy cover may also decrease temperatures in late fall or early winter. Tree canopies moderate heat loss from streams when the air temperature is cooler than the water. A reduction in canopy cover accelerates heat loss, with the greatest effect on small streams, and little or no effect on wide rivers. Before ice begins to form on streams in late fall and early winter, rapid decreases in stream temperatures can occur during the night.

Changes in water temperatures from the removal of riparian vegetation may benefit or negatively impact salmonid populations. Among the potential benefits is a short-term increase in primary and secondary production that would increase the amount of available food. Studies have shown that after logging, increases in filamentous algae promoted the abundance of invertebrate grazers such as baetid mayflies, grazing caddisflies, and midges that were more likely to contribute to the insect drift and be available as food for salmonids (Hawkins et al., 1982).

Increased water temperatures during summer months as a result of logging can have negative impacts on salmonids (Beschta et al., 1987). These impacts can result in increased stress, and even death, during rearing; prevention or delay of upstream migration by adults; reduced resistance to diseases; poor growth of juveniles due to reduced metabolic efficiency; and shifts in the competitive advantage of salmonids over non-salmonid species (Hallock et al., 1970; Hughes and Davis, 1986; Reeves et al., 1987, Spence et al., 1996).

Dissolved Oxygen. Dissolved oxygen levels in forest streams are generally not a significant source of mortality for adult salmonids, but oxygen limitations can cause mortality while eggs and fry are in the gravels. Dissolved oxygen levels decline when water temperatures increase and stream flows decline. As water warms, it loses its capacity to hold or retain dissolved oxygen; at low flows, the surface mixing of water and air is minimal. A substantial reduction in canopy cover (shade), therefore, has the potential to reduce dissolved oxygen levels in streams if stream temperatures become elevated. Increased nutrient levels also can reduce dissolved oxygen levels by increasing the biological oxygen demand in the water. Tree removal near streams may result in nutrient loading through soil disturbance and the input of organic material. However, nutrient levels quickly return to normal levels following harvest activities (Chamberlain et al., 1991, in Quigley and Arbelbide, 1997). Hicks et al. (1991) concluded that there was no evidence of a major effect of logging on salmonids due to low dissolved oxygen concentrations in surface water.

Contaminants. Most aspects of forest management require the use of mechanized equipment. Where machinery is used, there is the potential for contamination of stream waters through accidental spills of fuels, oils, and other toxic materials. The potential risk and magnitude of pollution is related to the location and duration of the activity. Landings near streams have the greatest potential to deliver pollutants to streams because they are areas of concentrated activity. The application of pesticides, herbicides, and fire retardant also has the potential to introduce pollutants to streams. These contaminants are most likely to be introduced as aerosols and as chemicals are released through runoff from precipitation.

Forest practices can lead to changes in nutrient distribution and dynamics in upland areas, which in turn affect availability in streams (Spence et al., 1996). Harvest intensity (i.e., the proportion of forest canopy removed), type of harvest, and cutting frequency all affect the rate of nutrient removal from the system (Beschta et al., 1995). Despite the loss of nutrients stored in removed biomass, nutrients are generally more available to stream organisms in the years immediately following harvest (Spence et al., 1996). The addition of slash to the forest floor (Frazer et al., 1990), accelerated decomposition of organic litter resulting from increased sunlight reaching the ground (Beschta et al., 1995), and increased water availability for leaching of materials, increased surface runoff and erosion that contributes nutrients to the stream environment (Gregory et al., 1987) are largely responsible for this increase. As soils stabilize and revegetation occurs, the rate of nutrient input typically declines (Spence et al., 1996).

Studies have shown increases in plant nutrients (inorganics such as nitrogen, phosphorus, potassium, calcium) after logging, but these increases were shown to be moderate and for short time periods (Brown et al., 1973; Scrivener, 1982). The nutrient enhancement coupled with increases of solar radiation usually lead to increases in autotrophic production and possible increases in invertebrate grazer populations (Gregory et al., 1987). However, it is inconclusive if salmonid populations respond in either increased growth or numbers to nutrient increases (Gregory et al., 1987).

Effects of Forest Management on Physical Habitat. Harvesting trees causes changes in forest structure and landscape composition. Tree removal in riparian corridors reduces the potential for input of LWD and organic matter to a stream, and can reduce bank stability if trees are removed near the stream bank (Swanson et al., 1987; MBTSG, 1998). These changes have the potential to alter channel morphology and reduce stream habitat complexity. Water removal and culverts can also influence the quantity of available habitat and the ability of fish to move between habitats.

Large Woody Debris. Riparian areas provide numerous ecological functions that support aquatic ecosystems. Thinning and harvesting of timber in riparian areas reduces the availability of LWD that enters streams. In the past, timber harvesting has resulted in reductions of in-channel LWD and potential LWD by extensive clearing of stream channels, removal of most large conifers from the riparian zone, and short-rotation timber harvesting. These activities have altered the sources, delivery processes, and redistribution of woody debris in watersheds and have impacted the abundance and distribution of Pacific salmonids (Bisson et al., 1987; Maser and Sedell, 1994).

LWD provides complexity by adding woody cover or facilitating the creation of hydrologic features such as pools, gravel bars, and backwater areas. In small streams, gravel bars created by log jams or single pieces of LWD are sometimes the only suitable spawning gravels for long distances. Pools and backwater areas provide cover by virtue of deep water and provide refugia from high stream flows. These areas often are critical to the juvenile lifestage of salmonids and other fish species. Amphibians may also utilize pools and backwater areas during one or more life history stages. LWD provides nutrients to a stream as well as a substrate for aquatic invertebrate (insect) production (Bisson et al., 1987; Montgomery et al., 1996).

Bank Stability. Tree removal near streambanks may increase the potential for bank erosion, which can result in the loss of underbank habitat and decreased water depth. Many salmonid species, particularly adults, use undercut banks as holding habitat and feeding stations. Undercut areas provide fish refugia from main channel velocities, overhead cover from predators, and a place to feed on drifting aquatic and terrestrial insects and smaller fish. Undercut banks form when soils are scoured beneath vegetation or roots that hold the surface soils intact. Removal of trees along streambanks can eliminate or reduce the potential for this type of habitat. The root systems of trees near the banks also provide channel stability during periods of high flow, and reduce the potential for floodplain and streambank erosion (MBTSG, 1998).

Water Removal. Pumping and transporting water from streams for watering roads can potentially have adverse effects because of reduced stream flows and the entrainment of organisms, unless water intakes are appropriately screened. Reductions in stream flows during late summer and early fall are particularly important because stream flows are naturally low during this time of year. Fish that become entrained are essentially lost to the population.

Culverts. Culverts designed and built for water passage can be a barrier to fish movement. Culverts with an opening larger than necessary may create water depths too shallow for fish passage, especially during low-flow periods. Depending on the water velocity, extremely long culverts may preclude fish passage since fish cannot sustain high swimming speeds for long periods of time (Bell, 1986). Culverts with high slopes may create velocities during certain flows that are impassible by fish, regardless of culvert length. The last aspect of culverts is drop, which is the vertical distance from the discharge of the culvert into the stream. Depending on the distance, drop may preclude small fish from passage and even discourage larger fish from attempting passage (Bell, 1986).

Effects of Fire Management. To reduce fire hazards, fire prevention involves silvicultural practices such as thinning, salvage, and prescribed burning, and the construction of barriers such as fire breaks. Fire control involves mechanical and chemical methods of fire suppression.

Fire prevention and control, particularly from activities in or near riparian corridors, have the potential to affect several aquatic habitat functions. Examples of these effects include the following:

- Removal or reduction of LWD, which could reduce habitat complexity and alter stream channel configuration.

- Reduction in stream canopy cover, which could increase stream water temperatures.
- Promotion of hillslope mass wasting and surface erosion through the reduction of surface vegetation. This could cause increased surface erosion and sedimentation of streams, which could alter peak and low flows if it occurs over a large area.
- Use of chemical retardant to fight wildfires, which can kill fish and amphibians if applied on and near streams in sufficient quantities. There is also the potential for mortality of aquatic invertebrates and the increased nutrient input to downstream reaches, which could result in indirect effects of fire retardant on aquatic species.
- Fire plow lines and soil scarification, which could increase stream sedimentation.

Effects of Recreation and Fishing. Important values of most aquatic ecosystems are the recreational and fishing opportunities they provide. Maintenance of high-quality recreation values for many rivers, streams, and lakes is often a natural resource management goal of resource agencies. However, recreation and fishing activities can adversely affect fish populations and aquatic habitats as described below.

Introduction of Non-Native Fish Species. The introduction of non-native fish species is usually intended to create or expand fishing opportunities, but instead can adversely affect the native fish community. This can occur through specific species interactions, including competition, predation, and hybridization. Competition occurs over a wide range of ecological situations when two or more organisms compete for the same limited resource. It includes physical competition between individuals (Chapman, 1966), and niche specialization where one species is more efficient at using a habitat than another (Miller, 1967). Predation includes predation on one species by another, and predation by larger (older) fish on smaller ones of the same species. Hybridization and genetic introgression includes reproductive crosses between species that result in changes to the gene pool of one species (such as cutthroat trout/rainbow trout hybrids or introduction of genetic material from hatchery fish). All three interactions may affect native fish populations simultaneously.

Legal Fishing. Legal fishing has the potential to adversely affect local populations of native salmonids, primarily through incidental catch and habitat alteration. Incidental catch can result in unintentional angling mortality through wounding, stress, or the misidentification and unintentional harvest of some species. Wading by anglers can trample spawning redds and increase bank erosion. Trampling can result in the direct mortality of incubating fish eggs and recently emerged fry, while increased bank erosion can accelerate habitat degradation.

Illegal Fishing. One of the most detrimental activities on some species is illegal fishing or poaching. Laws and regulations are developed for certain species to protect sensitive life stages such as spawning adults, certain local populations that are depressed, or, in the case of threatened species, to prevent extinction. Poaching can severely impact fish populations by further reducing populations or sensitive life stages that are already depressed, and by directly killing individuals of a species.

Foot Traffic. Foot traffic can damage vegetation along lakes and streams, either directly through trampling or indirectly through soil compaction. Vegetation damage can lead to erosion and sedimentation, depending on the amount of activity, and can accelerate habitat

degradation. Foot traffic through areas used for spawning (fish) or reproductive activities (reptiles and amphibians) can impact these species through disturbance of essential reproductive behaviors. Trampling of spawning redds can result in the direct mortality of incubating fish eggs and recently emerged fry.

Off-Road Use of Recreational Vehicles. The effects of off-road recreational vehicle use can alter plant community structure and create gaps in vegetation along shorelines and streams (Quigley and Arbelbide, 1997). The partial loss of vegetation can increase erosion along waterbodies. Also, use of off-road vehicles in streams may result in the direct destruction of redds, eggs, and possibly young fish.

3.5 Vegetation/Plant Species of Concern

3.5.1 Introduction

This section relies on data made available from Green Diamond, the California Natural Diversity Database (CNDD), CDFG, and USFWS. Data has been collected, assessed, and simplified for purposes of this EIS. This chapter describes vegetation contained within the coverage area for the Proposed Action and other action alternatives, as well as for all of the Green Diamond fee-owned lands within the Primary Assessment Area in northern California. Vegetation has been grouped into habitat type classifications. The frequency, composition, and spatial distribution of habitat types within Green Diamond's fee ownership within the Primary Assessment Area and the general character of the Primary Assessment Area have been characterized by data provided by Green Diamond.

Green Diamond uses a cover type classification system that focuses on merchantable timber for timber management purposes. Aerial interpretation and ground-truthing is performed according to the established criteria of this system. Biologists at Green Diamond have recently developed a computer algorithm that converts the merchantable timber cover type classification system into the California Wildlife Habitat Relationships (CWHR) System (Mayer and Laudenslayer, 1988). The CWHR system was used in this analysis to identify potential wildlife use within the Green Diamond ownership and to compare existing conditions with future wildlife habitat trends under each project alternative. The current habitat conditions are described below according to CWHR, with the exception of "bare land" and "unclassified," which are classes defined by Green Diamond. The habitat codes, size classes, and canopy closure classes in the CWHR system are defined in Table 3.5-1.

Unclassified land represents either areas that Green Diamond has never surveyed, since most of these areas are lands where some other entity has cutting rights, or lands not located within an HPA and not classified as rain-on-snow. Bare lands are areas where vegetation is absent, for any one of a number of reasons. These lands are mostly a collection of bare rock outcrops, major landslides, and rock pits (i.e., areas being mined for rock to use on roads).

The model used by Green Diamond biologists to convert Green Diamond timber type maps to CWHR classification has not been field-tested and is intended for general characterization purposes only. The classifications derived from the model are based on larger scale habitat characteristics; that is, small inclusions of a particular habitat type may be generally incorporated into another CWHR classification. Further, it is possible that some of the habitat within an HPA on the Green Diamond ownership is identified as Montane Riparian

TABLE 3.5-1
Definitions of CWHR Habitat, Size, Class, and Canopy Closure Class Codes

Habitat Codes	Definition
MHW	Montane Hardwood
CSC	Coastal scrub
DFR	Douglas-fir
MHC	Montane hardwood/conifer
RDW	Redwood
KMC	Klamath Mixed Conifer
LAC	Lacustrine
RIV	Riverine
UNCL	Unclassified
WTM	Wet Meadow
URB	Urban
BARE	Bare land
PGS	Perennial Grassland
Size Classes	**Definition**
1	Stand has a quadratic mean diameter of < 1 inch
2	Stand has a quadratic mean diameter of 1 to 5.9 inches
3	Stand has a quadratic mean diameter of 6 to 10.9 inches
4	Stand has a quadratic mean diameter of 11 to 23.9 inches
5	Stand has a quadratic mean diameter of 24 to ≥ 32 inches
6	Stand has Size Class 5 trees over a distinct layer of Size Class 4 or Class 3 trees; total canopy closure is at least 60 percent
Canopy Closure Classes	**Definition**
S (sparse)	Stand has 10 to 24.9 percent total canopy closure
P (open)	Stand has 25 to 39.9 percent total canopy closure
M (moderate)	Stand has 40 to 59.9 percent total canopy closure
D (dense)	Stand has 60 to 100 percent total canopy closure

habitat. The algorithm is not able to distinguish this habitat type from other forest habitat types. Therefore, no Montane Riparian habitat has been identified in the data presented below. For the most part, Green Diamond does not have these narrow riparian zones mapped as distinct polygons in their geographic information system (GIS). As a consequence of the fact that much of Green Diamond's property would qualify as a temperate rainforest, the riparian vegetation is not significantly different from the surrounding forest across much of the area. The distinctly unique riparian areas present within the ownership are either rare enough, or small enough, such that Green Diamond has not delineated them. The areas that have been classified as Riverine as opposed to Riparian, are legitimate riverine areas, consisting of large enough bodies of flowing water and their associated beds/bars (submerged in winter; exposed in summer). These areas have been typed out as polygons that are classified in the system as "non-forested waterways." While the CWHR classifications derived from the computer algorithm may be imprecise, they are sufficient for characterizing the Green Diamond ownership and for determining potential impacts from action and no action alternatives.

Sensitive plant species potentially occurring within the Primary Assessment Area and the Green Diamond ownership were identified by the following sources: the CNDD, Green Diamond observations, and discussions with USFWS and CDFG. Information from the CNDD was made available via regularly updated computer software called RAREFIND. Sensitive species lists were generated for each of the USGS 7.5' quadrangles (over 50 quadrangles, one million acres) containing the 11 HPAs and Green Diamond's California ownership outside the HPAs, which is predominately rain-on-snow areas. This information was then entered into an ACCESS database to associate species occurrence by HPA (or by USGS quadrangle if outside the HPAs).

3.5.2 Regional Setting

3.5.2.1 General Vegetative Character

Productive soils, moderate temperatures, and seasonally abundant moisture support a mixed cover of dense forest and prairie vegetation within the Primary Assessment Area. Redwood is the dominant tree on the relatively moist flood plains, low stream terraces, and lower hillslopes adjacent to the main channel. On the upper slopes, Douglas-fir is the dominant conifer associated with western hemlock, tanoak, and Pacific madrone.

Areas of natural prairie and woodland vegetation are intimately associated with forested areas throughout much of the Primary Assessment Area. The most common communities of nonforest vegetation are grass prairies, grass-bracken-fern prairies, oak-grass woodlands, oak-poison oak-grass woodlands, and oak-madrone-brush woodlands. The origin of the grass and grass-bracken-fern prairie is partly the result of hillslope mass wasting, natural fires and fires set by local Native American tribes, and lateral variability in soil parent materials (Swanston et al., 1995).

Eleven CWHR habitat types are present within the Green Diamond ownership. While it is unlikely, more habitat types may be present within the "Primary Assessment Area" that comprises the current ownership and lands that may be acquired by Green Diamond in the future. In addition to the 11 CHWR habitat types, Green Diamond has included two classifications to describe land cover within its ownership, including Bare Land (Bare)

and Unclassified Land. Of the 13 habitat types that are present, however, only 5 are forested: Montane Hardwood (MHW), Klamath Mixed Conifer (KMC), Douglas-fir (DFR), Redwood (RDW), and Montane Hardwood Conifer (MHC). Five non-forested vegetative habitat types that are present and intermixed with the forested habitat types are Perennial Grassland (PGS), Wet Meadow (WTM), Riverine (RIV), Lacustrine (LAC), and Bare. Other non-forested habitat types that are present within the Green Diamond ownership include Coastal Scrub (CSC), Urban (URB), and Unclassified Land. CSC, URB, and Unclassified Lands are not generally associated with commercial timberlands. They are, therefore, not included in the Action Area or Primary Assessment Area (see Section 3.1), and not described or analyzed in detail in this EIS. Table 3.5-2 provides a breakdown of the distribution and abundance of the forested and non-forested habitat types within the Green Diamond ownership. Figure 3.5-1 provides a graphic display of the habitat types within the Green Diamond ownership as distributed throughout the 11 HPAs.

More than 96 percent of the Green Diamond ownership is forested, with RDW being the most common forest habitat type. RDW is also the most common habitat type of all habitats present. It represents about 55 percent of the acreage found within forested habitat types. RDW is followed in percent composition by DFR (18.7 percent), MHC (13.7 percent), and MHW (9.1 percent). KMC only accounts for about 26 acres. KMC is only found in the rain-on-snow areas of Green Diamond's ownership. RDW, DFR, MHW, and MHC are found in all 11 HPAs. DFR, KMC, and MHW are found primarily within the eastern portion of the Green Diamond ownership. Whereas, as expected, RDW and MHC are found primarily along the western portion, or closer to the coast. MHC is found only in the northwestern portion of the Green Diamond ownership.

The primary hardwood species that are represented within the MHW and MHC habitat types are red alder, tanoak, Pacific madrone, Oregon white oak, and black oak. Red alder is the dominant overstory species in the riparian areas. Tanoak and Pacific madrone occur along ridge lines and mid-slope areas and are intermixed with conifers. Oregon white oak and black oak occur in the drier transition zones between Douglas-fir forests and prairies.

A long history of logging in the region has resulted in a mixture of even-aged stands. Using GIS data and CDFG's CWHR criteria, the general stand composition and structure within the Green Diamond ownership were determined. Approximately 12 percent of the Green Diamond ownership within the 11 HPAs and the rain-on-snow areas is characterized by age classes greater than 60+ years. Most of the older vegetation is located within the Coastal Lagoons and Mad River Hydrographic Areas and the Little River Hydrologic Unit (see Figure 3.5-2). Other, general regional characteristics include:

- About 64 percent of the Green Diamond ownership within the 11 HPAs and the rain-on-snow areas is classified as CWHR size class 1-3
- Approximately 29 percent of the Green Diamond ownership within the 11 HPAs and the rain-on-snow areas is forest habitat classified as CWHR size class 4, stands with an average diameter at breast height (dbh) between 12 and 24 inches
- More than 63 percent of the forested habitat within the Green Diamond ownership within the 11 HPAs and the rain-on-snow areas has dense canopy closure

TABLE 3.5-2
Percent Composition of Habitat Type Within Green Diamond Ownership

	Acreage Distribution in Hydrographic Planning Areas												
CHWR Classification	**Smith River**	**Coastal Klamath**	**Blue Creek**	**Interior Klamath**	**Redwood Creek**	**Coastal Lagoons**	**Little River**	**Mad River**	**N. Fork Mad River**	**Humboldt Bay**	**Eel River**	**Non-HPA (rain-on-snow)***	**Total Ownership Acreage**
Montane Hardwood	4.64%	3.42%	4.62%	27.82%	15.86%	0.24%	0.84%	13.51%	4.59%	0.20%	0.92%	9.92%	9.13%
Klamath Mixed Conifer	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%	0.01%
Douglas-Fir	15.06%	6.19%	9.37%	33.13%	34.14%	11.75%	7.72%	22.23%	22.63%	2.06%	4.85%	43.84%	18.74%
Redwood	55.06%	81.36%	77.80%	10.61%	33.05%	86.08%	86.24%	40.15%	51.90%	96.32%	92.90%	0.49%	54.75%
Montane Hardwood Conifer	20.26%	6.25%	2.88%	25.16%	14.50%	0.55%	4.84%	12.60%	18.37%	0.42%	0.07%	44.57%	13.74%
Riverine	1.09%	0.55%	3.55%	0.21%	0.69%	0.22%	0.00%	1.42%	0.74%	0.00%	0.71%	0.12%	0.67%
Bare	0.01%	0.05%	0.09%	0.08%	0.08%	0.40%	0.17%	0.09%	0.05%	0.07%	0.01%	0.18%	0.11%
Coastal Scrub	3.33%	1.98%	1.53%	1.38%	0.22%	0.63%	0.02%	0.25%	0.08%	0.32%	0.07%	0.04%	1.11%
Perennial Grassland	0.14%	0.06%	0.16%	1.59%	1.10%	0.04%	0.17%	9.75%	0.47%	0.61%	0.47%	0.73%	1.56%
Wet Meadows	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Urban	0.34%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	0.00%	0.00%	0.00%	0.14%
Unclassified	0.06%	0.00%	0.00%	0.00%	0.34%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%
Lacustrine	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

***** Green Diamond ownership outside of the 11 HPAs

3.5.2.2 CWHR Classifications

Klamath Mixed Conifer. The KMC habitat type is restricted to the Klamath region of northern California and southwestern Oregon. It occurs along the eastern boundaries of Del Norte and Humboldt counties at elevations from 4,500 to 7,000 feet, often on steep slopes or in narrow valleys. While very similar to the mixed conifer type, it is distinguished by its higher species diversity. Douglas-fir and white fir are the dominant tree species, with Shasta red fir, lodgepole pine, Jeffrey pine, mountain hemlock, western white pine, Brewer spruce, canyon live oak, and black oak also included in the community. The understory is comprised of a rich shrub layer including: chinquapin, Sierra laurel, Saddler oak, dwarf rose, manzanita, huckleberry, oak, snowberry, and Oregon grape, as well as a well-developed and diverse herbaceous layer.

Following disturbance, a dense community of montane chaparral develops from seeds in the soil seed bank. If adequate seed sources are present, a dense stand of young conifers follows the shrub stage within 20 to 30 years. The successional stages are often dependent on the type and frequency of disturbance as well as site-specific environmental factors. The communities are considered to be relatively well adapted to low intensity fires; however, intense or frequent fires may result in continued dominance of the montane chaparral type.

KMC represents less than 26 acres of the Green Diamond ownership, and is found only in the rain-on-snow areas. All habitat present has been classified as KMC1P (size class 1, open).

Douglas-Fir. The DFR type is widespread throughout northwestern California, including Del Norte and Humboldt Counties, at elevations ranging from 500 to 2,000 feet. Douglas-fir is the characteristic dominant species and associated species of conifers and hardwoods vary depending on soils, moisture, topography and disturbance history. On dry, steep slopes, canyon live oak is frequently abundant, but other trees, shrubs and herbs are sparse. In moderately dry areas, tanoak, Pacific madrone, sugar pine, ponderosa pine, and black oak are common components of the canopy, with Oregon grape, California blackberry, dwarf rose, and poison oak occurring in the shrub layer. Forbs and grasses include Pacific trillium, western swordfern, insideout flower, broadleaf starflower, deer vetch vanillaleaf, bracken fern, western fescue, common beargrass, and whitevein shinleaf. On the wettest sites, Port Orford cedar and Pacific yew are present in the canopy and common shrubs include vine maple, California hazel, and Pacific rhododendron.

Following disturbance, resprouting tanoak typically dominates with various other shrubs and forbs. In moist areas where young Douglas-fir is present in the tanoak community, the shrubs are generally overtopped by the trees in 15 to 30 years. The shrub community may persist for 60 to 100 years on dryer sites. Snags and downed logs, an important structural component of this habitat, increase in density or volume with stand age. In the absence of fire or other disturbance, western hemlock may occur as a codominant with Douglas-fir and tanoak in areas transitional to redwood forests. In the absence of disturbance, climax stands typically develop in 80 to 250 years.

DFR represents about 18.7 percent of the Green Diamond ownership within the 11 HPAs and the rain-on-snow areas, with about 82,848 acres recorded. Most of this acreage (26 percent) is found in the Interior Klamath HPA. This habitat type is also abundant in the Redwood Creek Hydrologic Unit and Mad River Hydrographic Region. Nearly 60 percent

of the DFR habitat type is found within the eastern portion of the Green Diamond ownership. Very little of the DFR habitat type is found within the Humboldt Bay and Eel River HPAs located in the southern portion of the Green Diamond ownership (360 and 384 acres, respectively). About 71 percent of this habitat type is characterized as size class 1 through 3, with the remaining 29 percent characterized as size class 4 through 6. Size class 6, however, accounts for less than 1.0 percent of the DFR habitat. Size class 1 is the most abundant, accounting for about 35 percent of this habitat type. The next most abundant class (31 percent) is class 3. About 59 percent of this habitat type is characterized as having a dense canopy.

Redwood. The RDW habitat type refers to the mixed conifer forests that occur in the moist coastal environments at elevations ranging from sea level up to 3,000 feet. Redwoods are found throughout this range, but are only dominant in a narrow band within ten miles of the coast. Further inland, Douglas-fir becomes the dominant canopy species. Common associated species include sitka spruce, grand fir, Pacific madrone, and tanoak. Western red cedar and western hemlock are present, but are not significant species in the canopy. The moist climate and fertile soils result in a generally lush understory growth of shrubs, ferns, herbs, and grasses. Common understory species include barbary salal, coast rhododendron, ocean spray, huckleberry, snowbrush, ceanothus, sword fern, deer fern, and salmonberry.

This habitat type typically recovers rapidly from disturbance. Within 10 years, the early herbaceous vegetation is replaced by shrubs and redwood sprouts. Within 30 to 60 years, the shrub stage is followed by a mixture of conifers and hardwoods, with persistent shrubs remaining in the understory. A mature stand, dominated by redwoods with a second canopy layer of Douglas-fir requires at least 150 years to develop.

RDW represents about 55 percent of the Green Diamond ownership in the 11 HPAs and the rain-on-snow areas, with 241,973 acres recorded. Most of this acreage (nearly 30 percent) is found in the Coastal Klamath Hydrographic Region. The Coastal Lagoons Hydrographic Region contains another 14 percent of this habitat type. Redwood is least common in the Interior Klamath Hydrographic Region and the rain-on-snow areas. While only 3.0 percent of the total RDW type is found within the Eel River Hydrographic Region, RDW accounts for almost 93 percent of the habitat found within this HPA. About 58 percent of the RDW habitat type is characterized as size class 1 through 3, with the remaining 42 percent characterized as size class 4 through 6. Size class 6 accounts for less than 1 percent of the RDW habitat type. Size class 4 is the most abundant, accounting for approximately 37 percent of this habitat type. The next most abundant class (35 percent) is class 4. Almost 59 percent of the RDW habitat type within the Green Diamond ownership is qualified as having a dense canopy.

Montane Hardwood Conifer. The MHC habitat type occurs throughout California and occurs extensively in both Del Norte and Humboldt counties on coarse, well-drained soils, at elevations ranging from 1,000 to 4,000 feet. This habitat type is a transition between the conifer dominated forests and the montane hardwood and is distinguished by having at least a third of the canopy species comprised of hardwoods and at least a third conifers. Typical canopy species include ponderosa pine, Douglas-fir, incense cedar, black oak, tanoak, Pacific madrone and golden chinquapin.

OREGON

CALIFORNIA

DEL NORTE CO

Map Location

Crescent City

Smith River HPA

101

Coastal Klamath HPA

Blue Creek HPA

96

Pacific Ocean

Redwood Creek HPA

Interior Klamath HPA

SISKIYOU CO

Coastal Lagoons HPA

Little River HPA

North Fork Mad River HPA

Arcata

Eureka

Humboldt Bay HPA

Mad River HPA

HUMBOLDT CO

TRINITY CO

Eel River HPA

LEGEND

- DOUGLAS FIR
- MONTANE HARDWOOD
- REDWOOD
- MONTANE HARDWOOD CONIFER
- PERENNIAL GRASSLANDS
- COASTAL SHRUB
- AQUATIC (RIVER, WET MEADOW, LACUSTRINE)
- OTHER (UNCLASSIFIED, BARREN, URBAN)
- MAJOR WATER BODIES
- GREEN DIAMOND OWNERSHIP AREA
- HYDROGRAPHIC PLANNING AREAS
- COUNTY BORDER
- RIVERS
- MAJOR ROADS
- CITIES

5 0 5 Miles

SCALE IS APPROXIMATE

N

Figure 3.5-1
Habitat Types

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CH2MHILL

OREGON

CALIFORNIA

DEL NORTE CO

Map Location

Crescent City

Smith River HPA

Coastal Klamath HPA

Blue Creek HPA

Pacific Ocean

Redwood Creek HPA

Interior Klamath HPA

Coastal Lagoons HPA

Little River HPA

North Fork Mad River HPA

Arcata

Eureka

Humboldt Bay HPA

Mad River HPA

Eel River HPA

SISKIYOU CO

HUMBOLDT CO

TRINITY CO

101

96

LEGEND

- AGE 0 - 19
- AGE 20 - 39
- AGE 40 - 59
- AGE 60 - 79
- AGE 80 - 99
- AGE > 100
- MAJOR WATER BODIES
- HYDROGRAPHIC PLANNING AREAS
- COUNTY BORDER
- RIVERS
- MAJOR ROADS
- CITIES

5 0 5 Miles

SCALE IS APPROXIMATE

N

Figure 3.5-2
Timber Age Classes

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CH2MHILL

The multi-layered dense canopy precludes much understory vegetation; however, shrubs often become abundant following disturbance. Immediately after disturbance resprouting hardwoods dominate with a tall stand of mixed conifers and hardwoods developing within 15 to 20 years. The conifers generally grow faster, reaching moderate size in 30 to 50 years, while the hardwoods require 60 to 90 years to fully recover.

MHC represents about 14 percent of the Green Diamond ownership in the 11 HPAs and the rain-on-snow areas, with 60,779 acres recorded. Most of this acreage (about 26 percent) is found in the Interior Klamath Hydrographic Region. The Smith River Hydrographic Region contains another 15 percent and the Mad River Hydrographic Region contains 10 percent of this habitat type. Rain-on-snow areas contain more than 18 percent of this habitat type on the Green Diamond ownership. MHC is least common in the southern portion of the Green Diamond ownership, where the Eel River and Humboldt Bay Hydrographic Areas each contain less than 0.10 percent of the habitat type. About 73 percent of this habitat type is characterized as size class 3, with the remaining 27 percent characterized as size class 4 through 6. Size class 6 accounts for a little under 2 percent of the MHC habitat type on the Green Diamond ownership in the 11 HPAs and rain-on-snow areas. About 93 percent of the MHC habitat type within the Green Diamond ownership is characterized as having a dense canopy.

Montane Riparian. Although not specifically delineated by Green Diamond (given the small scale of this habitat type relative to the Primary Assessment Area), the MRI habitat type likely occurs within the Primary Assessment Area. This diverse habitat type occurs throughout the Klamath, Cascade, Coast and Sierra Nevada Mountains on seasonally flooded or saturated soils at elevations up to 8,000 feet. Winter deciduous broad-leaf trees dominate the canopy. The vegetation structure is variable depending on specific site conditions and shrubs may be common or sparse. In the northern coast range, including Humboldt and Del Norte counties, the sub-type of this habitat is dominated by red alder. Associated riparian canopy species include: black cottonwood, bigleaf maple, dogwood, Sitka spruce, Hooker willow, Arroyo willow and box elder. The herbaceous layer is generally lush and frequently dominated by ferns. The transition to non-riparian vegetation is frequently abrupt. This habitat type is relatively stable but may contain a mosaic of stages depending on the flood history.

Perennial Grassland. Perennial grassland habitat type, also known as coastal prairie, is restricted to the central and northern coastal areas, occurring within 65 miles of the shoreline at elevations up to 3,300 feet. This habitat type often occurs on ridges and south-facing slopes intermixed with forest and scrub habitats. Native perennial bunchgrasses, such as California oat grass, Pacific hairgrass, and Idaho fescue are common, as well as several non-native perennial and annual grasses, including sweet vernal grass, redtop, Kentucky bluegrass, and softcress. Bracken fern, coast carex, and numerous forbs are also present in this habitat type.

Considered to be relatively stable under natural disturbance regimes, overgrazing, fire suppression, cultivation, and the introduction of non-native species have significantly impacted PGS.

PGS represents approximately 1.6 percent (or 6,892 acres) of the Green Diamond ownership in the 11 HPAs and rain-on-snow areas and is mostly (70 percent) found in the Mad River

HPA. This HPA, in addition to the Interior Klamath HPA, comprises over 85 percent of this habitat type within the Green Diamond ownership. This habitat type is least common in the Coastal Lagoons Hydrographic Region, where only 16 acres are recorded.

Wet Meadows. Wet meadows occur extensively throughout the Sierra Nevada and Klamath Mountain ranges at elevations ranging from 4,600 to 6,000 feet on soils saturated throughout the growing season. This type occurs in northern Humboldt County and throughout Del Norte County. The herbaceous layer is composed of a rich diversity of grasses, sedges, rushes, and forbs with shrubs and trees sparse or absent. Important species include thingrass, abruptbeak sedge, Nebraska sedge, tufted hairgrass, needle spikerush, Nevada rush, iris leaf rush, pullup muhly, and panicled bulrush. Willow and bilberry are the only shrubs that may occur in any significant abundance.

Long-term succession eventually leads to replacement of wet meadows with forests; however, significant disturbance, such as overgrazing or altered hydrology, is generally required to allow tree invasion to occur.

This habitat type represents only 10 acres of the Green Diamond ownership and is all found within the Smith River and Interior Klamath Hydrographic Regions.

Riverine. This classification refers strictly to waterways and is specifically described in Section 3.3 (Hydrology and Water Quality) of this EIS. Although the Green Diamond GIS system does not include riparian zones around these riverine habitats, Green Diamond has completed numerous field studies to determine riparian habitat characteristics within the Primary Assessment Area and the ownership. Riparian vegetation in the coastal watersheds of northern California support a diversity of tree species including alder, willows, western red cedar, coastal redwood, sitka spruce, Douglas-fir, western hemlock, and big leaf maple. Channel habitat typing and assessment within the Primary Assessment Area and Green Diamond ownership was conducted on 41 stream reaches for nearly 60 miles of stream channel. Canopy closure, as measured from the center of the stream, ranged from 70 percent to 95 percent in seven out of eight sub-basins sampled. Canopy closure was only 34 percent in one sub-basin due to a recent wildfire. Species composition within 50 feet of the bankfull channel was predominantly deciduous (69 percent to 91 percent) along all eight streams. The shift in composition favoring deciduous species is due in part to past harvesting practices and current restrictions on management activities within riparian areas. The predominant species observed in the riparian areas was red alder.

Lacustrine. Lacustrine habitats are inland depressions or dammed riverine channels containing standing water. This habitat type represents only 8 acres within the Green Diamond ownership, and is found entirely in the Redwood Creek Hydrologic Unit.

Bare Ground. This land cover type includes rock pits, slides and outcrops. Only 0.11 percent or 465 acres of this land cover type is found on the Green Diamond ownership within the 11 HPAs and rain-on-snow areas. This type is mostly (34 percent) found in the Coastal Lagoons. North Fork Mad River, Smith River, Eel River and Humboldt Bay Hydrographic Areas have the fewest acres of this habitat type with only 14, 2.7, 0.5 and 12.9 cres, respectively.

3.5.3 Hydrographic Planning Area Setting

Table 3.5-2 presents the percent composition of each habitat type within Green Diamond ownership and by HPA. A brief characterization of the Green Diamond ownership within each HPA is provided below.

3.5.3.1 Smith River Hydrographic Region

The Smith River Hydrographic Region is heavily forested, except for areas on the coastal plain that support agricultural and urban development. Although this HPA is at the north end of the range of redwood, this species is the dominant component of most cover types. Sitka spruce is a major stand component on coastal aspects, and Douglas-fir is the principal constituent of many stands in the more inland portions of this HPA. Western hemlock, western red cedar, and grand fir occur as minor stand components on lower slopes near the coast. Red alder dominates most riparian zones and many lower slopes on north to east aspects throughout this area. Tanoak and madrone are common on drier sites toward the interior, particularly upper slopes with south to west aspects. Stand ages vary from recently planted harvest units to 60-year-old second-growth forests.

The Green Diamond ownership within this HPA is primarily composed of the RDW (55.1 percent) and MHC (20.3 percent) habitat types. DFR represents 15.1 percent of the Green Diamond ownership in this HPA. Other habitat types each comprise less than 5 percent of Green Diamond ownership within the HPA.

3.5.3.2 Coastal Klamath Hydrographic Region

The Coastal Klamath Hydrographic Region is dominated by redwood and redwood/Douglas-fir forests, with Sitka spruce occupying a narrow strip of westerly aspects along the coast and some lower slopes for a short distance inland. The redwood/Douglas-fir forests also include grand fir, western red cedar, and western hemlock on lower slopes and in riparian zones. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood, with pacific madrone occurring as a minor stand component on drier sites. As distance from the coast increases, the proportion of redwood in stands decreases and Douglas-fir and tanoak become more prevalent. Ridge tops and upper south to west slopes in the most inland reaches can support nearly pure Douglas-fir or tanoak/madrone stands.

Due to a band of serpentinaceous soils on the Red Mountain–Rattlesnake Mountain ridge that forms the divide between Turwar Creek and Goose Creek, a distinct ecotone occurs around 2,500 to 3,000 feet elevation where redwood and Douglas-fir forest rapidly gives way to a non-forest landscape dominated by manzanita, with knobcone pine, ponderosa pine, and Port Orford cedar at the transition and persisting upslope in the bottom of many watercourses.

A few isolated small stands of old growth exist on Green Diamond's property within this HPA, in addition to those in State and Federal parks situated within a few miles of the coast. Most of the forests in this HPA were harvested between the 1930s and the 1970s, and stand ages reflect that history.

The RDW habitat type comprises by far the greatest amount of Green Diamond acreage within this HPA with about 81.4 percent coverage. MHC amd DFR comprise about 6.3 and

6.2 percent, respectively, of the Green Diamond ownership in this HPA. Other habitat types each comprise less than 4 percent of Green Diamond acreage within the HPA.

3.5.3.3 Blue Creek Hydrologic Unit

Blue Creek's elevation range (50 ft. to 5,700 ft.) and its location at the inland edge of summer fog intrusion provide for a diverse association of forest types. At the mouth of Blue Creek, coastal redwood/Douglas-fir forest predominates, and redwood persists nearly to Green Diamond's property line, approximately 7 miles upstream. Six Rivers National Forest owns the entire HPA above Green Diamond's property, and the forest there progresses from Douglas-fir/tanoak at lower elevations to a montane conifer forest more typical of the Klamath Mountains at higher elevations, with Douglas-fir and white fir the primary overstory species. As in the Coastal Klamath Hydrographic Region, serpentinaceous soils on South Red Mountain generate a vegetative cover type above 2,500 to 3,000 feet that is dominated by manzanita, with knobcone pine, ponderosa pine, and Port Orford cedar at the transition and persisting upslope in the bottom of many watercourses. This same soil-vegetation complex occupies over much of the Slide Creek subwatershed that is mostly within the National Forest on the south slope of Blue Creek.

Timber harvesting operations began around 1960 in this HPA, and by 1990 all but scattered remnants of the original forest on Green Diamond's property had been harvested. Very little timber harvesting has occurred within the 80 percent of this watershed owned by the National Forest, and roughly 40 percent of that ownership is in the Siskiyou Wilderness Area.

Green Diamond ownership within this HPA is primarily composed of the RDW (77.8 percent) habitat type. DFR comprises about 9.4 percent, and other habitat types each comprise less than 5 percent of the HPA area owned by Green Diamond.

3.5.3.4 Interior Klamath Hydrographic Region

The Interior Klamath Hydrographic Region spans the transition from coastal redwood/Douglas-fir forests to more mesic interior landscapes that are dominated by Douglas-fir/tanoak forests, with grasslands appearing on some drier ridge tops and south to west aspects. On the east side of the Klamath River, redwood only occurs north of Cappell Creek and only on lower slopes along the river face. On the west side of the Klamath, redwood persists to the Redwood Creek divide in Roach Creek and throughout the area north and west of this tributary. Higher elevations at the eastern boundary of this Region (4,000 to 4,500 feet) support montane conifer forests dominated by Douglas-fir and white fir.

Red alder occurs in riparian zones along lower stream reaches throughout the region, and golden chinquapin can be found as a stand component on more xeric sites. Oregon white oak is common at the margins of grasslands, with California black oak also found on drier soils.

With the exception of the areas along the western margin of this HPA that are in Six Rivers National Forest, and some fragmented stands on the Hoopa Indian Reservation, most of the forest in this area is young growth originating from timber harvesting activities that occurred between the 1940s and the 1980s.

Green Diamond's ownership within this HPA is primarily comprised of three habitat types in near equal portions: DFR (33.1 percent), MHC (25.2 percent), and MHW (27.8 percent). Only

about 10.6 percent of Green Diamond's lands within this HPA are comprised of the RDW habitat type. Other habitat types each comprise less than 2 percent of Green Diamond land within this HPA.

3.5.3.5 Redwood Creek Hydrologic Unit

The Redwood Creek Hydrologic Unit supports cover types that range from Sitka spruce/Douglas-fir forest at the coast to Douglas-fir/white fir forest at the watershed's origin, 46 miles south-southeast of its mouth.

The redwood/Douglas-fir forest also includes grand fir, western red cedar, and western hemlock on lower slopes near the coast and in riparian zones. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

Aspect strongly affects the distribution of redwood within the watershed. Redwood persists roughly halfway up the west side of the drainage, but only one-third of the way up the east side. The drier regime created by the west facing slope also leads, along with soil type differences, to the appearance of natural grasslands on the east side of the drainage approximately 10 miles from the mouth of Redwood Creek, while they do not appear on the west side until south of Highway 299, approximately two-thirds of the way up the drainage. These grasslands and associated true oak woodlands become more prominent in the upper portion of the watershed, leading to a history of agricultural use—principally livestock grazing—since settlers arrived.

The middle to upper reaches of Redwood Creek transition rapidly to Douglas-fir/tanoak forest at the limits of the redwood forest, and white fir becomes prevalent near the watershed's 5,300-foot crest.

Agricultural development and the small town of Orick on the alluvial plain between Redwood Creek's estuary and the mouth of Prairie Creek constitute the only significant conversion of native forest to other uses within the drainage. Except for that area, roughly the lower third of the drainage is in Redwood National Park and Prairie Creek State Park. These parks support 25,000 acres of old growth, uncut coniferous forest, principally redwood and redwood/Douglas-fir types and another 1,800 acres where logging has occurred but over 50 percent of the original stand remains. The remainder of the forested area within the watershed has been harvested since the 1930s, with very few sites that support any significant remnants of the original forest.

Green Diamond's ownership within this HPA is primarily comprised of the RDW habitat type (33.1 percent), and the DFR habitat type (34.1 percent). The MHC and MHW habitat types together comprise about 30 percent of Green Diamond ownership in this HPA. This HPA contains the only known occurrence of the LAC habitat type within the 11 HPAs and rain-on-snow areas.

3.5.3.6 Coastal Lagoons Hydrographic Region

The Coastal Lagoons Hydrographic Region encompasses the coastal drainages between Redwood Creek and Little River, its inland extent being defined by the divide into those drainages. As it extends only 10 miles inland and crests at 2,800 feet elevation, the entire HPA is within the zone of summer fog intrusion, and all vegetative types therefore reflect a strong coastal influence.

Aside from coastal scrub and wetland vegetation around the lagoons, and residential development along U.S. Highway 101 (including the town of Trinidad), the entire HPA is forested. Sitka spruce and Douglas-fir/spruce forests along the coast rapidly give way to redwood and redwood/Douglas-fir forests that persist to the eastern boundaries of the HPA. Minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes near the coast and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

The RDW habitat type comprises nearly 86 percent of the Green Diamond ownership in this HPA, while the next most abundant habitat type is DFR with about 11.8 percent. Other habitat types each comprise less than 1 percent of the HPA. This HPA contains the only occurrence of the WTM habitat type found within the 11 HPAs and rain-on-snow areas.

3.5.3.7 Little River Hydrologic Unit

The Little River Hydrologic Unit extends inland from the coast approximately 12 miles and reaches an elevation of 3,360 feet. Aside from residential and agricultural development along U.S. Highway 101, the entire unit is forested, with no natural prairies or other non-forest openings.

Sitka spruce and Douglas-fir/spruce forests along the coastal face give way within a mile or two of the coast to redwood and redwood/Douglas-fir forests. Minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes near the coast and in riparian zones. All but the extreme eastern tip of the Unit, approximately the last mile or two of the main stem of Little River, is within the zone of summer fog intrusion. This area supports redwood as a significant, if not dominant, stand component. Above the limit of fog intrusion, Douglas-fir and tanoak dominate the landscape. Red alder is the most common hardwood found in riparian zones throughout the Unit.

The RDW habitat type comprises about 86 percent of Green Diamond lands within this HPA. The next most abundant habitat types are DFR and MHC with about 7.7 percent and 4.8 percent coverage, respectively. Other habitat types each comprise less than 1 percent of Green Diamond land within this HPA.

3.5.3.8 Mad River Hydrographic Region

The Mad River Hydrographic Region extends inland from the coast approximately 26 miles and reaches an elevation of 5,200 feet. It encompasses a range of vegetative types from coastal scrub and Sitka spruce forest to Douglas-fir/white fir forests at elevations above 4,000 feet in the extreme southeastern corner of the HPA.

Redwood/Douglas-fir forests dominate roughly the lower two-thirds of the HPA. This habitat type also includes grand fir, western red cedar, and western hemlock on lower slopes near the coast. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood, with pacific madrone occurring as a minor stand component on drier sites. As distance from the coast and elevation increase, the proportion of redwood in stands decreases and Douglas-fir and tanoak become more prevalent, with these species dominating the landscape at elevations above 2,000 feet. Occasional incense cedar are also found at higher elevations along the western boundary of the HPA.

Extensive prairies are particularly distinctive features on south- to west-facing slopes and ridgetops in the upper one-third of the HPA. In this area California black oak forms nearly pure stands as an ecotone between prairies and Douglas-fir forest.

Timber harvesting in this HPA began in the late 1800s near the coast as white settlers arrived. By 1930 almost all the redwood type had been harvested. The Douglas-fir dominated forests in the upper reaches of the HPA were not extensively logged until the 1940s, and by 1970, very little timberland remained in the HPA that had not been logged. Harvesting of mature second-growth forests was initiated in the lower reaches of the HPA in the 1960s.

The RDW habitat type comprises about 40 percent of this HPA. The next most abundant habitat type is DFR with about 22 percent coverage. The MHC and MHW habitat types together comprise about 26 percent of Green Diamond ownership in this HPA. Nearly 10 percent of the Green Diamond ownership in this HPA is characterized as PGS.

3.5.3.9 North Fork Mad River Hydrologic Unit

The North Fork Mad River Hydrologic Unit is one of the most heavily forested HPAs. All but an estimated 300 acres of natural grassland was in forest cover at the time of white settlement. The only changes in land use that have occurred since that time include Green Diamond's mill complex at Korbel, the right-of-way for State Highway 299 that bisects the Unit, and a portion of the town of Blue Lake.

The mouth of the North Fork is located approximately 8 miles from the coast, and its eastern-most edge is roughly 13 miles inland. Its elevation ranges from 200 feet to 3,400 feet. Redwood occurs to around 2,200 feet in elevation throughout most of the Unit. A notable exception, undoubtedly due to soil characteristics, is a band of Douglas-fir dominated forest on both sides of the drainage that begins just above Korbel and persists to a line across the watershed approximately where Highway 299 crosses the North Fork. This area contains only occasional individual redwoods, regardless of elevation, and has a higher proportion of western red cedar and western hemlock on lower slopes and in riparian areas than would normally be expected this far inland.

Higher elevations along the eastern and southern boundary of this unit are forested entirely with Douglas-fir and tanoak, either in relatively pure stands or associated in mixed stands. Red alder occurs in riparian zones throughout the unit, except at the highest elevations.

The RDW habitat type comprises about 52 percent of the Green Diamond ownership in this HPA, with the next most abundant habitat type being DFR with 22.6 percent coverage, followed by MHC with 18.4 percent coverage. Other habitat types each comprise less than 5 percent of lands owned by Green Diamond within this HPA.

3.5.3.10 Humboldt Bay Hydrographic Region

The Humboldt Bay Hydrographic Region encompasses Humboldt Bay and the four major streams that drain into it: Jacoby Creek, Freshwater Creek, Elk River, and Salmon Creek. As its eastern boundary is only 14 miles inland, and elevation does not exceed 2,800 feet, the entire HPA is within the zone of summer fog intrusion and all vegetative types reflects a strong coastal influence. Natural grasslands that typify the inland reaches of most HPAs

exist as only a few small prairies at the extreme eastern margin of the HPA, on or near the divide into the Mad River and Eel River drainages.

This HPA is the most heavily populated by people. Residential, commercial, and agricultural development has eliminated or drastically altered most of the natural vegetative communities on the coastal plain, and has significantly impacted most estuarine habitats. Although hillsides adjacent to the coastal plain still retain much of the indigenous redwood/Douglas-fir/red alder forest, residential development permeates all but the steepest slopes surrounding the cities of Arcata and Eureka.

Outside of developed areas, redwood/Douglas-fir forests dominate, and persist to the eastern boundaries of the HPA. Spruce is common near the coast, and minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

The predominant habitat type on the Green Diamond ownership within this HPA is RDW with 96.3 percent of the ownership in this habitat type. Other habitat types each comprise less than 3 percent of lands owned by Green Diamond within this HPA.

3.5.3.11 Eel River Hydrographic Region

The Eel River Hydrographic Region extends 27 miles inland and reaches an elevation of 3,700 feet at Iaqua Buttes, on the divide into the Upper Mad River Hydrographic Region. Dune and salt marsh vegetation at the estuary give way to agricultural development that has occurred throughout the extensive floodplain of the lower Eel and Van Duzen Rivers. Urban development has been restricted to a few small communities and a strip of residential development along Highway 36 in the lower Van Duzen.

Above the alluvial plain, forest cover dominates, with the usual progression of redwood/Douglas-fir forests near the coast to Douglas-fir and Douglas-fir/tanoak forests in the interior. Spruce is common on coastal faces and at the margins of the coastal plain, and minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood. Other common hardwoods are California laurel (pepperwood), Pacific madrone, and California black oak.

Extensive prairies become prevalent in the most inland portions of the HPA, dominating many south to west slopes and ridge tops. Nearly pure stands of California black oak commonly form a transition type between prairies and conifer forest.

The predominant habitat type on the Green Diamond ownership within this HPA is RDW with 92.9 percent of the ownership in this habitat type. The DFR habitat type covers approximately 4.8 percent of the Green Diamond ownership in this HPA. Other habitat types each cover less than 1 percent of lands owned by Green Diamond within this HPA.

3.5.4 Plant Species of Concern

The CNDD identified 46 plant species of special concern located within the Primary Assessment Area. An additional 5 plant species of concern were identified as potentially occurring in the rain-on-snow areas outside of the Primary Assessment Area. Of the 51 plant

species of special concern, 4 are federally and/or State-listed as endangered, including Humboldt milk-vetch (*Astragalus agnicidus*), Kneeland prairie pennycress (*Thlaspi californicum*), McDonald's rock cress (*Arabis macdonaldiana*), and western lily (*Lilium occidentale*). An additional 11 plant species considered Federal species of concern were initially identified as having the potential to occur on Green Diamond property based on habitat associations and distribution.

The habitat association and distribution of the 51 special-status plant species are summarized in Table 3.5-3 below. The habitat requirements, occurrence and distribution, and life history characteristics of the 4 listed species and 11 Federal species of concern that potentially occur within the Primary Assessment Area and/or Green Diamond ownership in rain-on-snow area outside the Primary Assessment Area are described below.

Plant descriptions for the 4 listed species and 11 Federal species of concern are from the 1992 Green Diamond NSOHCP and the July 2000 CNPS rare plant database. References include Hickman, 1993; Skinner and Palik, 1994; Abrams, 1923, 1944, 1951; and Munz and Keck, 1970 (citations and CNPS Codes provided below).

3.5.4.1 Bensoniella *(Bensoniella oregona)*

Bensoniella is an evergreen perennial herb that blooms in July. The plants occur in the Klamath Mountains of northwestern California and southwestern Oregon. Habitats include streams, meadow edges, and openings in low montane mixed evergreen and white fir forests, from 3,000 to 5,000 feet in elevation. Thought to be extinct, the species was observed in Humboldt County in 1977 and numerous populations have subsequently been identified. Bensoniella sites have been impacted from grazing and logging activities such as road construction, tree removal, and increased sedimentation. Although currently not listed by the State of California or the Federal government, bensoniella is a USFWS species of special concern. There are currently two known occurrences in the general area at Mad River Buttes and Maple Creek.

3.5.4.2 Howell's Montia (*Montia howellii*)

Howell's montia is a perennial herb blooming from March to May. The current range of this species is limited to northern California, western Oregon, Washington, and British Columbia. Habitat includes wet disturbed areas around meadows, vernal pools, and moist shady places in redwood forests generally occurring at elevations less than 1,300 feet. Road construction and tree removal are potential threats to this species. The species was presumed to have gone extinct in California (CNPS 1A), but numerous sitings of this species have recently occurred in isolated areas within the Coastal Lagoons Hydrographic Region (O'Dell, personal communication, August 15, 2001). This species is a USFWS species of special concern. The two CNDD recorded occurrences in the area, at Miranda and Bridgeville, are both extirpated.

3.5.4.3 Humboldt Milk Vetch (*Astragalus agnicidus*)

This species was presumed to be extinct until 1987 when a single population was discovered on a private ranch south of Miranda, in Humboldt County, California. The plants occur in disturbed, mixed evergreen forest openings approximately 2,500 feet in elevation. Potential impacts from timber activities are unknown. The species is currently listed as endangered California.

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
American Manna Grass *Glycera grandis*	--	--	2	Wet meadows, ditches, streams, ponds	Moderate potential for occurrence, some habitat present	4, 8, 9	No records
Arctic starflower *Trientalis arctica*	--	--	2	Meadows, seeps, bogs, fens	Low due to limited habitat availability	1[a]	No records
Bensoniella *Bensoniella oregona*	-----	--	1B	Stream banks, meadows, bogs, fens lower montane coniferous forest	Moderate potential for occurrence, some habitat present. No specimens found during THP surveys	4, 8, 9, 11	No records
Black crowberry *Empetrum nigrum ssp. hermaphroditum*	--	--	2	Coastal bluff scrub, coastal prairie	Moderate potential for occurrence, some habitat present	1,6[b]	No records
Bog club moss *Lycopodiella inundata*	--	--	2	Bogs, fens, marshes, swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	6,7	No records
Coast checkerbloom *Sidalcea oregana ssp. eximia*	--	--	1B	Endemic to Humboldt County. Gravely soils in meadows and seeps. North coast coniferous and lower montane coniferous forests	Moderate potential for occurrence, some habitat present	1, 4, 7, 8, 9, 10	USGS Quad: Hyampom
Coast Range lomatium *Lomatium martindalei*	--	--	2	Lower montane coniferous forests, coastal bluffs, meadows	Moderate potential for occurrence, some habitat present	1, 3	No records
Dwarf alkali grass *Puccinellia pumila*	--	--	2	Mineral springs and coastal salt marshes	Low, limited habitat in study area	8, 10	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
English peak greenbriar *Smilax jamesii*	--	--	1B	Marshes, lakes, swamps and streams in lower montane coniferous forests and north coast coniferous forests	Moderate potential for occurrence, some habitat present	3	No records
Fiberous pondweed *Potamogeton foliosus var. fibrillosus*	--	--	2	Marshes, ponds, small streams	Moderate potential for occurrence, some habitat present	1[a]	No records
Flaccid sedge *Carex leptalea*	--	--	2	Meadows, bogs, fens, marshes and swamps	Moderate potential for occurrence, some habitat present	1, 2, 4, 6, 7, 8, 10	No records
Great Burnet *Sanguisorba officinalis*	--	--	2	Marshes, swamps, bogs, fens, seeps, riparian areas, meadows, broad-leaved upland forest, north coast coniferous forest	Moderate potential for occurrence, some habitat present	4, 8, 9, 11	No records
Henderson's fawn lily *Erthronium hendersonii*	--	--	2	Lower montane coniferous forests	Good potential for occurrence	1	No records
Horned butterwort *Pinguicula vulgaris ssp. macroceras*	--	--	2	Bogs, fens, meadows, seeps, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.[b]
Howell's jewel flower *Streptanthus howellii*	--	--	1B	Lower montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Howell's montia *Montia howellii*	-----	--	1A	Vernally wet sites, meadows, northeast coniferous forest	Moderate potential for occurrence, some habitat present	8, 10	USGS Quad: Miranda

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Humboldt milk-vetch *Astragalus agnicidus*	-----	SE	1B	Broad-leaved upland forest	Moderate potential for occurrence, some habitat present. No specimens found during THP surveys	No records	USGS Quad: Miranda[b]
Indian pipe *Monotropa uniflora*	--	--	2	Broad-leafed upland forest and north coast coniferous forest, often associated with redwoods and western hemlock	Good potential for occurrence	1, 8	No records
Kneeland prairie pennycress *Thlaspi californicum*	FE	--	1B	Serpentine rock outcrops within coastal prairies	Moderate potential for occurrence, some habitat present	8, 10, 11	No records
Koehler's stipitate rock cress *Arabis koehleri var.stipitata*	--	--	1B	Lower montane coniferous forests, chaparral, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.[b]
Maidenhair spleenwort *Asplenium trichomanes ssp. trichomanes*	--	--	2	Lower montane coniferous forest	Good potential for occurrence	1	No records
Maple leaved checkerbloom *Sidalcea malachroides*	--	--	1B	Coastal woodlands and clearings, often in disturbed areas. Broad-leaved upland forest, coastal prairie, coastal scrub, north coast coniferous forest	Good potential for occurrence; not known on Green Diamond property	1, 2, 4, 7, 8, 9, 10, 11[a]	No records
Marsh pea *Lathyrus palustris*	--	--	2	Coastal prairie, coastal scrub, bogs, fens, marshes, swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	1, 4, 6, 8, 10[a]	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Marsh violet *Viola palustris*	--	--	2	Coastal scrub, bogs and fens	Moderate potential for occurrence, some habitat present	1, 4, 6, 8	No records
McDonald's rock cress *Arabis macdonaldiana*	FE	SE	1B	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.[b]
Meadow Sedge *Carex praticola*	--	--	2	Moist to wet meadows	Moderate potential for occurrence, some habitat present	1, 4, 8, 9	No records
Mendocino gentain *Gentiana setigera*	-----	--	1B	Lower montane coniferous forests, meadows, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Northern microseris *Microseris borealis*	--	--	2	Meadows, bogs, fens, marshes and swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	4, 8, 9	No records
Nuttall's saxifrage *Saxifraga nuttallii*	--	--	2	North coast coniferous forests	Good potential for occurrence	1	No records
Opposite leaved lewisia *Lewisia oppositifolia*	--	--	1B	Lower montane coniferous forests, sometimes on serpentine	Good potential for occurrence; not known on Green Diamond property	1	No records
Oregon Fireweed *Epilobium oreganum*	-----	--	1B	Bogs, fens, meadows, montane coniferous forest	Moderate potential for occurrence, some habitat present; not known on Green Diamond property	3, 4, 8, 9, 11	No records
Oregon lungwort *Mertansia bella*	--	--	2	Meadows, seeps, upper montane coniferous forests	Known only from Siskiyou County	No records	USGS Quad: Broken Rib Mt.[b]

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Purple stemmed checkerbloom *Sidalcea malvaeflora ssp. patula*	-----	--	1B	Coastal prairie, broad-leaved upland forest	Moderate potential for occurrence, some habitat present	1, 7, 8, 10, 11[a]	No records
Robust false Lupin *Thermopsis robusta*	--	--	1B	North coast coniferous forest, broad-leaved upland forest	Known to occur on Green Diamond property (Blue Creek Mt., Johnson)	2, 3, 4, 5, 7, 8, 9[a]	No records
Robust monardella *Monardella villosa ssp. globosa*	--	--	1B	Chaparral, cis-montane woodlands	Moderate potential for occurrence, some habitat present	10	No records
Running pine *Lycopodium clavatum*	--	--	2	Moist areas in north coast coniferous forest, marshes and swamps. Known in California only from Humboldt County	Moderate potential for occurrence, some habitat present	2, 4, 5, 6, 7, 8, 9, 11[a]	No records
Sanford's arrowhead *Sagittaria sanfordii*	-----	--	1B	Marshes, swamps, ponds, ditches	Low due to limited habitat availability	1	No records
Siskiyou Indian paintbrush *Castilleja miniata ssp. elata*	--	--	2	Lower montane coniferous forests, bogs, fens, stream benches, associated with serpentine	Moderate potential for occurrence, some habitat present	1, 3	No records
Siskiyou phacelia *Phacelia leonis*	--	--	1B	Upper montane coniferous forest, meadows and seeps, sometimes on serpentine	Known only from Siskiyou and Trinity Counties	No records	Quad: Broken Rib Mt.[b]
Small ground cone *Boschniakia hookeri*	--	--	2	North coast coniferous forest	Good potential for occurrence	1, 5	No records
Sonoma manzanita *Arctostaphylos canescens ssp. sonomensis*	--	--	1B	Chaparral, lower montane coniferous forest	Good potential for occurrence	4, 8, 9	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Thurber's reed grass *Calamagrostis crassiglumis*	-----	--	2	Coastal scrub, freshwater marshes	Moderate potential for occurrence, some habitat present	1[a]	No records
Two Flowered Pea *Lathyrus bifolorus*	-----	--	1B	Serpentine endemic found only in Humboldt County in lower montane coniferous forests	Low due to limited habitat availability	11	No records
Waldo Buckwheat *Erogonum pendulum*	--	--	2	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Waldo Daisy *Erigonium bloomeri var. nudatus*	--	--	2	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	No records	Quad: Broken Rib Mt.[b]
Waldo rock cress *Arabis aculeolata*	--	--	2	Broadleafed upland forest, lower montane coniferous forest, upper montane coniferous forest. Often found in serpentine slopes and ridges	Low potential for occurrence due to limited habitat availability; only 10 known recorded California occurrences in Del Norte and Siskiyou counties	No records	Quad: Broken Rib Mt.[b]
Water bulrush *Scirpus subterminalis*	--	--	2	Marshes and swamps; montane lake margins, in shallow water	Moderate potential for occurrence, some habitat present	5	Quad: Broken Rib Mt.[b]
Western Bog Violet *Viola primulifolia ssp. occidentalis*	-----	--	1B	Bogs, fens, marshes, swamps, streamside flats associated with serpentine	Low potential for occurrence due to limited habitat availability	1	No records
Western lily *Lilium occidentale*	FE	--	1B	Coastal scrub, freshwater marshes, bogs and fens, coastal prairie, north coast coniferous. Forest	Moderate potential for occurrence; some habitat present; no specimens found during THP surveys	1, 8, 10[a]	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Wolf's evening primrose *Oenothera wolfii*	-----	--	1B	Lower montane coniferous forests, coastal bluff scrub, coastal prairie, dunes	Moderate potential for occurrence, some habitat present	1, 2, 6, 7, 10	No records
Yellow-tubered toothwort *Cardamine nuttallii var. gemmata*	-----	--	1B	Lower montane and north coast coniferous forests associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records

[a] Range within the Primary Assessment Area extends beyond Green Diamond ownership
[b] In rain-on-snow lands of Green Diamond property outside of HPA coverage

U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories
FE Federal Endangered

California Department of Fish and Game (CDFG) State Listing Categories
SE California Endangered

California Native Plant Society (CNPS)
CNPS 1A Presumed extinct in California
CNPS 1B Rare, threatened, or endangered in California and elsewhere
CNPS 2 Rare, threatened, or endangered in California, but more common elsewhere

Hydrographic Planning Areas
1 - Smith River Hydrographic Region
2 - Coastal Klamath Hydrographic Region
3 - Blue Creek Hydrologic Unit
4 - Interior Klamath Hydrographic Region
5 - Redwood Creek Hydrologic Unit
6 - Coastal Lagoons Hydrographic Region
7 - Little River Hydrologic Unit
8 - Mad River Hydrographic Region
9 - North Fork Mad River Hydrologic Unit
10 - Humboldt Bay Hydrographic Region
11 - Eel River Hydrographic Region

3.5.4.4 Kneeland Prairie Penny Cress (*Thlapsi californicum*)

Kneeland Prairie Penny Cress is a perennial herb that flowers from April to July. A single occurrence of this species is known from Humboldt County, California. Historically, it is presumed to have been found on serpentine rock outcrops within coastal prairies at elevations of 400 to 1,200 feet. The current population could be potentially threatened by road maintenance activities, but is protected by the landowner. The effects of timber activities are unknown. This species is currently listed as endangered by the Federal government. No specimens have been observed on Green Diamond property.

3.5.4.5 Macdonald's Rock Cress (*Arabis macdonaldiana*)

Macdonald's rock cress is a perennial herb that flowers from May to early June. It is known to occur in Curry County, Oregon, and Del Norte and Mendocino counties in California. Only the two populations from Red Mountain are recognized as unhybridized strains. The plant occurs on serpentine soils in open, rocky areas of montane conifer forests at elevations around 4,000 feet. Existing threats to the population are from strip mining activities. The potential impacts of timber activities are unknown. The species is currently listed as endangered by the Federal government and the State of California. No specimens have been observed on Green Diamond property.

3.5.4.6 Mendocino Gentian (*Gentiana setigera*)

Mendocino gentian is a perennial herb blooming from August to September. Distribution ranges from the Klamath mountains in southwestern Oregon to the outer north coast rages in the locale of Red Mountain, Mendocino County, to western Siskiyou County in California. Habitats include wet meadows, seeps, bogs, streamsides, and moist areas associated with Port Orford, Jeffrey pine, western white pine, and red fir forests from 3,500 to 6,500 feet in elevation. Mining activities and wetland alteration are known to impact this species. Logging activities such as road construction and tree removal are potential impacts on the species. Mendocino gentian is a USFWS species of special concern. There are no known occurrences in the general area.

3.5.4.7 Oregon Fireweed (*Epilobium oreganum*)

Oregon fireweed is a perennial herb that blooms from June to August. Distribution ranges from the north coast range of California through the Klamath Mountains region of southwestern Oregon. Habitats include mesic sites in conifer forests, small streams, ditches, bogs, and fens between 1,600 and 5,200 feet in elevation. This species is known to be impacted by logging activity. Although currently not listed by the State of California or the Federal government, Oregon fireweed is a USFWS species of special concern. There are several known occurrences within the general area: Sims Mountain, Broad Camp Mountain, Willow Creek, and Grouse Mountain.

3.5.4.8 Purple-Stemmed Checkerbloom (*Sidalcea malviflora ssp. patula*)

This perennial herb of the mallow family is found in coastal prairies and broad-leaved upland forests. It blooms from March to June and is recognized by its pink flowers. It is presumed to be extant. Although currently not listed by the State of California or the Federal government, the purple-stemmed checkerbloom is a USFWS species of special concern.

3.5.4.9 Sanford's Arrowhead (*Sagittaria sanfordii*)

Sanford's arrowhead is an emergent perennial herb blooming from May to August. Distribution ranges throughout much of the California coast range form Del Norte County to northern Ventura County. Habitats include freshwater marshes, swamps, ponds, ditches, sloughs, and slow moving waterways generally below 1,000 feet in elevation. The greatest impacts on this species have been from grazing, channel alteration, and development. Logging activities such as road construction and tree removal have potential impacts on the species. Although currently not listed by the State of California or the Federal government, Sanford's arrowhead is a USFWS species of special concern. It is known to occur in the Crescent City area.

3.5.4.10 Thurber's Reed Grass (*Calamogrostis crassiglumis*)

Thurber's reed grass is an evergreen perennial herb that blooms from June to July. Its range includes the central and northern coast ranges of California. Habitats include moist areas within coastal scrub, freshwater marshes, and swamps. Grazing and direct physical impacts from logging activities such as road construction and tree removal are potential threats to this species. Thurber's reed grass is a USFWS species of special concern. This plant is known to occur in the Crescent City area.

3.5.4.11 Two Flowered Pea (*Lathtrus biflorus*)

This is a small perennial herb in the legume family. This minute plant rarely exceeds heights of 2 inches and is easily identified by its unbranched, straight, bristle-like tendrils occurring at the ends of the compound leaves. The greenish-white flowers occur in pairs, hence the name two flowered pea, bloom from May through July and have distinctive dark striations. Endemic to California, the two flowered pea occurs in the north coast mountains and is generally associated with high-elevation (4,500 ft) Jeffery pine forests on serpentine substrates. Occurrence is restricted to a few small populations and the species is considered to be endangered throughout its range. Although currently not listed by the State of California or the Federal government, the two flowered pea is a USFWS species of special concern.

3.5.4.12 Western Bog Violet (*Viola primulifolia ssp. occidentalis*)

Western bog violet is a perennial herb blooming from April to September. The range is from the northern part of Del Norte County, near Gasquet, to southwestern Oregon. Habitats include bogs, marshes, fens, and swamps on serpentine soils or in mixed conifer forests below 2,500 feet in elevation. Mining, logging, road construction, and off-road vehicles are known to impact this species. Potential impacts in the area could result from road building and timber removal. Although currently not listed by the State of California or the Federal government, the western bog violet is a USFWS species of special concern. There are no known occurrences in the general area.

3.5.4.13 Western Lily (*Lilium occidentale*)

Western lily is a seasonal perennial herb blooming from June to July. Its range extends from coastal southwestern Oregon to Humboldt County, California. Habitats include coastal scrub and prairie, freshwater marshes, and coniferous forest openings, generally at elevations less than 300 feet. Habitat loss, grazing and over-collection of bulbs pose the

greatest threats to this species. Potential impacts in the area could result from road building and timber removal. The western lily is currently listed as endangered by the Federal government. This species is known to occur at Fields Landing, Arcata, and Crescent City.

3.5.4.14 Wolf's Evening Primrose (*Oenothera wolfii*)

Wolf's evening primrose is a seasonal perennial herb that blooms from May to October. Range includes the northern coastal areas and the western Klamath Mountains in Humboldt and Del Norte counties. Habitats include coastal bluff scrub, coastal prairie, moist areas in coastal dunes, moist areas in lower montane mixed conifer forest types, and roadsides less than 300 feet in elevation. Known impacts include road maintenance, foot traffic, and hybridization with non-native species. Potential impacts in the area could result from road building and timber removal. Although currently not listed by the State of California or the Federal government, Wolf's evening primrose is a USFWS species of special concern. There are several known occurrences in the general area: Crannell, Regua, Smith River, and Crescent City.

3.5.4.15 Yellow-Tubered Toothwort (*Cardamine nuttallii var. gemmata*)

Yellow-tubered toothwort is a seasonal perennial herb that blooms from April to May. This species is known from fewer than 10 occurrences from the Klamath-Siskiyou Mountains of southwestern Oregon and in Del Norte County, California. Habitats include moist associated Jeffrey pine forests on serpentine, yellow pine, mixed conifer, and redwood forests, as well as stream banks and shallow running water at elevations ranging between 300 and 3,000 feet. Mining activities are known to impact this species and road building and timber removal are likely to impact the species in the area. Although currently not listed by the State of California or the Federal government, the yellow-tubered toothwort is a USFWS species of special concern. Currently there is one known occurrence in the general area at High Divide.

3.6 Terrestrial Habitat/Wildlife Species of Concern

3.6.1 Study Methodology

This chapter of the EIS relies on data made available from Green Diamond, the CNDD, CDFG, and USFWS. This chapter describes wildlife contained within the Primary Assessment Area for the Proposed Action and other action alternatives, as well as for the entire Green Diamond ownership in northern California. Vegetation was grouped into habitat type classifications as described in Section 3.5.1. Known or potential wildlife use within these defined habitat types was then described primarily using the CWHR system (Mayer and Laudenslayer 1988) and CNDD.

Rare wildlife species were identified using a July 2000 query of the CNDD for all USGS quadrangles occurring within the Primary Assessment Area and within Green Diamond ownership outside of the HPAs. This information was loaded into an Access database to sort information by species, HPA, and USGS quadrangle; therefore, if a species is identified as occurring within the Primary Assessment Area within a particular HPA, it implies that the species is located within a topographic quadrangle occurring within the Primary Assessment Area. It is possible that the actual species record location is outside of Primary Assessment Area boundaries.

3.6.2 CWHR Habitat Characterizations

3.6.2.1 Klamath Mixed Conifer

Numerous small meadows and seeps found throughout this habitat type and the high diversity of vegetation make this an excellent habitat for wildlife, including several rare and endangered species, such as the northern spotted owl and peregrine falcon.

3.6.2.2 Douglas-Fir

The Douglas-fir habitat occurs within a matrix of habitat types and supports a high diversity of wildlife species. Common bird species include northern spotted owl, western flycatcher, chestnut-backed chickadee, golden-crowned kinglet, Hutton's vireo, solitary vireo, hermit warbler, and the varied thrush. Several rare and endangered amphibians are also found associated with this habitat type, including Pacific giant salamander, Olympic salamander, Del Norte salamander, black salamander, clouded salamander, tailed frog, and northwestern garter snake. Mammal species typically associated with this habitat are fisher, deer mouse, dusky-footed woodrat, western red-backed vole, Douglas' squirrel, Trowbridge's shrew, and shrew-mole.

3.6.2.3 Redwood

The redwood habitat type supports a high diversity of wildlife species. Nearly 200 species of wildlife use redwoods for food, cover, and other habitat needs. The canopy supports western flycatcher, Steller's jay, chestnut-backed chickadee, golden-crowned kinglet, Vaux's swift, raven, and varied thrush. The trunks attract pygmy nuthatches, hairy woodpeckers, northern spotted owls, northern flying squirrels, and Douglas' squirrels. The branches provide suitable nesting habitat for marbled murrelet and red tree vole. On the forest floor, one finds blue grouse, Townsend's chipmunks, Trowbridge's and Pacific shrews, elk, mule deer, salamanders, and wrens. Redwoods support other sensitive, rare, and endangered species, such as red-legged frog, ensatina, osprey, ringtail, fisher, and peregrine falcon.

3.6.2.4 Montane Hardwood

Bird and animal species characteristic of this habitat type include disseminators of acorns (scrub and Steller's jays, acorn woodpecker, and western gray squirrel) plus those that use acorns as a major food source, including wild turkey, mountain quail, band-tailed pigeon, California ground squirrel, dusky-footed woodrat, black bear, and mule deer. Deer also use the foliage of several hardwoods. Many amphibians and reptiles are found on the forest floor of this habitat. Among them are Mount Lyell salamander, ensatina, relictual slender salamander, western fence lizards, and sagebrush lizard. Snakes include rubber boa, western rattlesnake, California mountain king snake, and sharp-tailed snake.

3.6.2.5 Montane Hardwood-Conifer

The diversity of vegetation within this habitat type is excellent for wildlife. Older trees and snags provide important habitat for cavity nesters, and many of the hardwoods are masting species characterized by periodic prolific seed production which provide food resources for birds and mammals.

3.6.2.6 Perennial Grassland

Grasslands provide important habitat for numerous wildlife species, including the peregrine falcon, burrowing owl, northern harrier, California vole, Roosevelt elk, and black-tailed deer.

3.6.2.7 Wet Meadows

Wet meadows provide important habitat for numerous bird species, including waterfowl, as well as mammals, such as mule deer and elk. Species that may be found in this habitat type include foothill yellow-legged frog, northern harrier, merlin, sharp-shinned hawk, northern goshawk, and ensatina.

3.6.2.8 Lacustrine

According to Mayer and Laudenslayer (1988), the Lacustrine habitat type supports about 23 percent of the species in the CWHR database, including 18 mammals, 101 birds, 9 reptiles, and 22 amphibians.

3.6.2.9 Riverine

The open water zones of large rivers provide resting and escape cover for many species of waterfowl. The open water area also provides good hunting ground for gulls, terns, osprey, and bald eagle. Near-shore waters provide food for waterfowl, herons, shorebirds, belted-kingfisher, and American dipper. Many insect-eating birds are also commonly found along waterways, including swallows, swifts, and flycatchers. Small mammals commonly found in this habitat type include river otter, mink, muskrat, and beaver.

3.6.3 Wildlife Species of Concern

A July 2000 query of the CNDD identified 28 wildlife species (excluding fish) of special concern located on commercial timberlands within USGS quadrangles encompassing the Primary Assessment Area within the 11 HPAs and the rain-on-snow areas under Alternative C. As a result of discussions among the USFWS, CDFG, and Green Diamond, another 20 wildlife species were added to the sensitive wildlife species list developed for purposes of this EIS. Of the 48 sensitive wildlife species identified, 8 species are federally or State listed: American peregrine falcon, bald eagle, bank swallow, little willow flycatcher, marbled murrelet, northern spotted owl, western snowy plover, and Oregon silverspot butterfly. Seven of these eight species are known or thought to occur within the Primary Assessment Area. There is no suitable habitat for the western snowy plover on commercial timberlands constituting the Primary Assessment Area.

The habitat association and distribution of the 48 special-status wildlife species are summarized in Table 3.6-1 below. The habitat requirements, occurrence and distribution, and life history characteristics of the seven federally or State listed species that potentially occur within the Primary Assessment Area are described below.

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Birds							
American peregrine falcon *Falco peregrinus*	FE	CE	BFS	Breeds on high cliffs near wetlands, lakes and rivers	Moderate potential for occurrence, some habitat present; infrequently observed.	Coastal lowlands near Humboldt Bay, USGS Quad: Miranda	USGS Quad: Miranda
Bald eagle *Haliaeetus leucocephalus*	FT	CE	BFS	Nests in large old growth, trees near ocean shore, lakes and rivers	Regular winter inhabitant; two nest sites known in ownership (Mad River and Klamath River; moderate potential for occurrence in other areas; some habitat present).	1, 2, 3, 4, 8, 9, 11	USGS Quads: Hennessy Peak, Sportshaven
Bank swallow *Riparia riparia*	-----	CT	-----	Colonial nester in riparian area with vertical sandy banks composed of fine soils	Moderate potential for occurrence, some habitat present; none observed.	1, 6, 7	No record
Black swift *Cypseloides niger*	-----	CSC	-----	Breeds in small colonies adjacent to waterfalls in deep canyons and coastal bluffs, forages widely	Low potential for occurrence due to limited habitat availability.	1	No record
Black-crowned night heron *Nycticorax nycticorax*	-----	-----	-----	Margins of lacustrine, large riverine, and fresh and saline emergent habitats	Moderate potential for occurrence, some habitat present.	4, 7, 8, 9, 10	No record
Coopers hawk *Accipiter cooperii*	-----	CSC	-----	Open woodlands, nests in riparian areas	Known to occur on Green Diamond property (Maple Creek); appear to be ubiquitous. Moderate potential for occurrence in other areas.	4, 8, 9	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Golden eagle *Aquila chrysaetos*	-----	CSC	BFS	Rolling foothills and open mountain terrain in oak woodlands and most major forested habitats.	Occasionally seen in the open woodlands of the eastern portion of the Green Diamond ownership, but no nests documented. Low potential for occurrence in other areas.	Infrequent observations, open areas in the interior regions of ownership	USGS Quad: Miranda
Great blue heron *Ardea herodias*	-----	-----	BFS	Wet meadows, marshes, lake margins, rivers and streams and tidal flats	Foraging known to occur on Green Diamond property (Hydesville, Fortuna). One rookery known near Eel River. Moderate potential for occurrence in other areas.	1, 2, 3, 5, 7, 8, 10	No record
Great egret *Ardea alba*	-----	-----	BFS	Colonial nester in large trees near marshes, tidal flats, rivers and lakes	Moderate potential for occurrence, some habitat present. Foraging only.	1, 8, 10	No record
Little willow flycatcher *Empidonax trailii brewsteri*	-----	CE		Riparian areas with extensive willow vegetation	One breeding site known in the Klamath region. Low potential for occurrence in other areas.	No record	No Record
Marbled murrelet *Brachyramphys marmoratus*	FT	CE		Late seral conifer forest and marine waters	Known to occur in a number of residual old-growth stands in the Klamath region and one-second growth stand with residual structure in the Little River drainage. Low potential for occurrence in other areas.	2, 4, 7	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Merlin *Falco columbarius*	-----	CSC		Frequents coastlines, open grassland, woodlands, lakes, wetlands, edges and early successional forest stages	Low potential for occurrence. Not seen except for coastal bottoms in winter. Probably do not occur within ownership.	No record	No record
Northern harrier *Circus cyaneus*	-----	CSC		Open habitats including grasslands, scrublands, and wetlands	Moderate potential for occurrence. Observed in non-forested areas of ownership.	No record	No record
Northern goshawk *Accipiter gentilis*	-----	CSC	BFS	Nests on northern slopes in coniferous forests	Low potential for occurrence; rare or absent from Green Diamond ownership.	11*	USGS Quad: Hennessy Peak
Northern spotted owl *Strix occidentalis caurina*	FT	CSC	BFS	Old growth or mixed mature-old growth forests	Moderate potential for occurrence. Known to occupy and reproduce on the Green Diamond ownership.	All planning areas*	USGS Quads: Broken Rib Mountain, Hennessy Peak, Sportshaven, Hyampom
Olive-sided flycatcher *Contopus borealis*	-----	-----		Forest and woodland riparian zones	Moderate potential for occurrence. Commonly seen throughout the Green Diamond ownership; confirmed nest sites.	No record	No record
Osprey *Pandion haliaetus*	-----	CSC	BFS	Freshwater lakes, bays, ocean shore, large streams	Known to occupy and reproduce within Green Diamond property (Ah Pah Ridge, Arcata South, Fields Landing, McWhinney Creek, Requa). Moderate potential for occurrence in other areas.	All planning areas except Eel River*	USGS Quads: Hennessy Peak, Myers Flat, Miranda

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Purple martin *Progne subis*	-----	CSC		Forest and woodland with cavity trees and riparian zones	Occasionally seen throughout the ownership and several nest sites known in Korbel tract. Moderate potential for occurrence in other areas.	No record	No record
Sharp-shinned hawk *Accipiter striatus*	-----	CSC		Early to mid seral forest and riparian zones. Frequently seen throughout ownership, but specific nest sites have not been confirmed	Moderate potential for occurrence. Ubiquitous throughout the ownership. Nest sites observed in older 2nd growth stands.	No record	No record
Short-eared owl *Asio flammeus*	-----	CSC		Marshlands, grasslands, and forest clearings	Moderate potential for occurrence. Seen at several sites throughout the ownership, but no known breeding sites.	No record	No record
Snowy egret *Egretta thula*	-----	-----	-----	Riverine, emergent wetland, lacustrine, and estuarine habitats. Nests in large trees in the vicinity of foraging areas.	Low potential for occurrence due to limited habitat availability.	1, 8, 10	No record
Tricolored blackbird *Agelaius tricolor*	-----	CSC	-----	Highly colonial species, largely endemic to California. Requires open water with protected areas for nesting	Moderate potential for occurrence, most numerous in the Central Valley.	10	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Vaux's swift *Chaetura vauxi*	-----	CSC		Conifer forest with large snags	Moderate potential for occurrence. Frequently observed flying over Green Diamond's timberlands; no nest sites documented.	No record	No record
Western burrowing owl *Athene cunicularia*	-----	CSC		Grasslands and shrublands	Low potential for occurrence, limited habitat present. Seen in winter at the old office site in the Arcata "bottoms", and along the Bald Hill Road. No known breeding sites.	No record	No record
Western snowy plover *Charadrius alexandrinus nivosus*	FT	CSC	-----	Sandy beaches, salt ponds and levees, gravel bars along coastal rivers	None, no suitable habitat in the area.	No record	No record
White tailed kite *Elanus leucurus*	-----	-----	-----	Nests along rivers and marshes associated with oak woodlands in foothills and valley margins, forages in open meadows and grasslands	Moderate potential for occurrence, some habitat present.	1	No record
Yellow warbler *Dendroica petechia brewsteri*	-----	CSC		Riparian woodland	Moderate potential for occurrence. Seen commonly throughout Green Diamond's ownership, but no work done to confirm nest sites.	No record	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Yellow-breasted chat *Icteria virens*	-----	CSC		Riparian thickets and early seral forest	Low potential for occurrence, some habitat present. Rare occurrences in the Mad River area in 1996.	No record	No record
Mammals							
Fringed myotis *Myotis thysanodes*	-----	-----		Roosts in mines, caves, trees, and buildings; feeds along forest edges and over forest canopy	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Humboldt marten *Martes americana humboldtensis*	-----	CSC		Late seral conifer forest	Low potential for occurrence, some habitat present. Never been detected on Green Diamond lands. Martens detected close to the ownership in the Goose Creek drainage (tributary of the South Fork Smith River).	No record	No record
Long-legged myotis *Myotis volans*	-----	-----		Roosts in hollow trees, crevices, mines, and buildings; feeds in open habitats	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Long-eared myotis *Myotis evotis*	-----	-----		Roosts in trees, crevices, mines, caves and buildings; feeds within forest, and over water	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Pacific fisher *Martes pennanti pacifica*	-----	CSC	-----	Coniferous forests and shaded riparian areas	Known to occur on Green Diamond property at high elevations not dominated by redwoods (Ah Pah Ridge, Blue Lake, Holter Ridge, Klamath Glen, Lord Ellis Summit, Panther Creek). Moderate potential for occurrence in other areas.	All planning areas except Humboldt Bay*	USGS Quads: Broken Rib Mountain, Hennessy Peak, Myers Flat, Miranda, Sportshaven, Hyampom
Pallid bat *Antrozous pallidus*		CSC		Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats	Moderate potential for occurrence. Occurs throughout the region, roosting sites include trees, caves and rock crevices.	No record	No record
Red tree vole *Arborimus pomo*	-----	CSC	-----	Douglas fir, redwood and montane conifer-hardwood forests	Moderate potential for occurrence. Known to occur within ownership near Bald Hill.	All planning areas*	No record
Townsend's western big-eared bat *Corynorhinus townsendii*	-----	CSC	-----	Humid coastal regions of central and northern California, southern Oregon	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
White footed vole *Arborimus albipes*	-----	CSC	-----	Mature conifer forests, small streams with dense alder and shrub cover	Low potential for occurrence. Presumed rare within the ownership, but their presence has not been confirmed.	6	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Yuma myotis *Myotis evotis*	-----	-----		Roosts in buildings, trees, mines, caves, crevices, and bridges; feeds over water	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Reptiles and Amphibians							
Del Norte Salamander *Plethodon elongatus*	-----	CSC	-----	Old growth mixed conifer-hardwood forests	Known to occur on Green Diamond property, (Ah Pah Ridge, Bald Hills, Blue Creek Mt., Blue Lake, Board Camp, Childs Hill, Fern Canyon, French Camp ridge, Holter Ridge, Iaqua, Johnson, Klamath Glen, Korbel, Panther Creek, Requa). Moderate potential for occurrence in other areas.	All planning areas*	USGS Quads: Broken Rib Mountain, Hennessy Peak
Tailed frog *Ascaphus truei*	-----	CSC	-----	Permanent streams in montane conifer-hardwood, redwood, Douglas fir, and ponderosa pine forests	Known to occur on Green Diamond property (Ah Pah Ridge, Arcata South, Blue Lake, Childs Hill, Fields Landing, Grouse Mt., Holter Ridge, Korbel, Maple Creek, McWhinney Creek). Moderate potential for occurrence in other areas.	All planning areas*	USGS Quads: Broken Rib Mountain, Sportshaven

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Southern torrent salamander *Rhyacotriton variegatus*	-----	CSC	-----	Permanent streams in coastal redwood, Douglas fir, mixed conifer, montane hardwood, and montane riparian forests	Known to occur on Green Diamond property (Ah Pah Ridge, Arcata South, Blue Creek Mt., Blue Lake, Cant Hook Mt., Childs Hill, French Camp Ridge, Grouse Mt., Holter Ridge, Iaqua, Johnson, Klamath Glen, Lord Ellis Summit, Mad River Buttes, Maple Creek, Panther Creek). Good potential for occurrence in other areas.	All planning areas*	USGS Quads: Broken Rib Mountain, Hennessy Peak, Sportshaven, Hyampom
Northern red-legged frog *Rana aurora aurora*	-----	CSC	-----	Humid forests with intermixed hardwoods and grasslands, streamsides	Known to occur on Green Diamond property (Arcata North, Blue Lake, Fields Landing, Iaqua, Lord Ellis Summit). Moderate potential for occurrence in other areas.	All planning areas except Blue Creek and Eel River*	No record
Foothill yellow legged frog *Rana boylii*	-----	CSC	-----	Partly shaded shallow streams with rocky substrate, in a variety of habitats	Good potential for occurrence. Known to occur on Green Diamond property (Holter Ridge) along most Class I and some Class II streams.	1, 2, 4, 5, 8, 9, 10, 11*	USGS Quads: Broken Rib Mountain, Hennessy Peak
Northwestern pond turtle *Clemmys marmorata marmorata*	-----	CSC	-----	Ponds and swamps in grasslands, and mixed conifer-hardwood forests	Good potential for occurrence. Known Mad River, Lower Klamath, and Redwood Creek areas.	4, 7, 8, 9, 10, 11	USGS Quad: Hennessy Peak, Myers Flat, Sportshaven, Hyampom

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Green Diamond Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Invertebrates							
Ground beetle *Scaphinotus behrensi*	-----	CSC		Wooded areas with moist microhabitats, including logs and tree trunks	Moderate potential for occurrence, some habitat present.	No record	No record
Pomo bronze shoulderband snail *Helminthoglypta arrosa pomoensis*	-----	-----		Dense redwood forest	Unknown.	No record	No record
Oregon silverspot butterfly *Speyeria zerene hippolyta*	FT	-----		Coastal meadows in Del Norte County. The larvae feed only on the foliage of the western dog violet (*Viola adunca*)	Low potential for occurrence. 1990 recorded site in Kamph Memorial Park(near Hwy 1 and mouth of Smith River), outside Primary Assessment Area. Large population known in the vicinity of Lake Earl.	1	No record
Karok Indian Snail *Vespericola karokorum*	-----	-----	-----	Under leaf litter and woody debris in riparian areas with alder and maple	Moderate potential for occurrence, some habitat present.	3	No record

* Range within the Primary Assessment Area extends beyond Green Diamond ownership

U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories
FE Federal Endangered
FT Federal Threatened

California Department of Fish and Game (CDFG) State Listing Categories
CE California Endangered
CT California Threatened
CSC California Species of Special Concern

California Board of Forestry – Forest Practice Rules
BFS Sensitive Species

Hydrographic Planning Areas
1 - Smith River Hydrographic Region
2 - Coastal Klamath Hydrographic Region
3 - Blue Creek Hydrologic Unit
4 - Interior Klamath Hydrographic Region
5 - Redwood Creek Hydrologic Unit
6 - Coastal Lagoons Hydrographic Region
7 - Little River Hydrologic Unit
8 - Mad River Hydrographic Region
9 - North Fork Mad River Hydrologic Unit
10 - Humboldt Bay Hydrographic Region
11 - Eel River Hydrographic Region

3.6.3.1 American Peregrine Falcon (*Falco peregrinus anatum*)

Breeding territory typically includes the inland coastal mountains and the Klamath, Cascade, and Sierra Nevada mountain ranges. Breeding sites are generally on high cliffs near wetlands, lakes, and rivers or other sources of water. The peregrine falcon preys mainly on birds, striking with its feet in mid air, but will also take reptiles and small mammals. Perching sites and abundance of prey are important habitat characteristics. Use of pesticides has been cited as the main reason for the peregrine's decline in population; however, habitat modification also impacts this species.

Some habitat for this species is present within the lakes or ponds of the Redwood Creek Hydrologic Unit and the HPAs where Riverine habitat is found. Two currently known active nest sites and one historical nest site exist on the Green Diamond ownership. Two additional historically active nest sites are located on other ownerships immediately adjacent to Green Diamond lands.

3.6.3.2 Bald Eagle (*Haliaeetus leucocephalus*)

Western breeding and wintering territory includes the Pacific Coast from Alaska to Baja California. Ocean shorelines, lake margins, and river courses in northwestern California provide essential breeding areas. Nesting sites are typically associated with large old-growth, or forests with open-branched canopies such as ponderosa pines. Bald eagles roost communally during the winter. Pesticides, habitat loss, and human disturbances are the primary threats to this species.

A nesting pair of bald eagles has been observed along the Mad River on the Green Diamond ownership.

3.6.3.3 Bank Swallow (*Riparia riparia*)

The bank swallow breeds across North America from Alaska to California, but it winters in the tropics. They breed in colonies near riverbanks and creeks. This species requires vertical banks or cliffs with fine-textured soils to dig nesting holes. Most birds lay their eggs and forage for their young at the same time.

Some habitat for this species is present in HPAs where Riverine habitat is found.

3.6.3.4 Marbled Murrelet (*Brachyramphus marmoratus*)

This species is found along the north Pacific Rim from Asia to North America. Breeding populations in northern California are divided into two regions: (1) Del Norte and northern Humboldt counties, from the Smith River south to Little River; and (2) south–central Humboldt County along the Van Duzen and Eel rivers. Marbled murrelets are considered to have highly plastic nesting requirements and have been known to use tree branches, ground cavities, and open ground sites in alpine areas. Old-growth redwood forests with open crown structures and an open canopy stand appear to be favored nesting habitats. Extensive loss of this old-growth habitat is presumably the primary reason for the species decline in California. This species is known to occur in a number of residual old-growth stands in the Klamath region and one second-growth stand with residual structure in the Little River Hydrologic Unit. Based on survey results and consultations with USFWS, CDFG, and CDF, 20 stands located on Simpson's current fee ownership have been identified as suitable for

murrelet nesting based on levels of observed murrelet activity and stand characteristics. Stands are located near Terwer, Hunter, Mynot, Hoppaw, and Wilson Creeks, as well as the coastal area. Simpson survey results suggest that murrelets were not uniformly distributed across the landscape prior to timber harvesting in the region. Areas of optimal habitat were probably confined along major drainages. This is consistent with murrelet survey results in large (10,000-acre) stands of old-growth in nearby parks. Murrelet detections were highest in major drainages and declined toward major ridges (Miller and Ralph, 1995).

Critical Habitat for Marbled Murrelet. Critical habitat for federally endangered and threatened species is mandated under Section 4(a)(3) of the ESA. Critical habitat is defined as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed … on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed … upon determination that such areas are essential for the conservation of the species" (16 United States Code [USC] 1532[5][A]).

In 1996, the FWS (1996b) designated approximately 3.9 million acres of critical habitat distributed in 32 critical habitat units (CHUs) for the marbled murrelet to identify habitat considered most essential to eventual recovery of populations and delisting of the species in terms of habitat, distribution, and ownership. This designated critical habitat (DCH) includes predominantly federally owned lands (approximately 78 percent), followed by State and local land (21 percent), and private land (1 percent) (FWS, 1996b). Much of the DCH on Federal lands consists of large, contiguous blocks of Late-Successional forest and/or areas expected to develop into such habitat in the range of the species within the Late-Successional Reserve system established in the Northwest Forest Plan (USDA and USDI, 1994). Non-Federal lands were also included as DCH where large blocks of Federal land were inadequate or unavailable and where protection of habitat was considered crucial to sustaining the distribution of populations, such as in the Project Area (FWS, 1997b). Notably, DCH is protected under Section 7 of the FESA.

Approximately 1,400 acres of Green Diamond's current ownership, and an additional 3,350 acres within the adjustment area lands, are within the boundaries of a marbled murrelet CHU (CA-03-a). Portions of adjacent lands in public ownership, such as the Redwood National and State Parks, and the Headwaters Reserve have been designated as marbled murrelet critical habitat by the USFWS. Within the boundaries of the CHU, only those areas that contain one or both primary constituent elements are, by definition, critical habitat. These elements are (1) individual trees with potential nesting platforms, and (2) forested areas within 0.5 mile of individual trees with potential nesting platforms, and a canopy height of at least one-half the sitepotential tree height (USFWS, 1997b). Most of the DCH on Green Diamond's lands is currently not suitable for murrelet nesting, but was identified by the FWS as important to develop suitable habitat for marbled murrelet conservation in the future as described previously (USFWS, 1997b).

Green Diamond is not seeking coverage under the Permits for the harvest of trees, as described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.5, in any portion of the Eligible Plan Area that has been designated as critical habitat for the marbled murrelet, as defined in 50 C.F.R. 17.95, when the harvest of those trees would affect a "primary constituent

element" of critical habitat for the marbled murrelet, as defined in 50 C.F.R. 17.95 (adopted May 24, 1996 61 FR 26256).

3.6.3.5 Northern Spotted Owl (*Strix occidentalis caurina*)

This species has a wide range throughout western forests including the Coastal and Klamath Ranges of northern California. Northern spotted owls do not build nests but use naturally occurring sites. They generally nest in cool, shaded areas with a well-developed understory. They prefer natural cavities in large-diameter trees with broken tops. Diverse, multi-layered forests with moderate to high canopy closure (60 percent to 80 percent) and a canopy dominated by large (greater than 30 inches dbh) overstory trees provide optimal habitat conditions. Northern spotted owls have been observed over a wide range of elevations, although they avoid higher elevation, subalpine forests. Breeding and roosting habitat are sometimes found in younger forests, especially those with significant remnants of earlier stands as a result of fire, windstorms, or inefficient logging operations.

With the cooperation of the USFWS, Green Diamond prepared a separate HCP and obtained an incidental take permit for the species. The plan area for this species covers about 380,000 acres.

3.6.3.6 Little Willow Flycatcher (*Empidonax traillii* ssp. *brewsteri*)

The little willow flycatcher breeds in California from Tulare County north, along the western side of the Sierra Nevada and Cascades, extending to the coast in northern California**.** The willow flycatcher nests in riparian deciduous shrubs, preferably thickets of willows**,** at elevations ranging from 100 to 8,000 feet. Foraging typically occurs in wet meadows and montane riparian habitats. Most of the remaining breeding populations occur in isolated mountain meadows of the Sierra Nevada and Cascades, however a possible breeding population occurs along the Klamath River**.**

3.6.3.7 Oregon Silverspot Butterfly (*Speyeria zerene hippolyta)*

The Oregon Silverspot is found along the coast in northern California and Oregon and requires a meadow species of violet (*Viola adunca*) to complete its development. The Oregon silverspot requires one of three types of grasslands with nearby meadows: coastal salt spray meadows, stabilized dunes, and/or montane meadows, which are surrounded by forests. The grasslands that the Oregon silverspot inhabits provide larval host plants, adult nectar sources, and wind protection. Wind protection is provided by forest fringes around the inhabited meadows. The butterfly may retreat into these forests on especially windy days. A large population of Oregon silverspot butterflies is known from the vicinity of Lake Earl.

3.7 Air Quality

This section describes ambient air quality conditions in a regulatory context, and the potential impacts of the project on air quality issues of concern. General information on climate is described in Section 3.3.3.

The Primary Assessment Area and the additional rain-on-snow acres under Alternative C are located in the North Coast Air Basin, under the authority of the North Coast Unified Air Quality Management District (AQMD). The air quality of a region is determined by the

quantities and types of pollutants emitted, and by the concentrations and accumulations of those pollutants under the influences of local meteorology and topography. The North Coast Air Basin is considered to have good air quality.

The Clean Air Act of 1967, as amended in 1990 (42 U.S.C. 7401, et seq.), established national ambient air quality standards for several pollutants, including ozone, carbon monoxide, and particulate matter less than 10 microns in diameter (PM_{10}). In addition, State of California clean air standards have been in existence since 1968. Green Diamond lands are in attainment for all State and Federal air quality standards in Del Norte and Humboldt counties, with the exception of the State standard for PM_{10} (North Coast Unified AQMD, 1997).

Ambient PM_{10} standards are designed to prevent respiratory disease and protect visibility. Suspended particulate matter less than 10 microns in diameter can potentially reach the lungs when inhaled and cause respiratory health concerns. Few particles larger than 10 microns in diameter reach the lungs. In 1993, a chemical mass balance study of PM_{10} was performed by the North Coast Unified AQMD. For this study, 37 samples were collected approximately every 6 days in both Crescent City and Eureka. The results indicated that local PM_{10} originates from various sources, as described in Table 3.7-1.

TABLE 3.7-1
PM_{10} Source Apportionment for Crescent City and Eureka (Yearly Average)

Source	Crescent City (%)	Eureka (%)
Vehicles	23.1	43.7
Sea salts	34.9	24.7
Wood stoves*	21.7	12.6
Dust	8.9	6.6
Pulp mills/particle board driers	4.0	5.5
Nitrates	1.3	1.8
Sulfates	1.7	0.6
Unknown	4.5	4.6
Total	**100**	**100**

* In winter months, wood stoves contribute a substantially higher proportion of PM_{10} emissions.

Source: North Coast Unified AQMD, 1994.

Incidence of PM_{10} attributable to timber management is typically a result of slash burning and roadway dust entrainment. The AQMD study did not specifically characterize slash burning as a separate source of PM_{10}. However, PM_{10} attributed to wood stoves likely includes particulate matter resulting from other wood combustion sources (e.g., slash burning) (Torzynski, pers. comm., 2000). Slash burning is controlled by the AQMD through the issuance of burn permits, which include provisions for burn restriction during atmospheric conditions that escalate PM_{10} nonattainment.

3.8 Visual Resources

This section describes areas where the Primary Assessment Area may be visible to the general public, and focuses on adjacent public lands and nearby roadways. The Primary Assessment Area is interspersed among several public recreation areas, including Six Rivers National Forest (including the recreation-oriented Smith River unit) and the Redwood National and State Parks complex. Adjacent lands are described in detail in Section 3.11 (Land Use), and recreation use on these adjacent lands is described in Section 3.9 (Recreational Resources).

The primary public recreation areas with views of the Primary Assessment Area are Redwood National and State parks. The Primary Assessment Area borders the park in several areas, including most of the Redwood Creek watershed boundary. Limited viewing may also be possible from portions of the Smith River unit of Six Rivers National Forest, and from several other State park areas in central and southern Humboldt County. However, adjacency to parklands is limited in these areas.

U.S. Highway 101 is the primary roadway in the Primary Assessment Area. Highway 101 is a designated scenic highway in Del Norte County from approximately Crescent City to the south boundary of Del Norte Redwoods State Park, and is considered eligible for scenic highway designation in the remainder of Del Norte and Humboldt counties. All other highways in the vicinity of the Green Diamond ownership (U.S. Highway 199, U.S. Highway 299, and State Route (SR) 36) are considered eligible for scenic highway designation. Primary areas for viewing the Primary Assessment Area from these highways are as follows.

As Highway 101 proceeds south through Del Norte and Humboldt counties, it is likely that travelers will be able to view Primary Assessment Area in various locations, primarily in the area north of Crescent City, near the Klamath River confluence, and north of McKinleyville. In portions of this area, panoramic views of the Primary Assessment Area are possible from Highway 101, depending on topography in the vicinity. Views of the Primary Assessment Area from Highway 101 south of Eureka are limited. Highway 299 passes through a portion of the Primary Assessment Area east of Arcata. Views of the Primary Assessment Area from Highway 199 and SR 36 are limited.

3.9 Recreational Resources

Green Diamond provides recreational opportunities on its forestlands to groups and individuals, subject to written permit authorization. These activities are permitted on a limited basis within specified areas, and include hunting, fishing, camping, picnicking, hiking, motorcycle use, and shooting. The Primary Assessment Area is also adjacent to several national and State parks and recreation areas, as described below and in Section 3.8 (Visual Resources).

The Primary Assessment Area is in the vicinity of the Eel, Klamath, and Smith rivers, portions of which are designated Federal Wild and Scenic Rivers. Portions of the Primary Assessment Area may also be viewed from the Smith River National Recreation Area near Jedediah Smith Redwoods State Park. The 300,000-acre Smith River National Recreation

Area is a highly-valued recreation area by the USFS and the public. Recreation area users can kayak, canoe, boat, fish, swim, and view wildlife. Smith River National Recreation Area is accessible through a walk-in area off of the main roads. The nearby Six Rivers National Forest is also open to camping and hiking at both developed campsites and undeveloped forest sites by permit.

The Jedediah Smith and Del Norte Coast Redwoods State Parks are jointly managed by the National Park Service and California State Department of Parks and Recreation, and are part of the Redwoods National and State Park. Redwoods National and State Park comprise approximately 110,000 acres, of which a small portion is adjacent to the Primary Assessment Area. In conjunction with another nearby park (Prairie Creek Redwoods), these sites are considered to be "World Heritage Sites" and "International Biosphere Reserves." Panoramic and close-up views of different tree and vegetation types draw national and international visitors to the parks. The parks allow camping, hiking, horseback riding, and scenic driving.

The Merlo State Recreation Area allows fishing and small boats. The Humboldt Lagoons State Park allows camping and hiking, and fishing at the tide pools. The Humboldt Lagoons State Park is open to boating, fishing, hiking, bird and wildlife viewing, and picnicking. The Headwaters Reserve area encompasses 6,400 acres and is managed jointly by the Bureau of Land Management (BLM) and California Department of Parks and Recreation. Use is limited to day-hiking only. The King Range Landscape Conservation Area encompasses 60,000 acres and is managed by the BLM. The area promotes a variety of uses, including hiking, camping, hunting, and seashore activities.

3.10 Cultural Resources

The earliest inhabitants of the north coast regions are thought to be ancestors of the Karok, which were probably adapted to inland hunting and gathering and arrived sometime around 5,000 years ago (Hildebrant, 1981). Further investigations indicate that exploitation of marine resources apparently was not an important part of the subsistence patterns of the northwest coast until relatively recently. Local tribal groups represented in the Primary Assessment Area include the Tolowa, Yurok, Wiyot, Hupa, Chilula, and Whilkut tribes.

3.10.1 Tolowa

The historical territory of the Tolowa comprises most of present-day Del Norte County, extending from the Winchuck River on the California-Oregon border to Wilson Creek, approximately 17 miles south of Crescent City. Tolowa settlements were strongly oriented toward the coast, with some seasonal occupation along the Smith River drainages to take advantage of particular seasonal resources (Williams et al., 1982). Smelt, salmon, steelhead, and acorns were the staples of their diet, and were gathered, dried, processed, and stored in late summer/early fall in preparation for winter. Berries, shellfish, and sea lions, as well as deer and elk, were also gathered and hunted by the Tolowa (Gould, 1978; Williams et al., 1982).

Traditional areas of sacred and ceremonial importance to Tolowa continue to be used today. Goddard (1913) describes these areas as located near trails, on the crest of ridges, and a few in the neighborhood of springs (Maniery and Williams, 1982). The Tolowa recognized five

sacred high points within their territory, including Signal Hill and French Hill. Lesser peaks were also considered to hold healing or spiritual power and were revered (Drucker, 1937).

3.10.2 Yurok

The Yurok historically occupied and continue to occupy the lower reach of the Klamath River from approximately Bluff Creek downstream to the river's mouth at Requa, with some settlements along the Trinity River and along the coast primarily south of the Klamath River (Pilling, 1978). The Yurok are recognized for their skills in riverine salmon fishing, and traditional subsistence animal species also include ocean fish, sturgeon, sea lion, whale, deer, elk, and duck. Acorns, berries, bulbs, and grass seed are staple plant foods (Bearss, 1969). Like other North Coast tribes, the Yurok were skilled at basketmaking and woodworking. The Yurok are especially known for their redwood canoes, which were up to 40-feet long. In addition, redwood was used as a building material.

3.10.3 Wiyot

The historical center of Wiyot culture is around Humboldt and Arcata Bays, from Little River south to the Bear River Mountains. The Wiyot were known as a "tidewater" people, and, unlike most other tribes in northwestern California, were probably more closely affiliated with still water than the ocean or rivers (Nomland and Kroeber, 1936). Fish, primarily salmon, were the main source of animal protein, and the Wiyot also consumed mollusks (especially clams), sea lions, and deer and elk, as well as plant foods. Like other cultures in the area, the Wiyot used redwood extensively as a building material.

3.10.4 Hupa, Chilula, and Whilkut

The Hupa inhabited the area surrounding the lower reaches of the Trinity River from approximately Salyer to approximately 6 miles above the confluence with the Klamath River (Wallace, 1978). The Hupa relied heavily on salmon and acorns as food sources, but also consumed other fish (e.g., lampreys), deer, and elk, as well as various plant staples (Wallace, 1978). Like other tribes of the north coast of California, the Hupa were skilled in basketmaking and woodworking, but obtained their dugout redwood canoes in trade with the Yurok (Heizer, 1978; Wallace, 1978).

Chilula territory is closely affiliated with the lower reaches of Redwood Creek in what is now Redwood National Park (Bearss, 1969). Chilula villages were generally located adjacent to Redwood Creek from near the inland edge of the heavy redwood belt to a few miles above Minor Creek (Bearss, 1969). In the summer, the Chilula camped on the highland prairies of the Bald Hills, where seeds and roots were plentiful and game was abundant (Bearss, 1969). At one time, the Chilula were known as the Bald Hill Indians (Wallace, 1978). As with the other tribes of the north coast of California, salmon was a staple of the Chilula diet, and fishing was practiced on Redwood Creek (Wallace, 1978). However, the smaller size of Redwood Creek relative to other watercourses in the area did not support the use of dugout redwood canoes by the Chilula (Wallace, 1978). In terms of their culture, the Chilula were very similar to the Hupa in many ways (Wallace, 1978).

The Whilkut people inhabited the higher reaches of Redwood Creek and the Mad River, including the forested area between the two drainages (Wallace, 1978). Very little is known about the Whilkut people.

3.11 Land Use

3.11.1 Land Use Setting

The Primary Assessment Area is located within Del Norte and Humboldt counties, both of which contain significant amounts of land (both Federal and private) in timber production. Del Norte County is 705,920 acres, of which most is under State or Federal ownership as parks/recreation areas or national forests (County of Del Norte, 1996). Private commercial forestlands in Del Norte County comprise approximately 146,771 acres, including Green Diamond fee-owned lands. Humboldt County is 2,286,270 acres is size, with approximately 990,000 acres as private lands devoted to timber production (Humboldt County, 1984).

The Primary Assessment Area in Del Norte County borders a mix of other land uses, primarily other timber production areas and parks/recreation areas. Most of the eastern boundary of the Primary Assessment Area in Del Norte and Humboldt counties border the Six Rivers National Forest, which is managed by the USFS for multiple uses including timber production and recreation. The Primary Assessment Area also borders the Redwood National and State Parks (Redwood National Park, and Jedediah Smith, Del Norte Coast Redwoods, and Prairie Creek Redwoods State Parks), which are managed jointly by the National Park Service and the California Department of Parks and Recreation. Other State park areas are also located nearby the Primary Assessment Area. Commercial timber harvesting is not allowed in the parks, and resource preservation and recreation values are the primary management emphases. The Primary Assessment Area also borders the Hoopa Indian Reservation in northeastern Humboldt County. Green Diamond lands border other industrial and non-industrial forestlands on the east and west throughout central Humboldt County. The western boundary of the Headwaters Reserve, managed by BLM and the California Department of Parks and Recreation, abuts the Primary Assessment Area in central Humboldt County. Other portions of the Primary Assessment Area are generally surrounded by other industrial and non-industrial forestlands.

Developed population centers near the Primary Assessment Area in Del Norte County are generally not present. The primary Humboldt County population center within the vicinity of the Primary Assessment Area is the Eureka/Arcata area. Other towns near the Primary Assessment Area include Fortuna, Rio Dell, and Carlotta.

3.11.2 Land Use Regulations

Local land use regulations that apply to the Primary Assessment Area include the general plans and zoning ordinances of both Del Norte and Humboldt counties. Primary Assessment Area lands are designated as “Forestry” in the Del Norte County General Plan, and as “Timber Production” in the Humboldt County General Plan. These designations are applied to areas that have essential characteristics for timber production, and are intended to conserve forest resource values of the designated area. Most of the Primary Assessment Area is zoned as TPZ. Created in accordance with California’s Timberland Productivity Act of 1982, the classification is intended to promote continued timberland management. Land use in a TPZ classification is restricted to growing and harvesting timber, in addition to other compatible uses.

3.12 Social and Economic Conditions

Timber management activities within the Primary Assessment Area and the additional 25,677 rain-on-snow acres under Alternative C can influence local social and economic conditions. For the purposes of this analysis, the geographic area of influence with regard to socioeconomic effects is considered to be Del Norte and Humboldt counties.

3.12.1 Social Factors

As shown in Table 3.12-1, both Del Norte and Humboldt counties have experienced relatively steady population growth over the past decade. During the 1990s, Del Norte County's population grew by 11 percent while Humboldt County grew by 6 percent. These are both slightly less than the State's growth rate over the same period of 13 percent. Because of the rural character of the two counties, the lifestyles of its residents are closely tied to the land. In the EIS for the Six Rivers National Forest Management Plan (USFS, 1995), four social groups were identified based on values and behaviors relating to natural resource management. Members of the "amenity emphasis" and "environmental priority" groups place a high value on maintaining the natural resources of the region, although for different personal and ideological reasons. "Commodity dependent" residents are economically linked to the utilization of natural resources, and are very closely tied to their resource-based lifestyle. The "Native American" group is linked to the biological resources of the forest area for cultural and social reasons, including subsistence and commercial fishing. Members of the "Native American" group may also be employed in the forest products sector and thus are economically dependent on the industry. Membership in these groups is not mutually exclusive; it is common for members to identify with more than one social group at a time (USFS, 1995).

TABLE 3.12-1
Del Norte and Humboldt Counties Population, January 1991 to 2001

Year	Del Norte	Humboldt
1991	25,200	120,500
1992	26,500	121,900
1993	27,000	123,300
1994	27,450	124,100
1995	27,600	124,200
1996	27,550	124,800
1997	27,950	125,600
1998	28,100	126,000
1999	27,600	125,900
2000	28,000	127,600
2001	28,100	127,800

Source: California Department of Finance, Demographic Research Unit.

3.12.2 Economic Factors

Historically lumber and wood products manufacturing have been important industries in Del Norte and Humboldt counties. The forest products industry reached a highpoint in the North Coast Region during the post-World War II housing boom in the 1950s. The industry has seen a significant decrease in employment since that time when it dominated the region's economy (USFS, 1995).

Table 3.12-2 shows the employment data for Del Norte and Humboldt counties by industry sectors. The employment distribution is similar for both counties with retail trade and services having the greatest percentage of employment. Del Norte County has a significantly higher percentage of employment in State government at 20 percent compared to 6 percent for Humboldt County. The relatively large percentage of State employees in Del Norte County is attributable to the Pelican Bay State Prison.

TABLE 3.12-2
Del Norte and Humboldt Counties Employment by Industry, 2000

	Del Norte County		Humboldt County	
Industry	**Jobs**	**%**	**Jobs**	**%**
Agriculture, forestry, and fishing	450	6	1,100	2
Construction and mining	200	3	1,800	4
Lumber and wood products	170	2	3,700	7
Other manufacturing	300	4	2,300	5
Transportation, communications, and utilities	240	3	1,900	4
Wholesale trade	120	2	1,400	3
Retail trade	1,410	18	10,500	21
Finance, insurance, and real estate	130	2	2,200	4
Services	1,530	19	12,900	25
Federal government	140	2	1,000	2
State government	1,590	20	3,200	6
Local government	1,570	20	8,700	17
Total employment	**7,850**		**50,700**	

Source: California Economic Development Department, California Labor Market Information Service.

As illustrated in Table 3.12-2, lumber and wood products manufacturing and forestry play a relatively small role in each county's economy in terms of employment. This is down from the industry peak during the 1950s when forest products accounted for approximately 34 percent of the North Coast region's employment (USFS, 1995). The California Employment Development Department projects little change in employment in the lumber and wood products sector in the two counties for the immediate future, with Del Norte showing no change from 1997 to 2004 and Humboldt showing a projected 14.8 percent decrease in lumber and wood production employment from 1997 to 2004.

Average annual unemployment in the two counties, as well as the State of California, is shown in Table 3.12-3. Both counties typically experience higher unemployment rates than the State as a whole. Del Norte County spent most of the 1990s in double-digit unemployment, ranging from 3 to 5 percentage points higher than the State average. Humboldt County's unemployment was only slightly over the State average for the past decade.

TABLE 3.12-3
County and State Unemployment, 1990 to 2000

Year	Del Norte (%)	Humboldt (%)	California (%)
1990	11.1	7.7	5.8
1991	11.1	8.5	7.7
1992	14.2	9.8	9.1
1993	13.6	9.8	9.4
1994	11.9	8.6	8.6
1995	12.4	8.4	7.8
1996	10.2	7.5	7.2
1997	10.1	7.3	6.3
1998	10.3	7.2	5.9
1999	8.0	6.4	5.2
2000	8.7	6.3	4.9

Source: California Economic Development Department, California Labor Force Data.

Green Diamond Timber Company, an affiliate of Green Diamond Resource Company, formerly employed 675 people in timberlands, milling, and administrative operations. In late 2001, Green Diamond Timber Company went through a restructuring in which a new company, Green Diamond Resource Company, was created to own and operate the timberlands. Green Diamond Resource Company is the Permit applicant. Green Diamond Resource Company is currently hiring employees from Green Diamond Timber Company to staff the timberlands operations by mid-2002. The number of employees at Green Diamond Resource Company is expected to be 265, whose functions include: secretarial, bookkeeping and accounting; planning and logistics associated with resource management operations, including road construction and maintenance, site preparation, planting, vegetation control, pruning, pre-commercial thinning, commercial timber harvesting, and cone collection; and mechanical and repair activities. All these activities are conducted over the entire year; consequently, the 265 jobs are year-round jobs.

In addition to work conducted by Green Diamond employees themselves, many of the forest management activities (e.g., tree planting, pre-commercial thinning, logging, fertilizer application) are contracted directly to other firms. Also, the mills dependent on Green Diamond Resource Company timber in the region employ approximately 410 people.

Additional contributions of the Green Diamond lands to local economic conditions include the indirect effect of employee wages on the purchase of goods and services from local businesses, and the contribution of yield taxes on timber purchases, which are distributed to Del Norte and Humboldt counties.

CHAPTER 4

Environmental Consequences

CHAPTER 4

Environmental Consequences

4.1 Introduction

This chapter presents the results of the impacts analysis for the Proposed Action (i.e., the issuance of an ITP/ESP by the Services) and the alternatives. The impact assessment focuses on the potential beneficial and adverse effects on resources that could result from implementing the various alternatives. This chapter is organized in the following way:

- Section 4.1 – Introduction
- Section 4.2 – Geology, Geomorphology, and Mineral Resources
- Section 4.3 – Hydrology and Water Quality
- Section 4.4 – Aquatic Resources
- Section 4.5 – Vegetation/Plant Species of Concern
- Section 4.6 – Terrestrial Habitat/Wildlife Species of Concern
- Section 4.7 – Air Quality
- Section 4.8 – Visual Resources
- Section 4.9 – Recreational Resources
- Section 4.10 – Cultural Resources
- Section 4.11 – Land Use
- Section 4.12 – Social and Economic Conditions
- Section 4.13 – Summary of Cumulative Impact Analysis

Section 4.1 discusses the geographic scope of the analysis (Section 4.1.1) and the approach to the cumulative impact analysis (Section 4.1.2). Sections 4.2 through 4.12 comprise the impact analysis for the resource areas. Within each of these resource category sections, analysis of the direct, indirect, and cumulative impacts of the Proposed Action and alternatives is conducted. Section 4.13 presents a summary of all of the individual resource section cumulative impacts analyses.

In addition to the consideration of direct, indirect, and cumulative impacts, CEQ regulations implementing NEPA require that the analysis of potential impacts resulting from implementation of the Proposed Action and other action alternatives include a discussion of any adverse environmental impacts which cannot be avoided, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved (40 CFR Section 1502.16). Because the conclusion in relation to each of these three concepts would be the same for all alternatives, these concepts are not analyzed further in this document.

4.1.1 Scope of the Impacts Analysis

The physical scope for analysis of direct and indirect impacts in this EIS is the Primary Assessment Area, which includes 683,674 acres of commercial timberlands within those portions of the 11 HPAs where Green Diamond operates or could operate in the future

(see Figure 4.1-1). Areas labeled in Figure 4.1-1 as "Green Diamond" and "Other Commercial Timberland" represent the Primary Assessment Area.) The HPA areas are described in detail in Section 3.1 and throughout Chapter 3. As discussed in greater detail in Sections 5 and 7 of Green Diamond's proposed AHCP/CCAA, general habitat and relevant environmental conditions, as well as the potential impacts to the covered species, are sufficiently similar across the Primary Assessment Area to support the application of conservation measures contained in the proposed AHCP/CCAA on any lands on which Green Diamond operates within the 11 HPAs during the term of the Permits. For purposes of analysis, site-specific information on Green Diamond-owned lands has been extrapolated to other commercial timberlands within the Primary Assessment Area. In addition to the Primary Assessment Area, the analysis of Alternative C (see Sections 2.5 and 3.1) includes an additional 25,677 acres of rain-on-snow area. For a discussion of the geographical scope of the cumulative analysis, see Section 4.1.2 below.

As discussed in Chapter 2, it is important to note that the Proposed Action (AHCP/CCAA approval and issuance of the Permits) does not include authorization or regulation of future timber harvesting operations on Green Diamond lands. Future THPs will be authorized by CDF, and the conservation measures developed in the proposed AHCP/CCAA to protect and improve habitat for the covered species will be incorporated directly into future THPs. Under the No Action Alternative, Green Diamond would continue to prepare THPs in accordance with the requirements of the CFPRs, other applicable laws, and Green Diamond's management policies. In contrast, under the Proposed Action, Green Diamond would prepare THPs in accordance with the same requirements as the No Action (i.e., CFPRs, other applicable laws, and Green Diamond's management policies) but also with the requirements of the AHCP/CCAA's Operating Conservation Program. By incorporating the components of the AHCP/CCAA's conservation program into the analysis of the Proposed Action, this EIS addresses both the impacts of issuing the Permits and implementing the conservation measures as well as the potential direct and indirect environmental impacts of future timber harvesting actions on Green Diamond lands within the Action Area.

4.1.2 Cumulative Impacts Analysis

4.1.2.1 NEPA Requirements for Cumulative Impacts Assessment

The CEQ regulations implementing NEPA define a "cumulative impact" for purposes of NEPA as follows:

> Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable **future** actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR Section 1508.7).

The CEQ also requires development of a baseline (or benchmark) "against which to compare predictions of the effects of the proposed action and reasonable alternatives" (CEQ, 1997).

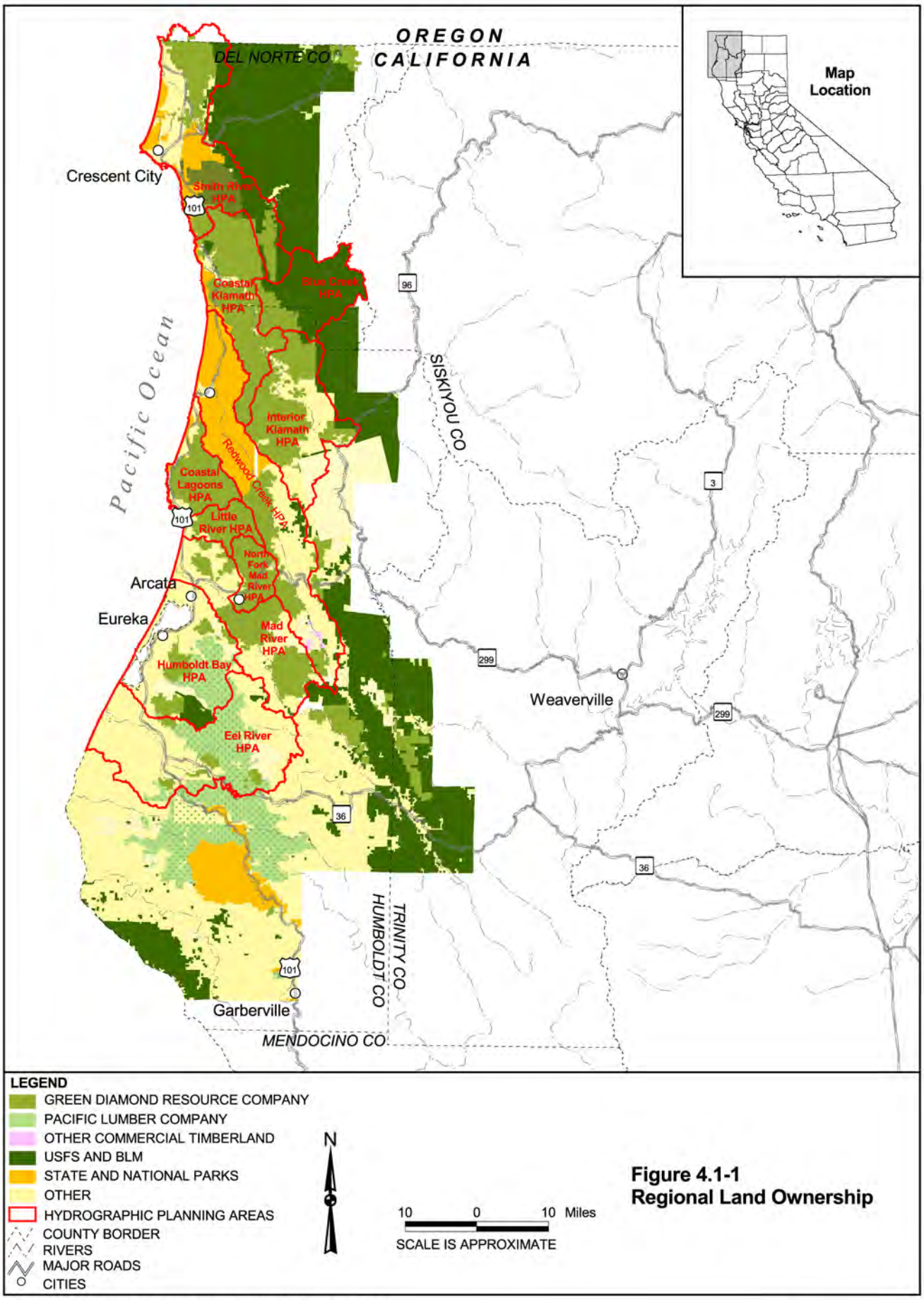

Figure 4.1-1
Regional Land Ownership

SLCDB\GIS\PROJECTS\SIMPSON\PROJECTS\FIGURE4-1-1.APR - 12/28/04 - PCS

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4.1.2.2 Approach to Cumulative Effects in This EIS

General Approach. Potential cumulative impacts (both beneficial and adverse) are assessed relative to the No Action Alternative for each of the separate resource category sections in this chapter (see Sections 4.2 through 4.12). For the No Action Alternative, potential effects are assessed in terms of trends and future conditions. For most of the resources, the cumulative effects analyses grouped HPAs and analyzed them together, due to insufficient data being available to analyze at the individual HPA scale.

Cumulative impacts would occur if the incremental impacts of the Proposed Action (or the incremental impact of the individual proposed action alternatives, result in a significant effect when they are added to the environmental impacts of past, present and reasonably foreseeable actions. For an impact to be considered cumulative, these incremental impacts must be related in space and time, so that they are either capable of combining (when considering potential incremental impacts of future projects) or have, in fact, combined (when considering impacts of current and past projects).

Baseline. The CEQ requires that a baseline (or benchmark) be used for assessing incremental impacts to resource areas, and the CEQ cites the no action alternative as the appropriate benchmark (CEQ, 1997). The benchmark used in this EIS is the No Action Alternative, as described in Section 2.

Actions That Could Have Associated Cumulative Effects. In consideration of actions to include in the cumulative impacts assessment in this EIS, past, present, and reasonably foreseeable future actions that have the potential to combine with incremental effects of the Proposed Action (or alternatives), if any, to result in cumulative impacts, are those that:

- Have an application for operations pending before an agency with permit authority or
- Are of a similar character, could affect similar environmental resources, or are located in geographic proximity to the Proposed Action

On the basis of the criteria listed above, several actions were considered for inclusion in the cumulative analysis. The list of other actions considered for inclusion in the cumulative impact assessment were:

1. Continued timber production from non-Green Diamond commercial timberland
2. Implementation of conservation measures contained in the PALCO multi-species HCP on PALCO lands
3. Continued implementation of aquatic and riparian resource guidelines contained in the Northwest Forest Plan on Federal lands
4. Management within State and Federal parks
5. Agricultural and grazing activities
6. Residential development and operation of existing residential infrastructure
7. Application of herbicides and fertilizers

On the basis of further review, several of these actions (Numbers 1, 2, 3, and 4) were determined to meet the criteria for consideration as other actions in a cumulative analysis. These actions are described in detail in Section 4.1.2.3.

The remaining activities (Numbers 5, 6, and 7) are not considered as other actions in the cumulative analysis conducted in this EIS. They do, however, provide relevant context and an understanding of historical conditions within the 11 HPAs. These activities are discussed further in Section 4.1.2.4 below. Because limited information is available about these activities within the 11 HPAs, or because they influence the condition of the environment to a minor or unknown extent, they are not included as "other cumulative actions" actions in the analysis of cumulative impacts in this EIS (Chapter 4). They are discussed to provide context for the No Action benchmark.

Geographic Scope of Cumulative Assessment. The CEQ guidelines state that cumulative effects analyses should be limited to the effects that can be evaluated meaningfully by the decision makers. The guidelines further state that the area to use in defining the cumulative impacts geographical boundary should extend to the point at which the resource is no longer affected significantly (CEQ, 1997). The assessment area for conducting the cumulative impact assessment is the 11 HPAs (plus the additional 25,677 acres of rain on snow for Alternative C). For most of the resources, the cumulative effects analyses groups HPAs and analyzes them together, because limited resource data are available at the individual HPA scale to result in quantitative analysis of cumulative impacts.

In general the larger the ownership in an HPA, the greater the potential for the Proposed Action to result in improvements in relation to current conditions or conditions that would result under the No Action Alternative. For example, improvements over the No Action Alternative would be least, but still represent a positive influence, in the Eel River HPA because Green Diamond owns only 4 percent of this watershed. In contrast, Green Diamond owns about 90 percent of the land in the North Fork Mad River HPA. Therefore, improvements associated with the implementation of the Proposed Action over the No Action Alternative would affect a major portion of this watershed. The single exception to this is the Blue Creek HPA, where 50 percent of the HPA is designated as Six River Forest Service Wilderness, where Green Diamond's management related impacts are the only major ones, and improvements associated with implementation of the Proposed Action are expected to be greater than the percentage of ownership alone would indicate.

4.1.2.3 Other Actions Assessed in the Cumulative Impacts Analysis

The other past, present, and reasonably foreseeable actions included in the cumulative analysis are discussed below. State and Federal land management actions outside the 11 HPAs are not assessed because almost no timber harvesting occurs on these State and Federal lands and streamside and upslope activities on these lands that could affect aquatic resources are extremely limited.

Continued Timber Production on Non-Green Diamond Commercial Timberland. The management regimes on non-Green Diamond commercial timberland throughout the 11 HPAs, as well as the rain-on-snow areas of Green Diamond ownership outside the HPAs (except under Alternative C), are characterized by application of the CFPRs. With the exception of the *Pacific Lumber Company (PALCO) Multi-Species HCP* (PALCO HCP) (Pacific

Lumber Company, 1999), no other company-specific conservation strategy for the management of aquatic or terrestrial wildlife habitat is known to exist within the 11 HPAs. On non-Green Diamond and non-PALCO commercial timberlands within the 11 HPAs, therefore, CFPRs (as described in Sections 1.5.3 and 2.1), would continue to be implemented under all the alternatives.

Implementation of Conservation Measures Contained in the PALCO Multi-Species HCP on PALCO Lands. On PALCO lands within the southern most portion of the Primary Assessment Area, the CFPRs are supplemented by additional measures contained in the PALCO HCP. The PALCO HCP covers approximately 211,000 acres of commercial timberland in Humboldt County, much of which is located within the Humboldt Bay and Eel River HPAs. The aquatic conservation strategy contained in the PALCO HCP establishes riparian management zones (RMZs) that extend out to 170 feet and 75-100 feet on Class I and Class II streams, respectively. RMZ management and widths may change based on watershed analysis, extending to 170 feet on both Class I and II streams. The RMZs include an inner no-cut area and an outer band of selective harvest where no even-aged management is allowed. The use of heavy equipment is excluded from the riparian zones. Conservation measures also include limitations on wet weather use of roads, progressive stormproofing of existing logging roads, and special timber harvesting restrictions on potentially unstable areas and steep slopes that are designed to minimize the potential for sediment delivery to streams as a result of forest management operations. Additional watershed-specific restrictions may also apply based on results of watershed analyses that are ongoing.

The PALCO HCP conservation strategy also establishes a series of reserves that are large, contiguous areas of second growth and old growth surrounding some of the larger remaining stands of uncut old-growth redwood on the ownership. Timber harvesting within these reserves is limited to habitat enhancement projects to benefit the marbled murrelet over the 50-year Permit term (1999-2049). In addition, PALCO will implement silvicultural prescriptions that favor attainment of mature forest conditions within a 300-foot selective harvest buffers on PALCO property that is directly adjacent to old-growth redwood in State parks. Additional wildlife protections for the northern spotted owl, bald eagles, and other terrestrial wildlife species will also be implemented.

Continued Implementation of Aquatic and Riparian Resource Guidelines Contained in the Northwest Forest Plan on Federal Lands. The NWFP provides the basis for aquatic and riparian resource management on U.S. Forest Service and Bureau of Land Management Lands within the 11 HPAs. NWFP standards were developed to provide a wide range of benefits to many unlisted as well as listed species on the basis of Federal multiple-use management principles. Under the NWFP, riparian buffers of 300 feet, 150 feet, and 100 feet are applied around all Class I, Class II, and Class III streams, respectively. Minimal timber harvesting is allowed within these zones.

Management within State and Federal Parks. Current management programs exist for lands managed by the State of California and the National Park Service outside the Primary Assessment Area but within the 11 HPAs. Essentially no commercial timber harvesting occurs on these State and Federal lands; thinning of some timber stands may occur occasionally for stand improvement purposes. In addition, streamside and upslope activities

that would affect aquatic resources are extremely limited and consist primarily of road and trail construction and use.

Representative land ownership for the actions noted above that have been carried forward for detailed analysis (as a percentage of total HPA acreage) for the HPAs addressed in this EIS is presented in Table 4.1-1. The geographic location of the representative land ownership for the actions is shown in Figure 4.1-1.

TABLE 4.1-1
Land Ownership as a Percentage of Total in the 11 HPAs

HPA	Green Diamond	PALCO	Other Commercial Timberland	USFS/BLM	Parks	Other
North Fork Mad River	89.8	0.0	0.0	0.0	0.0	10.2
Little River	87.7	0.0	0.0	0.4	0.4	11.5
Coastal Klamath	82.1	0.0	0.9	3.1	5.7	8.3
Coastal Lagoons	74.6	0.0	0.7	0.0	9.2	16.2
Interior Klamath	51.7	0.0	0.0	6.3	0.3	41.7
Mad River	41.3	0.3	4.7	0.9	0.0	52.8
Smith River	24.3	0.0	13.3	19.5	15.9	27.1
Blue Creek	19.2	0.0	0.0	47.2	0.0	33.6
Redwood Creek	17.5	0.0	4.5	3.3	41.8	32.8
Humboldt Bay	12.6	22.2	7.6	5.3	0.2	52.1
Eel River	3.9	27.0	4.4	0.5	0.0	64.1

4.1.2.4 Description of How Landscape Conditions Have Changed Over Time

As discussed in Section 4.1.2.2, a variety of activities have contributed to the condition of the landscape, including agriculture and grazing, residential development, and the application of herbicides and fertilizers. These activities are included to provide relevant context and an understanding of historical conditions within the 11 HPAs and how the condition of the landscape has changed over time. In addition, many of these activities are anticipated to continue in the future regardless of whether the Proposed Action is implemented.

Changes in environmental laws beginning in 1973 have generally contributed to a slowing of the historical trend or, in some cases, restoration of properly functioning habitats and environments. Despite these trends, however, conditions resulting from these activities (and not attributable to the Proposed Action's conservation measures) are expected to continue throughout the period of the Permits without regard to the Proposed Action.

Agricultural and Grazing Activities. Agricultural areas, which include activities of grazing, dairy farming, and the cultivation of crops are relatively limited in the 11 HPAs. Agricultural and grazing use of lands with the Humboldt Bay, Mad River, Eel River and Redwood Creek HPAs have affected and are expected to continue to affect stream bank

stability and surface erosion. In general, livestock grazing within or immediately adjacent to streams and other aquatic areas are primary causes of stream bank erosion and fine sediment delivery. These activities are expected to continue to contribute fine sediment, and little or no coarse sediment to the 11 HPA area. The extent of this future contribution and potential hydrologic conditions is unknown. Although it is anticipated that agriculture and grazing activities will continue to occur in the future, the extent to which they would occur and result in changed conditions is unknown. Water quality related to agriculture and grazing is regulated under applicable laws.

The recent upward trend in value of dairy-related agricultural products (e.g., milk, cows and calves, pasture, hay, and silage) in Humboldt County, for example, is expected to continue as human populations continue to increase. As a result, the dairy industry within the 11 HPAs, primarily in the lowlands of the Eel, Mad and Smith River watersheds below the Green Diamond ownership, is expected to persist.

Residential Development and Operation of Existing Residential Infrastructure. Rural community areas include existing development and those areas where future housing development would occur. The most common effects of housing development in a watershed are: hardening of stream banks (e.g., levee construction); increased peak flows from storm runoff; pulses of increased fine sediment during construction periods; and loss of riparian vegetation due to encroachment on the riparian zone by buildings and infrastructure.

The moderate rate of human population growth in Humboldt County (about 2.8 percent increase from 1995 through 1998) and the three north coastal counties (about 3.3 percent overall increase from 1995 through 1998) (California Department of Finance, 1997, 1998a, 1998b) is expected to continue. In Humboldt County, most of this growth is expected to be concentrated near the cities of Eureka, Arcata, and McKinleyville. Although it is anticipated that residential development will continue to occur in the future, the extent to which it would occur and result in changed conditions is unknown. Water quality related to residential infrastructure is regulated under applicable laws.

Application of Herbicides and Fertilizer. The application of forest chemicals will not be covered under the ITP or CCAA/ESP (the "Permits"). This section analyzes potential effects from exposure to these chemicals and from the alteration of habitat or changes in primary and secondary production that may occur within the Action Area as a result of application of these chemicals.

The contamination of surface waters by herbicides, and the resultant risk of toxic effects on salmonids, depends on the form and application rate of the chemical, the application method, soil type, weather conditions during and after application, the presence of riparian buffers, and the distance of the application area from flowing water. The persistence of these chemicals in the environment varies due to differences in water solubility, absorption rates into organic and inorganic matter, and sensitivity to photo decomposition or microbial activity. No-spray riparian buffers substantially reduce the risk of contamination (Norris et al. 1991), but toxic levels of chemicals may still reach streams from runoff and wind drift (Schulz 2004). If contamination of surface waters occurs and results in sufficiently high concentrations of a chemical, impacts to salmonids and designated critical habitat may occur, including acute and chronic toxicity, leading to injury or death, behavior

modifications, reduced growth, decreased reproductive success, and increased vulnerability to diseases and pathogens (reviewed in Beschta et al., 1995). Norris et al. (1991) reviews the behavior and toxicity of many of the commonly used herbicides, but newer chemicals are not discussed. Although there is substantial literature on the toxicity of various herbicides on salmonids, most of the information comes from laboratory studies focusing on acute lethal doses and not on chronic toxicity (Spence et al., 1996).

Contamination of surface waters by herbicides, and the resultant risk of toxic effects on salmonids, also depends on the effectiveness of existing State and Federal regulatory requirements for pesticide use. The application of forest chemicals by Green Diamond is regulated by the California Department of Agriculture and by the U.S. Environmental Protection Agency (EPA). Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA evaluates all pesticides for environmental risks, and then registers pesticides for use in compliance with labeling conditions tailored to each pesticide. In conjunction with that process, EPA is required to consult with the Services under Section 7 of the ESA.

On January 22, 2004, the district court for the Western District of Washington in Seattle issued an injunction against the EPA and vacated EPA's authorization of most agricultural uses of 54 active ingredients within 20 yards (and aerial application within 100 yards) of salmon streams in California, Oregon, Idaho, and Washington (Washington Toxics Coalition v. Environmental Protection Agency, Case No. C01-0132C). Those active ingredients which require buffers are indicated in Table 4.1-2. There are further modifications imposing stricter requirements for certain specific pesticides and excluding certain other practices from the injunction. The injunction lasts until EPA has completed its consultation obligation. NMFS, EPA, and the USFWS have issued a joint rule to streamline pesticide consultation procedures for all pesticides registered under FIFRA. (69 FR 47732, August 5, 2004).

In this assessment, the Services have considered the application methods used by Green Diamond in the absence of the court-mandated buffers for selected pesticides. Green Diamond applies herbicides either by hand, roadside or aerially and the associated application methods are listed in Table 4.1-2 for each chemical. For aerial applications, Green Diamond complies with pesticide labeling conditions and uses the following default measures:

1. No herbicide shall be applied within a 100 foot horizontal buffer zone of a Class I or II flowing stream.
2. No application of herbicide will take place when the wind velocity exceeds five miles per hour.

For ground applications, the following measures are used in addition to compliance with pesticide label conditions:

1. Foliar treatments will not be conducted when wind speeds exceed ten miles per hour on the spray site.
2. An untreated 50-foot buffer will be maintained on all flowing water.
3. A copy of Green Diamond's Spill Contingency Plan will be kept on site in case of an accidental spill of any hazardous materials.

TABLE 4.1-2
Forest Chemicals and Methods of Application Currently Used by Green Diamond as Part of Its Forest Management Activities

Chemical Trade Name	Application Type	Active Ingredient	Buffer Required?
Aatrex	Pre-emergent; applied by hand. Short in duration in the soil.	Atrazine	No
Arsenal	Post-emergent; applied by hand. Used to prepare clearcut sites for reforestation, to release conifers from competing vegetation, and to provide control of many annual and perennial weeds.	Imazapyr	No
Chopper	Post-emergent; applied by hand. Used to control perennial broadleaf weeds.	Imazapyr	No
Garlon 4	Post-emergent; applied by hand, aerially, and roadside. Used to control broadleaf weeds and brush.	Triclopyr BEE	Yes
Honcho	Post-emergent; applied by hand. Used to control undesirable grasses and broadleaf species.	Glyphosate	No
Mirage	Post-emergent; applied by hand and roadside. Used to control undesirable grasses and broadleaf species.	Glyphosate	No
Oust	Pre-emergent; applied by hand. Used for non-selective weed control. Applied to soils at extremely low rates and has moderate to low persistence.	Sulfometuron methyl	No
Riverdale LV6	Post-emergent; applied by hand, aerially, and roadside. Used to control many types of broadleaf vegetation, especially woody species such as willow, alder, sumac, and sagebrush.	2,4-D	Yes
Herbimax (adjuvant)	Foliar applications.	Oil surfactant	No
Moract (adjuvant)	Foliar applications.	Oil surfactant	No
R-11 (adjuvant)	Foliar applications.	Non-ionic surfactant	No
Activator 90 (adjuvant)	Foliar applications.	Non-ionic surfactant	No
MSO Concentrate (adjuvant)	Foliar applications.	Methylated seed oil	No
Soy Oil	Basal applications.	Soy bean oil	No

Note: On June 22, 2004, the district court for the Western District of Washington in Seattle (see *Washington Toxics Coalition v. Environmental Protection Agency*, Case No. C01-0132C) vacated EPA's authorization of most agricultural uses of 54 active ingredients within 20 yards (and aerial application within 100 yards) of salmonid streams in California, Oregon, and Washington. Those chemicals requiring this buffer are indicated.

The application of chemicals by Green Diamond or their representatives is subject to the requirements of all applicable Federal and State laws, including the recent court decision cited above, as well as the prohibitions against take of listed species pursuant to Section 9 of the ESA. Other land owners in the Action Area can also be expected to use pesticides in

compliance with State and Federal law, but they may not apply the additional practices used by Green Diamond:

- **Atrazine.** Atrazine is the active ingredient in "Aatrex" and is used by Green Diamond for the selective control of broadleaf and grassy weeds. Tests indicate that most of the atrazine disappears from the soil within one year of application. However, while in the soil, atrazine is highly mobile and may be delivered to watercourses during rainfall events and potentially affect aquatic biota. Studies on agricultural croplands indicate that runoff from adjacent fields may generate concentrations in receiving streams up to 0.032 mg/L (Frank and Sirons, 1979; Norris et al., 1991). No residues were detected in receiving waters when a 3 meter unsprayed buffer strip was left adjacent to the watercourse (Douglass et al., 1969; Norris et al., 1991). Given that Green Diamond applies atrazine by hand, The Services do not expect instream concentrations will exceed those seen for the above cited agricultural plots where the substance was more broadly applied.

  Aquatic invertebrates, which provide a food source for salmonids, are also sensitive to atrazine. Concentrations of 0.23 mg/L of atrazine resulted in reduced hatching success, larval mortality, developmental retardation and a reduction in the number of emerging adult chironomids (Macek et al., 1976; Norris et al., 1991). Although chironomids are typically not a principal source of invertebrate prey for salmonids, the data indicate the magnitude in which effects to aquatic invertebrates could be expected. A limitation with using chironomids is that they may be a more tolerant species than mayflies and caddisflies, which are a principal food source for juvenile salmonids. However, given the concentrations observed in the above field studies compared to the sensitivity of chironomids to atrazine in the water column, The Services do not expect that any mortality or developmental changes in aquatic invertebrates will appreciably alter the prey base available to juvenile salmonids.

  Laboratory and field tests show that atrazine is toxic to fish when present in sufficient concentrations. Concentrations of 0.24 mg/L produced significant reductions in the survival and growth of brook trout fry (Macek et al. 1976; Norris et al., 1991). Analysis of muscle tissue from brook trout indicated that these fish did not bioconcentrate detectable amounts of atrazine after prolonged exposure (Macek et al., 1976; Norris et al., 1991). We reason that the low concentrations expected in streams combined with the levels required to induce effects in salmonids will not result in detectable changes in salmonid growth, reproduction or survival rates. Although the above information is for juvenile fish, the Services do not have information concerning the effects on other life history stages. It is expected that adults are least likely to be affected given that when they are present in streams most likely to contain detectable amounts of atrazine, stream flows are much higher, and any sources of atrazine are diluted. Although information on the susceptibility of developing salmonid eggs to atrazine exposure is not available, it is expected that levels which would affect the development of aquatic invertebrates would be sufficient to cause a change in egg-to-fry development. In this case, it is noted that the earliest developmental stage of gammarids (amphipods) was reduced when exposed to 0.14 mg atrazine/L (Macek et al., 1976; Norris et al., 1991). This suggests that the smallest developing organisms will not experience detectable effects by the presence of atrazine given the expected concentrations of the substance in the water column. In

summary, it is not expected that the application methods and expected concentrations of atrazine will result in detectable effects on salmonids in the Action Area.

- **Imazapyr.** Imazapyr is the active ingredient in "Arsenal" and "Chopper," used by Green Diamond to prepare clearcut sites for reforestation and control competing vegetation around young conifers. A substantial amount of testing of imazapyr products has been conducted to evaluate its potential toxicity to non-target organisms. In Washington State, Imazapyr was undetectable in the initial tidal exchange waters following the direct application of the compound to estuarine sediments (WSDA, 2004). Imazapyr is considered practically non-toxic to fish based on standard 96-hour exposure studies (WSDA 2004). Bioaccumulation of imazapyr in aquatic invertebrates is low, therefore the potential for exposure through ingestion of other organisms is also low (WSDA, 2004). Tests for sub-lethal effects revealed no effects on hatching or survival in rainbow trout with concentrations up to 92 and 118 mg/L (WSDA, 2004). Based on this information, any mortality or changes in reproductive success of salmonids from Green Diamond's use of this herbicide is not expected.

- **Triclopyr BEE.** Triclopyr BEE is the active ingredient in "Garlon 4," used by Green Diamond for control of competing vegetation in recently clear-cut areas. Garlon 4 is highly toxic to rainbow trout, with median lethal concentrations (LC50) occurring at 0.74 mg/L (Dow Chemical Company, 1983; Norris et al., 1991). Fortunately, triclopyr dissipates relatively rapidly in the soil through microbial activity and photo decomposition, reducing the likelihood of exposure. In soils of increasing organic matter such as would be found on Green Diamond's timberlands, this dissipation appears to occur much more rapidly (Norris et al., 1991). McKellar et al. (1982, Norris et al., 1991) found that water concentrations of triclopyr following heavy treatment in small, forested watersheds (11.2 kg/hectare) ranged from non-detectable to 0.02 mg/L. Choon et al. (1986; Norris et al., 1991) concluded that there is little likelihood that triclopyr will leach from adjacent forest applications into water. Therefore, given the buffers required for application, avoiding aerial application when wind speeds exceed five mile per hour, and the low mobility of Garlon 4, we expect a low likelihood of salmonid exposure to Triclopyr BEE. We reason that the uncertainties associated with buffer strips and aerial application measures (Schulz, 2004) combined with the length of the Permit period (50 years) may result in one or more instances of exposure over the life of the Permits. However, in the event of exposure, it is not expected that the concentrations of the compound will occur in sufficient quantities to cause a detectable response in salmonids based on the studies cited above.

- **Glyphosate.** Glyphosate is the active ingredient in "Honcho" and "Mirage" and is used to control grasses and other undesirable plant species. Glyphosate is very immobile in the soil and rapidly rendered inactive over a period of several weeks (Norris et al., 1991). Where agricultural applications have been monitored, concentrations in runoff ranged up to 5.2 mg/L when runoff occurred the day after heavy application (8.96 kg/hectare) but for lower application rates, concentrations up to 0.094 mg/L were observed (Norris et al., 1991). In forested applications with no buffer strips and the streams receiving direct aerial application of the herbicide, the concentration of glyphosate reached 0.5 mg/L (Norris et al., 1991). Studies indicate median lethal concentrations for rainbow trout occurring as low as 2 mg/L, but effects are very dependent on pH. Glyphosate is

considered relatively non-toxic to fish and one of the forest herbicides least likely to have sublethal effects (NMFS, 2003d). The potential for the compound to build up in the tissues of aquatic organisms is very low (Extoxnet, 1996). Since glyphosate is applied by hand and roadside, and is very immobile in the soil, instream concentrations approaching those seen in studies above are not expected. Thus, it is expected that the salmonids will rarely be exposed to the substance. Therefore, any salmonid mortality or changes in growth rates or reproductive success are not expected.

- **Sulfometuron-methyl.** Sulfometuron-methyl is the active ingredient in "Oust" and is used by Green Diamond in the control of competing vegetation. Sulfometuron-methyl is used for conifer site preparation and release and general weed control along roadsides. The following information is summarized from the California Department of Pesticide Regulation's (CDPR, undated) document summarizing the environmental fate of sulfometuron-methyl. Sulfometuron-methyl is slightly toxic to fish and aquatic invertebrates. Its LC50 in adult rainbow trout is greater than 12.5 mg/L. Toxicity to rainbow trout occurs at 13 ppm. Levels of sulfometuron-methyl in Bluegill sunfish were well below the level for toxicity after exposure to the compound for 28 days and therefore it is not thought to bioaccumulate. Because it does not bioaccumulate, the compound is only slightly toxic to freshwater fish. Sulfometuron-methyl is practically nontoxic to the water flea (*Daphnia magna*), suggesting that aquatic invertebrates, and thereby the prey base of salmonids, are not affected by low levels of the compound in streams. Little specific information is available on the potential sublethal effects of the compound (NMFS, 2003d), although the water flea mentioned above is often regarded as a sensitive indicator to toxic substances (CDPR, undated). Since sulfometuron-methyl shows little tendency to bioaccumulate and does not have long-term persistence in food chains, we do not expect any chronic effects to occur (NMFS, 2003d). Given the hand application of this compound and the relatively low rates of application by Green Diamond, it is expected that salmonid exposure to the compound will be very low, if any, and, consequently, any mortality or reduced reproductive success or growth rates in salmonids is not expected.

- **2,4-D.** 2,4-D is the active ingredient in "Riverdale LV6" and is used to control competing woody vegetation (see Table 4.1-2). This is a widely used herbicide, applied to control vegetation for several purposes. In soil, 2,4-D persists for a very short time, rapidly disappearing due to plant uptake and microbial decomposition. Further, soil organic matter readily adsorbs 2,4-D which tends to limit its mobility. Norris (1981; Norris et al., 1991) concluded that direct application and drift to surface waters are the processes most likely to produce the highest residue levels, but that persistence is brief, usually less than 48 hours. In comparing expected concentrations resulting from field application to lethal thresholds, NMFS (2003d) concluded that no impacts to any aquatic species is likely to occur from the general use of 2,4-D in a watershed.

  Physiological and morphological alterations have been seen in fish exposed to 2,4-D. Common changes seen in physiological parameters are changes in enzyme activity levels (Nešković et al., 1994). Exposure to 2,4-D has also been shown to cause morphological changes in gill epithelium in carp. These changes include lifting of the gill epithelium and clubbing of gill filaments, but are considered non-lethal if the fish is removed to clean water for recovery (Nešković et al., 1994). In field conditions this

would be equivalent to swimming to an untreated area or the herbicide concentration falling off to negligible levels. Carpenter and Eaton (1983) investigated the metabolism of 2,4-D in rainbow trout after injection, and found that almost 99 percent of the compound is excreted in the urine as unchanged 2,4-D, with a half-life of only 2.4 hours. Less than 1percent was found in the bile of treated fish, presumably as a conjugated metabolite. Given the aerial application buffers and avoiding aerial application when wind speeds exceed five miles per hour will minimize any drift, particularly where herbicide is applied on recently harvested areas and the application is from a low altitude. However, given the uncertainties surrounding the effectiveness of no-spray buffers and aerial drift, there is still the likelihood that some of the compound may enter a nearby watercourse over the life of the Permit. However, given the short persistence time in water should drift occur, we do not expect any mortality or reduced reproductive success or growth rates from the use of 2,4-D.

- **Adjuvants**. The various adjuvants listed in Table 4.1-2 used by Green Diamond are surfactants used to improve the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids. Some surfactants are toxic. The surfactant R-11 has a 96 hour LC50 of 3.8 ppm for rainbow trout, making it considerably more toxic than the glyphosate it is commonly mixed with (Diamond and Durkin 1997). Curran et al. (2004) found that R-11 was significantly more toxic to smaller rainbow trout (0.39 g) than it was to larger fish (15.46 g) when the LC50 of each size was compared (5.19 ppm versus 6.57 ppm) and that EPA test criterion size (< 3g) indicates that differences in fish size may cause differences in the 96-h LC50 as great as 200 percent. Furthermore, the surfactant R-11 has been cited as a potential cause of endocrine disruption in fish and amphibians as one of its constituents is a nonylphenol polyethoxylate (NPE). Nonylphenols are weakly estrogenic, and have been shown to cause endocrine disruption under laboratory conditions at low doses (20 ppb) (UK Marine SACS Project, 2003). In comparison to the herbicides used during vegetation treatments, the surfactant R-11 is more toxic and has a range of effects that present themselves in the low parts per billion concentration range. Little information could be located on the potential toxicity of the other adjuvants listed in Table 4.1-2. For methylated seed oils, a LC50 value of 53.1 mg/L was reported (NMFS, 2003d) suggesting that mortality is unlikely given the relatively high water concentration needed and provisions for avoiding streams. Preliminary laboratory results indicate that R-11 is likely the most toxic of the adjuvants used (Cabarrus et al., 2002).

  There is some risk of surfactant drift during aerial applications that the spray buffers and wind speed limitations will reduce. Also, the proposed action will retain forested buffers along Class I and II streams and areas within the buffer will not be aerially treated. Under these limitations, aerial drift that enters flowing waters is only possible in rare instances. However, given the small concentrations of the surfactant R-11 needed to cause the effects noted above, the aerial application of R-11 may ultimately increase the likelihood of reproductive disruptions, reduced growth rates or even mortality of salmon and steelhead. Sublethal effects are characterized as those that occur at concentrations that are below those that lead directly to death. Sublethal effects may impact the fish's behavior, biochemical and/or physiological functions, and create histological alterations of the fish's anatomy. In addition, changes in the sensitivities of fish to other contaminants (i.e., chemical synergism), may increase the likelihood of

mortality of exposed fish. For example, the toxicity of R-11 may increase when mixed with an herbicide (WSDA, 2003). Thus, the additive and synergistic effects of chemical mixtures may result in greater than expected toxicity (Lydy et al., 2004). In considering the effects of R-11 on salmonids we note two critical areas of uncertainty; (1) the extent of toxicity of R-11 to salmonids and their prey base, and (2) the uncertainties surrounding the effectiveness of no-spray buffers and aerial application measures discussed by Schulz (2004). While the application measures and the forest buffers reduce the chance of exposure from aerial applications, it is possible that exposure may occur over the 50-year term of the Permits. The likelihood of this occurring, however, is considered to be low given that, in order for exposure and the sublethal response to occur, the application site not only must be near a watercourse with salmonids present, but the spray buffers, wind speed limits and forested buffers prescribed in the AHCP/CCAA also must fail in their purpose. Further, it is presumed that Green Diamond and other land owners will comply with any use restrictions for R-11 or other pesticides that are imposed in connection with future registration action by EPA and resulting consultation on the effects of pesticides on listed species.[1]

Given that toxicology data are largely unavailable for the other adjuvants, the effects on salmonids are unknown except for soy oil discussed below.

- **Soy oil.** Soybean oil is mixed with herbicides and used by Green Diamond as an adjuvant. Adjuvants can affect herbicide performance in many ways including the spread of spray droplets on the leaf surface, retention of spray on the leaf, and penetration of the herbicide through the plant cuticle. The base oil is considered non-toxic to aquatic organisms, but formulated products may have additive effects that are toxic. The LC50 for rainbow trout in laboratory tests was 633 parts per million, but bubbling air through the test containers virtually eliminated the toxicity Cheng et al. (1991). Although the Services do not have information on the concentrations that may be found in watercourses following soy-oil based applications, it is expected that the combination of buffer strips and application at the base of vegetation will minimize the delivery of soy oil to watercourses. Therefore, toxic effects in salmonids are not expected.

- **Summary**. The Services' review of the application methods, transport and fate of the various herbicides indicates that the chance of these chemicals entering a fish-bearing watercourse is low. Further, toxicology data indicate that the exposure levels to be expected under forest application would not be sufficient to cause adverse effects to salmonids. It is noted, however, that mixtures of the various compounds may be having greater effects on salmonids and their habitat than that considered for the compounds individually (Lydy et al., 2004). For instance, the Services are concerned with the aerial application of mixtures that include the surfactant R-11. Despite the lack of information

[1] Under ESA Section 7, EPA consults with USFWS and NMFS on effects to listed species when EPA registers a pesticide under the authority and requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Since 1998, it has been the policy of the USFWS not to provide incidental take coverage for the use of registered pesticides in ESA Section 10 habitat conservation plans because ESA Section 7 requires EPA to consult on the effects of pesticide registration. See Memorandum to Ecological Services Project Leaders, Region 1 (July 27, 1998). NMFS follows this practice as well. Accordingly, EPA is consulting with NMFS on the effects to salmonids from the registration of certain pesticides pursuant to its obligations under Section 7 of the ESA and recent court orders issued in Washington Toxics Coalition v. EPA, No. C01-132C (W.D. Wa., July 2, 2002), and a consent decree reached in a similar case, Californians for Alternatives to Toxics v. EPA, No. C00-3150 CW (N.D. Ca., decree entered Sept. 18, 2002).

on the toxicology of other adjuvants, and the uncertainties surrounding mixtures of these compounds generally, existing information for R-11 indicates that aerial application of this substance may cause sublethal effects with consequent mortality of salmonids where streamside buffers are narrow and aerial drift occurs. While the risk to salmonids is expected to be exceedingly low in any given year, isolated incidences of aerial drift and exposure could occur in the Permit area during the 50-year term of the proposed AHCP/CCAA. Because exposure to low concentrations of R-11 could induce a sub-lethal response, it is possible that individual salmonids may experience reductions in growth rates or other sub-lethal effects where aerial applications occur adjacent to fish-bearing streams. As previously mentioned, the Services consider this to have a low likelihood of occurring given that, in order for exposure and sublethal effects to occur, the application site would have to be near a watercourse with salmonids present and the AHCP/CCAA measures described above would have to fail in their purpose. It is also presumed that Green Diamond will comply with any use restrictions for R-11 and other pesticides that are imposed by EPA as a result of future assessments of the impacts of registered pesticides on listed species.

4.1.3 Analysis of the Additions and Removal of Acres to the Initial Plan Area

In the future, commercial timberlands within the 11 HPAs that Green Diamond acquires or transfers out of ownership will be either added to or removed from the covered lands under Green Diamond's AHCP/CCAA. However, the acreage of the Plan Area will not contract or expand by more than 15 percent of the total acreage of the Initial Plan Area without an amendment to the Plan or Permits (IA Section 11).

Based upon the analysis of the HPAs provided in the Plan, it is presumed that all commercial timberlands within each HPA in the Eligible Plan Area share similar relevant characteristics and, therefore, such lands added to or removed from the Plan Area during the term of the Permits will not likely result in adverse effects on the covered species different from those analyzed in connection with the following analysis for each of the alternatives.

4.2 Geology, Geomorphology, and Mineral Resources

The purpose of this section is to evaluate the potential impacts to geology, geomorphology, mineral resources, and associated erosion from implementing the Proposed Action (the conservation measures in the proposed AHCP/CCAA) and alternatives, including the No Action Alternative.

Geomorphology and geologic resources in the Primary Assessment Area can be affected in several ways. Primarily, the effects are related to movement of surface materials, including soils, weathered rock, and sediment (i.e., hillslope mass wasting). When delivered to streams, these materials can affect water quality (see Section 4.3, Hydrology and Water Quality) and fish habitat (see Section 4.4, Aquatic Resources).

Currently, sediment inputs to Primary Assessment Area stream networks result from existing roads, implementation of THPs, natural conditions, and legacy conditions. As noted in AHCP/CCAA Table 7-1, the individual Hydrographic Planning Area Assessment Summaries contained in AHCP/CCAA Section 4.4 (e.g. Sections 4.4.2.9, 4.4.4.9, and 4.4.5.9)

and Appendix E.3, the potential for adverse sediment impacts to aquatic habitat conditions is one of the greatest environmental concerns in the Primary Assessment Area.

Several potential resource issues within the Primary Assessment Area (i.e., mineral-resource depletion, fire-prevention and fire-suppression activities, and earthquakes or volcanic eruptions) would have no or negligible direct or indirect impacts as a result of implementing the Proposed Action or the action alternatives. These issues are discussed below, but are not analyzed in greater detail in this EIS:

- The Proposed Action or the other alternatives would not affect the extraction and processing of mineral resources (Section 3.2.5, Mineral Resources) in the Primary Assessment Area. Green Diamond's rock pits are generally less than 2 acres in size; are located more than 100 and 75 feet from Class I and II streams, respectively; and are exempt from SMARA regulations. Any extraction of in-stream gravel from locations throughout the Primary Assessment Area would be conducted in compliance with permitting and regulatory requirements of the CDFG and other State or Federal regulations. These activities would be the same for the No Action Alternative, Proposed Action, and other action alternatives. Also, instream gravel extraction would not be a covered activity under the Proposed Action and other action alternatives.
- The Proposed Action or the alternatives would not affect wildfire prevention and suppression activities in the Primary Assessment Area. Depending on the location and characteristics of a particular fire, uncontrolled fires, areas of high-intensity burns, and fire-suppression activities can potentially result in conditions leading to increased sediment delivery and hillslope mass wasting. Under the various alternatives, wildfire prevention and wildfire suppression activities would continue to be practiced by Green Diamond when and where necessary.
- The potential for soil compaction to result from implementing the Proposed Action or any of the alternatives is expected to be the same and are, therefore, not assessed in detail in this EIS.
- The likelihood or magnitude of earthquakes or volcanic eruption will be unaffected by implementation of the Proposed Action or the other action alternatives; therefore, these events are not assessed in detail in this EIS.

4.2.1 Methodology

Geologic maps and watershed maps developed by the California Geologic Service (CGS) (formerly known as the California Division of Mines and Geology [CDMG]), CDF, and the U.S. Geological Survey (USGS) indicate the location of potentially unstable geologic features. However, the geologic and watershed maps and THPs that are currently available provide only partial coverage of the Primary Assessment Area. As a result, the quantification of impacts to geology and geomorphology for the entire Primary Assessment Area is limited to the analysis and assumptions discussed below. Potential adverse impacts include acute or chronic changes in geomorphic and hydrologic processes that affect soil productivity, and delivery of surface materials to streams and rivers in the Primary Assessment Area. Potential effects could be localized or dispersed over a wide area. The following subsections focus on: (1) the likelihood that slope stability and the rates of hillslope mass wasting and sediment

delivery would change under the Proposed Action and other alternatives; (2) the effects of those changes; and (3) measures for avoiding potentially significant impacts or reducing them to insignificance.

The primary processes with the potential to result in impacts to geology and geomorphology and deliver sediment to watercourses within the Primary Assessment Area are:

- Surface erosion
- Hillslope mass wasting
- Reduced bank stability
- Road related sediment production

Excessive sediment, both coarse and fine has historically resulted in significant adverse effects to watercourses in the Primary Assessment Area. Table 4.2-1 presents general activities that have contributed to sediment delivery. For purposes of this analysis, sediment loading is considered excessive when the amount of sediment that is delivered to a watercourse is greater than the stream's ability to transport sediment out of the system, leading to stream aggradation, channel filling and/or cementation.

TABLE 4.2-1
General Activities Contributing to Delivery of Coarse and Fine Sediment

Management Activity	Coarse Sediment	Fine Sediment
Hillslope erosion	No	Yes
Road surface erosion	No	Yes
Road-related mass wasting	Yes	Yes
Timber harvest-related mass wasting	Yes	Yes
Burning	No	Yes
Grazing	No	Yes
Timber harvest methods	Yes (Historic only)	Yes

The AHCP/CCAA elaborates on the condition of the 11 HPAs relevant to previous sediment delivery. Table 7-1 of the AHCP/CCAA summarizes the limiting habitat of the covered species within the individual HPAs. Excess sediment delivery to streams in the Coastal Klamath, Interior Klamath, Coastal Lagoons, Redwood Creek, Little River, North Fork Mad River, Mad River, Humboldt Bay and the Eel River HPAs has contributed to limited aquatic habitat. In addition, the Redwood Creek, Mad River, Eel River, and Van Duzen River watersheds have been listed as impaired under CWA Section 303(d) relative to sediment (AHCP/CCAA Table 4-3). Any future management-related sediment delivery to impaired streams above existing levels could prolong the time required for recovery of habitat. Although not all Primary Assessment Area streams are affected by sediment, for purposes of evaluating differences among the alternatives, streams within the Primary Assessment Area were analyzed in this EIS using the assumption that all streams are currently affected adversely by sediment and that additional sediment delivery in excess of background levels would have negative effects on aquatic habitats.

4.2.2 No Action Alternative

Under the No Action Alternative, Green Diamond would continue to conduct timber harvesting and related operations in the Action Area, in accordance with the measures described in Section 2.1 of this EIS. NMFS and USFWS would not issue Green Diamond an ITP or ESP, and Green Diamond would not implement an AHCP/CCAA.

Forest management practices can affect slope stability and increase the potential for hillslope mass wasting by changing vegetative cover, hillslope shape, and water flow above and below the ground surface. Different forest management operations have distinct effects on the factors that control slope stability and hillslope mass wasting. The actual influence of specific forest management activities on slope stability, however, depends on topography, geologic material strengths, patterns of surface and subsurface flow, patterns of water inflow, the design and construction of the road network, harvesting practices that account for the density of residual trees and understory vegetation, and the rate and type of revegetation (Sidle et al., 1985; Yoshinori and Osamu, 1984).

4.2.2.1 Surface Erosion

Most studies indicate that the sediment inputs from timber harvesting alone (primarily surface erosion) are substantially less than those from the associated road systems (Raines and Kelsey, 1991; Best et al., 1995). Overall, any change in surface erosion sediment delivery (positive or negative) is not expected to result in a substantial reduction in contribution to overall watershed sediment budgets given the small role harvest surface erosion plays (i.e. 4-5 percent of the total budget) (see AHCP/CCAA Section 5.3.2).

4.2.2.2 Hillslope Mass Wasting

Landslide rates and hillslope mass wasting associated with roads are greater than landslide rates associated with timber harvesting alone (Sidle et al., 1985). Currently, the average long-term increase in sediment delivery as a result of mass wasting-hillslope failure is estimated to be between 1.25 to 4.00 times greater than background levels (see AHCP/CCAA Appendix F1, Section F1.2.1.5.1) within the Primary Assessment Area. The potential for mass soil movement owing to timber harvesting in sensitive areas would decrease under the No Action Alternative.

4.2.2.3 Bank Stability

Bank stability is most directly related to increased peak flows rather than to root strength or tree retention, except perhaps in Class-III channels, where clearcutting might contribute locally to sensitive slope stability and channel bank conditions. Quantitative estimates of current erosion associated with the loss of bank stability would be speculative. Qualitative data from Green Diamond's retrospective Class III channel study (described in AHCP/CCAA Appendix C4), however, suggest that among 100 channels surveyed (including 107 sample sites) 57 percent had no recognizable bank erosion. Under the No Action Alternative, the Primary Assessment Area drainages could experience short-term localized adverse changes in existing hydrologic conditions (i.e., magnitude and timing of naturally occurring peak and low flows) after timber removal. Changes to channel morphology or the occurrence of bed scour and bank erosion as a result of management activities, however, are not anticipated to differ substantially under the No Action Alternative when compared with existing conditions.

4.2.2.4 Road-Related Sediment Production

Currently, road density on Green Diamond's ownership and other private timberlands (assumed to be equal to Green Diamond's road densities) in the Primary Assessment Area average 5.7 miles per square mile (see AHCP/CCAA Table 6-10). The existing road network comprises both legacy roads and roads where modern design and construction practices have been incorporated. The estimated proportion of the road network hydrologically connected (i.e., capable of direct delivery of water born sediment to watercourses) averages 33 percent (see AHCP/CCAA Appendix F2, Table F2-6).

Under the No Action Alternative, sediment delivery from roads would be reduced primarily through continued implementation of Green Diamond's practices as described in Section 2.1.1.3, that include use of Green Diamond of best management practices (BMPs) that are based on techniques described in Weaver and Hagans (1994), and treatment of road sediment delivery sites prioritized using a formal assessment methodology. Generally, roads would be upgraded to meet current standards when they are used to gain access to and haul logs from individual THP units. Some legacy roads would also be decommissioned. The percent of the road network that is currently hydrologically disconnected from the watercourses (67 percent) is anticipated to increase as a result of implementation of these practices under the No Action Alternative. In combination, these practices will result in a trend towards a reduction in road-related mass wasting, surface erosion, and sediment delivery over time. (Also see Section 4.3, Hydrology and Water Quality, and Section 4.4, Aquatic Resources, for a discussion of impacts to hydrology/water quality and aquatic resources.)

Under the No Action Alternative, Green Diamond foresters and geologists would survey the THP area during THP preparation to identify potentially unstable features using existing geologic maps, such as those developed by the CGS, CDF (e.g., North Coast Watershed Mapping), USGS, and other agencies. The geologist would then determine the extent of unstable features and assess the likelihood of sediment delivery (particularly sediment delivery to fish-bearing streams). Relying on existing guidelines and professional judgment, Green Diamond foresters and geologists would also identify and implement measures to minimize impacts from potential hillslope mass wasting events, surface erosion, sediment input from roads, and reduced stream-bank stability within the THP area. This process provides opportunities to identify unstable areas with a recognizable risk of sediment delivery to streams.

On the basis of continued emphasis by Green Diamond on (1) BMPs based on techniques described in Weaver and Hagans (1994); (2) utilization of a formal methodology for assessing and prioritizing low-, moderate-, and high-risk sediment delivery sites on roads; and (3) identification of recognizable unstable areas with sediment delivery potential and minimization of management practices on these areas within THP units, it is anticipated that impacts to geology and soils under the No Action Alternative would be reduced over the entire Action Area over time, compared with existing conditions. However, as noted in Section 1.5.3.1, continued implementation of the CFPRs on non-Green Diamond commercial timberlands within the 11 HPAs may not necessarily minimize potential impacts of activities that could otherwise result in hillslope mass wasting and sediment delivery.

4.2.3 Proposed Action

Overall, the Proposed Action would reduce the potential to deliver sediment to Primary Assessment Area watercourses from existing sediment sources (e.g., from existing roads and skid trails) by implementing:

- Ownership-wide Road Management Plan (AHCP/CCAA Section 6.2.3)
- Riparian management measures (allowing only one commercial entry except where cable corridors are necessary to conduct intermediate treatments in adjacent stands) (AHCP/CCAA 6.2.1)
- Slope stability measures (AHCP/CCAA Section 6.2.2), and
- Harvest-related ground disturbance measures (AHCP/CCAA Section 6.2.4)

In addition, the Proposed Action would implement some of these measures on an ownership-wide basis, rather than on a THP-by-THP basis (e.g., the Road Management Plan), throughout the Action Area. This would result in a broader and a more expedited application of the conservation measures compared to existing conditions or conditions that are expected to occur over time under the No Action Alternative.

The conservation measures to reduce impacts to geology and soils and reduce sediment delivery to the aquatic network under the Proposed Action fundamentally differ from the No Action Alternative in several ways:

- Some measures (i.e., road management measures) to reduce sediment delivery under the Proposed Action would be applied across the entire Action Area, whereas the No Action Alternative would apply conservation measures on a THP-by-THP basis (see Section 4.2.2).
- In addition to the CFPR procedures that focus on unstable areas and active erosion sites, the Proposed Action would include conservation measures designed to address erosion and sediment-causing activities throughout the Primary Assessment Area.
- The Proposed Action commits Green Diamond to a 15-year accelerated road program that addresses high- and moderate-risk sediment delivery sites.
- The Proposed Action will treat all high- and moderate-risk sediment delivery sites by the end of the 50- year Permit terms.
- The Proposed Action places additional restrictions on wet weather and winter season road and equipment use throughout the Primary Assessment Area.

The following sections discuss measures and prescriptions, specified in the Proposed Action, to implement these sediment reduction measures.

4.2.3.1 Surface Erosion

The Proposed Action prescriptions that address surface erosion are the riparian conservation measures, harvest-related ground disturbance measures, and the proposed Road Management Plan.

Within the Primary Assessment Area, surface erosion is characterized by a typically water-driven, two-part process that involves grain detachment and grain transport. Surface erosion can occur as a sheet process (which is typically difficult to recognize in the field) or as a rill and gully forming process (which is typically more readily identifiable) (Swanston, 1991). Surface erosion is most likely to occur in the Primary Assessment Area where bare mineral soil is exposed or overland flow occurs (e.g., when the precipitation rate exceeds the infiltration capacity).

Sediment delivery from hillslope surface erosion is of most concern on slopes that are adjacent to watercourses, although erosion does occur higher on the hillslope and within harvest units. Hillslopes adjacent to a watercourse are more likely to deliver sediment to that watercourse through erosion processes than hillslopes distant from that watercourse. This is because of the relative transport distance necessary to deliver sediment to the watercourse and the relative likelihood that, within those distances, eroded sediment will be stored on the hillslope. Naturally, the farther a grain has to travel, the more likely it is that it would be deposited on a hillslope before being delivered to a watercourse.

As is the case for WLPZ management prescriptions contained in the No Action Alternative, RMZ management prescriptions under the Proposed Action and the other action alternatives include conservation measures designed to impede sediment delivery in areas where sediment would have relatively short transport distances to watercourses. These measures include minimum overstory canopy-retention standards within RMZ inner and outer zones, limitations on equipment use, and retention of trees judged to be critical to maintaining bank stability (see Section 6.2.1 of the AHCP/CCAA). Vegetation is well documented as an effective means of erosion prevention and control because it absorbs the impact of rain drops, reduces runoff velocity, increases water percolating into the soils, and binds soils with roots (Goldman et al., 1986; Gray and Sotir, 1996). Vegetative buffers are also effective in preventing or impeding eroded sediment from reaching watercourses, which is, in part, why waterbars are often designed to be discharged into vegetation rather than onto bare slopes. Vegetative buffers on toe slopes have also been observed to intercept sediment from upslope landslides. Although the No Action Alternative stream buffers for Class I watercourses are slightly different compared to the Proposed Action, the overall effectiveness of these measures in maintaining bank stability and providing for sediment filtration is not considered to be significantly different.

The harvest-related ground disturbance conservation measures (Section 6.2.4 of the AHCP/CCAA) are designed to minimize management-related surface erosion. In particular, there are operational restrictions on silvicultural and logging activities during those time periods when timber operations have a greater potential for sediment delivery to watercourses. The time period restrictions allow only those harvest activities with relatively low ground disturbance (and associated low potential for surface erosion), such as certain ground-based yarding (not requiring constructed skid trails) and skyline and helicopter yarding, to be conducted during the winter period. Those harvest activities that have the potential to create more ground disturbance (e.g., skid trail construction and mechanized site preparation) are limited to the summer period, with some activities (e.g., ground-based yarding with tractors, skidders, or forwarders) extending into the early spring or late fall if certain favorable climatic conditions occur. More closely spaced waterbreaks are required on highly erodible soil types upslope of RMZs or EEZs where skyline yarding roads require

treatment. In addition, some harvest-related ground disturbance measures focus on minimizing ground disturbance and the associated exposure of bare mineral soil within harvest units.

See Section 4.2.3.4 for a discussion of road-related sediment production and the effects of implementing Green Diamond's proposed Road Management Plan.

4.2.3.2 Hillslope Mass Wasting (Not Road Related)

In general, the potential for sediment delivery to watercourses from hillslopes within the Primary Assessment Area is greatest in RMZs, steep streamside slope management zones (SMZs), headwall swales, and deep-seated landslides (see Section 3.2.3.3, Landslide Classification and Landslide-Prone Terrain, and AHCP/CCAA Appendix F). The Proposed Action includes slope stability conservation measures that would:

- Prohibit timber harvesting within the "inner zone" of all Class I RMZs and 2nd order or larger Class II RMZs that are located below designated "steep streamside slope management zones" (SMZs) (see AHCP/CCAA Sections 6.2.2.1 and 6.3.2.1), except for purposes of creating cable-yarding corridors when other options are impractical. (RMZ areas located below an SMZ are referred to as RSMZs in the AHCP/CCAA.) Retention of a minimum 85 percent overstory canopy closure would be required in Class I and 2nd order or larger Class II "outer zones" where RSMZs have been established.
- Allow limited timber harvesting within the first 1,000 feet of a 1st order Class II RSMZ inner zone subject to 85 percent overstory canopy closure retention post-harvest. A minimum 75 percent canopy retention within the first 1,000 feet of a 1st order Class II RSMZ outer zone would also be required. (See AHCP/CCAA Section 6.2.2.1.)
- Prohibit timber harvesting within the entire RSMZ for the Coastal Klamath and Blue Creek Hydrographic Areas.
- Use single-tree selection as the initial default silvicultural prescription within SMZs and headwall swales.
- One commercial harvesting entry would be allowed within SMZs and headwall swales for the term of the Permits, except where cable corridors are necessary to conduct intermediate treatments. If cable corridors through SMZs are necessary to conduct intermediate treatments (e.g. commercial thinning) in adjacent stands prior to even-aged harvest, Green Diamond will apply the restrictions in AHCP/CCAA Section 6.2.2.1.7 except harvesting of trees in the SMZs will be limited to cable corridors only. Any cable roads established in the SMZ as part of the intermediate treatment will, to the extent feasible, be reused during the even-aged entry in the adjacent stand.
- All hardwoods within SMZs and headwall swales would be retained and, wherever possible, Green Diamond would provide for even spacing of unharvested conifers such that all species and size classes represented in pretreatment stands would generally be represented post harvest.
- Establish no-cut zones within the toe, and 25 feet upslope from the top of the toe of active deep-seated landslides, except for purposes of creating cable-yarding corridors

when other options are impractical. Similarly establish no-cut zones upslope of the deep-seated landslide scarp so as to taper to the lateral margins of the scarp.

- Prohibit timber harvesting within the boundaries of shallow rapid landslides, and retain a minimum 70 percent overstory canopy within 50 feet above and 25 feet on the sides of shallow rapid landslides.
- Provide for site-specific geologic review of Mass Wasting Prescription Zones that may result in tailored prescriptions.

As under the No Action Alternative, Green Diamond foresters and geologists would survey THP areas to determine whether portions of these meet the CFPR definition of unstable areas. In addition, under the Proposed Action, Green Diamond foresters and geologists would determine if portions of the THP area meet the AHCP/CCAA's definition of Mass Wasting Prescription Zones, described in AHCP/CCAA Section 6.3.2.2.2. Mass Wasting Prescription Zones include (1) headwall swales; (2) steep streamside slopes; or (3) historically active, deep-seated landslides. Forest management activities conducted in the vicinity of these unstable geologic features could increase the potential for hillslope mass wasting and sediment delivery.

During THP development, Simpson's registered professional forester would do one of the following when he or she determined that any portion of the THP met the definition of a steep streamside slope; headwall swale; or historically active, deep-seated landslide:

- Impose the default prescription applicable to that feature as set forth above, or
- Retain a California Professional Geologist to:
  - Evaluate the likelihood that timber harvesting operations will cause, or significantly elevate the risk of causing or reactivating, landslides within the prescription zone that will likely result in sediment delivery to watercourses; and
  - Work with the RPF to prepare a more cost-effective, site-specific alternative to the default prescription designed to minimize that likelihood and minimize and mitigate potentially significant impacts on the covered species from sediment delivery resulting from landslides caused or exacerbated by timber harvest operations. Alternative prescriptions can be applied to any of the MWPZs except RSMZs. A qualified biologist will be involved in evaluating the potential biological consequences whenever a more cost effective alternative to the default prescription is proposed.

The alternate approach could be applied to portions of any SMZ outside of RMZs, field verified headwall scarps, or historically active, deep-seated landslides. THPs for which a geologic report has been prepared (and whose conclusions allow for measures other than those specified in the AHCP/CCAA) would be identified as such when submitted for review by CDF and other agencies. A THP map and letter of notice that describes the alternative prescriptions would be sent to the Services when a THP with alternative prescriptions is proposed.

The AHCP/CCAA conservation measures are based on the following assumptions:

- Implementing harvest-related activities on any unstable feature that meets the definition of a headwall swale; steep streamside slope; or historically active, deep-seated landslide poses a certain level of environmental risk
- Applying the AHCP/CCAA measures to harvesting activities on that feature will achieve a reduction in management-related sediment delivery from landslides relative to appropriate historical clearcut reference areas.

The goal of the steep streamside slope conservation measures in the AHCP/CCAA is to reduce management-related landslide occurrences and associated sediment loads, which will minimize the possible effects of management-related sediment input on the covered species from mass-soil movement. Tree retention in the SMZs and associated RSMZs is expected to maintain a network of live roots that would preserve soil cohesion and contribute to slope stability in these areas. Tree retention also is expected to help maintain forest canopy, which would preserve some measure of rainfall interception and evapotranspiration. Maintenance of rainfall interception and evapotranspiration is expected to contribute to slope stability conditions in some locations by minimizing the likelihood of management-induced high ground water ratios. Limited road construction and road reconstruction on unstable slopes and in RMZs would likely result in avoiding or reducing the undercutting and overburdening of sensitive hill slopes and help avoid unnatural concentration of storm runoff on these slopes. The application of more conservative SMZ prescriptions in HPAs more susceptible to hillslope mass wasting, plus the avoidance or limitation of timber harvesting in certain landslide-prone areas, would result in a reduced potential for sediment delivery to streams in the Action Area. On this basis, the measures in the Proposed Action are anticipated to result in incremental improvements over existing conditions as well as improve conditions compared to the No Action Alternative (see Table 4.2-2).

TABLE 4.2-2
Effectiveness of the Proposed Action to Reduce Timber Harvest-Related Mass Wasting Within the Action Area Only

MWPZ	Background Landslide Yield (cubic yards/year)	Pre-Proposed Action Yield (cy/yr)	Post-Proposed Action Yield (cy/yr)	Pre-Proposed Action Percent Over Background Rate Due to Harvest	Post-Proposed Action Percent Over Background Rate Due to Harvest
RMZ	10,241	13,200	10,276	129%	100%
SSS	4,374	8,748	6,182	200%	141%
SHALSTAB	6,981	17,451	11,169	250%	160%
DSL	22,832	24,442	24,201	107%	106%
Shallow rapid	N/A	N/A	N/A		
Other areas	13,610	27,220	27,220	200%	200%
Total	58,038	91,061	79,048	157%	136%

A value of 100% indicates that mass wasting will not be increased due to timber harvest. This analysis assumed that active, shallow landslides are already accounted for in the estimates of mass wasting occurring from the other areas outside of designated protection areas.

Source: Values are from Appendix F3 of the AHCP/CCAA.

The implementation of the various SMZ widths, plus the avoidance or limitation of timber harvesting in certain landslide-prone areas, would also result in an improvement to water quality conditions because of a reduced potential for sediment delivery to streams in the Primary Assessment Area. On this basis, the measures in the Proposed Action are anticipated to result in improvements in water quality over existing conditions as well as improve conditions compared to the No Action Alternative. (See Section 4.3, Hydrology and Water Quality.)

4.2.3.3 Reduced Streambank Stability

Erosion and slope failure of stream banks can potentially result from forest management. This can be the result, in part, of increased peak-flow intensity and duration, as well as reduced root reinforcement of total soil cohesion. As discussed in Section 4.3, Hydrology and Water Quality, the Primary Assessment Area drainages could experience short-term, localized adverse changes in the existing hydrologic conditions (i.e., magnitude and timing of naturally occurring peak and low flows) after timber removal. However, overall peak flows are not expected to substantially change with implementation of the Proposed Action.

The riparian conservation measures for Class I and II watercourses that require retention of 85 percent overstory canopy closure in the RMZ inner zone and prohibit harvesting of trees that are likely to recruit to stream channels, plus Tier B Class-III measures that require retention of trees that are judged to be critical to maintaining bank stability, will likely lead to increased bank stability under the Proposed Action when compared to existing conditions or the conditions that are expected to occur under the No Action Alternative. In addition, implementation of the general riparian conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.1) is expected to contribute to streambank stabilization. Although the width of the inner protection zone for Class I streams and overall width of the Class II stream protection zones are wider under the No Action Alternative, it is not expected that substantially different level of impacts to bank stability will occur under the Proposed Action.

It is unknown if the protection measures for Class III streams under the Proposed Action would result in increased bank stability when compared to the No Action Alternative. The Proposed Action will allow for greater retention of hardwoods in RMZs and EEZs in Tier B Class III watercourses relative to No Action Alternative.

4.2.3.4 Road-Related Sediment Production

The Proposed Action identifies road-related surface erosion and road-related mass wasting as major contributors to the sediment budget in most managed watersheds. To address potential road-related sediment production, the AHCP/CCAA includes road management conservation measures for both new and existing roads (see Section 6.2.3 of the AHCP/CCAA). These include the following measures common to the Proposed Action, and Alternatives A and C (see Table 2.7-1 comparing the alternatives):

- Methodology to classify roads on the basis of use and to prioritize road work and site-specific repairs
- Improved standards for road repairs and upgrades
- Improved standards for stream crossing, and culvert repairs and upgrades

- Improved standards for temporary and permanent roads
- A training program for equipment operators and supervisors on the Road Management Plan and other AHCP/CCAA standards and practices

The Proposed Action's Road Management Plan also provides additional measures that include:

- An accelerated repair of high-and moderate-risk sediment delivery sites
- A commitment to fix all of the high and moderate-risk sediment delivery sites by the end of 50-year term of the Permits
- Increased restrictions on wet weather road use, construction, up-grading, and decommissioning

These road-related conservation measures will result in an anticipated increase in the estimated proportion of hydrologically disconnected roads to 93 percent, as compared to 67 percent under the No Action Alternative (AHCP/CCAA Appendix F2, Table F2-6) and would reduce road-related sediment production and delivery to Primary Assessment Area streams. Under this alternative, high- and moderate-risk sediment delivery sites on the entire ownership would be treated by the end of the 50-year term of the Permits and some sites would be treated under an accelerated program. Under the No Action Alternative, all of the high- and moderate-risk sediment delivery sites would not necessarily be treated within the next 50 years and there would be no accelerated road treatment program. Therefore, under the Proposed Action, the incremental improvements to water quality through reduced road-related sediment input are greater than the improvements that are expected to occur under the No Action Alternative.

Green Diamond has performed a general assessment of its ownership within the Action Area that identifies road-related sediment sources requiring treatment (e.g., stabilization of dirt or other remediation to prevent road-related, sediment-producing failures or hillslope mass wasting events). At the time the sediment model was run in 2002, Green Diamond estimated the volume of potential sediment associated with high- and moderate-risk sediment delivery sites (based on both the probability of delivery to watercourses and the sediment volume associated with such delivery) to be 6,436,000 cubic yards (see Appendix F of the AHCP/CCAA). Under the AHCP/CCAA, Green Diamond's proposed Road Management Plan is designed to provide treatment of all high- and moderate-risk sediment delivery sites over the term of the AHCP/CCAA, to minimize potential delivery of sediment to riparian and aquatic areas. In addition, in the AHCP/CCAA, Green Diamond commits to provide an average of $2.5 million per year for the first 15 years of the AHCP/CCAA (for a total of $37.5 million) to accelerate implementation of the treatments for the high- and moderate-risk sites. (The acceleration period would be adjusted following revision of the estimate of sediment yield from high- and moderate-risk sediment delivery sites at the end of the first five years following issuance of the Permits. The acceleration period and monetary commitment could be adjusted (upward or downward) by up to 1.5 years and $3.75 million depending on the revised estimate of sediment yield.)

On the basis of the current estimate of 6,436,000 cubic yards of sediment requiring treatment, $2.5 million per year for 15 years would result in 48 percent of the overall volume being treated in the first 15 years of the AHCP/CCAA (see Figure 4.2-1). This 48 percent equates to 3,058,000 cubic yards of sediment, which could otherwise wash into streams on

or adjacent to Green Diamond's ownership, being treated within the first 15 years of the AHCP/CCAA (see Appendix F of the AHCP/CCAA). In contrast, if the road-related treatment was performed without the acceleration at approximately $1 million per year (Green Diamond's current road work expenditure), less than 1,223,000 cubic yards would be removed during the first 15 years, as based on Green Diamond's anticipated timber harvest levels over the next 15 years. Implementation of the Road Management Plan under the Proposed Action would result in improved sediment control by accelerating the reduction of sediment loading compared to the rate at which sediment delivery would be reduced under the No Action Alternative.

Figure 4.2-1 shows road-related sediment delivery (high and moderate-risk sediment delivery sites only) asymptotically approaching 3,000 cubic yards per year during the last decade of the term of the Permits. This suggests that the road management measures will not be 100 percent effective in controlling sediment associated with high- and moderate-risk sediment delivery sites. Some of the reasons why the road management measures will not be 100 percent effective are: (1) sediment delivery occurs before the site can be treated; (2) some sites are located in inaccessible areas where treatment is infeasible; and (3) the underlying geology and soils at the site preclude lowering the risk of sediment delivery, even with treatment.

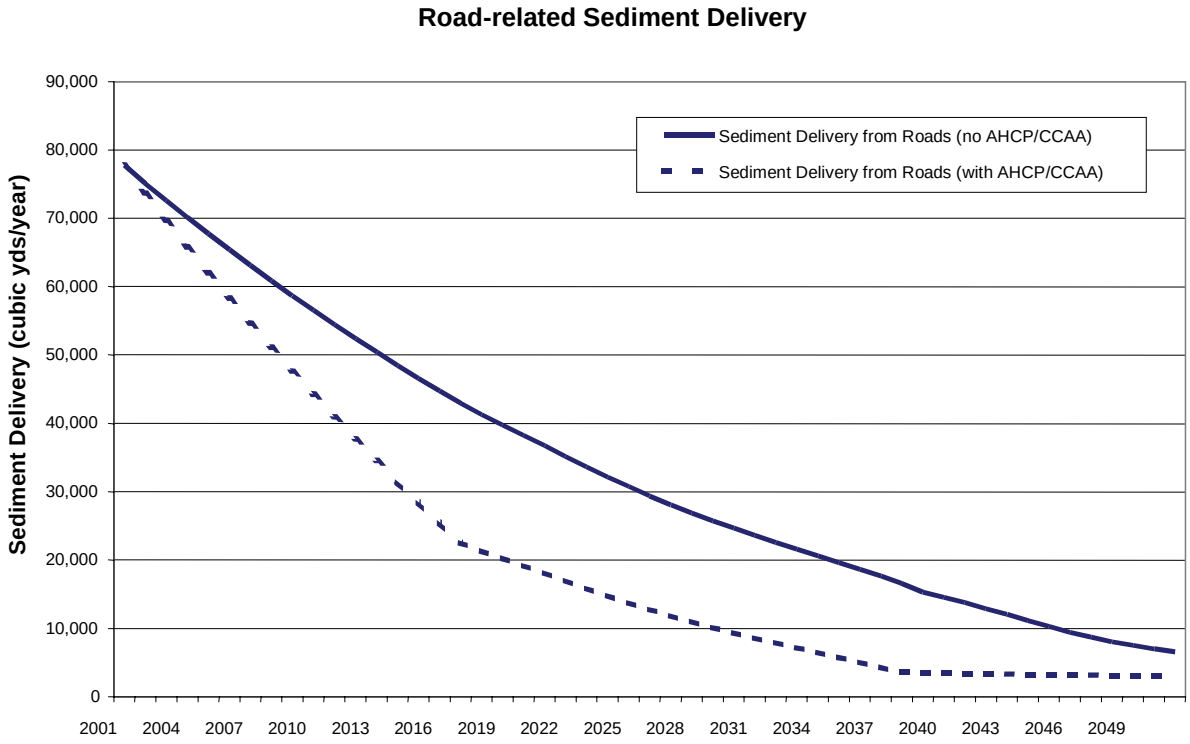

FIGURE 4.2-1
Road-Related Sediment Delivery

The AHCP/CCAA does not present an estimate for sediment delivery from the low-risk sediment delivery sites. Based on inventories performed on several streams on Green

Diamond lands in the Lower Klamath Basin (Pacific Watershed Associates, 1997; Yurok Tribe, 1998, 1999, 2000), and basin-wide assessments of Green Diamond's partial ownership in the Redwood Creek Watershed (Redwood National and State Parks, 2003), it is estimated that low-risk sites contain an additional 6 percent to 20 percent in sediment volume. Extrapolation of these findings results in an additional estimated volume of 1.3 million cubic yards of potentially deliverable sediment currently contained in the low-risk sites within the Action Area. Low-risk sites fail and deliver sediment to streams at much lower rate (approximately 25 percent) when compared to the high- and moderate-risk sediment delivery sites, and are included in the estimates of pre- and post-Proposed Action road sediment delivery rates within the Action Area contained in Table 4.2-3. Road-related conservation measures described above would be implemented within the Action Area on an accelerated basis, with anticipated application of protective new road design and existing road decommissioning, on a faster schedule than would occur under the No Action Alternative.

TABLE 4.2-3
Expected Delivery Rates of Derived Sediment from Various Source Areas Within the Current Action Area Only

	Roads (cy/yr)*	RMZ (cy/yr)	SSS (cy/yr)	Headwall Swale (cy/yr)	Deep-Seated Failures (cy/yr)	Outside Measure Zones (cy/yr)	Total Hillslope (cy/yr)
Background rate	0	10,241	4,374	6,981	22,832	13,610	58,038
Pre-Proposed Action rate	81,668	13,200	8,748	17,451	24,442	27,220	172,729
Post-Proposed Action rate	6,901	10,276	6,182	11,169	24,201	27,220	85,949

* Includes estimate of failure rate for low-risk sediment delivery sites

Source: Values from AHCP/CCAA Appendix F3, Table F3-8.

4.2.4 Alternative A

General timber harvesting and forest management activities, and road management and riparian conservation measures in the AHCP/CCAA would remain the same under Alternative A as in the Proposed Action. As a result, potential impacts to the geology and geomorphology within the Primary Assessment Area would be the same (i.e., consistent and expedited coverage within the Action Area that results in improved conditions, expected to occur over time, compared with existing conditions and the No Action Alternative).

4.2.5 Alternative B

Under Alternative B, Green Diamond would continue to conduct timber harvesting on its property in accordance with existing regulations and management practices. Under Alternative B, existing measures implemented by Green Diamond would be supplemented by an AHCP/CCAA conservation strategy specific to this alternative. This strategy would include fixed riparian-buffer widths, within which no management or timber harvesting would occur, adjacent to Class I and II streams, and establishment of ELZs along Class III streams. Green Diamond would not implement a road management plan designed to accelerate reductions of

sediment loading from priority sites on the ownership. Additional slope stability and ground disturbance measures also would not be implemented. Effectiveness monitoring would not be as extensive under this alternative as under the Proposed Action, and adaptive management with structured feedback loops would not be implemented.

Overall, implementation of Alternative B is anticipated to result in improved erosion and sediment control compared to existing conditions or to conditions anticipated to occur under the No Action Alternative, although the improvements would not be as great as those that would occur under the Proposed Action. Because Green Diamond would not implement a more comprehensive, ownership-wide Road Management Plan, or slope stability or ground disturbance measures under this alternative, hillslope mass wasting would likely occur with more frequency and sediment volume to streams than would occur under the Proposed Action. Alternative B conservation measures would provide a degree of protection to geology and soils in the Primary Assessment Area above what would be anticipated under the No Action Alternative, but less than the degree of protection to geology and soils provided under the Proposed Action. Also, under Alternative B, not all of the high- and moderate-risk sediment delivery sites would be treated and no accelerated treatment program would occur.

4.2.6 Alternative C

Under Alternative C, general timber harvesting, forest management activities, road management, and riparian conservation measures would essentially be the same as the Proposed Action. Under Alternative C, adaptive management would provide a mechanism for strengthening or relaxing individual conservation measures in the rain-on-snow areas, if monitoring indicates, on the basis of specific performance criteria, that a change is necessary. Overall, implementation of Alternative C is anticipated to result in improved erosion and sediment control to existing conditions or to conditions anticipated to occur under the No Action Alternative, although the improvements would not be as great as those that would occur under the Proposed Action. Green Diamond's commitment to provide for an expenditure of $2.5 million per year for the first 15 years of the AHCP/CCAA to accelerate implementation of treatments for high- and moderate-risk sediment delivery sites would be extended to include the additional 25,677-acre rain-on-snow areas under Alternative C. Because accelerated site treatments would be spread over a larger area, potential benefits would be diluted relative to what would be expected to occur under the Proposed Action. Also, since the adaptive management "account" for the Proposed Action would also apply to a larger area under Alternative C, potential benefits specific to adaptive management may also be diluted relative to what would be expected to occur under the Proposed Action. Implementation of Alternative C, therefore, would result in geomorphologic conditions comparable to or slightly less than the improved conditions that would result from implementing the Proposed Action.

4.2.7 Cumulative Impacts – Geology, Geomorphology, and Mineral Resources

The purpose of this cumulative impact assessment is to evaluate the potential effects of the Proposed Action and the other action alternatives on geomorphology and associated sediment delivery. The assessment of potential cumulative impacts on geology and geomorphology was conducted using the approach described in Section 4.1.2, Cumulative Impacts. The assessment area for cumulative impacts consists of the 11 HPAs that contain

Action Area lands owned by Green Diamond and covered in its AHCP/CCAA, as well as other lands that are predominantly either privately owned, administered by a Federal-resource management agency, or State or Federal park lands.

Conservation measures associated with the PALCO HCP exceed the CFPR standards and are designed to minimize adverse geomorphologic effects using various prescriptions directed at riparian management, road management, and reduced sediment delivery from other upslope sources. The beneficial effects of the PALCO HCP on geomorphology would have a primary and positive influence on conditions in the Eel River and Humboldt Bay HPAs. These are the only HPAs being considered in this EIS where PALCO has substantial ownership.

The USFS and/or BLM manage Federal lands in the Blue Creek and Smith River HPAs. Less than 7 percent of lands in the other HPAs are managed by either of these agencies. The resource management strategies on lands administered by the USFS and BLM include the continued implementation of guidelines contained in the NWFP for Federal lands. These strategies do not allow timber harvesting or activities in wide, fixed-width riparian buffers before a completed watershed analysis and no timber management in the Blue Creek HPA. These strategies are expected to result in improvements to geomorphology and the associated reduction in delivery of sediment within HPAs where the USFS/BLM administers public lands. Current protections for and benefits to geomorphology in those HPAs where Federal agencies are the predominant land managers would be expected to continue into the future.

Benefits associated with resource management on lands administered by the State of California and the National Park Service are most important in the Redwood Creek and Smith River HPAs, where State and Federal park lands together comprise 41.8 percent and 15.9 percent of the total land ownership, respectively. Resource management strategies in parklands essentially allow no commercial timber harvesting. In addition, streamside and upslope activities that would affect water quality conditions are extremely limited. Therefore, park management practices are anticipated to result in improvements to geomorphology.

Current protections for and benefits to geomorphology in those HPAs where Federal agencies are the predominant land managers would be expected to continue into the future.

To estimate the relative changes in geomorphology-sediment-related cumulative effects associated with the alternatives, expected sediment delivery rates within the Primary Assessment Area (the 683,674 acres of Green Diamond and other private commercial timberlands within those portions of the 11 HPAs where Green Diamond operates or could operate in the future) have also been calculated. The estimates provided in Table 4.2-4 were "scaled up," from the AHCP/CCAA Table F3-8, to include the additional 267,000 acres of non-Green Diamond timberlands, and assume the rate/acre values to be same for both Green Diamond and the other private commercial timberlands. Although detailed information for the other timberlands is not available, these lands are sufficiently similar across the Primary Assessment Area to support extrapolation of results for Green Diamond's ownership. The results from this scale-up are presented in Table 4.2-4 are discussed under each to the following sediment source discussions.

TABLE 4.2-4
Total Expected Delivery Rates of Derived Sediment from Various Source Areas for All Private Timber Lands Within the Primary Assessment Area

	Roads (cy/yr)	RMZ	SSS	Headwall Swale	Deep-Seated Landslides	Not Protected	Total Hillslope (Except Roads)
Background rate	0	16,816	7,182	11,463	37,490	22,348	95,299
No-Action rate	127,587	21,674	14,364	28,655	40,134	44,695	149,522
Proposed Action rate	52,866	19,034	11,800	22,372	40,134	44,695	138,035

Notes:

Assumed that no acres have been added or subtracted from Green Diamond's ownership.

Same rate of failure as defined for the Green Diamond ownership for the additional 267,412 acres of private timberland.

4.2.7.1 Cumulative Impacts Associated with Mass Wasting

Currently the rate of mass wasting-hillslope failure is estimated to be between 1.25 to 4 times more than Background (AHCP/CCAA Appendix F 1.2.1.5.1). Under the No Action Alternative, undesirable effects on geology and soils would be reduced by Green Diamond's compliance with State regulations that direct the review of some THP areas by a California Professional Geologist or Certified Engineering Geologist before timber operation, BMPs that guide management planning; road construction, use, and management; restoration of disturbed areas; harvest intensity and extent; silviculture for forest health; and range management. As noted in Section 1.5.3.1, continued implementation of the CFPRs on non-Green Diamond commercial timberlands within the 11 HPAs may not necessarily minimize potential impacts of activities that could otherwise result in hillslope mass wasting and sediment delivery.

The Proposed Action and the other Action alternatives are expected to result in incremental reductions in hillslope mass wasting sediment delivery compared to the No Action Alternative. However, a comparison of the "pre-plan or No Action Alternative," and the "Proposed Plan" sediment delivery rates from Hillslope Mass Wasting, for all the HPA private timberlands, shows that the differences between the No Action and the Proposed Action sediment delivery rate for mass wasting are not significant (Table 4.2-4). The difference between the No Action sediment delivery rate and Proposed Action is 9,110 cubic yards annually with a total of 130,505 cubic yards being delivered (including 95,298 cubic yards of "background "sediment delivery). In addition, sediment production is expected to continue to occur well into the future, especially from natural sources and existing non-Green Diamond roads that are not maintained to current Green Diamond BMP standards for forest roads and other upland activities.

4.2.7.2 Cumulative Impacts Associated with Bank Stability

Quantitative estimates of current erosion associated with the loss of bank stability are very speculative. However, qualitative data from Green Diamond's retrospective Class III channel study, described in AHCP/CCAA Appendix C4, suggest that among 100 channels surveyed, including 107 sample sites, 57 percent of the sites had no recognizable bank

erosion. Under the No Action alternative, bank stability is expected to increase for all private timber lands within the HPAs due to continued implementation of the CFPRs sections for Threatened and Impaired (T&I) watersheds.

The effect of implementing the Proposed Action and Action Alternatives A and C would be similar to the No Action Alternative. Alternative B, with its wide no-road and no-cut riparian stream buffers, would result in the greatest improvement of bank stability. All of the alternatives provide only incremental improvements over the current existing conditions, but are comparable to those that would occur under the No Action alternative.

4.2.7.3 Cumulative Impacts Associated with Surface Erosion (Non-Road)

Overall, any change in surface erosion sediment delivery (positive or negative) is not expected to result in a significant reduction in contribution to overall watershed sediment budgets given the small role harvest-related surface erosion plays (i.e., 4 to 5 percent of the total budget) (AHCP/CCAA Section 5.3.2, p.5-7).

Effects from harvest-related surface erosion with the implementation of the Proposed Action, which includes limitations on ground-based yarding or mechanized site preparation during the wet weather period, will be reduced compared to the No Action alternative. Effects to Surface Erosion with the implementation of Alternatives A and C would have the same cumulative impact as the Proposed Action. Alternative B's larger RMZ widths would result in improved filter strip properties and result in reduced sediment delivery relative to the Proposed Action. This reduction however may be partially or completely offset by loss of the Proposed Action's ground-based yarding and mechanized site preparation limitations during the wet weather period.

4.2.7.4 Cumulative Effects Associated with Road-Related Sediment Delivery

Surface Erosion. The current road density on Green Diamond's ownership in the 11 HPAs, averages 5.7 mi/sq mi [AHCP/CCAA Table 6-10]. Current road density on other private timberlands in the 11 HPAs is assumed to be equal to Simpson's road densities. The existing road network is comprised of both legacy roads and roads built with modern construction and design. The estimated proportion of the road network that is hydrologically connected (i.e., capable of direct delivery of water born sediment) averages 33 percent in the 11 HPAs (AHCP/CCAA Appendix F2, Table F2-6).

Implementation of the No Action Alternative is expected to reduce road-related surface erosion compared to existing conditions due to employment of Green Diamond's BMPs and treatment of road sediment sources, which use a formal assessment methodology. Implementation of Alternative B would have the same result as the No Action alternative. Under the Proposed Action there will be a greater overall reduction in road-related surface erosion compared to the No Action alternative or Alternative B due to the accelerated road program (EIS 4.3.3.3), and an anticipated decrease in hydrologically connected roads, from 33 percent to 7 percent (AHCP/CCAA Appendix F-2, Table F2-6). The effects of implementation of Alternatives A and C are generally expected to be the same as the Proposed Action. Alternative B would result in incrementally lesser reduction of road-related sediment than the Proposed Action due to its reduced treatment of high- and moderate-risk sites.

Road-Related Mass Wasting. Utilizing the rate for annual road-related mass wasting from Appendix F, Table F3-8 of AHCP/CCAA, and adjusting it for the additional private timberlands included in the HPAs, the estimated delivery for road-related mass wasting for the all the timberlands in the 11 HPAs is 74,228 cubic yards annually in the No Action alternative. Implementation of the No Action alternative and Alternative B assumes that there will be a reduction in future road failures due to repairs made on a THP-by-THP basis (AHCP/CCAA Appendix F3, Table F3-12).

Road-related mass wasting and associated cumulative effects under the Proposed Action will decrease significantly compared to the No Action alternative (Table 4.2-4 and AHCP/CCAA, App F3, Table F3-12). Alternative A effects would be equivalent to the Proposed Action's. Alternative C would result in less road related mass wasting than the No Action Alternative, but incrementally more than the Proposed Action due to a reduction in the amount of sediment treated at high- and moderate- risk sites per unit area.

All Road Sediment. Figure F3-2 of the Plan illustrates the annual sediment delivery rates that would occur under the Plan, without the Plan (the No Action Alternative), and if Green Diamond were to cease doing business; the relative difference between the curves in this figure reflect the relative savings in sediment between the three scenarios. Under the Plan, the annual sediment contributions from management declines significantly more rapidly and significantly more overall than under the No Action Alternative and no business scenario (no Green Diamond operations), primarily due to the accelerated road repair and decommissioning program.

Under the No Action Alternative, Green Diamond would stabilize an estimated 82,000 cubic yards of sediment associated with problematic legacy road sites each year for the next 15 years. This scenario stabilizes 19 percent of the total cubic yards of such sites, as compared with the 48 percent of the total that would be stabilized under Proposed Action, based on the current estimate of 6,436,000 cubic yards of sediment requiring treatment (see Figure 4.2-1). Under the Proposed Action, approximately 204,000 cubic yards of sediment would be stabilized. This represents a 250 percent improvement over the No Action scenario (AHCP/CCAA Appendix F3, § F3.5; Table F3-10). The No Action and Proposed Action alternatives also have different results over the 50-year term of the Permits, and the differences grow larger as time passes. For example, in year 30, the sediment delivery rate is 174 percent greater under the No Action Alternative than with Plan implementation (23,627 cubic yards per year as compared to 8,635 cubic yards per year). (See AHCP/CCAA Appendix F3, § F3.5.)

4.2.7.5 Cumulative Effects Associated with Sediment Filtration

There is a lack of information on the role the current riparian protection measures have in providing sediment filtration within the 11 HPAs, but they are assumed to be recovering from past management practices which allowed substantial harvesting in these areas. Prior to 1973, harvest in RMZs was no different than in upslope areas (Section 3.4.5.2). The No Action alternative conservation measures are expected to result in a trend towards a reduction of management-related sediment delivery from within WLPZs along Class I and II watercourses. (Section 4.4.2.2). The implementation of the Proposed Action, Alternative A, or Alternative C would result in increased sediment filtration compared to the No Action Alternative based on the longer and more protective Class II RMZs and the application of

RSMZ and SMZ measures, but this increased filtration is not considered to be significant. (Sections 4.4.3.2 and 4.4.6). Alternative B will increase sediment filtration more than the other Action Alternatives because it would implement wider, non-managed RMZ buffers (Section 4.4.5.2).

In addition, the other actions in this cumulative assessment (i.e., the three predominant conservation or management strategies listed below and described in Section 4.1.2.3) would also result in incremental improvements during the term of the Permits, cumulative impacts to geology and geomorphology resulting from implementation of these other actions would not occur.

4.2.7.6 Cumulative Impacts Summary

Overall, the cumulative effect of implementing all of these resource management programs on erosion and sediment control under the Proposed Action (and other action alternatives) would be an improvement of aquatic resources and riparian habitat conditions relative to existing conditions and the No Action Alternative in each of the 11 HPAs over time. The overall cumulative benefits to geomorphology are expected to be slightly greater under the Proposed Action and Alternatives A and C than under Alternative B, because of differences (or, in some cases, absences) in a broad range of enhanced forest management practices and an adaptive management monitoring program with structured feedback mechanisms. The sediment control benefits associated with implementation of the Road Management Plan and the accelerated road sediment site repair, under the Proposed Action, or Alternative A and C provide shadowing reduction in cumulative sediment delivery compared to all the other sediment conservation measures combined. Therefore, the road plan and the accelerated road repair provide the greatest benefit to the covered species. Negative adverse conditions resulting from on-going and past land management activities are expected to continue throughout the term of the Permits. However, the benefits of implementing the Proposed Action are expected to incrementally reduce these adverse conditions both early in the AHCP/CCAA implementation and over the life of the Permits.

4.3 Hydrology and Water Quality

The purpose of this section is to evaluate the impacts of expected changes in watershed characteristics on hydrology and water quality of the associated streams within the Primary Assessment Area as a result of implementing the Proposed Action and other alternatives. As described in Section 3.3, Hydrology and Water Quality, the primary water quality parameters of concern for the evaluation of project impacts are suspended sediment, turbidity, and water temperature.

Presented below is an overview of the general types of hydrologic and water quality impacts than can occur in forested areas. This overview is followed (in Sections 4.3.2 through 4.3.6) by an assessment of the AHCP/CCAA conservation measures (and the alternatives, including the No Action Alternative) on hydrologic and water quality conditions in the Action Area. Section 4.3.8 presents the cumulative impacts assessment for hydrology and water quality.

Studies show that increases in summertime stream temperatures can adversely affect the covered species by reducing growth efficiency, increasing disease susceptibility, changing the age of smoltification, causing loss of rearing habitat, and shifting the competitive

advantage of salmonids over non-salmonid species. In contrast, decreases in water temperatures are beneficial to aquatic resources (see Sections 3.3.5 and 3.4.2.2). Stream temperatures can be affected by direct shading, reduced surface and groundwater flows and sediment disposition. Stream temperatures can affect the survival and/or reproduction of both salmonids and amphibians.

Hydrology in forested areas can be affected by peak flows during storm events that can cause scour, alter channel morphology, and cause flooding. Alteration of snow pack, enhancement of runoff throughout timber harvest units or along roads, interception of groundwater flows by roads, and alteration of evapotranspiration through changes in forest structure all have the potential to affect Primary Assessment Area hydrology (Beschta et al., 1995; Ziemer, 1998). In particular, snow buildup in logged areas above 2,000 feet elevation and subsequent melting during rainstorms (known as rain-on-snow events) results in enhanced flows and increased potential for erosion (Christner and Harr, 1982; Harr, 1986). Summer base flows could increase in logged versus unlogged areas in the short term and return to pre-harvest conditions within a few years (Ziemer et al., 1996). Excessive sediment input can fill pools, eliminate spawning gravels, decrease channel stability, increase nutrient and contaminant loads, and modify overall channel morphology. Sediment input is important in directly affecting fish and fish spawning success but is also useful as a surrogate for changes in concentrations of sediment-associated contaminants (primarily metals and many pesticides) (Lee et al., 1997) and nutrient input.

Stream temperatures can be affected by changes to direct shading, reduced surface and groundwater flows, and sediment deposition (MacDonald et al., 1991). Stream temperatures can affect the survival and/or reproduction of native salmonids and amphibians; streams can lose fish populations from increased water temperatures attributable to timber harvesting activities (Henjum et al., 1994).

Green Diamond has conducted pre- and post-harvest temperature measurements. Average weekly temperatures have been described for a number of Primary Assessment Area streams (see Section 3.3). Green Diamond's studies of temperatures in harvested and unharvested watersheds, before and after treatment, indicate either increased or decreased average temperatures as a result of timber harvesting (see Appendix C-5.2 of the AHCP/CCAA). The study results indicate that timber harvesting has no consistent effect on stream temperatures for the monitored watersheds.

Potential impacts to hydrology and water quality are assessed in this EIS over broad geographic areas rather than for individual project features. This evaluation focuses on impacts to watersheds through changes in flow, water temperature, and sediment inputs.

4.3.1 Methodology

Methods to evaluate the significance of the alternatives to Primary Assessment Area hydrology and water quality are those qualitative and quantitative techniques used in evaluating: (1) changes in peak and low (base) flows, (2) changes in slope stability and soil delivery to the streams (see Section 4.2, Geology, Geomorphology, and Mineral Resources), and (3) changes in riparian vegetation and shading (Section 4.4, Aquatic Resources). Those evaluations are used to assess relative changes in hydrology, sediment delivery, and water temperature, respectively.

Changes in stream hydrology and water quality would be significant: (1) if they result in increased flooding conditions or scouring, or (2) if they produce degraded water quality conditions that exceed water quality guidelines or criteria (such as Basin Plan limits). Whenever possible, quantitative water quality assessments are estimated. It is important to note, however, that determinants of water quality, such as relative rates of erosion or stream shading, do not lend themselves to precise numeric estimates of changes in sediment loading or the temperature regime. Instead, relative changes are based on the overall extent of change comparing conditions expected to occur over time under the No Action Alternative with current conditions, or by comparing conditions expected over time under the other alternatives with those conditions expected over time under the No Action Alternative.

4.3.2 No Action Alternative

Under the No Action Alternative, Green Diamond would continue to conduct timber harvesting and related operations in the Action Area in accordance with the measures described in Section 2.1 of this EIS. Hydrologic and water quality conditions are generally expected to improve over time throughout the Primary Assessment Area compared with existing conditions. Specific changes anticipated to occur over time under the No Action Alternative are presented below.

As noted in Section 1.5.3.1, continued implementation of the CFPRs on non-Green Diamond commercial timberlands within the 11 HPAs may not avoid or minimize the potential to adversely impact hydrologic and water quality conditions. However, adherence to the CFPRs within specific locals, land ownerships, or regions may achieve such avoidance or minimization.

4.3.2.1 Hydrology

The primary effects of timber harvesting on hydrology pertain to peak flows, low (base) flows, water yield, and run-off timing (Spence et al., 1996). In rain-dominated systems in the Coast Range, increases in peak flows, water yield, and summer flows have been observed following timber harvesting activities. The effect of timber harvesting on peak flows generally diminishes with increasing watershed size and with increasing flow magnitude (Beschta et al., 2000; Ziemer, 1998). Increases in summer flows generally diminish after a few years.

Under the No Action Alternative, Green Diamond would continue to implement current road management practices that would result in the decommissioning of a number of roads and improvements in the design and drainage of existing roads associated with individual THPs. Through the road upgrading and decommissioning program, it is anticipated that 67 percent of the road network would be hydrologically disconnected from area watercourses under the No Action Alternative (AHCP/CCAA Appendix F2, Table F2-6). The continued use of cross-drains, rolling dips, and outsloping, would reduce the amount of concentrated surface runoff at any point along the road surface. Water from inboard ditches would be dispersed onto the forest floor where it would infiltrate, reducing the potential effects on peak flows and sediment delivery associated with road network runoff relative to existing conditions.

Under the No Action Alternative, the Primary Assessment Area drainages could experience short-term localized adverse changes in the existing hydrologic conditions (i.e., magnitude and timing of naturally occurring peak and low flows) immediately after timber removal. Changes to channel morphology or the occurrence of bed scour and bank erosion as a result of management activities, however, are not anticipated to differ substantially under the No Action Alternative when compared with existing conditions.

4.3.2.2 Water Temperature

Under the No Action Alternative, stream shading is expected to improve over time in the Primary Assessment Area compared with current conditions. Current canopy closure requirements and tree retention standards are expected to help maintain stream shading in the critical "inner zone" where microclimate effects have the greatest potential to affect changes in water temperatures directly. Canopy closure would decline slightly after harvesting, but is anticipated to increase from current conditions in all stands as they re-grow after previous timber harvesting. Increased canopy closure could, therefore, result in slight decreases in water temperatures in Primary Assessment Area streams. (As discussed in Section 3.3.5 and 3.4.2.2, decreases in water temperature are generally beneficial to aquatic resources. See Section 4.4 for a discussion of impacts to aquatic resources.)

The reduced sediment delivery to streams expected under the No Action Alternative also has the potential to result in decreases in water temperature compared to current conditions. Turbidity, sediment deposition, and the incidence of shallower, wider channels can increase the amount of solar radiation retained in the water column, leading to increased water temperatures. This effect is usually associated with larger, low-gradient rivers where turbidity is higher and exposure to sunlight is prolonged. Streams within the Primary Assessment Area are usually exposed to short-term, high-turbidity events only during snowmelt and rain events, few of which occur during the period of highest temperatures. (As discussed in Section 3.3.5 and 3.4.2.2, decreases in water temperature are generally beneficial to aquatic resources. See Section 4.4 for a discussion of impacts to aquatic resources.)

4.3.2.3 Sediment Control

Although sediment delivered to streams can originate outside of the riparian zone, maintenance of riparian buffers aids in the filtration of overland sediment flow and helps to minimize direct sediment inputs from the riparian zone. Exclusion of heavy equipment and mechanical site preparation from Class I and II WLPZs and limits on heavy equipment use in Class III ELZs are anticipated to minimize ground disturbance that currently affects areas adjacent to Primary Assessment Area watercourses. Treating management-related bare soil exposures in excess of 100 square feet also will reduce the potential for management-related sediment delivery from within the WLPZs along Class I and Class II watercourses. See Section 4.2, Geology, Geomorphology and Mineral Resources, for a more comprehensive discussion of potential impacts associated with erosion and sediment delivery.

Under the No Action Alternative, road-related sediment delivery would be reduced primarily through continued implementation of Green Diamond's practices as described in Section 2.1.1.3, that include employment by Green Diamond of best management practices (BMPs) based on techniques described in Weaver and Hagans (1994), and treatment of road

sediment delivery sites prioritized using a formal assessment methodology. Generally, roads would be upgraded to meet current standards when they are used to gain access to and haul logs from individual THP units. Therefore, under this alternative, high- and moderate-risk sediment delivery sites on the entire ownership would only be addressed on a THP-by-THP basis rather than under an accelerated program as described under the Proposed Action. This approach, however, would still result in substantial reduction of sediment delivery over existing conditions and over the next 50 years. Although Green Diamond would continue to build new roads to gain access to and manage its lands, continued application of Green Diamond's practices as described in Section 2.1.1.3 would still be expected to result in a trend towards a reduction in road-related mass wasting, surface erosion, and sediment delivery over time throughout the Primary Assessment Area. Accordingly, under the No Action Alternative, in-stream and riparian habitat conditions affected by sediment delivery are also generally expected to result in a trend towards improved conditions compared to existing conditions.

In addition, Primary Assessment Area streams generally have low levels of LWD that is small in size (< 2 feet in diameter) as a result of past management within stream channels and adjacent riparian areas. The canopy closure requirements and tree retention measures described as part of the No Action Alternative would likely contribute to increased LWD size in the future. The presence of LWD in stream channels also aids in pool formation and sediment storage and sorting. Therefore, compared to existing conditions, increases in LWD recruitment and the volume of LWD may improve aquatic habitat and stream substrate conditions in the Primary Assessment Area over the AHCP/CCAA term and the term of the Permits.

As discussed above, it is expected that that Green Diamond's practices would be expected to result in a reduction in sediment delivery to watercourses and an increase in LWD recruitment over time under the No Action Alternative. It is also anticipated, therefore, that suspended sediment levels, turbidity, nutrient and contaminant loading would also decrease under the No Action Alternative compared to existing conditions.

4.3.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting in the Action Area in accordance with existing regulations and management guidelines. In addition, the measures currently used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's AHCP/CCAA Operating Conservation Program, which includes establishment of riparian management zones (RMZs) and equipment exclusion zones (EEZs). Green Diamond also would implement the ownership-wide mitigation, management, and monitoring measures in accordance with the AHCP/CCAA. These measures, which are described in the AHCP/CCAA and summarized in this EIS in Chapter 2, Proposed Action and Alternatives, include:

- Implementation of an ownership-wide Road Management Plan that provides for: selective and road-related fish passage enhancement (barrier removal); implementation of practices that are designed to minimize sediment discharge to Class I, II, and III streams; and decommissioning of some roads. The Road Management Plan provides for accelerated repair (over a 15-year period) of high- and moderate-risk sediment delivery

sites on roads on Green Diamond fee ownership in accordance with the schedule established in the AHCP/CCAA.

- Protection of unique geomorphic features, such as channel migration zones and floodplains.
- Adoption of various slope stability and ground disturbance conservation measures.
- Implementation of effectiveness monitoring, plus adaptive management with structured feedback loops.

Overall, the conservation measures contained in the Proposed Action would not result in significant adverse changes to hydrological conditions and would result in improvements in water quality conditions relative to the No Action Alternative. The conservation measures would reduce harvest- and road-related sediment production and delivery to Primary Assessment Area streams and reduce water temperature and improve other water quality conditions (i.e., sediment) for the covered species. Monitoring and adaptive management activities would provide additional flexibility and a mechanism for changing or revising the AHCP/CCAA prescriptions, if needed, based on their demonstrated effectiveness and other new information.

4.3.3.1 Hydrology

In general, harvest-related ground disturbance can cause soil compaction and result in reduced infiltration capacity of soils and altered subsurface water movement, leading to increased surface runoff. Under the Proposed Action, establishing EEZs would result in a reduction in Primary Assessment Area locations potentially exposed to soil compaction from use of heavy equipment. In addition, for those areas in which heavy equipment would be used, site preparation measures (including seasonal operating limitations for tractors, skidders, and forwarders, and minimized use of tractor and-brushrake piling) would result in reduced potential for ground compaction related to covered activities compared with what occurs under current conditions, or what is anticipated to occur over time under the No Action Alternative. These harvest-related ground disturbance prevention/conservation measures are expected to reduce: (1) adverse impacts of operations-related alterations in hydrology (by minimizing soil compaction that can increase the magnitude of peak flows) and (2) the volume of sediment available for runoff during peak flow events.

In relation to current conditions and the conditions expected to occur under the No Action Alternative, the slope stability conservation measures in the Proposed Action (AHCP/CCAA Section 6.2.2) have the potential to result in a greater reduction in sediment delivery from steep streamside slopes and unstable areas by avoiding new road construction or substantial upgrades of existing roads on these features. In addition, tree retention in these and other potentially unstable areas would preserve some level of rainfall interception and evapotranspiration in comparison to the No Action Alternative.

The riparian conservation measures under the Proposed Action would maintain in-channel LWD and provide increased potential for LWD recruitment compared with existing conditions or conditions expected to occur over time under the No Action Alternative. The presence of LWD in stream channels aids in pool formation, and sediment storage and sorting. Therefore, compared to current conditions or conditions expected to occur under

the No Action Alternative, increased LWD recruitment and the volume of LWD are expected to improve aquatic habitat and stream substrate conditions in the Primary Assessment Area over the term of the Permits.

The conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.1) are anticipated to minimize the potential impacts that could otherwise result from altered hydrology in the Primary Assessment Area. They would reduce the impacts of forest management on surface runoff and peak flows, reduce soil compaction and disturbance, and maintain or enhance in-channel LWD. Adverse impacts to hydrology and water quality that would occur would be minimized by the improved riparian conditions resulting from riparian management and decreased sediment production and delivery, as described below.

4.3.3.2 Water Temperature

The Proposed Action's overstory canopy closure requirements and tree retention standards are more protective overall than those that would be implemented under the No Action Alternative, particularly in Class II watercourses (see Section AHCP/CCAA 6.2.1 and Chapter 2 of this EIS for a description of these measures). Implementation of Proposed Action measures would help to maintain stream shading in the critical "inner zone" where microclimate effects are anticipated to have the greatest potential to affect water temperatures. Although the inner zone width along Class I watercourses is slightly less under the Proposed Action (50 to 70 feet) than under the No Action Alternative (75 feet), Class II RMZs under the Proposed Action are wider than under the No Action Alternative (75 to 100 feet compared to 50 to 75 feet), and require greater overstory canopy retention (70 percent compared to 50 percent). Overall, overstory canopy closure, while expected to slightly decrease in the short term following harvesting under all the alternatives except Alternative B (because no harvesting would be allowed), is likely to increase relative to current conditions in all stands as they regenerate following timber harvesting. The overall increase in overstory canopy closure is anticipated to result in slight decreases in water temperatures in Primary Assessment Area streams. (As discussed in Sections 3.3.5 and 3.4.2.2, decreases in water temperature are generally beneficial to aquatic resources. See Section 4.4 for a discussion of impacts to aquatic resources.)

Although the sample size is small, Green Diamond has direct experimental data to support the conclusion that the slight decrease in overstory canopy closure following harvest that could potentially occur under the Proposed Action (and other alternatives except Alternative B) would not result in significant impacts on water temperature. Using a before-after-control-impact (BACI) experimental design, Green Diamond assessed the influence of even-aged timber harvesting on water temperature in small Class II watercourses where the influence of overstory canopy reduction has the greatest potential to impact water temperature (see Appendix C-5.2 of the AHCP/CCAA, Class II Paired Watershed Temperature Monitoring). Two of the treated streams showed minor increases (ranging from 0.5 to 1.0°C) in water temperature within the limits of the harvest unit relative to the controls during the warmest time of day in the warmest 14-day period of the summer. Two of the treated streams showed minor decreases (ranging from 1.3 to 1.4°C) in water temperature. These decreases likely resulted from increased ground water inputs following harvesting of the adjacent stand.

On the basis of the minimal changes in temperature (both positive and negative) under the most extreme annual conditions, a measurable increase in water temperature in Class I or larger Class II streams caused by minor reductions in overstory canopy closure following timber harvesting is not anticipated. Any increase in water temperature that might occur is expected to be slight and less than significant, and over the term of the Permits, stream temperatures are expected to be maintained or improved compared with existing conditions and with conditions expected to occur over time under the No Action Alternative.

Reduced sediment delivery to streams under the Proposed Action, relative to the No Action Alternative and current conditions, also could indirectly contribute to minor decreases in water temperature. Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel morphology such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998). With the slope stability and road management measures designed to minimize management-related sediment inputs, sediment production and delivery would be reduced relative to existing conditions and conditions under the No Action Alternative. Given that water temperatures generally meet or exceed RWQCB Basin Standards (see Section 3.3.5), and are generally favorable for the covered aquatic species throughout the Primary Assessment Area even with past sediment inputs (see AHCP/CCAA Appendix C-5), reduced sedimentation under the Proposed Action would reduce the likelihood that aggradation of channels would result in elevated water temperatures.

4.3.3.3 Sediment Control

Under the Proposed Action, sediment production and delivery that could result in increased sediment loading, sedimentation, and turbidity levels would be reduced compared with both existing conditions and conditions anticipated to occur over time under the No Action Alternative. See Section 4.2, *Geology, Geomorphology and Mineral Resources,* for a more comprehensive discussion of potential impacts associated with erosion and sediment delivery. The Proposed Action identifies four primary sediment-input processes and proposes a number of specific prescriptions and conservation measures to minimize potentially adverse effects associated with these processes. The primary sediment-input processes are:

- Surface erosion
- Hillslope mass wasting
- Reduced bank stability
- Road-related sediment production

Although erosion does occur higher on hill slopes and within harvest units, the assessment of sediment production resulting from surface erosion focuses on slopes adjacent to watercourses because these are the areas with the greatest potential to deliver sediment to watercourses. As is the case for WLPZ management prescriptions contained in the No Action Alternative, RMZ management prescriptions under the Proposed Action include conservation measures designed to impede sediment delivery in areas where sediment would have relatively short transport distances to watercourses (AHCP/CCAA Section 6.2.1). These measures include increased overstory canopy retention standards within RMZs, limitations on equipment use, retention of trees likely to recruit as LWD, and retention of trees that contribute to maintaining bank stability. Implementing the retention standards is expected

to result in almost no loss in total forest canopy in the inner zone of RMZs along Class I and Class II watercourses, and is anticipated to increase overstory canopy along Class II watercourses relative to the No Action Alternative and existing conditions. This overstory canopy would impede grain detachment in these critical areas, where detached sediment would have relatively short transport distances to watercourses. On this basis, the measures associated with the Proposed Action are anticipated to result in reductions in sediment delivery compared to existing conditions as well as compared to the No Action Alternative.

Harvest-related ground disturbance conservation measures (AHCP/CCAA Section 6.2.4) focus on minimizing ground disturbance and exposure of bare mineral soil within harvest units. These measures include: (1) site-specific site preparation methods, (2) limited operating periods for the construction of skid trails and use of ground-based yarding equipment, (3) limiting use of ground-based yarding equipment that requires constructed skid roads to slopes less than or equal to 45 percent (with some exceptions), (4) preferential use of cable yarding systems, and (5) water-barring of cable corridors, where necessary. All of these ground disturbance conservation measures would minimize the potential for soil compaction and management related surface erosion within harvest units, throughout the term of the Permits.

Sediment production from hillslope mass wasting within the Primary Assessment Area is greatest in steep streamside slopes, headwall swales, and historically active deep-seated landslides (see Section 3.2.3.3, Landslide Classification and Landslide Prone-Terrain). Under the Proposed Action, these areas would be subject to default slope stability conservation measures intended to reduce landslide occurrences and associated sediment production (AHCP/CCAA Section 6.2.2). The Proposed Action would result in these sensitive areas receiving additional protection by establishing slope management zones (SMZs) upslope of the RMZ along Class I and Class II watercourses. The width of the SMZ would vary among the 11 HPAs, with wider more conservative SMZs identified for those HPAs with the potential deliver sediment from the longer locations from watercourses. Single tree selection harvest would be the most intensive silvicultural prescription allowed within the SMZ and no harvest would be allowed in the inner portion of the RMZ downslope of the SMZ (i.e., the RSMZ) along Class I and larger Class II watercourses. Timber harvesting would be prohibited within the entire RSMZ below SMZs in the Coastal Klamath and Blue Creek HPAs. In addition, no harvest would be allowed within the toe and 25 feet upslope from the top of the toe or scarp of historically active deep-seated landslides. Alternative prescriptions to the default slope stability measures may be developed through site-specific review by a California registered geoloigist.

Tree retention in the SMZs and associated RSMZs is expected to maintain a network of live roots that would provide soil cohesion and contribute to slope stability in these areas. Tree retention also is expected to help maintain forest canopy, which would preserve some measure of rainfall interception and evapotranspiration. Maintenance of rainfall interception and evapotranspiration is expected to contribute to slope stability conditions in some locations by minimizing the likelihood of high ground water ratios that are management related. Limited road construction and road reconstruction on unstable slopes and in RMZs would likely result in avoiding or reducing the undercutting and overburdening of sensitive hill slopes, helping to avoid unnatural concentration of storm runoff on these slopes. The implementation of SMZs (and the application of more

conservative SMZ prescriptions in HPAs more susceptible to hillslope mass wasting) would reduce impacts compared to the No Action Alternative because of reduced potential for sediment delivery to streams in the Primary Assessment Area. On this basis, the measures associated with the Proposed Action are anticipated to result in improvements over existing conditions as well as improvements in conditions expected to occur under the No Action Alternative.

Road-related erosion and hillslope mass wasting are known to be substantial contributors to the sediment budget in most managed watersheds. The Road Management Plan and associated conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.3) would reduce road-related sediment production and delivery to Primary Assessment Area watercourses relative to measures under the No Action Alternative and existing conditions. (See Section 4.2.3.4, Road Related Sediment Production.) The Road Management Plan provides for accelerated repair of high- and moderate-risk sediment delivery sites on roads on the Green Diamond fee ownership. The road-related conservation measures would reduce road-related sediment production and, therefore, result in benefits to Primary Assessment Area streams because of reduced potential for sediment delivery. In addition, the reduction in sediment production and delivery under the Proposed Action would be greater than the reduction anticipated under the No Action Alternative because the Proposed Action measures emphasize strategic identification and classification of roads targeted for improvement. Under this alternative, high- and moderate-risk sediment delivery sites in the Primary Assessment Area would be addressed using an accelerated program. (Under the No Action Alternative, high- and moderate-risk sediment delivery sites would not receive accelerated treatment.) Under the Proposed Action, therefore, the improvement in water quality is greater than what is expected to occur under the No Action Alternative.

Green Diamond has performed a general assessment of its ownership within the Action Area that identifies road-related sediment sources requiring treatment (e.g., stabilization of dirt or other remediation to prevent road-related, sediment-producing failures or hillslope mass wasting events). At the time the sediment model was run in 2002, Green Diamond estimated the volume of potential sediment associated with high- and moderate-risk sediment delivery sites (based on both the probability of delivery to watercourses and the sediment volume associated with such delivery) to be 6,436,000 cubic yards (see AHCP/CCAA Appendix F). Under the Proposed Action, Green Diamond's Road Management Plan is designed to provide treatment of all high- and moderate-risk sediment delivery sites over the term of the Permits, to minimize potential delivery of sediment to riparian and aquatic areas. In addition, in the AHCP/CCAA, Green Diamond commits to provide an average of $2.5 million per year for the first 15 years of the AHCP/CCAA (for a total of $37.5 million) to accelerate implementation of the treatments for the high- and moderate-risk sites. (The acceleration period would be adjusted following revision of the estimate of sediment yield from high- and moderate-risk sediment delivery sites at the end of the first five years following issuance of the Permits. The acceleration period and monetary commitment could be adjusted (upward or downward) by up to 1.5 years and $3.75 million depending on the revised estimate of sediment yield.)

On the basis of the current estimate of 6,436,000 cubic yards of sediment requiring treatment, the expenditure of $2.5 million per year for 15 years would result in 48 percent of

the overall volume being treated in the first 15 years of the Permits. (See AHCP/CCAA Appendix F). In contrast, under the No Action Alternative, the road-related treatments performed without the acceleration (approximately $1 million per year), 19 percent of the overall volume equating to 1,223,000 cubic yards would be removed during the first 15 years (see Figure 4.2-1). Implementation of the Road Management Plan under the Proposed Action would provide greater improvements to water quality than would result under the No Action Alternative by accelerating the reduction of sediment loading.

Based on inventories preformed on several streams on Green Diamond lands, in the Lower Klamath basin (Yurok assessments, 1997, 1998, 1999, 2000) and basin-wide assessment of Green Diamond partial ownership in the Redwood Creek Watershed (Redwood National and State Parks, 2003), which show that low-risk sediment delivery sites contain 6 to 20 percent additional sediment volume, an additional 1.3 million cubic yards of potentially deliverable sediment are currently contained in low priority road sites across the Action Area.

4.3.4 Alternative A

Because timber harvesting and forest management activities, as well as road management and riparian conservation measures, under Alternative A would be the same as under the Proposed Action, potential effects on hydrology and water quality within the Primary Assessment Area would be the same as described for the Proposed Action (see Section 4.3.2). Changes in hydrologic conditions under Alternative A would be comparable to those of the Proposed Action.

4.3.5 Alternative B

Under Alternative B, Green Diamond would continue to conduct timber harvesting on its property in accordance with existing regulations and management practices. Under Alternative B, existing measures implemented by Green Diamond to protect Class I, Class II, and Class III streams would be supplemented by a conservation strategy specific to this alternative. This strategy would include fixed riparian buffer widths within which no management or timber harvesting would occur adjacent to Class I and Class II streams, and establishment of ELZs along Class III streams. Green Diamond would not conduct accelerated treatment of high- and moderate-risk sediment delivery sites on the ownership, and would protect unique geomorphic features, such as channel migration zones (CMZs) and floodplains, as specified in the CFPRs. Slope stability and ground disturbance measures would only be applied through implementation of the CFPRs. Effectiveness monitoring would not be as extensive under Alternative B and would not be linked with adaptive management measures with structured feedback loops.

Overall, implementation of Alternative B is anticipated to result in improved water quality compared with existing conditions and with conditions anticipated to occur under the No Action Alternative. These improvements, however, would not be as great as those that would occur under the Proposed Action, primarily because of the lack of a property wide road management plan and the associated accelerated treatment of high- and moderate-risk sites and other measures. Enhanced riparian zone protection is also expected to result in additional improvement in water quality compared with existing conditions or improvements expected to occur over time under the No Action Alternative or the Proposed Action. Without implementation of an ownership-wide Road Management Plan, the

conservation measures contained in Alternative B are not expected to reduce road-related sediment production and delivery to Primary Assessment Area streams as greatly as would implementation of the Proposed Action, Alternative A, or Alternative C. Under Alternative B, impacts to hydrology would be the same as the Proposed Action and the No Action (i.e., no changes would occur to the hydrologic regime and, therefore, no impacts would occur).

4.3.5.1 Hydrology

Upslope management under Alternative B would be similar to that under the Proposed Action (and other action alternatives), and would not likely result in substantial changes, except possibly short-term localized effects to the existing hydrologic regime or in the magnitude and timing of naturally occurring peak and low flows in Primary Assessment Area drainages. Thus, as discussed under the Proposed Action, no significant impacts to channel morphology and incidence of bed scour and bank erosion would result from implementing Alternative B.

4.3.5.2 Water Temperature

The elimination of commercial harvest in the riparian buffers under Alternative B would help to maintain stream shading in the critical "inner zone" where microclimate effects would have the greatest potential to impact water temperatures directly. Canopy closure would likely increase from current conditions in some stands as they re-grow after previous timber harvesting. Increased canopy closure could, therefore, result in slightly decreased water temperatures in Primary Assessment Area streams. (As discussed in Sections 3.3.5 and 3.4.2.2, decreases in water temperature are generally beneficial to aquatic resources. See Section 4.4 for a discussion of impacts to aquatic resources.) The elimination of commercial entry into the riparian buffers during the term of the Permits, however, would help ensure that temperatures and microclimate would remain suitable during the term of the Permits. Implementation of the no-harvest riparian buffer zone could result in incremental benefits compared to the improvements expected to occur over time under the No Action Alternative.

Turbidity, sediment deposition, and the incidence of shallower, wider channels can potentially increase the amount of solar radiation retained in the water column, leading to increased water temperatures. This effect is usually associated with larger, low-gradient rivers where turbidity is higher and exposure to sunlight is prolonged. Streams within the Primary Assessment Area, however, are usually exposed to short-term, high-turbidity events only during snowmelt and rain events, few of which occur during the period of highest temperatures. The reduction in sediment delivery to streams under Alternative B also has the potential to contribute to minor decreases in water temperature. These decreases, however, would be less than those anticipated under the Proposed Action because the Road Management Plan (and its sediment reducing conservation measures) would not be implemented under Alternative B. (As discussed in Sections 3.3.5 and 3.4.2.2, decreases in water temperature are generally beneficial to aquatic resources. See Section 4.4 for a discussion of impacts to aquatic resources.)

4.3.5.3 Sediment Control

Sediment production and delivery to Primary Assessment Area streams under Alternative B would be comparable to levels anticipated to occur under the No Action Alternative (i.e., a

trend towards general reduction in sediment production and delivery over time). Similar to the No Action Alternative, sediment reduction would occur primarily as a result of implementing current forest road management and maintenance practices. Generally, however, roads would be upgraded to meet current standards when those roads are used to gain access to and haul logs from individual THPs. This approach involving continued implementation of Green Diamond's practices would result in a reduction of sediment delivery and in road-related hillslope mass wasting over the term of the Permits. This trend is expected to be similar to that resulting from the No Action Alternative and would lead to a gradual improvement in water quality conditions in the Primary Assessment Area compared with existing conditions.

4.3.6 Alternative C

General timber harvesting and forest management activities, as well as road management and riparian conservation measures, under Alternative C would essentially be the same as the Proposed Action.

Under Alternative C, adaptive management would provide a mechanism for strengthening or relaxing individual conservation measures in the rain-on-snow areas if monitoring indicates that a change is necessary. Overall, implementation of Alternative C is anticipated to result in improved water quality compared to existing conditions or to conditions anticipated to occur under the No Action Alternative. Green Diamond's commitment to provide an average of $2.5 million per year for the first 15 years of the Permits to accelerate implementation of treatments for high- and moderate-risk sediment delivery sites would be extended to include the additional 25,677-acre rain-on-snow areas under Alternative C. Because accelerated treatment of sites over the 15-year period would be spread over a larger area, potential benefits of this measure would be diluted relative to what would be expected to occur under the Proposed Action. Also, since the adaptive management "account" for the Proposed Action (AHCP/CCAA Section 6.2.6.3) would also apply to a larger area under Alternative C, the fully stocked acreage balance in the account would likewise be diluted relative to what would be expected to occur under the Proposed Action. Implementation of Alternative C, therefore, would result in water quality conditions that are the same or slightly less beneficial than conditions under the Proposed Action.

Under Alternative C, impacts to hydrology would be the same as or less than the No Action Alternative, but more than expected level of impacts under the Proposed Action.

4.3.7 Cumulative Impacts – Hydrology and Water Quality

The assessment of potential cumulative impacts on hydrology and water quality in this EIS was conducted using the approach described in Section 4.1.2, Cumulative Impacts. The assessment area for cumulative impacts consists of the 11 HPAs that contain Action Area lands owned by Green Diamond and covered in its proposed AHCP/CCAA, as well as other lands that are predominantly either privately owned, administered by a federal-resource management agency, or State or Federal park lands.

Conservation measures associated with the PALCO HCP exceed the CFPR standards and are designed to protect hydrology and water quality using various prescriptions directed at riparian management, road management, controlling sediment delivery, and exclusion

areas. The beneficial effects of the PALCO HCP on hydrology and water quality would have a primary and positive influence on habitat conditions in the Eel River and Humboldt Bay HPAs. These are the only HPAs being considered in this EIS where PALCO has significant ownership.

The USFS and/or BLM also manage federal lands in the Blue Creek and Smith River HPAs. Less than 7 percent of lands in the other HPAs are managed by either of these agencies. The resource management strategies on lands administered by the USFS and BLM include the continued implementation of aquatic and riparian resource guidelines contained in the NWFP for federal lands. These strategies generally do not allow timber harvesting or activities in relatively wide, fixed-width riparian buffers before a completed watershed analysis, and are expected to result in incremental improved hydrology and water quality conditions within HPAs where the USFS/BLM administer public lands. Current protections for and benefits to hydrology and water quality conditions in those HPAs where federal agencies are the predominant land managers would be expected to continue into the future.

Benefits associated with resource management on lands administered by the State of California and the National Park Service are most significant in the Redwood Creek and Smith River HPAs, where State and Federal parklands together comprise 41.8 percent and 15.9 percent of the total land ownership, respectively. Resource management strategies in parklands essentially allow no commercial timber harvesting. In addition, streamside and upslope activities that would affect water quality conditions are extremely limited. Therefore, park management practices are anticipated to result in improvements to hydrology and water quality.

4.3.7.1 Cumulative Effects and Hydrologic Conditions

Past timber management within the 11 HPAs has affected peak flows, water temperatures, and sedimentation of streams. Changes in peak flows (timing and intensities) have resulted in additional water runoff throughout timber harvest units or along roads, the interception of groundwater flows by roads, and alteration of evapotranspiration through changes in forest structure. The normal hydrologic cycles for some of the HPAs have also been modified by dams, water diversions, development, and agriculture (See Section 3.3.2, Watershed Characteristics). These activities have resulted in adverse environmental conditions in some locations including insufficient stream flows, and have resulted in instances of increases in stream temperatures, stranded juvenile entrainment, and alterations to aquatic habitat (see Section 3.4.2.4).

Existing adverse conditions related to the hydrologic cycle are expected to improve under the No Action Alternative although recovery will not be complete given the continuation of impacts described above. Implementation of the Proposed Action will result in an incrementally greater improvement in conditions compared to the No Action Alternative, but impacts are not likely to be eliminated. The most important measures will address road upgrading and decommissioning programs that would hydrologically disconnect the road network from area watercourses on a THP-by-THP basis (see AHCP/CCAA Section 6.2.3). However, incremental short-term and localized increases in the peak flows will likely occur in association with timber harvesting.

The Proposed Action, Alternative A, and Alternative C are expected to incrementally reduce the magnitude of peak flows in all of the HPAs compared to the No Action Alternative. However, the level of reduced impacts may not be significant.

The levels of impact associated with Alternative B are expected to be approximately the same as the other Alternatives. Although Alternative B proposes wider, no harvest buffers on Class I and Class II streams, upslope management would be similar.

4.3.7.2 Cumulative Effects and Stream Water Temperatures

All streams in the 11 HPAs generally have good water temperatures for salmonids (375 of 400 Class I temperature records were at or below 17.4EC (AHCP/CCAA Appendix C5.1). Temperature has not been identified as a limiting factor for the aquatic covered species and their habitats (AHCP/CCAA Table 7-1, and individual HPA Assessment Summaries contained in AHCP/CCAA Section 4.4; e.g. Sections 4.4.1.9, 4.4.2.9, 4.4.8.9, 4.4.2.6.1, 4.4.4.6.1 and 4.4.7.6.1). Appendix C1 of the AHCP/CCAA, Section C1.3.1 describes canopy closure for 58 streams as ranging from 36 percent in Terwer Creek (in the Coastal Klamath HPA) to 99 percent in the Upper South Fork of the Little River (in the Little River HPA). The California Department of Fish & Game's Salmonid Restoration Manual recommends that a mean canopy closure of approximately 80 percent is desirable to maintain suitable summer water temperatures for juvenile Coho salmon. Sixty-nine percent of the streams assessed had mean canopy closures equal to or greater than 80 percent.

Under the No Action Alternative, stream shading is expected to improve over time and in-stream conditions associated with sediment delivery are expected to trend toward improved conditions as compared with existing conditions. Slight decreases in water temperatures from the improved stream shading, canopy closure requirements, and tree retention standards are expected.

Although there are slight differences in riparian buffers compared to the No Action Alternative, the canopy closure requirements, tree retention standards, and limitations on equipment use in the RMZs under the Proposed Action are more protective than those that would be implemented under the No Action Alternative. In addition, timber harvest within the RMZ is limited to a single entry during the term of the Permits, except where cable corridors are necessary to conduct intermediate treatments (see AHCP/CCAA Section 6.2.1). This will help to maintain stream shading overall in the critical inner zone where microclimate effects are anticipated to have the greatest potential to affect water temperatures.

As discussed in section 4.2, the Proposed Action, Alternative A, and Alternative C's Slope Stability and Road Management Measures will reduce sediment inputs and the likelihood that aggradation of channels could result in elevated water temperatures as compared with the No Action Alternative. Stream shading would likely improve over time to a greater degree under the Proposed Action, contributing to slight decreases in water temperatures.

Under Alternate B, stream temperatures also would decrease compared to the No Action Alternative as a result of wider, no-harvest riparian buffers and reduction in sediment delivery. However, the reduction in sediment delivery and decrease in water temperature is expected to be less than are expected to occur under the Proposed Action due the Road Management Plan that would not be implemented under this alternative.

4.3.7.3 Cumulative Effects Sediment and Water Quality

Several of the larger watercourses in the 11 HPAs are listed as water quality impaired under Section 303(d) of the CWA (see Table 3.3-2). In many cases, the listed cause of impairment is excessive sedimentation of streams. Although there is limited turbidity data available, the Daily Mean Turbidity for the mainstem Klamath, Smith and Eel rivers are presented in Table 3.3-3. Adverse existing conditions relating to excessive sediment have resulted from past activities and include stream channel aggradation, pool filling, and cementation of bed substrate. It is assumed that during past sediment loading activities, turbidity levels were above the desired levels.

Implementation of the No Action Alternative is expected to decrease sediment delivery to HPA streams compared to current conditions. Therefore, suspended sediment levels and turbidity would decrease relative to current conditions (Section 4.2). As discussed in Section 4.2, the Road Management Measures under the Proposed Action, Alternative A and Alternative C will reduce sediment inputs as compared with the No Action Alternative. These sediment minimization measures will further reduce the likelihood that aggradation of channels could result in elevated water temperatures. Alternative B would provide for greater improvements in water quality than the No Action Alternative, primarily from increased filtration strips associated with wider riparian buffers.

4.3.7.4 Cumulative Effects Summary

Under the No Action Alternative, adverse existing conditions associated with changes in hydrologic conditions are expected to improve. This improvement would result from the decommissioning of a number of roads and improving the design and drainage of existing roads. Such improvements will include reducing the length of hydrologically connected inboard ditches that drain and deliver water-borne sediment directly into watercourses, by routing ditch flow onto stable forest floor locations where it can be disbursed and infiltrate, having less impact on peak flows (Sections 4.3.2.1 and 4.4.2.1; AHCP/CCAA Section 5.2).

Overall, implementation of the comprehensive prescriptive measures contained in the Proposed Action's Operating Conservation Program (e.g., establishment of riparian management zones (RMZs) and equipment exclusion zones (EEZs), and increased canopy closure and tree retention within the RMZs) would result in improved water quality conditions, as discussed in Sections 4.3.2 through 4.3.6. Hydrologic conditions associated with the Proposed Action and other action alternatives are not anticipated to significantly change compared with existing conditions or the conditions expected to occur under the No Action Alternative.

Because Alternatives A and C incorporate conservation measures that are the same or similar to the Proposed Action, implementation of these alternatives is also anticipated to result in improvements to hydrographic and water quality conditions when compared to the No Action Alternative.

Implementation of Alternative B is also anticipated to result in generally improved hydrographic and water quality conditions compared to those anticipated to occur under the No Action Alternative, although the improvements would not be as great as those that would occur under the Proposed Action, Alternative A, or Alternative C. Under Alternative B, stream temperatures would decrease compared to the No Action Alternative

as a result of wider, no-harvest riparian buffers and a reduction in sediment delivery. Although Alternative B proposes wider, no-harvest buffers on Class I and Class II streams compared to the Proposed Action, upslope management would be similar. Alternative B would provide for greater improvements in water quality than the No Action Alternative, primarily from increased filtration resulting from wider riparian buffers.

4.4 Aquatic Resources

This section addresses the potential for impacts to aquatic resources in the Primary Assessment Area as a result of implementing the Proposed Action and other alternatives, including the No Action Alternative. The following discussion assesses the potential for impacts to occur to aquatic and riparian function and habitat quality.

4.4.1 Methodology

Methods used to evaluate the potential for adverse or beneficial effects on aquatic resources are based on anticipated changes in hydrology, riparian conditions, sediment production and delivery, and the resulting changes in aquatic habitat quality. These anticipated changes and potential effects are evaluated as part of the Proposed Action, other action alternatives, and the No Action Alternative. As described in Section 3.4.5, Ecological Implications of Land Management Activities on Aquatic and Riparian Habitat, Fish, and Amphibians, management activities have the potential to affect aquatic resources in several ways. The potential impacts on habitat and biota that are evaluated in this section include:

- Changes in peak flows that have the potential to affect channel morphology through bed scour and bank erosion
- Reduction (over time) in the amount of LWD that could be recruited into the watercourses, contributing to reduced sediment storage sites, and reduced pool numbers and volumes
- Removal of riparian vegetation resulting in altered thermal regimes, changes in nutrient cycling, and destabilization of streambanks
- Increases in sediment supplies from surface erosion, hillslope mass wasting, and bank erosion, leading to channel aggradation, loss of pool volume, and degradation of spawning gravels

These potential changes to the stream channel and associated riparian areas could adversely or beneficially affect the quantity and quality of aquatic habitat for species through changes in temperature, sedimentation, habitat complexity, and connectivity. Habitat complexity refers primarily to instream habitat, which provides cover for fish and helps define and add complexity to the stream channel through undercut banks, pools, and other features. Connectivity refers to stream corridor connectivity, which is important to those species with multiple life histories (developmental stages), movement, and migration strategies.

To the extent that the above factors can affect conditions for aquatic species, they are discussed individually in the following assessment. Most of these discussions are, by necessity, qualitative in context because of the nature of management activities proposed. Where possible, however, quantitative information is presented to facilitate comparisons

among the Proposed Action, other action alternatives, and the No Action Alternative, as well as comparisons to current conditions. Many of these comparisons are based on the relative magnitude and direction of change in habitat conditions anticipated under the various alternatives evaluated and the consequences these changes would represent to the covered aquatic species. Supporting information for the aquatic resources analysis, including changes in sediment production and delivery and in hydrology, is described in greater detail in Sections 4.2 (Geology, Geomorphology, and Mineral Resources) and 4.3 (Hydrology and Water Quality). Other factors that can affect aquatic resources (e.g., fishing), as well as the research and monitoring programs that would be implemented, also are described and their effects evaluated in this assessment.

4.4.2 No Action Alternative

Under the No Action Alternative, timber harvesting and related operations in the Primary Assessment Area would be conducted in accordance with Green Diamond's practices as described in Section 2.1 of this EIS. The NMFS and USFWS would not issue Green Diamond an ITP or an ESP, and Green Diamond would not implement an AHCP/CCAA.

As discussed in Sections 4.2 and 4.3, forest management practices can affect slope stability by changing vegetative cover, hillslope shape, and water flow above and below the ground surface. In addition, changes in stream temperatures that can occur from sedimentation and reduced recruitment of LWD can affect the survival and/or reproduction of salmonids and amphibians. Overall conditions for geology and hydrology are anticipated to improve over time under the No Action Alternative. (See Section 4.2, Geology, Geomorphology, and Mineral Resources and Section 4.3, Hydrology and Water Quality.)

For example, under the No Action Alternative, the canopy closure requirements and tree retention measures described as part of the No Action Alternative would contribute to LWD recruitment in a way that in-channel LWD loading, and LWD size could increase in the future (see Section 4.3.2). The presence of LWD in stream channels aids in pool formation and sediment storage and sorting. Therefore, compared to current conditions, increases in LWD recruitment and the volume of LWD could improve aquatic habitat and stream substrate conditions in the Primary Assessment Area. Current canopy closure requirements and tree retention standards are expected to help maintain stream shading in the critical "inner zone" where microclimate effects have the greatest potential to affect changes in water temperatures directly. In addition, a process would be implemented to survey unstable areas and geologic features, and subsequently develop site-specific risk minimization measures for incorporation into THPs, as necessary and appropriate. These measures are expected to result in improvements to aquatic and riparian habitat conditions in the Primary Assessment Area over time compared with existing conditions (see Section 4.2).

Current Green Diamond practices require establishment of WLPZs along fish-bearing and non-fish bearing streams, stipulate procedures for addressing "unstable areas," and include requirements and guidance for activities including, but not limited to: road construction, maintenance, and use; restoration of disturbed areas; timber harvesting intensity and extent; and silvicultural practices. Methods of avoidance and mitigation of site conditions and activities that could result in adverse impacts on aquatic resources would be addressed to the degree required by current regulations and by other management guidelines employed by Green Diamond.

Because the factors that have the potential to adversely affect aquatic and riparian habitat conditions would either remain the same or improve over time, these conditions and the aquatic species dependent on their maintenance are also expected to improve over time compared with current conditions.

4.4.2.1 Hydrologic Effects

As discussed in Section 4.3, Hydrology and Water Quality, the primary effects of timber harvesting on surface water hydrology pertain to peak flows, low (base) flows, water yield, and run-off timing. In rain-dominated systems in the Coast Range, increases in peak flows, water yield, and summer flows have been observed following timber harvesting activities. The effect of timber harvesting on peak flows generally diminishes with increasing watershed size and with increasing flow magnitude. Increases in summer flows generally diminish after a few years.

Under the No Action Alternative, implementation of Green Diamond's current road management practices would result in decommissioning of a number of roads within the Primary Assessment Area and improvements in the design and drainage of existing roads in conjunction with the operation of individual THPs. Road-upgrading and decommissioning program, implemented in conjunction with operation of individual THPs, would result in 67 percent of the road network becoming hydrologically disconnected from area watercourses and would incrementally reduce the potential for sediment to reach Primary Assessment Area watercourses. The use of cross-drains, rolling dips, and outsloping would reduce the amount of concentrated surface runoff at any point, and water from inboard ditches would be dispersed onto the forest floor where it can infiltrate, reducing the effects on peak flows and sediment delivery that can result from road network runoff.

Implementation of the No Action Alternative is not, therefore, expected to substantially change the existing hydrologic regime or the magnitude and timing of naturally occurring peak and low flows in Primary Assessment Area drainages. (See Section 4.3, Hydrology and Water Quality, for further discussion of flow regimes.) As such, no change from existing conditions is expected in channel morphology, incidence of bed scour and bank erosion, or quality of aquatic habitat as a result of altered hydrologic conditions. Any aquatic habitat that could be adversely affected as a result of altered hydrology due to management would further improve as a result of riparian management as described below.

4.4.2.2 Riparian Conditions

Establishing minimum 150-foot-wide WLPZs along Class I watercourses and variable width WLPZs along Class II watercourses, in conjunction with harvest restrictions, canopy closure, and post-harvest tree stocking (i.e., tree retention) requirements within WLPZs are anticipated to help maintain riparian functions such as LWD recruitment, stream shading, sediment filtration, bank stability, and nutrient input. These measures are also expected to provide a suitable microclimate for amphibian and other species that use habitats along streams.

LWD Recruitment. The presence of LWD in stream channels aids in pool formation, provides refugia from peak flows, and maintains overwintering habitat for salmonids and other fishes. Primary Assessment Area streams generally have low levels of LWD that is small in size (< 2 feet in diameter) as a result of past management within stream channels and

adjacent riparian areas. The canopy closure requirements and tree retention standards that would be implemented under the No Action Alternative are expected to help maintain potential LWD recruitment in a way that in-channel LWD loading and size increase in the future. Whether such an increase would occur within a given stream reach would depend on the current condition and trend of existing LWD levels and the length of time necessary to recruit additional wood to streams from adjacent riparian areas. For example, if little or no recruitment of wood has occurred recently and existing pieces of wood are decaying or being washed out of a stream reach, in-stream levels of wood could continue to decline for some time, despite the fact that riparian protection would provide increased potential for recruitment in the future.

Stream Shading. The canopy closure requirements and tree retention standards of the No Action Alternative are expected to help maintain stream shading in the critical "inner zone" where microclimate effects would have the greatest potential to affect amphibians directly or affect anadromous and resident salmonids indirectly through changes in water temperatures. Canopy closure would likely increase relative to current conditions in all stands as they regenerate after timber removal, although it could temporarily decline slightly following harvesting in the future. Increased canopy closure could, therefore, result in slightly decreased water temperatures in Primary Assessment Area streams. (Also see Section 4.3.2.2 for a discussion of water temperature.)

Sediment Filtration. Although most sediment delivered to streams originates outside of the riparian zone, maintenance of riparian buffers aids in the filtration of overland sediment flow and helps to minimize direct sediment inputs from the riparian zone. Exclusion of heavy equipment and mechanical site preparation from Class I and II WLPZs, plus limitations on heavy equipment use in Class III ELZs, under the No Action Alternative will contribute to minimizing the level of ground disturbance that occurs adjacent to Primary Assessment Area watercourses. Maintaining at least 50 percent surface cover and treating bare soil exposures caused by management in areas greater than 100 square feet in WLPZs is expected to result in a trend towards a reduction of management-related sediment delivery along Class I and II watercourses.

Streambank Stability. Bank stability could increase under the No Action Alternative, relative to existing conditions, because of the riparian conservation measures that require substantial tree retention and limit site disturbance within WLPZs along Class I and II watercourses. For Class I watercourses, the CFPRs require retention of the 10 largest dbh conifers (live or dead) that are most conducive to recruitment for every 330 feet of stream channel length within 50 feet of the stream margin. For Class II watercourses, two trees per acre greater than 16 inches dbh and 50 feet tall where they exist within 50 feet of the stream margin must be retained. In addition the CFPRs require that all trees that contribute to bank stability shall not be harvested.

Nutrient Input. The riparian conservation measures under the No Action Alternative would favor conifers over hardwoods in the WLPZs. The level of harvest in both the inner and outer zones of all WLPZs would maintain the overstory canopy, so that the longer-lived conifers would eventually replace the short-lived hardwoods. In the long term, this is anticipated to reduce the level of nutrient inputs relative to current levels, although such a process would be slow and gradual and would not result in complete elimination of

hardwoods or insufficient nutrient input from riparian areas. It is anticipated that any effects from this process on aquatic species and their habitats would likely be minimal (i.e., less than significant) and mitigated by the benefit of increased LWD recruitment through the retention of conifers.

4.4.2.3 Sediment Production and Delivery

Hillslope erosion, sediment delivery, and sediment transport are all naturally occurring processes. After sediments are introduced to a watercourse, they are stored and eventually transported through the channel. Sediments in stream channels influence channel shape and formation, substrate composition, and quality of aquatic habitat. Timber harvesting and the construction and use of the associated road system have the potential to affect sediment input to Primary Assessment Area streams.

As described in Section 4.2, Geology, Geomorphology, and Mineral Resources, it is anticipated that impacts to geology and soils would be reduced over time compared to existing conditions. Sediment loading to Primary Assessment Area streams would be reduced by site preparation guidelines, tree planting, and stand maintenance. The potential for sediment delivery from these activities is much less than that caused by road construction and use.

Green Diamond's practices as described in Section 2.1.1.3 would be expected to result in a trend towards a reduction in road-related hillslope mass wasting, surface erosion, and sediment delivery over time throughout the Primary Assessment Area. Accordingly, under the No Action Alternative, in-stream and riparian habitat conditions affected by sediment delivery are also generally expected to result in a trend towards improved conditions compared to the existing conditions. Sediment delivery would be reduced primarily through continued implementation of Green Diamond's practices as described in Section 2.1.1.3, that include employment by Green Diamond of best management practices (BMPs) based on techniques described in Weaver and Hagans (1994), and treatment of road sediment delivery sites prioritized using a formal assessment methodology. Generally, roads would be upgraded to meet current standards when they are used to gain access to and haul logs from individual THP units. Green Diamond would continue to build new roads to access and manage its lands under the No Action Alternative (see Section 4.2.2). Potential benefits associated with reduced sediment loading, sedimentation, and turbidity include increased quantity and quality of suitable salmonid spawning gravels, greater survival of salmonid eggs and alevins in the gravels, and increased production of aquatic invertebrates that serve as foods for fish and other species. A gradual improvement in habitat conditions for all aquatic species is anticipated to occur because of the reduction in sediment delivery.

Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel morphology, such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998). The trend towards reduced sediment delivery to streams under the No Action Alternative also has the potential to contribute to minor decreases in water temperature. Turbidity, sediment deposition, and the incidence of shallow, wider channels can increase the amount of solar radiation retained in the water column, leading to increased water temperatures. This effect is usually associated with larger, low-gradient rivers where turbidity is higher and exposure to sunlight is prolonged.

Streams within the Primary Assessment Area are usually exposed to short-term, high-turbidity events only during snowmelt and rain events, few of which occur during the period of highest temperatures.

4.4.2.4 Aquatic Habitat

Overall, habitat conditions related to Green Diamond's forestry management activities for aquatic species are expected to improve under the No Action Alternative compared to existing conditions. The magnitude and rate of potential improvement in aquatic habitat during the term of the Permits, however, are not known. Under the No Action Alternative, water quality and substrate in Primary Assessment Area streams is expected to improve because of reduced human-caused sediment delivery. There would be little or no change in other clean water parameters such as nutrient loading, contaminant loading (e.g., herbicides), and dissolved oxygen levels under this alternative. Because canopy closure is expected to increase from current conditions and sedimentation and turbidity levels are expected to trend towards improved conditions under the No Action Alternative, future thermal conditions are expected to improve slightly over time relative to existing conditions as a result of implementing this alternative. Habitat complexity could increase slightly compared to existing conditions through increased LWD loading, increased bank stability, and reduced sediment delivery. Stream connectivity would improve over time relative to existing conditions through the replacement of drainage structures to allow unrestricted passage of all life stages of fish as specified in the CFPRs. Systematic and comprehensive removal of habitat connectivity barriers over the entire ownership would not occur. Barrier removal would generally be piecemeal and tied to implementation of individual THPs implemented on an opportunistic basis (i.e., not on an ownership-wide level) at any given point in time.

4.4.2.5 Other Factors

Factors other than hydrology, riparian conditions, sediment production and delivery, and aquatic habitat conditions can affect aquatic resources in Primary Assessment Area streams. These include the introduction and presence of non-native species, recreational fishing, illegal fishing, and forest management activities, such as drafting of water from streams for dust abatement, road maintenance, road construction, surfacing, fuel reduction, burning, and other land management practices. The No Action Alternative does not contain specific prescriptions to address issues related to fishing and non-native fish species occurrence or management. Green Diamond's rock pits are generally less than 2 acres in size and are located more than 100 and 75 feet from Class I and Class II streams, respectively. Water drafting is done only under strict guidelines to ensure that salmonid and headwater amphibian species are not accidentally suctioned up with the water or harmed by dewatering of the stream where they reside. Under the No Action Alternative, these factors would not result in any changes to aquatic resources and their habitats relative to existing conditions.

4.4.2.6 Research and Monitoring

As part of the THP process and other regulatory requirements, including those of the NSOHCP, Green Diamond conducts a number of research and monitoring activities. These include compliance and effectiveness monitoring, wildlife surveys, environmental

assessments, and watershed studies (e.g., in the TMDL context). In addition to these research and monitoring activities, Green Diamond may continue to conduct voluntarily, or allow the conduct of, various watershed, fish, and wildlife management activities for the enhancement or monitoring of watershed, wildlife, and fisheries resources. Examples of such activities that could be conducted in accordance with State and Federal laws include:

- Aquatic habitat enhancement (e.g., instream boulder or LWD placement)
- Activities associated with improving fish passage (e.g., fish ladder construction or repair, culvert improvement or replacement with bridges, blockage removal)
- Instream surveys and sampling of fish (including but not limited to spawning surveys and downstream migrant trapping), aquatic habitat conditions, macroinvertebrates, and water quality

4.4.2.7 Summary of Effects

Overall, aquatic and riparian habitat conditions related to Green Diamond's forestry management activities and practices are expected to result in a trend towards improved conditions under the No Action Alternative compared to existing conditions. The magnitude and rate of potential habitat improvement over the next 50 years, however, are not known. Under the No Action Alternative, water quality and substrate in Primary Assessment Area streams are anticipated to improve because of reduced sediment loading, sedimentation, and turbidity. A reduction in sedimentation would primarily benefit the anadromous salmonids that use Primary Assessment Area streams for spawning and rearing during the freshwater phase of their life cycle. A reduction in substrate embeddedness resulting from reduced sediment input also may benefit amphibian species, as well as resident salmonid and non-salmonid fish species.

Because canopy closure is expected to increase relative to current conditions and a trend towards a reduction in sediment delivery is also expected to occur under the No Action Alternative, future thermal conditions are expected to improve slightly relative to existing conditions. While water temperatures are generally suitable for most species occurring in the Primary Assessment Area, any improvements in summer water temperatures would benefit both fish and amphibians.

Habitat complexity could increase under the No Action Alternative compared to existing conditions through increased LWD loading and reduced sediment delivery. The physical processes associated with LWD include sediment sorting and storage, retention of organic debris, and modification of water quality. The biological functions associated with LWD structures include providing important rearing habitats, protective cover from predators and elevated stream flow, and regulation of organic material for the instream community of aquatic invertebrates. Creating and providing cover in pools, a primary function of LWD that benefits anadromous and resident salmonids, may be of limited benefit to headwater amphibian species, such as torrent salamanders and larval tailed frogs, because they prefer riffle habitats. The primary benefit of LWD to these amphibians would be the maintenance and creation of suitable riffle habitat through the storing and sorting of sediment.

4.4.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting on the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. In addition, these regulations and guidelines would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2). Measures set forth in the Operating Conservation Program are summarized in Section 2.2, Proposed Action, and include:

- Implementation of an ownership-wide Road Management Plan that provides for: selective and road-related fish passage enhancement (barrier removal); implementation of practices that are designed to minimize sediment discharge to Class I, Class II, and Class III streams; and decommissioning of some roads. The Road Management Plan provides for accelerated repair of high- and moderate-risk sediment delivery sites on roads on the Green Diamond fee ownership in accordance with the schedule established in the AHCP/CCAA (AHCP/CCAA Section 6.2.3).
- Specified protection of unique geomorphic features, such as channel migration zones and floodplains (AHCP/CCAA Section 6.2.1).
- Adoption of various slope stability and ground disturbance minimization measures (AHCP/CCAA Sections 6.2.2 and 6.2.4).
- Implementation of effectiveness monitoring, plus adaptive management with structured feedback loops (AHCP/CCAA Sections 6.2.5, 6.2.6, and 6.2.7).

Under the Proposed Action, it is anticipated that habitat conditions would improve and aquatic and riparian resources would realize incremental benefits compared to the No Action Alternative. This would be largely attributable to implementation of the Road Management Plan, and enhanced riparian zone protection described in Chapter 2 as part of the Proposed Action. Overall, the minimization and mitigation measures are expected to reduce harvest- and road-related sediment production and delivery to Primary Assessment Area streams and to maintain or enhance existing riparian and aquatic conditions. The anticipated improvement in riparian conditions and the reduction in sediment production and delivery to streams would exceed the reductions expected under the No Action Alternative and would likely result in improved physical habitat for the covered species. Monitoring activities that would use the adaptive management "account" balance would also provide additional flexibility and a mechanism for changing or clarifying the AHCP/CCAA prescriptions, if needed.

4.4.3.1 Hydrologic Effects

Upslope management under the Proposed Action would be subject to additional management controls compared with the No Action Alternative and would not result in substantial changes in the existing hydrologic regime or in the magnitude and timing of naturally occurring peak and low flows in Primary Assessment Area drainages (see Section 4.3, Hydrology and Water Quality, for further discussion of flow regimes). Under the harvest-related ground disturbance measures (AHCP/CCAA Section 6.2.4), there are greater seasonal operating limitations that would minimize soil compaction. This could decrease the magnitude of peak flows and the volume of sediment available for runoff

during such events. The accelerated road plan (AHCP/CCAA Section 6.2.3) will increase the rate at which roads will be hydrologically disconnected from the watercourses. Riparian management measures (AHCP/CCAA Section 6.2.1) will also increase LWD recruitment. Over time these measures will increase the amount of LWD in streams, ultimately increasing the overwintering habitat for juvenile salmonids. This could avoid species displacement that can be caused by altered hydrology by providing increased habitat options for salmonids.

Harvest-related ground disturbance can reduce the infiltration capacity of soils and alter the process of subsurface water movement through soil compaction, leading to increased surface runoff. Under the Proposed Action (AHCP/CCAA Section 6.2.4), site preparation measures include seasonal operating limitations for tractors, skidders, and forwarders, and minimized use of tractor-and-brushrake piling. These harvest-related ground disturbance conservation measures would substantially reduce the impacts of any operations-related alterations in hydrology by minimizing soil compaction, which can increase the magnitude of peak flows and reduce the volume of sediment available for runoff during peak flow events.

Riparian conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.1) would reduce potential impacts of altered hydrology on aquatic habitat. Specifically, the riparian conservation measures would maintain in-channel LWD and provide increased LWD recruitment potential through enhanced riparian conservation measures compared to existing conditions and the No Action Alternative. The presence of LWD in stream channels aids in pool formation, sediment storage and sorting, provides refugia from peak flows, and maintains overwintering habitat for anadromous and resident salmonids and other fishes.

The conservation measures under the Proposed Action would reduce the impacts of forest management on surface runoff and peak flows, reduce soil compaction and disturbance, and maintain or enhance in-channel LWD beyond the reductions anticipated to occur over time under the No Action Alternative. Any impacts to aquatic habitat that could occur would be mitigated by improved riparian conditions resulting from riparian management and decreased sediment production and delivery, as described below.

4.4.3.2 Riparian Conditions

General Effects. In general, the riparian conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.1) are more protective of riparian functions than those described under the No Action Alternative and existing conditions, and they would, therefore, provide comparatively greater habitat benefits to the covered species. The Proposed Action limits commercial entry into the RMZs to one harvest entry during the term of the Permits, except where cable corridors are necessary to conduct intermediate treatments. In addition, the Proposed Action establishes RMZs at least 150 feet wide along Class I watercourses, with a variable-width inner zone ranging from 50 to 70 feet. The minimum RMZ width for Class I watercourses under the Proposed Action is comparable to or slightly less protective than the minimum WLPZ width for Class I watercourses under the No Action Alternative. Additional protection, however, is provided under the Proposed Action by harvesting only those trees that have a low likelihood of recruitment within Class I RMZs and the first 200 feet of Class II RMZs adjacent to a Class I RMZ, although the proposed inner RMZ band

is slightly narrower than the No Action Alternative. The Proposed Action also establishes SMZs upslope of Class I watercourses in areas identified as steep streamside slopes.

Minimum 100-foot-wide RMZs would be established along 2nd order or larger Class II watercourses under the Proposed Action; minimum RMZ width along 1st order Class II watercourses would be 75 feet. These widths are comparable to or greater than WLPZ widths along Class II watercourses under the No Action Alternative. The Proposed Action establishes a 30-foot wide inner zone for Class II RMZs within which 85 percent of the overstory canopy would be retained post-harvest; at least 70 percent overstory canopy would be retained within the outer zone of Class II RMZs. These retention standards exceed those for Class II WLPZs under the No Action Alternative, where the distances range from 50 feet to 75 feet (100 feet if cable yarding is not used on slopes greater than 50 percent) with a minimum of 50 percent to 70 percent total post-harvest canopy closure (i.e., understory plus overstory) is required. Additionally, the Proposed Action provides protection for LWD recruitment by harvesting only those trees that have a low likelihood of recruitment within the first 200 feet of Class II RMZs adjacent to a Class I RMZ. The Proposed Action also establishes SMZs upslope of Class II watercourses in areas identified as steep streamside slopes.

Overall, the Proposed Action provides riparian protection along Class III watercourses by establishing minimum 30- to 50-foot-wide EEZs. The No Action Alternative provides for 25- to 50-foot equipment limitation zones (ELZs), within which all trees needed for bank stability would be retained. Within the EEZ of Tier A (less than 60 percent to 70 percent slopes) Class III watercourses, all existing LWD on the ground would be retained and there would be no fire ignition during site preparation. Within the EEZ of Tier B (greater than 60 percent to 70 percent slopes), all hardwoods and nonmerchantable trees would be retained, as would all conifers that contribute to bank stability or act as a control point (retaining sediment or preventing headcutting) in the channel; at least one conifer per 50 feet of stream length would be retained.

Overall, the riparian conservation measures under the Proposed Action would provide greater protection of riparian functions such as LWD recruitment, stream shading, sediment filtration, bank stability, and nutrient input compared to the current conditions, and incrementally greater protection compared to the No Action Alternative. These measures would contribute to maintenance and development of a more suitable microclimate for amphibians and other species that use habitats along streams, and would benefit habitat used by the various life stages of the covered fish species present in Primary Assessment Area drainages. The effects of the additional protection provided under the Proposed Action on individual riparian functions and related aquatic functions are described below.

LWD Recruitment. The overstory canopy closure requirements and tree retention standards under the Proposed Action are equal to or more protective than what is included in the No Action Alternative. This would help to increase the potential for LWD recruitment so that in-channel LWD loading and size is likely to increase in the future. Whether such an increase would occur within a given stream reach would depend on the current condition and trend of existing LWD levels, and the length of time necessary to recruit additional wood to streams from adjacent riparian areas. For example, if little or no recruitment of wood has occurred recently, and existing pieces of wood are decaying or being washed out of a stream reach, in-stream levels of wood could continue to decline for some time, despite

the fact that riparian management under the Proposed Action would provide an increase in sources of future LWD and thereby increased potential for wood recruitment in the future.

While the minimum RMZ width and overstory canopy closure requirements of the Proposed Action are comparable to or greater than what is included in the No Action Alternative, the Proposed Action is expected to provide additional LWD recruitment by retaining at least 15 conifer stems greater than 16 inches dbh per acre. All trees within the inner zone of RMZs along Class I streams and portions of Class II streams that are determined to be likely to recruit LWD to the stream channel would be retained. Numerous criteria would be used to identify trees with a low likelihood of recruitment to the watercourse as potential candidates for harvesting within the RMZ. These criteria include, but are not restricted to, distance from the stream, direction of the tree lean, intercepting trees, side slope gradient, slope stability, and streambank stability. The riparian conservation measures under the Proposed Action would ensure that all trees with the greatest potential for LWD function (e.g., that can influence fluvial processes or provide cover for fish) would be retained. The limitation to a single commercial harvest entry into the RMZ (except where cable corridors are necessary for intermediate treatments) during the term of the Permits would ensure that this additional LWD recruitment potential would be maintained during the term of the Permits.

Geologic processes also can be important mechanisms that provide LWD to streams, and sometimes can be the primary mechanism by which LWD reaches streams. In particular, shallow rapid landslides have the potential to deliver large amounts of LWD when they form in inner gorges. In addition, debris torrents from small headwater Class II and Class III streams can be an important source of LWD when they empty directly into large Class II or Class I streams. The Proposed Action provides for tree retention in SMZs, primarily to minimize the likelihood of management-induced landslides. However, the SMZ, RSMZ, and RMZ prescriptions for tree retention would ensure that when a landslide does occur, it has the potential to deliver LWD to the adjacent stream.

Based on modeling conducted for the AHCP/CCAA of future LWD recruitment, it is anticipated that 99 percent of the total potential recruitment for managed potential tree height would be provided along Class I watercourses for site index 100. Along Class II watercourses, 95 percent of potential LWD recruitment would be attained for managed potential tree height at site index 100. Along first order Class II watercourses, 85 percent of potential LWD recruitment would be attained for managed potential tree height at site index 100. Managed potential tree height is defined as the height a dominant redwood tree would grow in 60 years (112 and 134 feet on site index 100 and 120 lands, respectively). Site potential tree height is defined as the maximum, or asymptotic, height of a dominant redwood left to grow indefinitely (216 and 245 feet on site index 100 and 120 lands, respectively). There would be little difference in the level of LWD recruitment expected at site index 120 or with differing inner zone widths along Class I watercourses. (See Section 7.2.3 of the AHCP/CCAA.)

The preceding discussion of future LWD recruitment potential focused on the proportion of trees that would be available for recruitment. The size of trees is also important in assessing impacts on LWD. Only a small proportion of the trees within RMZs would be harvested, and those that remain would continue to grow and age following removal of the adjacent upland stands. Trees in the RMZs would be increasing in age throughout the term of the AHCP/CCAA, such that by the end of the term over one-third of the RMZ stands would be

greater than 100 years old and the remainder would be between 51 and 100 years. At age 100 in a typical redwood zone, there would be approximately 120 trees per acre, with around 12 percent of the trees larger than 36 inches dbh. A few trees would exceed 48 inches dbh and the tallest trees in the stand would be about 170 feet tall.

While the RMZ measures are designed to replenish LWD into channels naturally, the time it would take to grow and recruit the larger pieces of LWD through natural processes would likely extend beyond the term of the AHCP/CCAA. The riparian conservation measures would minimize impacts of past practices and improve LWD recruitment in area streams. These measures would help to maintain and improve channel complexity and provide habitat necessary for all life stages of salmonids and amphibians. Implementation of riparian conservation measures under the Proposed Action would result in increased tree retention and LWD recruitment that would help mitigate effects of altered hydrology that could occur as a result of upslope management. (See Section 4.3, Hydrology and Water Quality.)

Stream Shading. The overstory canopy closure requirements and tree retention standards under the Proposed Action are comparable to or are more protective than those included in the No Action Alternative. They would help to maintain stream shading in the critical "inner zone" where microclimate effects would have the greatest potential to impact amphibians directly or impact anadromous and resident salmonids indirectly through changes in water temperatures. Although the inner zone width along Class I watercourses is slightly less under the Proposed Action than under the No Action Alternative, the effects on microclimate and stream temperatures are not expected to be substantially different. Overstory canopy closure would likely increase over current conditions in all stands as they regenerate after timber removal and could temporarily decline slightly following harvesting in the future. In some stands there could be an immediate net reduction of overstory canopy closure of up to approximately 15 percent to 20 percent following timber harvest in the outer zone that would be replaced within 5 to 10 years by recovery of the remaining tree crowns. On average, the average-sized harvest unit (currently about 25 acres) would influence approximately 1,000 feet of watercourse if the unit surrounds or is adjacent to a watercourse.

Although the sample size is small, Green Diamond has direct experimental data to support the conclusion that its riparian conservation measures would not result in significant impacts to aquatic resources resulting from a slight change in water temperature (See Section 4.3.3.2 of this EIS and Appendix C-5.2 of the AHCP/CCAA, *Class II Paired Watershed Temperature Monitoring*.) Two of the treated streams showed minor increases (ranging from 0.5°C to 1.0°C) in water temperature within the limits of the harvest unit relative to the controls during the warmest time of day in the warmest 14-day period of the summer; two of the treated streams showed minor decreases (ranging from 1.3°C to 1.4°C) in water temperature. These decreases likely resulted from increased ground water inputs following harvesting of the adjacent stand.

On the basis of the minimal changes in temperature under the most extreme annual conditions, and the anticipated substantial increase in riparian protection under the Proposed Action, a measurable increase in water temperature in Class I or larger Class II streams caused by minor reductions in canopy closure following timber harvesting is not anticipated. Limiting entry (i.e., a single commercial entry during the term of the Permits

except where cable corridors are necessary for intermediate treatments) into the RMZ would further reduce any potential minor impact from the slight temperature increases. Any increase in water temperature would be slight and less than significant, and over the term of the AHCP/CCAA, stream temperatures would be maintained or improved compared with existing conditions or with conditions expected to occur over time under the No Action Alternative.

Sediment Filtration. Although sediment can be delivered to streams from outside of the riparian zone, maintenance of riparian buffers can aid in filtering overland sediment flow and helps to minimize direct sediment inputs from or through the riparian zone. As under the No Action Alternative, exclusion of heavy equipment and mechanical site preparation within Class I and Class II RMZs, plus exclusion of heavy equipment in Class III EEZs, would minimize the level of ground disturbance that occurs adjacent to Primary Assessment Area watercourses under the Proposed Action. Maintaining at least 50 percent surface cover and treating bare soil in excess of 100 square feet would minimize the potential for management-related sediment delivery from within the RMZs along Class I and Class II watercourses. For Class I watercourses, the wider zone of 85 percent overstory canopy required by the CFPRs under the No Action Alternative will provide greater sediment filtration than the Proposed Action. For Class II watercourses, the Proposed Action has an inner zone of 85 percent overstory canopy closure that would provide more sediment filtration than the No Action Alternative. In turn, LWD recruitment would help minimize the effects of sediment production and delivery by providing in-channel LWD, which functions to sort and increase the storage of sediment within stream channels. All of these improved functions would benefit aquatic and riparian habitat used by the covered species.

Streambank Stability. Management-induced erosion and hillslope mass wasting from watercourse banks can be amplified by increased peak flow intensity and duration, as well as by reductions in root reinforcement of soil cohesion when vegetation is removed. The riparian conservation measures under the Proposed Action for Class I and II watercourses require 85 percent overstory canopy retention in the RMZ inner zone and prohibit harvesting of trees that are likely to recruit to stream channels. In addition, Tier B Class-III measures require retention of trees that are judged to be critical to maintaining bank stability. These measures will likely lead to greater bank stability under the Proposed Action compared with existing conditions. Under the No Action Alternative, however, the CFPRs require that removal of trees may not result in any measurable decrease in the stability of a watercourse channel or of a lake or watercourse bank. Therefore, the effects of the Proposed Action are expected to be similar to the No Action Alternative.

Nutrient Input. The riparian conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.1) would favor conifers over hardwoods in the RMZs. Similar to the No Action Alternative for the WLPZs, the level of harvest in both the inner and outer zones of all RMZs under the Proposed Action would maintain the overstory canopy, so that the longer-lived conifers would eventually replace the short-lived hardwoods. In the long term, this is anticipated to reduce the level of nutrient inputs relative to current levels, although such a. process would be slow and gradual, and would not result in complete elimination of hardwoods or insufficient nutrient input from riparian areas.

Aggradation of channels and scour from debris flows favor recolonization by the more rapidly growing hardwoods such as red alder. Therefore, both the slope stability and road management measures will tend to cause a decline in riparian hardwoods over time and a corresponding decrease in nutrient inputs. However, as noted above, this will be a long and gradual process that will not result in the total elimination of hardwoods.

It is anticipated that any effects on aquatic species and their habitats would likely be minimal (i.e., less than significant) and mitigated by the benefits of increased LWD recruitment through the retention of conifers. This is particularly relevant where structural elements of aquatic habitat are more limiting than nutrient availability.

4.4.3.3 Sediment Production and Delivery

As discussed in Section 4.2, Geology, Geomorphology, and Mineral Resources, it is anticipated that the combined effect of the AHCP/CCAA conservation measures under the Proposed Action (AHCP/CCAA Section 6.2) would reduce the potential to deliver sediment to Primary Assessment Area watercourses from existing sediment sources (e.g., from existing roads and skid trails) by implementing: (1) riparian management and slope stability measures, (2) the ownership-wide Road Management Plan, (3) harvest-related ground disturbance measures, and (4) the monitoring and adaptive management measures. In addition, the road-related conservation measures would be implemented within the Action Area on an accelerated basis, with anticipated application of protective new road design and existing road decommissioning on an expedited schedule compared to the No Action Alternative.

Sediment production and delivery to Primary Assessment Area streams would be reduced under the Proposed Action compared to the No Action Alternative and existing conditions. Potential benefits associated with reduced sediment loading, sedimentation, and turbidity were discussed in detail in Chapter 3 of this EIS. These benefits include, among others, increased quantity and quality of suitable salmonid spawning gravels, greater survival of salmonid eggs and alevins in the gravels, and increased production of aquatic invertebrates that serve as foods for fish and other species.

Reduced sediment delivery to streams under the Proposed Action also could contribute to minor decreases in water temperature. Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel morphology such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998). With the slope stability and road management measures designed to minimize management-related sediment inputs, sediment production and delivery would be reduced relative to past practices and the No Action Alternative. Given that water temperatures are generally favorable throughout the Primary Assessment Area even with past sediment inputs (see Appendix C-5 of the AHCP/CCAA), sediment minimization measures under the Proposed Action would further reduce the likelihood that aggradation of channels would result in elevated water temperatures.

The Proposed Action identifies four primary sediment-input processes and proposes a number of specific prescriptions and conservation measures to mitigate potentially adverse effects associated with these processes. The primary sediment-input processes are as follows:

- Surface erosion
- Hillslope mass wasting
- Reduced bank stability
- Road-related sediment production

Sediment production from surface erosion is of most concern on slopes that are adjacent to watercourses, although erosion does occur higher on the hillslopes and within harvest units. As is the case for management prescriptions under the No Action Alternative, RMZ management prescriptions under the Proposed Action include conservation measures designed to impede sediment delivery in areas where sediment would have relatively short transport distances to watercourses. These measures include minimum overstory canopy retention standards within RMZ inner and outer zones, limitations on equipment use, and retention of trees judged to be critical to maintaining bank stability. The retention standards would ensure that there would be almost no net loss in total forest canopy in the inner zone of RMZs along Class I and Class II watercourses, and would greatly increase overstory canopy along Class II watercourses relative to existing conditions. This overstory canopy would impede grain detachment in these critical areas, where detached sediment would have relatively short transport distances to watercourses.

Also, harvest-related ground disturbance measures focus on minimizing ground disturbance and the exposure of bare mineral soil within harvest units. AHCP/CCAA Section 6.2.4 describes conservation measures, including site preparation methods, limited operating periods for the construction of skid trails and use of ground-based yarding equipment, limiting use of ground-based yarding equipment that requires constructed skid roads to slopes less than or equal to 45 percent (with some exceptions), preferential use of cable yarding systems, and water-barring of cable corridors where necessary. The AHCP/CCAA also includes conservation measures for treatment of bare mineral soil within RMZs and on stream crossings. All of these ground disturbance conservation measures are expected to contribute directly to minimizing management related surface erosion within harvest units.

As discussed in Section 4.2.3.2, sediment production from hillslope mass wasting within the Primary Assessment Area is greatest in RMZs, steep streamside slopes, headwall swales, and historically active deep-seated landslides. (See Section 3.2.3.3, Landslide Classification and Landslide-Prone Terrain.) Under the Proposed Action (AHCP/CCAA Section 6.2.2), these areas are subject to specific slope stability conservation measures intended to achieve a reduction in management-related sediment delivery from landslides relative to appropriate historical clearcut reference areas. SSS areas would receive additional protection through establishment of SMZs upslope of the RSMZ along Class I and Class II watercourses. The width of the SMZ would vary among the 11 HPAs, with wider SMZs identified for those HPAs with potential to deliver sediment to watercourses from the longest distances. Selection harvest would be the most intensive silvicultural prescription allowed within the SMZ without geologic review, and no harvest would be allowed in the inner portion of the RMZ downslope of the SMZ along Class I and larger Class II watercourses. Timber harvesting would be prohibited within the entire RSMZ below SMZs in the Coastal Klamath and Blue Creek HPAs. In addition, no harvest would be allowed within the toe and 25 feet upslope from the top of the toe or scarp of historically active deep-seated landslides without geologic review.

Tree retention in the SMZs and associated RMZs is expected to maintain a network of live roots that would preserve soil cohesion and contribute to slope stability in these areas. Tree retention also would help maintain forest canopy, which would preserve some measure of rainfall interception and evapotranspiration. Maintenance of rainfall interception and evapotranspiration is expected to contribute to slope stability conditions in some locations by partially mitigating high ground water ratios that may be management related. Limited road construction and road reconstruction in SMZs and RSMZs is expected to reduce the undercutting and overburdening of sensitive hillslopes and help avoid unnatural concentration of storm runoff on these slopes.

The riparian conservation measures for Class I and II watercourses that require 85 percent overstory canopy retention in the RMZ inner zone, and that prohibit harvesting of trees that are likely to recruit to stream channels, will likely lead to increased bank stability under the Proposed Action. The Tier B Class-III measures that require retention of trees determined to be critical to maintaining bank stability will also contribute to increased bank stability.

Road-related erosion and hillslope mass wasting are known to be important contributors to the sediment budget in most managed watersheds. Eroded sediment can be delivered to watercourses through gullies or rills or through sheet transport processes from roads or through hillslope mass wasting. The Road Management Plan and associated conservation measures under the Proposed Action (AHCP/CCAA Section 6.2.3) would reduce road related sediment production and delivery to Primary Assessment Area watercourses relative to measures under the No Action Alternative.

Erosion will be reduced as a result of implementation of Green Diamond's Road Management Plan under the Proposed Action. The Road Management Plan includes measures common to Proposed Action, Alternative A, and Alternative C (see Table 2.7-1 comparing the alternatives), as follows:

- A methodology to classify roads on the basis of use and prioritize road work and site-specific repairs
- Standards for road repairs and upgrades
- Standards for stream crossing, culvert repairs and upgrades
- Standards for temporary and permanent roads
- A training program for equipment operators and supervisors on the Road Management Plan and other AHCP/CCAA standards and practices

The Proposed Action's Road Management Plan (AHCP/CCAA Section 6.2.3) also provides additional measures that would reduce road-related sediment production to a greater extent than under the No Action Alternative. These include:

- An accelerated repair of high-and moderate- risk sediment delivery sites
- A commitment to address all of the high- and moderate-risk sites by the end of the term of the Permits
- Increased restrictions on wet weather road use, construction, upgrading, and decommissioning

Green Diamond has performed a general assessment representing 26,000 acres of its ownership within the Action Area that identified road-related sediment sources requiring treatment (e.g., stabilization of dirt or other remediation to prevent road-related, sediment-producing failures or hillslope mass wasting events). At the time the sediment model was run in 2002, Green Diamond estimated the volume of potential sediment associated with high- and moderate-risk sediment delivery sites (based on both the probability of delivery to watercourses and the sediment volume associated with such delivery) to be 6,436,000 cubic yards (see Appendix F of the AHCP/CCAA). Under the Proposed Action, Green Diamond's Road Management Plan is designed to provide treatment of all high- and moderate-risk sediment delivery sites over the term of the Permits, to minimize potential delivery of sediment to riparian and aquatic areas. In addition, in the AHCP/CCAA, Green Diamond commits to provide an average of $2.5 million per year for the first 15 years of the AHCP/CCAA (for a total of $37.5 million) to accelerate implementation of the treatments for the high- and moderate-risk sites. (The acceleration period would be adjusted following revision of the estimate of sediment yield from high- and moderate-risk sediment delivery sites at the end of the first five years following Permit issuance. The acceleration period and monetary commitment could be adjusted (upward or downward) by up to 1.5 years and $3.75 million depending on the revised estimate of sediment yield.)

As discussed in Section 4.2.3.4, approximately 29 percent more potential sediment volume will be treated during the first 15 years of the Permit term under the Proposed Action compared to the No Action Alternative. (See Appendix F of the AHCP/CCAA.) (Also, see Figure 4.2-1 in Section 4.2, Geology, Geomorphology, and Mineral Resources, for a graphic depiction of the reduction in sediment delivery under the Proposed Action compared to the No Action.) Implementation of the Road Management Plan under the Proposed Action would result in improved sediment control by accelerating the reduction of sediment loading compared to the rate at which sediment would be reduced under the No Action Alternative. This would result in direct beneficial effects to aquatic and riparian species.

An additional benefit to aquatic species of treating the high- and moderate-risk sediment delivery sites on an accelerated basis is that less sediment would be delivered to Primary Assessment Area streams. These benefits would compound quickly over time because of the brief life-span of the covered species. On the basis of the sediment delivery study findings, it would take 38 years to stabilize 48 percent of the high- and moderate-risk sediment under the No Action Alternative. In contrast, under the "acceleration" scenario of the Proposed Action, 48 percent of the sediment would be stabilized within the first 15 years of the plan, which is 23 years earlier than under the No Action Alternative (see Figure 4.2-1). Because most of the covered fish species have a short (2-to-6 year) life cycle, several generations of fish would benefit over the 23 years difference in the time that it takes to reach the 48 percent benchmark.

4.4.3.4 Aquatic Habitat

Overall, habitat conditions related to forestry management activities for aquatic species are expected to improve under the Proposed Action relative to existing conditions and relative to the No Action Alternative. The magnitude and rate of potential improvement in aquatic habitat over the 50-year term of the Permits, however, are unknown. Under the Proposed Action, water quality and substrate in Primary Assessment Area streams are expected to

improve because of reduced sediment delivery. There would be little or no change in other clean water parameters such as nutrient loading, contaminant loading (e.g., herbicides), and dissolved oxygen levels. Because improvements in overstory canopy closure, shading, sedimentation, and turbidity are expected under the Proposed Action, future thermal conditions for covered species would be similar to or better than existing conditions as a result of implementing the Proposed Action. Habitat complexity would likely increase through increased LWD loading, similar or increased bank stability, and reduced sediment delivery relative to existing conditions and conditions under the No Action Alternative.

The road management practices described under the No Action Alternative (see Section 2.1) addresses fish access issues associated with new roads by installing bridges on fish-bearing streams where feasible. When a bridge installation is not feasible, a "fish-friendly" structure would be installed that would provide upstream and downstream fish passage. Under the Proposed Action, potential fish passage problems at existing road crossings would be documented during the road inventory process, and culverts that are impeding fish passage would be prioritized for replacement with a bridge or other "fish friendly" structure. As culvert replacement is implemented over time, fish passage problems at road crossings would be eliminated. These actions would result in improved stream connectivity in the Primary Assessment Area and have the potential for providing covered species access to potentially suitable, but presently unavailable, habitat in some stream reaches.

Throughout the Primary Assessment Area, there are a variety of stream reaches that occur above natural barriers to anadromy that appear to have habitat for anadromous salmonids, particularly coho salmon. Under the Proposed Action (AHCP/CCAA Section 6.2.8), Green Diamond would undertake a special project that is expected to expedite the conservation of this species by increasing the available habitat for spawning and rearing. Green Diamond would undertake a project involving trapping and transporting coho that are native to the stream system around a barrier during the spawning season for a ten-year period and allow them to spawn. Prior to undertaking the project, Green Diamond would evaluate the selected stream to assess whether salmonids residing in the basin above the barrier would be adversely affected by the translocation. The project would include monitoring of subsequent spawning, utilization of summer rearing habitat by the juvenile fish, and outmigrant trapping to document the number of smolts leaving the system. The upper North Fork of the Mad River has been identified as being one of the top candidate sites for the initial project. Impacts associated with relocating anadromous salmonids upstream of natural barriers are not significant, but will be thoroughly evaluated prior to implementation of the Operating Conservation Program (AHCP/CCAA Section 6.2).

It is expected that benefits to the covered species and their habitats under the Proposed Action would continue to accrue over the 50-year term of the Permits because of more time for the beneficial effects of the conservation measures and improved forest management practices to be realized. Examples of time-dependent benefits to covered species and their habitats include immediate and continued long-term reductions in sediment delivery from road and riparian management actions. In addition, a variety of improvements to riparian vegetation and function would interact to contribute collectively to long-term benefits to aquatic communities. These improvements include, among others, increased LWD recruitment, greater tree retention in riparian zones, and increased canopy closure and slightly reduced water temperature.

4.4.3.5 Other Factors

As discussed previously for the No Action Alternative, factors other than hydrology, riparian conditions, sediment production and delivery, and aquatic habitat conditions can affect aquatic resources in Primary Assessment Area streams. These include the introduction and presence of non-native species, recreational fishing, illegal fishing, and covered activities associated with forest management, such as drafting of water from streams for dust abatement, road maintenance, road construction, surfacing, fuel reduction burning and other land management practices. Similar to the No Action Alternative, the Proposed Action does not contain specific prescriptions to address issues related to fishing and non-native fish species occurrence or management. Water drafting is conducted only under strict guidelines to ensure that covered species are not accidentally suctioned up with the water or harmed by dewatering of the stream where they reside. Under the Proposed Action, these factors would generally not result in any changes to aquatic resources and their habitats relative to existing conditions.

Under the Proposed Action, the conservation measures specific to rock pit use and development (see Section 2.2.2) would minimize potential impacts to aquatic habitats that could be affected by these activities.

4.4.3.6 Research and Monitoring

As part of the THP process and other regulatory requirements, including those of the NSOHCP, Green Diamond conducts a number of research and monitoring activities. These include effectiveness monitoring, wildlife surveys, environmental assessments, and watershed studies. Under the Proposed Action, the level of effectiveness monitoring would be greater than under the No Action Alternative.

In addition to the required and voluntary research and monitoring activities presently being conducted by Green Diamond, additional monitoring would be conducted under the Proposed Action to document the level of effectiveness of the AHCP/CCAA measures.

Effectiveness monitoring (AHCP/CCAA Section 6.2.5) would evaluate the implementation and overall effectiveness of the Operating Conservation Program in achieving the AHCP/CCAA's biological goals and objectives. This monitoring will track trends in the quality and quantity of habitat for the covered species (as well as the distribution and relative abundance of the covered species) and provide information to better understand the relationships among specific aquatic habitat elements and the long-term persistence of the covered species. The effectiveness monitoring projects include temperature monitoring, channel and erosion monitoring, salmonid and amphibian population monitoring, and LWD assessments. These and other monitoring efforts are described in detail in Appendix D of the AHCP/CCAA.

Monitoring data could be collected year-round, as with some in-stream temperature recorders, or seasonally, as with the Class I channel dimensions monitoring. The data collected through some monitoring projects would be analyzed on an annual basis and other monitoring projects on a longer time interval. The intent is to provide a timely review of monitoring data that have monitoring thresholds associated with them to allow for corrective actions, if necessary, to occur. Based on the results of the effectiveness monitoring

under the Proposed Action, changes to management and conservation measures could be implemented through adaptive management.

Adaptive management is an important tool for natural resource management when there is substantial scientific uncertainty regarding appropriate management and conservation strategies (Walters, 1986). Adaptive management has two key features: (1) a direct feedback loop between science and management, and (2) the use of management strategies as a scientific experiment (Halbert, 1993; Walters, 1986). Green Diamond's monitoring and adaptive management program (AHCP/CCAA Section 6.2.6) incorporates both these features with the goals of: (1) increasing the understanding of watershed processes and the effects of management activities on the habitats and populations of the covered species over the term of the Permits; and (2) modifying some of the AHCP/CCAA's conservation measures as necessary in response to this new information. Under the Proposed Action, adaptive management would provide some flexibility and a mechanism for strengthening or relaxing individual conservation measures, depending on how well the measure is or is not working based on specific performance criteria. Modification of conservation measures would be limited by the adaptive management "account" balance established in the AHCP/CCAA.

The overall benefit of the monitoring and adaptive management program would be to: (1) monitor through time the habitat and populations of the covered species where they currently exist; (2) document the expected trend in recovery in areas that have been affected by past management activities or natural disturbances; (3) modify or augment existing conservation measures where is necessary; and (4) re-allocate resources to make the Operating Conservation Program more efficient, where warranted. In addition, the monitoring and experimental studies that would be conducted as part of the AHCP/CCAA would further the knowledge on conservation of aquatic species on managed landscapes, potentially benefiting these species throughout their range.

Under the Proposed Action, Green Diamond would commit to continue the various watershed, fish, and wildlife management activities for the enhancement or monitoring of watershed, wildlife, and fisheries resources described under the No Action Alternative in Section 2.1.2.5. Examples of activities that could be conducted include:

- Aquatic habitat enhancement (e.g., instream boulder or LWD placement)
- Activities associated with improving fish passage (e.g., fish ladder construction or repair, culvert improvement or replacement with bridges, blockage removal)
- Instream surveys and sampling of fish (including but not limited to spawning surveys and downstream migrant trapping), aquatic habitat conditions, macroinvertebrates, and water quality

4.4.3.7 Summary of Effects

Overall, aquatic and riparian habitat conditions related to forestry management activities are expected to improve under the Proposed Action relative to existing conditions and relative to continued implementation of the No Action Alternative. The anticipated improvement in riparian conditions and the reduction in sediment production and delivery to streams would exceed the improvements anticipated to occur over time under the No Action Alternative, and would likely result in improved physical habitat for all of the

covered species. Improvements in aquatic and riparian habitat benefiting the covered species would, in general, benefit other species associated with these habitats. It is expected that benefits to all these species and their habitats under the Proposed Action would continue to accrue over the 50-year term of the Permits because of more time for the beneficial effects of the conservation measures and improved forest management practices to be realized.

Under the Proposed Action, water quality and substrate in Primary Assessment Area streams would improve because of reduced sediment loading and sedimentation and turbidity. In turn, these improvements are expected to increase the quantity and quality of salmonid spawning gravels, resulting in greater survival of salmonid eggs and alevins in the gravels, and increased production of aquatic invertebrates that serve as foods for fish and other species. A reduction in sedimentation would primarily benefit the covered salmonids that use Primary Assessment Area streams for spawning and rearing during the freshwater phase of their life cycle. These fish species are coho salmon, Chinook salmon, steelhead, and rainbow and coastal cutthroat trout. A reduction in substrate embeddedness resulting from reduced sediment input also may benefit the two covered amphibian species—southern torrent salamander and tailed frog. Because management-related sediment production and delivery is expected to decrease substantially under the Proposed Action compared to the No Action Alternative, the benefits to covered species are anticipated to be correspondingly greater under the Proposed Action.

Because improvements in overstory canopy closure, shading, sedimentation, and turbidity are expected under the Proposed Action, future thermal conditions for covered species would be similar to or better than existing conditions as a result of implementing the AHCP/CCAA. Water temperature monitoring has shown that water temperatures in Primary Assessment Area streams are generally suitable for anadromous and resident salmonids and the covered amphibian species. Additionally, stream surveys indicate that tailed frogs and southern torrent salamanders are present in most streams sampled across the entire Primary Assessment Area, in stands ranging from recent even-aged harvesting units to mature second growth. This also suggests that water temperatures and microclimate variables are currently suitable for these and other amphibian species in the majority of streams in the Primary Assessment Area. Any improvements (reductions) in summer water temperatures would benefit the covered fish species and covered amphibian species, as well as other species associated with aquatic habitats.

Habitat complexity would increase under the Proposed Action relative to existing conditions and relative to the No Action Alternative through increased LWD loading, comparable bank stability, and reduced sediment delivery. LWD is recognized as a vital component of salmonid habitat. The physical processes associated with LWD include sediment sorting and storage, retention of organic debris, and modification of water quality. The biological functions associated with LWD structures include providing important rearing habitats, protective cover from predators and elevated stream flow, retention of gravels for salmonid redds, and regulation of organic material for the instream community of aquatic invertebrates. Maintaining a high percentage of the potential LWD recruitment would ensure that these functions would be provided over the proposed 50-year term of the Permits.

Creating and providing cover in pools, a primary function of LWD that benefits the covered salmonid species, may be of limited benefit to the covered amphibian species since torrent

salamanders and larval tailed frogs prefer riffle habitats. The primary benefit of LWD to the covered amphibian species is the creation of suitable riffle habitat through the storing and sorting of sediment. Increased LWD recruitment under the Proposed Action would help to maintain riffle habitats for the covered amphibians.

4.4.4 Alternative A

The only difference between Alternative A and the Proposed Action is that no monitoring would be conducted for the southern torrent salamander or tailed frog and the adaptive management provisions of the AHCP would not apply to these species. As a result, it would not be possible to use the adaptive management "account" to make changes to the AHCP/CCAAs Operating Conservation Program based on the needs of these species.

Because general timber harvesting and forest management activities, as well as road management and riparian conservation measures, would be the same under Alternative A as under the Proposed Action, potential effects on aquatic and riparian resources within the Primary Assessment Area would also generally be the same as described for the Proposed Action.

Implementation of Alternative A, therefore, would improve aquatic and riparian habitat conditions to the same degree as the Proposed Action, which exceeds improvements in habitat conditions anticipated to occur over time under the No Action Alternative.

These improvements would primarily benefit the two covered fish ESUs and one fish DPS, but they would also have general beneficial effects on other species associated with aquatic and riparian habitats. The two covered fish ESUs and the one covered fish DPS under Alternative A are the Southern Oregon/Northern California Coasts coho salmon ESU, the California Coastal Chinook salmon ESU, and the Northern California steelhead DPS that have been listed by NMFS as threatened under the Federal ESA.

4.4.5 Alternative B

Under Alternative B, Green Diamond would continue to conduct timber harvesting on its property as described under the No Action Alternative. Existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by an AHCP/CCAA conservation strategy specific to this alternative. This strategy would include fixed riparian buffer widths within which no management or timber harvesting would occur adjacent to Class I and II streams, and would establish of ELZs along Class III streams. Green Diamond would not implement an ownership-wide Road Management Plan, and would not automatically implement the specified protection measures for unique geomorphic features, such as CMZs and floodplains. Slope stability and ground disturbance measures would only be applied through the implementation of the current CFPRs. Effectiveness monitoring would not be as extensive under this alternative as under the Proposed Action, and adaptive management with structured feedback loops would not be implemented.

Overall, under Alternative B, it is anticipated that beneficial effects on aquatic and riparian resources resulting from forest management activities increase relative to current conditions and what is anticipated to occur under the No Action Alternative. Enhanced riparian zone protection could lead to additional improvement in riparian conditions over time compared to the No Action Alternative. Without implementation of a more comprehensive,

ownership-wide Road Management Plan and specific sediment minimization measures, the conservation measures contained in Alternative B are not expected to reduce substantially road-related sediment production and delivery to Primary Assessment Area streams relative to the Proposed Action and Alternative A. The anticipated improvement in riparian conditions could result in slightly improved physical habitat for aquatic and riparian species.

4.4.5.1 Hydrologic Effects

Upslope management under Alternative B would be similar to that under the No Action Alternative (and other action alternatives), and would not result in substantive changes in the existing hydrologic regime or in the magnitude and timing of naturally occurring peak and low flows in Primary Assessment Area drainages except locally and on a short-term basis. (See Section 4.3, Hydrology and Water Quality for further discussion of flow regimes.) As such, relatively little change from existing conditions is expected in channel morphology, incidence of bed scour and bank erosion, or quality of aquatic habitat as a result of altered hydrologic conditions. Any impacts that may occur as a result of altered hydrology because of upslope management would be mitigated somewhat by improved riparian conditions resulting from riparian management described below.

4.4.5.2 Riparian Conditions

General Effects. In general, the riparian conservation measures under Alternative B are more protective of riparian functions than those described under the No Action Alternative. Riparian buffers for Class I streams would have fixed widths of 150 feet (slope distance), as measured from the first line of perennial vegetation. Under Alternative B, there would be no forest management or riparian habitat management within Class I riparian buffers (with the exception of creating cable-yarding corridors when other options are impractical). The use of heavy equipment within Class I riparian buffers also would be prohibited under this alternative, except for the use of existing roads and stream crossings for log-hauling purposes (unless otherwise qualified by the CFPRs).

Riparian buffers for Class II streams would have fixed widths of 100 feet (slope distance), as measured from the first line of perennial vegetation. Under this alternative, there also would be no forest management or riparian habitat management within Class II riparian buffers (with the exception of creating cable-yarding corridors when other options are impractical). As for Class I riparian buffers, the use of heavy equipment within Class II riparian buffers would also be prohibited. Under Alternative B, protection of Class III streams would be the same as under the No Action Alternative.

Overall, the riparian conservation measures under Alternative B would provide a level of protection for riparian functions such as LWD recruitment, stream shading, sediment filtration, bank stability, and nutrient input greater than or similar to that under the No Action Alternative or the other action alternatives. With the elimination of forest management within riparian buffers along Class I and Class II watercourses, LWD recruitment would be maintained at a higher level than under any of other Alternative. These measures also would provide a better microclimate for amphibian and other species that utilize habitats along streams. The effect of riparian protection provided under Alternative B on individual riparian functions is described below.

LWD Recruitment. Because forest management would not be allowed in riparian buffers along Class I and II watercourses under Alternative B, LWD recruitment potential would be increased over that under all other alternatives, so that in-channel LWD loading and size would likely increase in the future. However, any benefits of management activities carried out under the No Action Alternative that have the effect of encouraging accelerated growth of conifers would not occur. Whether such an increase would occur within a given stream reach would depend on the current condition and trend of existing LWD levels, and the length of time necessary to recruit additional wood to streams from adjacent riparian areas. For example, if little or no recruitment of wood has occurred recently, and existing pieces of wood are decaying or being washed out of a stream reach, in-stream levels of wood could continue to decline for some time, despite the fact that riparian conservation measures under Alternative B would provide increased potential for recruitment in the future. The prohibition of commercial harvest entry into the riparian buffers (except where cable corridors are necessary) during the term of the Permits would ensure that this additional LWD recruitment potential would be maintained over the 50-year period.

No significant impacts to the hydrologic regime are expected to occur. Implementation of riparian conservation measures under Alternative B would result in increased LWD recruitment that would help mitigate effects of altered hydrology that could occur as a result of upslope management (see Section 4.3, Hydrology and Water Quality).

Stream Shading. The elimination of commercial harvest in the riparian buffers under Alternative B would help to maintain stream shading in the riparian buffer where microclimate effects would have the greatest potential to result in direct impacts to amphibians or indirect impacts to anadromous and resident salmonids through changes in water temperatures. Canopy closure would likely increase from current conditions in all stands as they recover from previous timber harvesting. Increased canopy closure could, therefore, result in slightly decreased water temperatures in Primary Assessment Area streams. The elimination of commercial entry into the riparian buffers (except where cable corridors are necessary to conduct intermediate treatments) during the term of the Permits would help ensure that temperatures and microclimate would remain suitable during the term of the Permits.

Sediment Filtration. Because sediment can be delivered to streams from outside of the riparian zone, maintenance of riparian buffers can aid in the filtration of overland sediment flow and help minimize direct sediment inputs from or through the riparian zone. Eliminating forest management activities within Class I and Class II riparian buffers would minimize the level of ground disturbance that occurs adjacent to Primary Assessment Area watercourses and would minimize the potential for management-related sediment delivery from within the riparian buffers along Class I and Class II watercourses. Eliminating forest management in the riparian buffers under Alternative B would likely enhance bank stability and contribute to higher levels of LWD recruitment relative to existing conditions, the No Action Alternative, and all other alternatives. In turn, LWD recruitment would help mitigate the effects of sediment production and delivery by providing in-channel LWD, which functions to sort and store sediment within stream channels.

Streambank Stability. Bank stability would increase under Alternative B, relative to existing conditions, the No Action Alternative, and all other alternatives because of the establishment of riparian buffers along Class I and Class II watercourses in which no

management would be allowed. Retention of all trees (and their root systems) within the riparian buffer would minimize management-related sediment inputs that could otherwise occur because of bank instability, and provide an overall benefit to covered species and their habitat by reducing sediment delivery to Primary Assessment Area drainages.

Nutrient Input. The riparian conservation measures under Alternative B would favor conifers over hardwoods in the RMZs. Maintenance of no-cut riparian buffers would maintain the overstory canopy, so that the longer-lived conifers would eventually replace the short-lived hardwoods. In the long term, this may reduce the level of nutrient inputs relative to current levels, although such a process would be gradual and would not result in complete elimination of hardwoods or insufficient nutrient input from riparian areas. It is anticipated that any effects on aquatic species and their habitats would be minimal (i.e., less than significant) and mitigated by the benefit of increased LWD recruitment through the retention of conifers. This is particularly relevant where structural elements of aquatic habitat are more limiting than nutrient availability.

4.4.5.3 Sediment Production and Delivery

As described in Section 4.2 (Geology, Geomorphology, and Mineral Resources), sediment production and delivery to Primary Assessment Area streams under Alternative B would likely be generally comparable to the No Action Alternative. Similar to the No Action Alternative, sediment reduction would occur primarily through implementation of current forest road management and maintenance practices. However, roads would be upgraded to current standards only as those roads are utilized in association with individual THPs. Under Alternative B, the design standards of new roads would be the same as the No Action Alternative. Road-related hillslope mass wasting and sediment delivery would still be expected to decrease over time through the application of Green Diamond's current practices. This reduction in sediment delivery is expected to result in a gradual improvement in habitat conditions for aquatic resources, particularly anadromous and resident salmonids (rather than the accelerated improvement that would occur under the Proposed Action and Alternatives A and C).

Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel morphology such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998). Reduced sediment delivery to streams under Alternative B could also contribute to minor beneficial decreases in water temperature. Turbidity, sediment deposition, and the incidence of shallow, wider channels can increase the amount of solar radiation retained in the water column, leading to increased water temperatures. This effect is usually associated with larger, low-gradient rivers where turbidity is higher and exposure to sunlight is prolonged. Streams within the Primary Assessment Area are usually exposed to short-term, high-turbidity events only during snowmelt and rain events, few of which occur during the period of highest temperatures.

4.4.5.4 Aquatic Habitat

Overall, habitat conditions for aquatic and riparian species are expected to improve under Alternative B compared to existing conditions and the No Action Alternative. The magnitude and rate of potential improvement in aquatic and riparian habitat during the term of the Permits, however, are unknown. Under Alternative B, water quality and

substrate in Primary Assessment Area streams would improve because of reduced sediment delivery. There would be little or no change in other water quality parameters, such as nutrient loading, contaminant loading, and dissolved oxygen levels under this alternative. Because canopy closure would likely increase and there would be little change in sedimentation and turbidity levels under Alternative B, future thermal conditions could improve slightly as a result of implementing this alternative compared to the No Action Alternative. Habitat complexity could increase slightly compared to existing conditions and the No Action Alternative through increased LWD loading, increased bank stability, and reduced sediment delivery due to the wider filter strip of the RMZ. Alternative B is similar to the No Action Alternative in that restoration or maintenance of fish passage would only occur during road upgrades and new road construction performed in association with THPs. Barrier removal would generally be piecemeal and tied to implementation of individual THPs scattered across the ownership at any given point in time.

4.4.5.5 Other Factors

As discussed previously for the No Action Alternative, factors besides hydrology, riparian conditions, sediment production and delivery, and aquatic habitat conditions can affect aquatic resources in Primary Assessment Area streams. These other factors include the introduction and presence of non-native species, recreational fishing, illegal fishing, and forest management activities, such as drafting of water from streams for dust abatement, road maintenance, road construction, surfacing, fuel reduction burning, and other land management purposes. Similar to the No Action Alternative, Alternative B does not contain specific prescriptions to address issues related to fishing and non-native fish species occurrence or management. Green Diamond's rock pits are generally less than 2 acres in size and are located more than 100 and 75 feet from Class I and Class II streams, respectively. Water drafting is conducted only under strict guidelines and in compliance with applicable laws to ensure that salmonid and headwater amphibian species are not accidentally suctioned up with the water or harmed by dewatering of the stream where they reside. Under Alternative B, these factors would not result in any changes to aquatic resources and their habitats relative to the No Action Alternative.

4.4.5.6 Research and Monitoring

As described previously for the No Action Alternative, Green Diamond conducts a number of research and monitoring activities as part of the THP process and other regulatory requirements. These include effectiveness monitoring, wildlife surveys, environmental assessments, and watershed studies. Under Alternative B, the level of effectiveness monitoring would be comparable to the No Action Alternative and less than under all other action alternatives.

As with the No Action Alternative, Green Diamond could continue to conduct voluntarily, or allow the conduct of, various watershed, fish, and wildlife management activities for the enhancement or monitoring of watershed, wildlife, and fisheries resources. Examples of such activities that could be conducted in accordance with State and Federal laws include:

- Aquatic habitat enhancement (e.g., instream boulder or LWD placement)
- Activities associated with improving fish passage (e.g., fish ladder construction or repair, culvert improvement or replacement with bridges, blockage removal)

- Instream surveys and sampling of fish (including but not limited to spawning surveys and downstream migrant trapping), aquatic habitat conditions, macroinvertebrates, and water quality

4.4.5.7 Summary of Effects

Overall, aquatic and riparian habitat conditions related to the covered activities are expected to improve under Alternative B relative to existing conditions and relative to the No Action Alternative. The magnitude and rate of potential improvement in aquatic habitat during the term of the Permits, however, are unknown. As described for the Proposed Action, it is expected that benefits to covered species and their habitats would accrue over the 50-year term of the Permits because of more time for the beneficial effects of the conservation measures and improved forest management practices associated with Alternative B to be realized.

Under Alternative B, water and substrate in Primary Assessment Area streams could become cleaner because of reduced sediment loading, sedimentation, and turbidity. A reduction in sedimentation would primarily benefit the anadromous salmonids that utilize Primary Assessment Area streams for spawning and rearing during the freshwater phase of their life cycle. A reduction in substrate embeddedness resulting from reduced sediment input also may benefit the covered amphibian species. The anticipated level of sediment reduction from roads in the Primary Assessment Area under Alternative B would be less than under the Proposed Action. An additional reduction in sediment delivered to streams from hillslope surface erosion is expected as a result of the wider filter strip of the RMZ.

Because canopy closure would likely increase under Alternative B, future thermal conditions could improve slightly as a result of implementing this alternative. While water temperatures are generally suitable for most of the covered species, any improvement (reduction) in summer water temperatures would benefit both fish and amphibians. Alternative B would develop and maintain the highest level of canopy closure of any of the action alternatives, including the Proposed Action.

Habitat complexity under Alternative B could increase compared to existing conditions through increased LWD loading, increased bank stability, and reduced sediment delivery. The physical processes associated with LWD include sediment sorting and storage, retention of organic debris, and modification of water quality. The biological functions associated with LWD structures include providing important rearing habitats, protective cover from predators and elevated stream flow, and regulation of organic material for the instream community of aquatic invertebrates. Creating and providing cover for pools, a primary function of LWD that benefits covered salmonids, may be of limited benefit to the headwater amphibian species covered in the AHCP/CCAA, since southern torrent salamanders and larval tailed frogs prefer riffle habitats. The primary benefit of LWD to the covered amphibians is the creation of suitable riffle habitat through the storing and sorting of sediment. Riparian buffers with no management would maintain a high percentage of the potential LWD recruitment and ensure that these functions would be provided over the term of the Permits.

4.4.6 Alternative C

General timber harvesting and forest management activities, as well as road management and riparian conservation measures, under Alternative C would essentially be the same as under the Proposed Action.

Under Alternative C, adaptive management would provide a mechanism for strengthening or relaxing individual conservation measures in the rain-on-snow areas if monitoring indicates, on the basis of specific performance criteria, that a change is necessary. Overall, implementation of Alternative C is anticipated to result in improved aquatic and riparian habitat conditions compared to existing conditions or to conditions anticipated to occur under the No Action Alternative. Green Diamond's commitment to provide $2.5 million per year for the first 15 years of the AHCP/CCAA to accelerate implementation of treatments for high- and moderate-risk sediment delivery sites would be extended to include the additional 25,677-acre rain-on-snow areas under Alternative C. Because accelerated site treatments over the 15-year period would be spread over a larger area, potential benefits may be diluted relative to what would be expected to occur under the Proposed Action. Also, since the balance within the adaptive management "account" for the Proposed Action would also apply to a larger area under Alternative C, utilization of the account balance may also be diluted relative to what would be expected to occur under the Proposed Action. Implementation of Alternative C, therefore, would result in aquatic and riparian habitat conditions comparable to or slightly less improved relative to conditions that would result from implementing the Proposed Action.

Improvements would primarily benefit the eight fish species covered under Alternative C, but they also would have general beneficial effects on the four amphibian species and one reptile species covered under this alternative that are associated with aquatic and riparian habitats.

4.4.7 Cumulative Impacts – Aquatic Resources

The assessment of potential cumulative impacts on aquatic resources was conducted using the approach described in Section 4.1.2, Cumulative Impacts, of this EIS. The assessment area for cumulative impacts consists of the 11 HPAs that contain Action Area lands operated by Green Diamond and covered in its AHCP/CCAA, as well as other lands that are predominantly either privately owned, administered by a Federal resource management agency, or are State or Federal park lands. Habitat and species present in watersheds within each HPA are largely influenced by management strategies of the various land and resource managers. Resource management strategies being employed in these HPAs, when combined with future management strategies that would be employed by Green Diamond, can affect covered species and their habitats, especially in those HPAs where covered species are widely distributed. The purpose of this cumulative impact assessment is to evaluate and compare the potential collective effects of the varied resource management strategies reflected in the action alternatives on the covered species being evaluated in this EIS.

As noted in this section (4.4, Aquatic Resources) and in other impact assessment discussions in this EIS (Section 4.2, Geology, Geomorphology, and Mineral Resources; and Section 4.3, Hydrology and Water Quality), continued implementation of Green Diamond's practices under the No Action Alternative and implementation of the CFPRs on other commercial timberlands within the 11 HPAs will result in a trend towards improved future aquatic and riparian habitat conditions compared to existing conditions. Conditions would be further improved under the Proposed Action and each of the other action alternatives. Implementing the Proposed Action or the other action alternatives would result overall in improvements to aquatic and riparian habitats. These improvements would accrue over the 50-year term of the Permits because of the additional time for the effects of the conservation

measures and improved forest management practices to be realized. Some improvements to aquatic and riparian habitats and covered species are expected to be slightly greater under the Proposed Action and Alternatives A and C than under Alternative B, because of differences between the alternatives (i.e. accelerated sediment reduction work).

As noted in Section 1.5.3.1, continued implementation of the CFPRs themselves (and the THP review and approval process) do not necessarily ensure "achievement of properly functioning habitat conditions" necessary to "adequately conserve anadromous salmonids" listed under the ESA. The BOF has adopted "interim" rules for Class I watercourses that have strengthened the CFPRs and the THP process. NMFS continues to find that the CFPRs do not ensure the achievement of properly functioning habitat for conservation of anadromous salmonids throughout their range in California. However, forest practices operations conducted pursuant to this process in a particular area, land ownership, or region may achieve such conditions.

Conservation measures associated with the PALCO HCP, like those being proposed by Green Diamond in its AHCP/CCAA, exceed the CFPR standards and are designed to improve riparian and aquatic habitats for certain species using various prescriptions directed at riparian management, road management, controlling sediment delivery, and exclusion areas. The beneficial effects of the PALCO HCP on those species would have a primary and positive influence on habitat conditions in the Eel River and Humboldt Bay HPAs. These are the only HPAs being considered in this EIS where PALCO has ownership.

The USFS and/or BLM also manage Federal lands in the Blue Creek and the Smith River HPAs. Less than 7 percent of lands in the other HPAs are managed by either of these agencies. The resource management strategies on lands administered by the USFS and BLM include the continued implementation of aquatic and riparian resource guidelines contained in the NWFP for Federal lands. These strategies do not allow timber harvesting or activities in wide, fixed-width riparian buffers prior to a completed watershed analysis, and are expected to result in incremental improvements in aquatic and riparian habitat conditions within HPAs where the USFS/BLM administer public lands. Current protections for and benefits to aquatic resources and riparian habitat in those HPAs where Federal agencies are the predominant land managers would be expected to continue into the future.

Incremental improvements associated with resource management on lands administered by the State of California and the National Park Service are most important in the Redwood Creek and Smith River HPAs, where State and Federal parklands together comprise 41.8 percent and 15.9 percent of the total land ownership, respectively. Resource management strategies in parklands essentially allow no commercial timber harvesting. In addition, streamside and upslope activities that would affect water quality conditions are extremely limited. Therefore, overall improvements are anticipated for aquatic resources and riparian habitat conditions in parkland drainages.

Overall, implementation of the Proposed Action, in conjunction with all of the above resource management programs on public and private lands is expected to protect and/or to improve aquatic resources and riparian habitat conditions in each of the 11 HPAs over time when compared with the No Action Alternative.

4.5 Vegetation/Plant Species of Concern

The purpose of this section is to evaluate the potential impacts of implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative, on vegetation and plant species of special concern. Growth projections indicate that under the current management regime, forest trends in the Green Diamond ownership will lead to increased age class and size, as well as increased total acreage with dense canopy closure. These trends are expected to accelerate under the Proposed Action and other action alternatives over the duration of the term of the Permits. The timing of past harvesting activity over the Green Diamond ownership has resulted in a current mosaic of age classes dominated by forests types less than 60 years old, with approximately 85 percent of the ownership supporting forests in these age classes. Twelve percent of the property is in forest types 60 years old or older. The proportion of the area in these older age classes is expected to remain at this level or increase over the term of the Permits for two reasons:

- CFPR adjacency constraints that are applied to even-aged harvesting units result in retention of many stands far past planned rotation age. If harvesting of a tract of mature timber is initiated around age 50, the harvesting of much of that tract will be constrained into the following decade, and the harvest of a few stands will be constrained past 70 years of age. This effect has been demonstrated in Green Diamond's long term operating plan (i.e., Option (a) document).
- Current rules and regulations, interacting with provisions of the NSOHCP, result in harvesting restraints or prohibitions on approximately 12 percent of Green Diamond's ownership in the Primary Assessment Area. Provisions of the AHCP/CCAA would add to the area subject to such restrictions. Trees in these areas will be retained at least through term of the Permits and will thus add to the total acreage in older age classes.

The accelerated development of mid- and late-seral stand types as a result of implementation of the conservation measures under the Proposed Action and other action alternatives is anticipated within riparian areas. These trends would be expected to result in some long-term beneficial effects to wildlife species that use these habitats relative to the No Action (See Section 4.6, Terrestrial Habitat/Wildlife Species of Concern).

4.5.1 Methodology

The assessment for vegetation and plant species of concern is based on information in the AHCP/CCAA; data collected and documented in the affected environment discussion of vegetation and plant species of special concern (see Section 3.5, Vegetation/Plant Species of Concern); widely accepted ecological principles of natural succession; and the latest understanding of forest succession in managed timberlands. A key premise of this assessment is that non-riparian lands under all the alternatives would be managed in accordance with existing regulations, other applicable laws, Green Diamond's NSOHCP, and Green Diamond operational policies and guidelines (i.e., the No Action Alternative, see Section 2.1). The Proposed Action and the other action alternatives would also apply all, or portions of, the conservation measures from the AHCP/CCAA. The analysis of the action alternatives is a qualitative assessment that focuses on the impacts of potential changes to habitat within the riparian zones; the greatest potential for vegetation changes exists within these areas. The assessment focuses on habitat type, vegetation structure, and canopy

closure for each of the alternatives. As discussed in Section 3.5, Vegetation/Plant Species of Concern, habitat types for vegetation are based on the California Wildlife Habitat Relationships (CWHR) System (Mayer and Laudenslayer, 1988). The CWHR classification identifies habitat type, size class, and canopy-cover class. In this EIS, the CWHR classification system is applied in the context of continued management of Green Diamond's timber resources achieve to maximum sustained production (MSP) of high-quality timber products (see Sections 1.5.3.1 and 1.6.3.2). The CWHR system is used in this analysis to identify potential changes to habitat type within Green Diamond's ownership and to compare existing conditions with future vegetative habitat conditions. (The assessment in this section is the basis for assessing impacts to wildlife species in Section 4.6, Terrestrial Habitat/Wildlife Species of Concern.) For those lands in the Primary Assessment Area not owned by Green Diamond, a general characterization is presented.

4.5.2 No Action Alternative

4.5.2.1 General Effects

In the context of Green Diamond's Option (a) document, changes to habitat type (i.e., species composition), size class, and canopy-cover class can occur on an individual harvest-unit basis. Size class and canopy closure within an individual timber harvest unit could change depending on the extent of timber harvesting conducted. This could occur both in upland areas (where even-aged management is applied) and in riparian areas (where selective harvest is conducted). Species composition in individual harvest units, however, is not anticipated to change because the CWHR-classified areas are not reclassified on the basis of timber harvesting. For example, when a montane hardwood/conifer forest is harvested, it retains its CWHR-assigned classification as a montane hardwood/conifer forest. Only the size class and canopy-cover class would change. This example applies to all the forest types described in Section 3.5, Vegetation/Plant Species of Concern.

As stated in Green Diamond's Option (a) document, timber stands in upland (non-riparian) areas on the Green Diamond ownership are considered ready for harvest once they enter the 50-year age class. State law, however, constrain both the size of even-aged management units and the timing of adjacent even-age harvesting operations. As a result, many stands may not be harvested until they reach the 70-year age class. The estimated average age of stands harvested is expected to be approximately 55 years as the property approaches full "regulation."

The timber harvesting cycle for uneven-age management areas (mostly riparian corridors) is generally between 10 and 50 years. Under the No Action Alternative, the potential for changes in species composition, size class, and canopy-cover class would be most evident in the riparian areas where complete stand replacement prescriptions, typical of the more upland areas, do not exist and individual tree selection and harvesting practices result in heavier emphasis on mid- to late-seral-stand development.

4.5.2.2 Riparian Management Effects

Historically, uneven-aged timber management within the Primary Assessment Area has focused on WLPZs, water supply areas, visually sensitive road corridors, nest sites of selected bird species (e.g., northern spotted owl), and residential property lines. Throughout much of the Primary Assessment Area, management practices that occurred prior to

implementation of the CFPRs in 1973 emphasized removal of most large conifers from the riparian zone. Before the CFPRs were implemented, decades of timber harvesting in the riparian zone altered the species composition and age classes of trees along stream channels. The removal of valuable conifer species led to the establishment and later predominance of early successional hardwood species, such as alders and willows, during this period.

Existing regulations, while allowing harvesting in riparian areas, provide guidelines that are designed to promote riparian stand diversity and enhance aquatic habitats. Under the No Action Alternative, these regulations and guidelines are augmented by additional measures, identified in the Green Diamond NSOHCP, that provide for retention of a variety of tree sizes (height and diameter) and species within WLPZs, with priority given to wildlife habitat trees.

The No Action Alternative, including the implementation of the measures designed to protect riparian vegetation and avoid impacts to occupied marbled murrelet habitat, plus continued implementation of Green Diamond's NSOHCP, is expected to provide the conditions in which a greater number of large trees could be present, over time, in riparian areas in the Primary Assessment Area. These conditions indicate an overall trend toward development of a greater number of large trees within riparian areas. Vegetation management activities in riparian areas would be expected to remain relatively unchanged from existing timber-harvesting practices, and similar species compositions would be retained.

4.5.2.3 Listed Plant Species and Other Plant Species of Concern

Under the No Action Alternative, Green Diamond would continue to exercise the precautions necessary to comply with the prohibitions on take of listed plants. Take of federally listed plants is not prohibited under the ESA, unless take prohibitions under State law exists. Green Diamond would continue to avoid or minimize potential adverse impacts to listed plants, including continuing to adhere to measures contained in the CFPRs (special protections afforded to meadows and wetlands), Green Diamond's own Plant Protection Program, and other measures identified during the THP preparation and review process. Existing regulations require that THPs include measures to avoid or minimize potential adverse impacts to listed plant species and other species of concern (if they occur) to a level of insignificance.

Green Diamond's Plant Protection Program (Green Diamond, 2001) is a three-tiered program that is based on an ongoing agreement with CDFG. Under Phase I of the agreement, Green Diamond avoids all listed plants/plant species of concern (referred to as "sensitive plants") or their habitats within THP project areas. Under Phase II of the agreement (currently being implemented by Green Diamond), Green Diamond surveys for sensitive plants in accordance with protocols approved by CDFG. Plant surveys are conducted in advance of operations within a project area or a generally larger area if specific project area boundaries are unknown. If the surveys indicate that sensitive plants do not exist within the project area, Green Diamond is allowed to initiate timber harvesting and related activities even if sensitive plant habitats are present. When plants are found, Green Diamond further consults with CDFG to determine appropriate site-specific mitigation for those plants that are incorporated into THPs, as necessary. If surveys are not possible due to project planning and timing, Green Diamond avoids sensitive plants and their habitats as provided under the Phase I portion of the agreement. Phase III plant protection measures, still under discussion with CDFG, provide for development of a more comprehensive,

long-term strategy for the entire ownership that will likely incorporate surveys for sensitive plants, impact avoidance and risk minimization measures, and monitoring. The suite of Phase III protection measures will be based on site-specific data collected during Phase II surveys. Green Diamond's botanist has responsibility for implementing the program, and training is provided to Green Diamond foresters on sensitive plant and habitat recognition. The Plant Protection Program is applied on all projects that are THP-related.

Four plant species listed as Federal- or State-endangered occur within the Primary Assessment Area, including Humboldt milk-vetch (*Astragalus agnicidus*), Kneeland prairie pennycress (*Thlaspi californicum*), McDonald's rock cress (*Arabis macdonaldiana*), and western lily (*Lilium occidentale*). Potential habitat for Humboldt milk-vetch (*Astragalus agnicidus*), a species listed by the State of California as endangered, occurs within the Primary Assessment Area; however, this species has not been observed in the Primary Assessment Area.

Western lily is primarily associated with wetland habitats that are protected from forestry activities under the CFPRs. These circumstances minimize potential effects within the habitat associations for western lily. Kneeland prairie pennycress is associated with broad-leaved upland forests and coastal prairies. Only activities incidental to the management of Green Diamond's merchantable timber would be expected to occur within broad-leaved forests and coastal prairie habitats. On this basis, minimal effects are anticipated in the habitat preferred by Kneeland prairie pennycress and Humboldt milk-vetch. McDonald's rock cress is associated with montane coniferous forests. Forest management activities would occur within this habitat type, and the potential for incidental disturbance of McDonald's rock cress exists.

Table 4.5-1 presents: (1) a list of all the plant species of concern known to occur or likely to occur within the 11 HPAs and Green Diamond ownership outside of the HPAs; (2) their habitat association; and (3) a summary of potential impacts associated with the No Action and other alternatives. For all species and all alternatives, either no impacts would occur or the impacts would be minimal and, therefore, less than significant. In addition, many of the species' habitats (e.g., coastal prairies, wetlands) would not be disturbed by Green Diamond's activities or would be disturbed only incidentally; changes to these habitats are anticipated to be negligible over time.

4.5.3 Proposed Action

Under the Proposed Action, Green Diamond's management of its lands and the conduct of timber harvesting in the Primary Assessment Area would be the same as under the No Action Alternative. In addition, existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment of RMZs for Class I and II streams, establishment of EEZs for Class III streams, and limited activities within the RMZs and EEZs. Green Diamond also would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs.

4.5.3.1 General Effects

In general, vegetation resources in the Primary Assessment Area and the 11 HPAs would be similar to the conditions described for the No Action Alternative, with the exception of riparian areas, landslide hazard areas, and in the vicinity of roads (current and future). The

TABLE 4.5-1
Plant Species of Special Concern: Habitat Association and Potential Impacts

Species	Habitat Associations	Impacts
Listed Species		
Humboldt milk-vetch *Astragalus agnicidus*	broad-leaved forests	None. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Kneeland prairie pennycress *Thlaspi californicum*	CSC	None; CSC not harvested and little disturbance in broad-leaved forests. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
McDonald's rock cress *Arabis macdonaldiana*	coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Western lily Lilium occidentale	CSC, freshwater marshes, bogs, fens, PGS, coniferous forests	None; CSC, PGS, and wetlands not harvested. Broad range of habitats. Special protections for wetland areas in existing regulations. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Non-Listed Species of Concern		
American Manna Grass *Glycera grandis*	WTM, ditches, RIV, LAC	None. Habitat is non-timberland. No direct disturbance. Special protections in existing regulations for habitat associations.
Arctic spoonwort *Cochlearia officinalis* var. *arctica*	CSC	None. Habitat is non-timberland. Incidental and less-than-significant disturbance possible. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Arctic starflower *Trientalis arctica*	Meadows, seeps, bogs, fens	None. Wetlands not harvested. Special protections in existing regulations for habitat associations.
Bensoniella *Bensoniella oregona*	RIV, meadows, bogs, fens, coniferous forests	None. Not likely to occur in timberlands; mostly associated with wetlands. Special protections in existing regulations for habitat associations.
Black crowberry *Empetrum nigrum* ssp. *hermaphroditum*	CSC, PGS	None; no timber harvesting in habitat areas (PGS and CSC); incidental and less-than-significant disturbance possible. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Bog club moss *Lycopodiella inundata*	Bogs, fens, marshes, swamps, coniferous forests,	None. Not likely to occur in timberlands; mostly associated with wetlands. Special protections in existing regulations for habitat associations. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Coast checkerbloom *Sidalcea oregana* ssp. *eximia*	Meadows and seeps, coniferous forests	None. Incidental and less-than-significant disturbance possible in forest areas. Special protections in existing regulations for meadows and seeps. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.

TABLE 4.5-1
Plant Species of Special Concern: Habitat Association and Potential Impacts

Species	Habitat Associations	Impacts
Coast Range lomatium *Lomatium martindalei*	CSC, meadows, coniferous forests	None; no timber harvesting in habitat areas (CSC); incidental and less-than-significant disturbance possible. Special protections in existing regulations for meadows. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Del Norte buckwheat *Eriogonum nudum* var. *paralinum*	CSC, PGS, open places along immediate coast	None; no timber harvesting in habitat areas (PGS and CSC); incidental and less-than-significant disturbance possible. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Dwarf alkali grass *Puccinellia pumila*	Mineral springs and coastal salt marshes	None. No activity in salt marshes. Special protections in existing regulations for habitat associations.
English peak greenbriar *Smilax jamesii*	Marshes, LAC, swamps, RIV, coniferous forests	None. No direct disturbance. Species associated primarily with wetlands and waterbody edges. Special protections in existing regulations for wetlands and waterbodies. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Fiberous pondweed *Potamogeton foliosus* var. *fibrillosus*	Marshes, ponds, small streams	None. Habitat is non-timberland. No direct disturbance. Special protections in existing regulations for habitat associations.
Flaccid sedge *Carex leptalea*	Meadows, bogs, fens, marshes and swamps	None. Not likely to occur in timberlands; mostly associated with wetlands. Special protections in existing regulations for habitat associations.
Great Burnet *Sanguisorba officinalis*	Marshes, swamps, bogs, fens, seeps, RIV, meadows, broad-leaved and coniferous forests	None. Not likely to occur in timberlands; mostly associated with wetlands. Special protections in existing regulations for meadows, marshes, and other wetland areas. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Henderson's fawn lily *Erthronium hendersonii*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Horned butterwort *Pinguicula vulgaris ssp. macroceras*	Bogs, fens, meadows, seeps	None. Wetlands not harvested. Special protections in existing regulations for habitat associations.
Howell's jewel flower *Streptanthus howellii*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Howell's montia *Montia howellii*	Vernally wet sites, coniferous forest	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.

TABLE 4.5-1
Plant Species of Special Concern: Habitat Association and Potential Impacts

Species	Habitat Associations	Impacts
Humboldt milk-vetch *Astragalus agnicidus*	Broad-leaved forests	None. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Indian pipe *Monotropa uniflora*	Often associated with redwoods and western hemlock; broad-leaved and coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Koehler's stipitate rock cress *Arabis koehleri var. stipitata*	Chaparral, coniferous forests	Less than significant. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Langsdorf's violet *Viola langsdorfii*	Bogs, fens and wet areas in CSC	None. Wetlands and CSC not harvested. Special protections in existing regulations for bogs, fens, and other wetland areas.
Maidenhair spleenwort *Asplenium trichomanes* ssp. *trichomanes*	Coniferous forests	Less-than-significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Maple leaved checkerbloom *Sidalcea malachroides*	Coastal woodlands and clearings, often in disturbed areas. CSC, PGS, broad-leaved and coniferous forests	Less than significant. CSC and PGS not harvested, and little disturbance in broad-leaved forest types. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Marsh pea *Lathyrus palustris*	PGS, CSC, bogs, fens, marshes, swamps, coniferous forests	None. CSC, PGS, and wetlands not harvested. Broad range of habitats. Special protections in existing regulations for wetland areas. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Marsh violet *Viola palustris*	CSC, bogs and fens	None. CSC and wetlands not harvested. Special protections in existing regulations for bogs and fens.
Meadow Sedge *Carex praticola*	Moist to wet meadows	None. Mostly associated with wetlands. Meadow and wetland protections in existing regulations.
Mendocino gentain *Gentiana setigera*	Meadows, coniferous forests	Less than significant. Special protections for meadows in existing regulations. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Northern microseris *Microseris borealis*	Meadows, bogs, fens, marshes and swamps, coniferous forests	None. Mostly associated with wetlands. Wetland and meadow protections in existing regulations. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Nuttall's saxifrage *Saxifraga nuttallii*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.

TABLE 4.5-1
Plant Species of Special Concern: Habitat Association and Potential Impacts

Species	Habitat Associations	Impacts
Opposite leaved lewisia *Lewisia oppositifolia*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Oregon Fireweed *Epilobium oreganum*	Bogs, fens, meadows, coniferous forests	Less than significant. Species mostly associated with wetlands. Wetland and meadow protections in existing regulations. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Oregon lungwort *Mertansia bella*	Meadows, seeps, coniferous forests	Less than significant. Special protections for meadows and seeps in existing regulations. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Purple stemmed checkerbloom *Sidalcea malvaeflora* ssp. *patula*	PGS, broad-leaved forests	None. PGS not harvested, and little disturbance in broad-leaved forests. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Robust false Lupin *Thermopsis robusta*	Broad-leaved and coniferous forests	Less than significant. Little disturbance in broad-leaved forests. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Robust monardella *Monardella villosa* ssp. *globosa*	Chaparral, montane woodlands	Less than significant. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Running pine *Lycopodium clavatum*	Moist areas, marshes and swamps, coniferous forests	None. Species mostly associated with wetlands. Wetland protections in existing regulations. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Sanford's arrowhead *Sagittaria sanfordii*	Marshes, swamps, ponds, ditches	None. Mostly associated with wetlands. Wetland protections in existing regulations.
Siskiyou Indian paintbrush *Castilleja miniata* ssp*. elata*	Bogs, fens, RIV, coniferous forests	Less than significant. Broad range of habitats. Special protections for bogs, fens, and other wetlands in existing regulations. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Siskiyou phacelia *Phacelia leonis*	Meadows and seeps, coniferous forests	Less than significant. Broad range of habitats. Special protections for meadows and seeps in existing regulations. Other potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Small ground cone *Boschniakia hookeri*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.

TABLE 4.5-1
Plant Species of Special Concern: Habitat Association and Potential Impacts

Species	Habitat Associations	Impacts
Sonoma manzanita *Arctostaphylos canescens* ssp. *sonomensis*	Chaparral, coniferous forests	Less than significant. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Thurber's reed grass *Calamagrostis crassiglumis*	CSC, freshwater marshes	None. CSC and wetlands not harvested. Special protections for wetland areas in existing regulations.
Two Flowered Pea *Lathyrus bifolorus*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Waldo Buckwheat *Erogonum pendulum*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Waldo Daisy *Erigonium bloomeri* var. *nudatus*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Waldo rock cress *Arabis aculeolata*	Broad-leaved and coniferous forests	Less than significant. Little disturbance in broad-leaved forests. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Water bulrush *Scirpus Subterminalis*	Marshes and swamps; LAC	Less than significant. Species is associated with wetlands and waterbody edges. Wetland protections in existing regulations.
Western Bog Violet *Viola primulifolia* ssp. *occidentalis*	Bogs, fens, marshes, swamps, streamside flats	Less than significant. Species associated w/ wetlands and waterbody edges. Wetland protections in existing regulations.
Wolf's evening primrose *Oenothera wolfii*	CSC, PGS, dunes, coniferous forests	Less than significant. No activity in dunes. CSC and PGS not harvested. Broad range of habitats. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.
Yellow-tubered toothwort *Cardamine nuttallii* var. *gemmata*	Coniferous forests	Less than significant. Potential impacts mitigated through adherence to general protection measures contained in existing regulations.

CSC Coastal Scrub
PGS Perennial Grassland
LAC Lacustrine
RIV Riverine
WTM Wet meadow

Proposed Action would implement additional measures (compared with the No Action Alternative) that could result in long-term beneficial effects to wildlife species associated with mid- to late-seral habitat types (see Section 4.6, Terrestrial Habitat/Wildlife Species of Concern). Beneficial effects on vegetation resources within these areas are anticipated to be greater under the Proposed Action than under the No Action Alternative, as a result of implementing AHCP/CCAA measures designed to protect riparian areas (AHCP/CCAA Section 6.2.1). These measures include:

- Class II RMZ widths of 75 to 100 feet compared to WLPZ widths of 50 to 100 feet for Class II streams under the No Action Alternative
- EEZs of 30 to 50 feet for Class III streams compared to ELZs of 25 to 50 feet under the No Action Alternative
- Inner- and outer-zone tree and overstory canopy retention standards for RMZs
- No mechanical site preparation by wheeled or tracked equipment in Class I or Class II RMZs

In addition, the AHCP/CCAA would:

- Prohibit timber harvesting within the "inner zone" of all Class I RSMZs and 2nd order or larger Class II RSMZs (see Section 2.2.3.1) that are located below designated "steep streamside slope management zones" (SMZs) (see Sections 6.2.2.1 and 6.3.2.1 of the AHCP/CCAA), except for purposes of creating cable-yarding corridors when other options are impractical. (RMZ areas located below an SMZ are referred to as RSMZs in the AHCP/CCAA.) Retention of a minimum 85 percent overstory canopy closure would be required in Class I and 2nd order or larger Class II RSMZ "outer zones."
- Allow limited timber harvesting within the first 1,000 feet of a 1st order Class II RSMZ inner zone subject to 85 percent overstory canopy closure retention post-harvest. A minimum 75 percent overstory canopy retention within the first 1,000 feet of a 1st order Class II RSMZ outer zone would also be required. (See Section 6.2.2.1 of the AHCP/CCAA).
- Prohibit timber harvesting within the entire RSMZ for the Coastal Klamath and Blue Creek Hydrographic Areas.
- Use single-tree selection as the initial silvicultural prescription within SMZs and the only prescription within headwall swales. In addition, one commercial entry would be allowed within SMZs and headwall swales for the term of the Permit (except for cable corridors necessary to conduct intermediate treatments). All hardwoods within SMZs and headwall swales would be retained and, wherever possible, Green Diamond would provide for even spacing of unharvested conifers such that all species and size classes represented in pretreatment stands would generally be represented post harvest. The AHCP/CCAA provides flexibility for this default prescription to be modified pursuant to site-specific geologic review.
- Establish no-cut zones within the toe, and 25 feet upslope from the top of the toe of active deep-seated landslides, except for purposes of creating cable-yarding corridors when other options are impractical. Similarly establish no-cut zones upslope of the

deep-seated landslide scarp so as to taper to the lateral margins of the scarp. The AHCP/CCAA provides flexibility for this default prescription to be modified pursuant to site-specific geologic review.

- Prohibit timber harvesting within the boundaries of shallow rapid landslides, and retain a minimum 70 percent overstory canopy within 50 feet above and 25 feet on the sides of shallow rapid landslides. The AHCP/CCAA provides flexibility for this default prescription to be modified pursuant to site-specific geologic review.

The development of additional acreage in mid- and late-seral stand types under the No Action Alternative would be accelerated as a result of implementing the additional conservation measures listed above for the Proposed Action. The accelerated development of these stand types is anticipated to be most pronounced within riparian areas.

4.5.3.2 Riparian Management Effects

Under the Proposed Action, only a small proportion of the trees within RMZs would be harvested; those that remain would continue to mature, following removal of adjacent upland stands. Trees in the RMZs would age throughout the term of the AHCP/CCAA. By the end of the term of the Permits, over one-third of the RMZ stands would be older than 100 years and the remainder would be between 51 and 100 years. At age 100, in a typical redwood zone, there will be approximately 120 trees per acre with around 12 percent of those trees larger than 36 inches dbh; a few trees would exceed 48 inches dbh; and the tallest trees in the stand would be approximately 170 feet (see Section 7.2.3 of the AHCP/CCAA). Under the Proposed Action, therefore, riparian areas would comprise more mature trees by the end of the Permit term, compared with either existing conditions or the improvements expected to occur over time under the No Action Alternative.

Vegetation management activities in riparian areas under the Proposed Action would result in a more desirable plant community composition over time relative to the No Action Alternative and existing conditions. More conifers would be maintained compared to what would be anticipated under the No Action Alternative, where mostly hardwoods currently exist in riparian areas.

4.5.3.3 Listed Plant Species and Other Plant Species of Concern

The impacts described for Humboldt milk-vetch, kneeland prairie pennycress, McDonald's rock cress, and western lily would be the same under the Proposed Action as those described for the No Action Alternative. Although certain minimal habitat disturbances are anticipated to occur under the Proposed Action, no significant impacts to listed plant species are expected. This is comparable to the level of disturbance expected to occur over time under the No Action Alternative. Take of federally listed plants is not prohibited under the ESA, unless take prohibitions under State law exists. Under the Proposed Action Green Diamond would continue to minimize adverse effects to listed plants and plant species of concern, including continuing to adhere to measures contained in the CFPRs (special protections afforded to meadows and wetlands), Green Diamond's own Plant Protection Program, and other measures identified during the THP preparation and review process

4.5.4 Alternative A

Under Alternative A, operations within the Action Area would be subject to the provisions of an ITP only, meaning there would be no coverage for unlisted species and no application for an ESP. Impacts to vegetation and plant species of concern would be the same as those described for the No Action and Proposed Action.

4.5.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. Green Diamond would not implement an ownership-wide Road Management Plan or slope stability and ground disturbance measures, and would not automatically implement the specified protection measures for unique geomorphic features, such as CMZs and floodplains. Effectiveness and compliance monitoring would not be as extensive under this alternative as for the Proposed Action, and adaptive management with structured feedback loops would not be conducted. Under this alternative, impacts to vegetation and listed plants/plant species of concern would be comparable to the No Action Alternative and the Proposed Action.

4.5.5.1 General Effects

In general, under Alternative B, vegetation resources in the Primary Assessment Area and the 11 HPAs would be similar to the conditions described for the No Action Alternative, with the exception of riparian areas. In this Alternative, Green Diamond would not conduct timber-harvesting activities within no-cut riparian buffers for Class I and II streams that are wider than the RMZs described for the Proposed Action. No-cut riparian buffers could result in long-term beneficial effects to plant species associated with riparian areas. Beneficial effects on plant species dependent on these habitats are anticipated to be greater within these areas under Alternative B than under the No Action Alternative.

The slope stability measures, designed to prevent or reduce erosion and to reduce the potential for hillslope mass wasting under the Proposed Action, would not apply under Alternative B. Consequently, landslide risks are anticipated to be similar to those under the No Action Alternative with concomitant impacts to standing vegetation in these areas.

The composition of plant communities in the Primary Assessment Area and the 11 HPAs would be similar to the other alternatives. Compared to the No Action Alternative, Alternative B would likely result in a smaller increase in stand types with intermediate-sized trees, yet there would likely be more stands with large-sized trees.

4.5.5.2 Riparian Management Effects

Within riparian areas, the benefits of Alternative B would be greater than the No Action Alternative. Establishment of fixed riparian-buffer areas, within which no management would occur, would provide for a greater number of large trees, at greater distances from the stream channels, than under any of the other action alternatives. The absence of management within the riparian buffers areas, however, indicates that differences would only become evident either at the end or past the term of the Permits.

4.5.5.3 Listed Plant Species and Other Plant Species of Concern

Although certain minimal habitat disturbances are anticipated to occur under Alternative B, no effects to listed plant species are expected. This is the same as the No Action Alternative. Under Alternative B, Green Diamond would continue to exercise the precautions necessary to comply with the prohibitions on take of listed plants. Take of federally listed plants is not prohibited under the ESA, unless take prohibitions under State law exists. Green Diamond would continue to minimize adverse effects to listed plants and other plant species of concern, including continuing to adhere to measures contained in the CFPRs (special protections afforded to meadows and wetlands), Green Diamond's own Plant Protection Program, and other measures identified during the THP preparation and review process.

4.5.6 Alternative C

Under Alternative C, Green Diamond would continue to conduct timber operations as described in the Proposed Action (see Section 2.2.2) and the No Action Alternative (see Section 2.2.1), with one exception. Alternative C adds 25,677 acres of rain-on-snow areas to be covered by the AHCP/CCAA.

4.5.6.1 General Effects

The impacts to vegetation resources from Alternative C would be the same as those described under the Proposed Action, except the measures described in the Proposed Action would be extended to Green Diamond ownership outside of the 11 HPAs in rain-on-snow areas. Also, prescriptions would be included for the marbled murrelet, bald eagle, and western pond turtle, which would be additional species covered under the ITP.

The conservation strategy described for the marbled murrelet under this alternative would allow phased harvesting of isolated, residual late-seral timber stands. Harvesting would occur first in stands with the lowest value for murrelets and there would be provisions for extended phasing of harvests in stands with the highest value for murrelets. Implementation of the species-specific measures for the murrelet under Alternative C would result in the loss of some late-seral stand types compared to the No Action Alternative.

4.5.6.2 Riparian Management Effects

Within riparian areas, the benefits of Alternative C would be greater than the No Action Alternative and similar to the Proposed Action except that benefits would extend to the additional 25,677 acres of rain-on-snow areas to be covered by the AHCP/CCAA.

4.5.6.3 Listed Plant Species and Other Plant Species of Concern

The impacts to listed plant species under Alternative C would be the same as under the No Action. The only listed species recorded to occur within Green Diamond-owned rain-on-snow areas is McDonald's rock cress. There are no listed plant species known or likely to occur in, or adjacent to, murrelet or bald eagle stands that could be affected by the murrelet and bald eagle prescriptions under Alternative C. Although certain minimal habitat disturbances are anticipated to occur under Alternative C, no effects to listed plant species are expected. Under Alternative C, Green Diamond would continue to exercise the precautions necessary to comply with the prohibitions on take of listed plants. Take of federally listed plants is not prohibited under the ESA, unless take prohibitions under State

law exists. Green Diamond would continue to minimize adverse effects to listed plants, including continuing to adhere to measures contained in the CFPRs (special protections afforded to meadows and wetlands), Green Diamond's own Plant Protection Program, and other measures identified during the THP preparation and review process.

The impacts to other plant species of concern under Alternative C would be the same as the No Action. There are five species, with a historic record in the rain-on-snow areas, that have not been recorded in the Primary Assessment Area. Although Humboldt milk vetch has been recorded to occur in the vicinity of the rain-on-snow areas, this species is associated with broad-leaved upland forests, which are not typically harvested. Oregon lungwort and Siskiyou phacelia have been recorded in the vicinity of the rain-on-snow area. These species, however, are known to occur only in Siskiyou and Trinity counties, whereas the Primary Assessment Area is located in Del Norte and Humboldt counties. Under Alternative C, Green Diamond would continue to exercise the precautions necessary to minimize adverse impacts to Waldo daisy and Waldo rock cress by adhering to measures contained in the CFPRs, Green Diamond's own Plant Protection Program, and other measures identified during the THP preparation and review process. There are no plant species of concern, known or likely to occur in or adjacent to murrelet or bald eagle stands, that could be affected by the murrelet and bald eagle prescriptions under Alternative C.

4.5.7 Cumulative Impacts – Vegetation/Plant Species of Concern

The assessment of potential cumulative impacts on vegetation and plant species of concern was conducted using the approach described in Section 4.1.2, Cumulative Impacts. The assessment area for cumulative impacts consists of the 11 HPAs that contain Action Area lands owned by Green Diamond and covered in its AHCP/CCAA; and other lands that are predominantly either privately owned, administered by a Federal resource management agency, or State or Federal park lands. Resource management strategies that are being applied in these HPAs, combined with future management strategies that would be used by Green Diamond, have the potential to result in cumulative effects on vegetation and plant species of concern. The purpose of this cumulative impact assessment is to evaluate the potential effects of these varied resource management strategies, including the Proposed Action of this EIS, on vegetation in the 11-HPA assessment area.

As noted in the previous impact discussions in this section, growth projections indicate that under the current management regime, forest trends in the Green Diamond ownership will lead to increased age class and size, as well as increased total acreage with dense canopy closure. These trends are expected to accelerate under the Proposed Action and other action alternatives over the duration of the term of the Permits. Changes in habitat type, size class, and canopy-cover class would be most evident in the riparian areas.

Although certain minimal habitat disturbances are anticipated to occur, no significant impacts to listed plant species or other plant species of concern are expected. Under all alternatives, including the No Action and Proposed Action, Green Diamond would continue to exercise the precautions necessary to comply with the prohibitions on take of listed plants. Take of federally listed plants is not prohibited under the ESA, unless take prohibitions under State law exists. Green Diamond would continue to minimize potential adverse effects to listed plants. This cumulative impact assessment considers four other predominant conservation or management strategies, besides Green Diamond's, that are

being used in the 11 HPAs. (See Section 4.1.2, Cumulative Impacts, for a description of these strategies.)

Continued implementation of the CFPRs on commercial timberlands within the 11 HPAs would result in a more varied vegetation mosaic over the landscape, compared to existing conditions, trending toward development of a greater number of mid- and late-seral forest types in riparian areas. These trends would also be generally consistent for the Proposed Action and other alternatives. Continued implementation of the CFPR measures designed to protect riparian vegetation and avoid impacts to occupied marbled murrelet and bald eagle habitat would provide the conditions in which a greater number of large trees could become present, over time, in riparian areas that overlap with murrelet and bald eagle habitat in the Primary Assessment Area. Vegetation management activities in riparian areas would be expected to remain relatively unchanged from existing timber-harvesting practices, and similar species compositions would be retained. On non-Green Diamond timberlands, continued implementation of measures contained in the CFPRs (special protections afforded to meadows and wetlands) and other measures identified during the THP preparation and review process would minimize potential adverse impacts to listed plants and other plant species of concern to a level of insignificance.

Conservation measures associated with the PALCO HCP are designed to avoid, mitigate, or reduce potential adverse impacts to plant species of concern by requiring surveys and implementing site-specific measures developed under consultation with CDFG and/or USFWS as appropriate. These measures augment existing regulatory protections for listed plant species and plant species of concern. The beneficial effects of the PALCO HCP on vegetation and plant species would have a primary and positive influence within three HPAs (Eel River, Humboldt Bay, and Mad River) where PALCO has ownership.

The USFS and/or BLM also manage Federal lands in the Blue Creek and Smith River HPAs. Less than 7 percent of lands in the other HPAs is managed by either of these agencies. The resource management strategies on lands administered by the USFS and BLM include the continued implementation of aquatic and riparian resource guidelines contained in the NWFP for Federal lands. The NWFP is based on an ecosystem approach to conservation of natural resources and includes wide, fixed-width riparian buffers prior to a completed watershed analysis and provides a wide range of benefits to many listed and unlisted plant species and their habitats. Current benefits to vegetation resources and plant species in those HPAs where Federal agencies are the predominant land managers would be expected to continue into the future.

Potential impacts to vegetation and plant species of concern associated with resource management on lands administered by the State of California and the National Park Service are most important in the Redwood Creek and Smith River HPAs, where State and Federal park lands together comprise 41.8 percent and 15.9 percent of the total land ownership, respectively. Resource management strategies in park lands generally allow no commercial timber harvesting; although thinning of some timber stands may occur occasionally for stand improvement purposes. In addition, streamside and upslope activities that would affect riparian resources are extremely limited. The low-level of active land management practices within park lands may result in a certain homogenization of upslope forest vegetation types over time, where the trend would be promotion of late-seral forests and associated shade-tolerant tree species.

Overall, the combined cumulative effect of these resource management programs would be a trend toward development of a greater number of mid- to late-seral forest stands within the 11-HPA assessment area, beyond currently existing levels and levels that would be expected under the No Action Alternative. Impacts to plant species of concern would be less than significant.

4.6 Terrestrial Habitat/Wildlife Species of Concern

The purpose of this section is to evaluate the potential impacts to terrestrial habitat and wildlife species of concern as a result of implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative. As discussed in Section 4.5, Vegetation/Plant Species of Concern, under the current management regime, forest trends in the Green Diamond ownership will lead to increased age class and size, as well as increased total acreage with dense canopy closure. These trends are expected to accelerate under the Proposed Action and other action alternatives over the duration of the term of the Permits. The accelerated development of mid- and late-seral stand types as a result of implementation of the conservation measures under the Proposed Action and other action alternatives is anticipated mostly within riparian and geologically unstable areas. These trends would be expected to result in some long-term beneficial effects to wildlife species that use these habitats relative to the No Action Alternative.[2]

4.6.1 Methodology

The assessment for terrestrial habitat and wildlife species of concern relies on information made available in Green Diamond's AHCP/CCAA and information collected and documented in Section 3.6, Terrestrial Habitat/Wildlife Species of Concern, Section 4.5, Vegetation/Plant Species of Concern. The assessment also relies on widely accepted associations between habitat type and wildlife use. As discussed in Section 4.5.1, Methodology, and in the affected environment discussion in Sections 3.5, Vegetation/Plant Species of Concern, and 3.6, Terrestrial Habitat/Wildlife Species of Concern, habitat types for terrestrial wildlife are based on the CWHR System (Mayer and Laudenslayer, 1988). The CWHR classification identifies habitat type, size class, and canopy-cover class. Projected changes in vegetation type and structure have the potential to affect various wildlife species that depend on particular habitat characteristics to meet life requisites. Changes resulting from alterations in stand characteristics are simultaneously beneficial for some species groups and adverse for other groups.

As discussed in Section 4.5, Vegetation/Plant Species of Concern, a core premise of this assessment is that non-riparian lands under all the alternatives would generally be managed in accordance with the CFPRs, other applicable laws, Green Diamond's NSOHCP, and Green Diamond operational policies and guidelines (i.e., the No Action Alternative [see Section 2.1]). The Proposed Action and the other action alternatives would also apply all or portions of the conservation measures of the AHCP/CCAA.

[2] Since none of the alternatives will include permit coverage for those activities that would affect the primary constituent elements of designated critical habitat for the marbled murrelet, none of the alternatives, including the proposed action alternative, would affect critical habitat for this species.

The analysis of the action alternatives is a qualitative assessment that focuses on the impacts associated with potential changes to habitat within the riparian zones. The greatest potential for vegetation changes to occur, as a result of implementation of the Proposed Action and other action alternatives, exists in these areas. The assessment focuses on CWHR habitat type, vegetation structure, and canopy closure for each of the alternatives considered for further evaluation. The existing terrestrial-wildlife habitat conditions are described in Section 3.6 of this EIS. This qualitative analysis further focuses on the potential changes to wildlife within forested areas in the riparian zone. Most of the non-forested natural habitat types described in Section 3.5 are either protected under existing regulations or do not have practical use to Green Diamond, other than as incidental access areas. Since the effects from implementation of the Proposed Action and other alternatives on these non-forested habitats would be negligible compared to current conditions, the wildlife assessment presented below focuses on forested habitats.

4.6.2 No Action Alternative

4.6.2.1 General Effects

Under the No Action Alternative, existing State regulations are augmented by additional measures identified in the Green Diamond NSOHCP, that provide for retention of a variety of tree sizes (height and diameter) and species within WLPZs, habitat retention areas (groups of retained trees greater than one-half acre) and individual tree clumps, with priority given to wildlife habitat trees. Over the term of the Permits, vegetation structure in riparian stands in the Primary Assessment Area is expected to remain about the same or slowly improve, over time, as the No Action Alternative's riparian management prescriptions are implemented over greater portions of the Green Diamond ownership. Implementation of the No Action Alternative is, therefore, expected to result in static or improved wildlife habitat conditions within both the Primary Assessment Area and the 11 HPAs relative to existing conditions. Under the No Action Alternative, a greater number of mature trees or late-seral-forest stands would exist within riparian areas throughout the Primary Assessment Area, especially within northern spotted owl protection zones, relative to existing conditions. The species that would benefit the most from this effect include frogs, salamanders, herons, eagles, bats, marbled murrelets, and owls.

Under the No Action Alternative, the number and acreage of stands with saplings and small-diameter trees would decrease during the Permit period. Wildlife species most adversely affected by these forest trends would be those that feed and breed in early successional riparian habitats (e.g., thrushes, warblers, and sparrows). However, because these species also use adjacent upland forests, impacts on these species are expected to be less than significant. Lands within the Primary Assessment Area have been managed for timber production for decades and the species that thrive there today have adapted to the disturbances associated with timber management.

4.6.2.2 Riparian Management Effects

Implementation of the No Action Alternative will continue to provide special benefits to frogs and salamanders as a result of the anticipated increase in the amount of available habitat for breeding and feeding. Similar increases in riparian habitat for feeding and roosting, for bats, owls, and similar animals, should reduce competition for tree nesting and

roosting sites among these types of animals. The increased amount of late-seral-forest habitat within riparian corridors, anticipated as a result of implementation of the No Action Alternative, would benefit herons and eagles through creation of a more varied habitat base for foraging and feeding.

4.6.2.3 Listed Wildlife Species and Other Wildlife Species of Concern

Under the No Action Alternative, Green Diamond would remain subject to State regulatory requirements to avoid or mitigate adverse effects of timber harvesting on all wildlife, including species listed or proposed for listing under the Federal and State ESAs. Continued compliance with existing regulations and implementation of Green Diamond's NSOHCP should result in a trend toward forest development that promotes greater structural diversity and a greater number of stands with late-seral forest characteristics, relative to what currently exists, (especially within WLPZs). This trend is beneficial to listed species, presumed or known to occur in the Primary Assessment Area, that breed or forage in older trees or late-seral stands. These species include the bald eagle, and northern spotted owl. The trend is also beneficial to other wildlife species of concern presumed or known to occur in the Primary Assessment Area that are associated with late-seral conditions (e.g., osprey, Vaux's swift, Humboldt marten, red tree vole, and tailed frog).

Table 4.6-1 presents: (1) a list of all the wildlife species of concern (listed and unlisted) known or likely to occur within the Primary Assessment Area; and (2) a summary of potential impacts associated with the No Action and other alternatives. For all species and all action alternatives, either no impacts would occur or the impacts would be minor. Minor beneficial effects are anticipated to occur to those species that occur in riparian and/or late seral forest habitats.

4.6.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to manage its lands and conduct timber harvesting in the Primary Assessment Area, the same as under the No Action Alternative. This would include continued implementation of the NSOHCP. In addition, the existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment of RMZs for Class I and II streams, establishment of EEZs for Class III streams, and limited activities within the RMZs and EEZs. Green Diamond also would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs.

4.6.3.1 General Effects

In general, the potential impacts associated with implementation of the Proposed Action on terrestrial wildlife species would be relatively similar to those described for the No Action Alternative. Differences between the two alternatives would be realized, primarily in RMZs.

Measures described under the Proposed Action to prevent or reduce erosion, for the purpose of providing cleaner water for aquatic species, would also benefit terrestrial species. Implementation of measures to reduce the potential for landslides would preserve more wildlife habitat and minimize the mortality or injury of wildlife during a landslide event. Measures designed with the long-term objective of decommissioning roads would

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Birds				
American peregrine falcon *Falco peregrinus*	Breeds on high cliffs near wetlands, lakes and rivers	No Effect. Although beneficial effects to associated habitats are anticipated to occur, changes in populations are anticipated to be negligible over time due to low species occurrence.	Same as the No Action Alternative.	Same as the No Action Alternative.
Bald eagle *Haliaeetus leucocephalus*	Nests in large old growth trees near ocean shore, lakes, and rivers	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time under the No Action. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value murrelet habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian and late seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species as compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to the species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Bank swallow *Riparia riparia*	Colonial nester in riparian area with vertical sandy banks composed of fine soils	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Black swift *Cypseloides niger*	Breeds in small colonies adjacent to waterfalls in deep canyons and coastal bluffs, forages widely	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Black-crowned night heron *Nycticorax nycticorax*	Margins of lacustrine, large riverine, and fresh and saline emergent habitats	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Coopers hawk *Accipiter cooperi*	Open woodlands, nests in riparian areas	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide greater benefits to this species as compared to the No Action Alternative.	Same as the Proposed Action.
Golden eagle *Aquila chrysaetos*	Rolling foothills and open mountain terrain in oak woodlands and most major forested habitats.	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Great blue heron *Ardea herodias*	Wet meadows, marshes, lake margins, rivers and streams, and tidal flats	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Great egret *Ardea alba*	Colonial nester in large trees near marshes, tidal flats, rivers, and lakes	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Little willow flycatcher *Empidonax traillii brewsteri*	Riparian areas with extensive willow vegetation	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Marbled murrelet *Brachyramphys marmoratus*	Late-seral and old-growth conifer forest and marine waters	Minor Beneficial Effect. Beneficial effects may occur in the long term, however, as a result of implementation of enhanced riparian protection measures and other conservation measures, such as timber stand retention adjacent to occupied murrelet habitat on adjacent public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Same as the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in adverse impacts to the species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Merlin *Falco columbarius*	Frequents coastlines, open grassland, woodlands, lakes, wetlands, edges, and early successional forest stages	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Northern harrier *Circus cyaneus*	Open habitats including grasslands, scrublands, and wetlands	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Northern goshawk *Accipiter gentilis*	Nests on northern slopes in coniferous forests	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Northern spotted owl *Strix occidentalis caurina*	Old growth or mixed mature-old growth forests	No effect. Implementation of the No Action is anticipated to lead to impacts commensurate with the NSOHCP.	Minor Beneficial Effect. Enhanced riparian and late seral-forest conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide additional benefits to this species compared to the No Action Alternative.	Phased harvesting of old-growth stands under Alternative C pursuant to species-specific measures for the marbled murrelet would likely not adversely impact spotted owls; other Alternative C measures would provide similar benefits to this species as the Proposed Action.
Olive-sided flycatcher *Contopus borealis*	Forest and woodland riparian zones	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide additional benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Osprey *Pandion haliaetus*	Freshwater lakes, bays, ocean shore, large streams	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Purple martin *Progne subis*	Forest and woodland with cavity trees, and riparian zones	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Sharp-shinned hawk *Accipiter striatus*	Early- to mid-seral forest and riparian zones	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian conditions resulting from implementation of conservation measures described under the Proposed Action and other action alternatives would likely provide additional benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Short-eared owl *Asio flammeus*	Marshlands, grasslands, and forest clearings	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Snowy egret *Egretta thula*	Riverine, emergent wetland, lacustrine, and estuarine habitats. Nests in large trees in the vicinity of foraging areas.	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Tricolored blackbird *Agelaius tricolor*	Highly colonial species, largely endemic to California; requires open water with protected areas for nesting	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Vaux's swift *Chaetura vauxi*	Conifer forest with large snags	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Some loss of snags would be anticipated under Alternative C as a result of phased harvesting of isolated timber stands of suitable marbled murrelet habitat over the term of the Permits resulting in some short-term adverse impacts to this species.
Western burrowing owl *Athene cunicularia*	Grasslands and shrublands	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Western snowy plover *Charadrius alexandrinus nivosus*	Sandy beaches, salt ponds and levees, gravel bars along coastal rivers	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
White tailed kite *Elanus leucurus*	Nests along rivers and marshes associated with oak woodlands in foothills and valley margins, forages in open meadows and grasslands	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Yellow warbler *Dendroica petechia brewsteri*	Riparian woodland	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Yellow-breasted chat *Icteria virens*	Riparian thickets and early-seral forest	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Mammals				
Fringed myotis *Myotis thysanodes*	Roosts in mines, caves, trees, and buildings; feeds along forest edges and over forest canopy	Minor beneficial effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Some short-term loss of snags would be anticipated under Alternative C as a result of phased harvesting of isolated timber stands of suitable marbled murrelet habitat over the term of the Permits resulting in some short-term adverse impacts to this species.
Humboldt marten *Martes americana humboldtensis*	Late-seral conifer forest	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value murrelet habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide additional benefits to this species compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to this species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Long-legged myotis *Myotis volans*	Roosts in hollow trees, crevices, mines, and buildings; feeds in open habitats	Minor beneficial effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Some short-term loss of snags would be anticipated under Alternative C as a result of phased harvesting of isolated timber stands of suitable marbled murrelet habitat over the term of the Permits resulting in some short-term adverse impacts to this species.
Long-eared myotis *Myotis evotis*	Roosts in trees, crevices, mines, caves, and buildings; feeds within forest and over water	Minor beneficial effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian and late-seral forest conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Some short-term loss of snags would be anticipated under Alternative C as a result of phased harvesting of isolated timber stands of suitable marbled murrelet habitat over the term of the Permits resulting in some short-term adverse impacts to this species.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Pacific fisher *Martes pennanti pacifica*	Coniferous forests and shaded riparian areas	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time under the No Action. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value murrelet habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to this species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Pallid bat *Antrozous pallidus*	Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
Red tree vole *Arborimus pomo*	Douglas fir, redwood, and montane conifer-hardwood forests	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time under the No Action. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value murrelet habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian conditions resulting from implementation of conservation measures described under the Proposed Action, Alternative A, and Alternative B would provide additional benefits to this species compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to the species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Townsend's western big-eared bat *Corynorhinus townsendii*	Humid coastal regions of central and northern California, and southern Oregon	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	**Proposed Action, Alternatives A and B**	**Alternative C**
White footed vole *Arborimus albipes*	Mature conifer forests, small streams with dense alder and shrub cover	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time under the No Action. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value murrelet habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian and late-seral forest conditions resulting from implementation of the conservation measures described under the Proposed Action, Alternative A, and Alternative B would provide greater benefits to this species compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to the species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Yuma myotis *Myotis evotis*	Roosts in buildings, trees, mines, caves, crevices, and bridges; feeds over water	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Reptiles and Amphibians				
Del Norte Salamander *Plethodon elongatus*	Old-growth mixed conifer-hardwood forests	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time under the No Action. Long-term beneficial effects, however, would likely accrue to the species as a result of implementation of enhanced riparian protection measures and other species-specific conservation measures, such as timber stand retention adjacent to high value habitat on public land and thinning of overstocked stands in neighboring Redwood National Park (RNP).	Enhanced riparian and late-seral forest conditions resulting from implementation of the conservation measures described under the Proposed Action, Alternative A, and Alternative B would likely provide greater benefits to this species compared to the No Action Alternative.	Implementation of species-specific conservation measures under Alternative C would likely result in short-term adverse impacts to the species compared to the No Action Alternative as a result of phased harvesting of residual old-growth stands.
Tailed frog *Ascaphus truei*	Permanent streams in montane-conifer hardwood, redwood, Douglas fir, and ponderosa pine forests	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced aquatic and riparian conditions resulting from implementation of the conservation measures described under the Proposed Action and other action alternatives would provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Southern torrent salamander *Rhyacotriton variegatus*	Seeps, springs, and streams in coastal redwood, Douglas fir, mixed conifer, montane hardwood, and montane-riparian forests	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced aquatic and riparian conditions resulting from implementation of the conservation measures described under the Proposed Action and other action alternatives would provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Northern red-legged frog *Rana aurora aurora*	Humid forests with intermixed hardwoods and grasslands, streamsides	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced aquatic and riparian conditions resulting from implementation of the conservation measures described under the Proposed Action and other action alternatives would provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Foothill yellow legged frog *Rana boylii*	Partly shaded shallow streams with rocky substrate, in a variety of habitats	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Same as the No Action Alternative.	Same as the No Action.
Northwestern pond turtle *Clemmys marmorata marmorata*	Ponds and swamps in grasslands, and mixed conifer-hardwood forests	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Potential benefits to the western pond turtle may occur under Alternative C through implementation of conservation measures specific to the species.

TABLE 4.6-1
Wildlife Species of Special Concern: Habitat Associations and Potential Impacts

Species	Habitat Associations	Potential Impacts		
		No Action	Proposed Action, Alternatives A and B	Alternative C
Invertebrates				
Ground beetle *Scaphinotus behrensi*	Wooded areas with moist microhabitats, including logs and tree trunks	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Pomo bronze shoulderband snail *Helminthoglypta arrosa pomoensis*	Dense redwood forest	Minor Beneficial Effect. Implementation of existing regulations and Green Diamond's NSOHCP is anticipated to lead to improved habitat conditions over time.	Enhanced riparian conditions resulting from implementation of conservation measures described for the Proposed Action and other action alternatives would likely provide greater benefits to this species compared to the No Action Alternative.	Same as the Proposed Action.
Oregon silverspot butterfly *Speyeria zerene hippolyta*	Coastal meadows in Del Norte County; larvae feed only on the foliage of the western dog violet (*Viola adunca*)	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.
Karok Indian Snail *Vespericola karokorum*	Under leaf litter and woody debris in riparian areas with alder and maple	No Effect. Changes in associated habitats and populations are anticipated to be negligible over time.	Same as the No Action Alternative.	Same as the No Action Alternative.

also restore wildlife habitat; measures that reduce soil compaction would also provide more vigorous plant life that serves to support wildlife species. Therefore, the non-riparian management measures presented in the Proposed Action would generally improve wildlife habitat quality, or minimize adverse effects to habitat quality, within portions of the Primary Assessment Area, relative to the No Action Alternative and current conditions.

4.6.3.2 Riparian Management Effects

Under the Proposed Action, only a small proportion of the trees within RMZs will be harvested, and those that remain will continue to mature, following removal of the adjacent upland stands. Trees in the RMZs will be increasing in age throughout the term of the AHCP/CCAA. By the end of the term, over one-third of the RMZ stands will be older than 100 years and the remainder will be between 51 and 100 years. At age 100 in a typical redwood zone, there will be approximately 120 trees per acre, with around 12 percent of the trees larger than 36 inches dbh. A few trees will exceed 48 inches dbh and the tallest trees in the stand will be about 170 feet. (See Section 7.2.3 of the AHCP/CCAA.) Under the Proposed Action, therefore, riparian areas would be comprised of a greater number of mature trees by the end of the term of the Permits, compared with either existing conditions or the improvements expected to occur over time under the No Action Alternative (see Section 4.5.3.2.) These trees would provide greater benefits to wildlife species dependent on late-seral-forest conditions, including frogs, salamanders, bats, owls, marbled murrelets, eagles, herons, and owls.

4.6.3.3 Listed Wildlife Species and Other Wildlife Species of Concern

Potential benefits to listed species under the Proposed Action would generally be greater than under the No Action Alternative, primarily because of increased overstory-canopy requirements within Class II RMZs, retention of all LWD within Class III Tier A EEZs, and retention of evenly distributed conifer trees within SMZs. Also, slightly more land would likely be left undisturbed in riparian areas relative to the No Action Alternative. These differences would amplify benefits described under the No Action Alternative for listed species that breed or forage in older trees and late-seral-forest stands, such as bald eagles, and northern spotted owls (Table 4.6-1). Implementation of the conservation measures noted above would also amplify benefits, relative to the No Action Alternative, for other wildlife species of concern (unlisted species) presumed or known to occur in the Primary Assessment Area. These would include species that breed or forage in older trees or late-seral stands (e.g., osprey, Vaux's swift, Humboldt marten, red tree vole, and tailed frog).

4.6.4 Alternative A

The only difference between this alternative and the Proposed Action is that no monitoring would be conducted for the southern torrent salamander or tailed frog, and the adaptive management provisions of the AHCP would not apply to these species. Impacts to terrestrial habitat and wildlife species of concern under Alternative A would generally be the same as those described for the Proposed Action.

4.6.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. Green Diamond would not implement an ownership-wide Road Management Plan or slope stability and ground disturbance measures, and would not automatically implement the specified protection measures for unique geomorphic features, such as CMZs and floodplains. Effectiveness and compliance monitoring would not be as extensive under this alternative as the Proposed Action would not be linked to the adaptive management "account." Under this alternative, impacts would be comparable to both the No Action Alternative and the Proposed Action.

4.6.5.1 General Effects

In general, vegetation resources in the Primary Assessment Area and the 11 HPAs would be similar to the conditions described for the No Action Alternative, with the exception of riparian areas. The conservation measures, specific to landslide-hazard areas, road construction and operation sites, and firelines outside the riparian zone, afforded by the Proposed Action would not be provided under Alternative B. Measures described under the Proposed Action to prevent or reduce the potential for landslides would not be present under Alternative B. Consequently the potential for loss of wildlife habitat and direct mortality or injury of terrestrial wildlife species during a landslide event would be similar to the No Action Alternative. Impacts in non-riparian areas would, therefore, be the same as under the No Action Alternative.

As under the No Action Alternative, the abundance of stands with saplings and small-diameter trees would decrease during the term of the Permits under Alternative B. A slight increase in high-density mature forest stands in RMZs would also be expected. Wildlife species most adversely affected by these forest trends would be those that feed and breed in early successional riparian habitats, such as thrushes, warblers, and sparrows. However, because these species also use adjacent upland forests, impacts on these species would be less than significant. Lands in the Primary Assessment Area have been managed for timber production for decades and the species that thrive there today have adapted to the disturbances associated with timber management.

4.6.5.2 Riparian Management Effects

Alternative B would eliminate timber harvesting and other forest management activities within all riparian buffers along Class I and II streams. Vegetation and wildlife habitat within riparian areas would develop naturally over time. Over time, benefits would eventually accrue to species dependent on these riparian and late-seral forest habitats, such as frogs, salamanders, bats, owls, herons, and eagles.

4.6.5.3 Listed Wildlife Species and Other Wildlife Species of Concern

Potential benefits to listed species under Alternative B would generally be greater than under the No Action Alternative, primarily because slightly more land would likely be left undisturbed in riparian areas relative to the No Action Alternative. Establishment of fixed riparian buffer areas, within which no management would occur, would also provide a greater number of larger trees at greater distances from stream channels than would be

provided under any of the other alternatives, including the Proposed Action. The benefits described under the No Action Alternative for listed species that breed or forage in older trees and late-seral-forest stands, such as bald eagles, northern spotted owls, and other wildlife species (e.g., osprey, Vaux's swifts, Humboldt martens, red tree voles, and tailed frogs) would be amplified under this alternative.

4.6.6 Alternative C

Under Alternative C, Green Diamond would continue to conduct timber operations as described in the Proposed Action (see Section 2.2.2), with the exception of adding 25,677 acres of rain-on-snow areas to be covered by the AHCP/CCAA. This alternative would also expand the list of covered species. Because this alternative is an expansion of the Proposed Action the mitigation and monitoring measures described for the species covered under the Proposed Action, would also be applied under Alternative C, where applicable and practicable. Because there is a potential for unique impacts in the rain-on-snow areas, the AHCP/CCAA would include an additional element in the monitoring program. This element would be designed to evaluate whether the measures described in the Proposed Action are adequate for the covered species in the expanded portion of this alternative's coverage area (i.e., the rain-on-snow areas). The adaptive management program noted for the Proposed Action, would also be included under Alternative C. Species-specific measures to allow incidental take of bald eagles, marbled murrelets, and western pond turtles would also be implemented under this alternative.

4.6.6.1 General Effects

Impacts to terrestrial habitat and wildlife species of concern under Alternative C would be the same as those described for the Proposed Action, with two exceptions: (1) the measures described in the Proposed Action would be extended to Green Diamond ownership outside of the 11 HPAs in rain-on-snow areas; and (2) mitigation and minimization measures specific to the marbled murrelet, bald eagle, and western pond turtle would be included. Because the adaptive management "account" for the Proposed Action would apply to a larger area under Alternative C, potential benefits may be diluted relative to what would be expected to occur under the Proposed Action. Implementation of Alternative C, therefore, would result in terrestrial wildlife habitat conditions slightly less improved relative to conditions that would result from implementing the Proposed Action or the No Action Alternative.

4.6.6.2 Riparian Management Effects

Under Alternative C, conservation measures described for the Proposed Action would extend to an additional 25,677 acres of rain-on-snow area currently owned by Green Diamond. General benefits to terrestrial habitat and wildlife species described for the Proposed Action relative to the No Action Alternative would also accrue in the additional areas covered under Alternative C. As noted above, because the adaptive management "reserve account" for the Proposed Action would apply to a larger area under Alternative C, potential benefits may be diluted relative to what would be expected to occur under the Proposed Action. Implementation of Alternative C, therefore, would result in terrestrial wildlife habitat conditions slightly less improved relative to conditions that would result

from implementing the Proposed Action and equivalent to or slightly greater than the No Action Alternative.

4.6.6.3 Effects from Harvesting of Marbled Murrelet Stands

Under Alternative C, Green Diamond would implement mitigation and management measures designed to minimize and mitigate the impact of incidental take on marbled murrelets. Specific measures, contained in the CFPRs or developed pursuant to the THP process, would be superseded by species-specific measures (contained in the AHCP/CCAA under this alternative) designed to comply with ESA requirements. Insofar as the murrelet, however, is also a State-listed species under CESA, Green Diamond would not undertake any AHCP measures that are likely to take this species unless it also receives incidental take authorization under State law.

Table 4.6-2 shows the anticipated conservation benefits or impact minimization and mitigation functions for each of the measures proposed in Alternative C to conserve marbled murrelets.

TABLE 4.6-2
Conservation Benefits and Impact Minimization and Mitigation Measures for Marbled Murrelet in Alternative C

Measure	Conservation Benefits/Impact Minimization and Mitigation Functions
(1) Retention and protection, over the 50-year term of the Permits, of timber stands, identified as suitable for murrelet nesting, located adjacent to large blocks of high-value murrelet habitat on public lands.	This measure minimizes adverse impacts to nesting murrelets and retains nesting and breeding opportunities in those stands that have the highest potential as nest stands.
(2) Phased harvest of isolated timber stands, with harvesting occurring first in stands with the lowest potential value for murrelets and provisions for extended phasing of harvests in stands with the highest potential value for murrelets.	This measure would reduce the potential effects of the harvesting of Green Diamond's murrelet stands on individual murrelets and the local population, by phasing the amount and location of the habitat removed. It temporarily retains nesting opportunities in those stands that have the highest value as nest stands.
(3) Thinning of overstocked stands in neighboring Redwood National Park (RNP) to accelerate development of buffer habitat and potential murrelet nesting habitat on public lands.	This measure would contribute to the survival and recovery of the species by providing for the accelerated development of buffer and potential nesting habitat for the local murrelet population. Over the long term, it would improve habitat conditions for the local murrelet population in relation to the No Action Alternative with respect to the harvesting of Green Diamond's small, isolated "murrelet" stands, by enhancing nesting opportunities in large tracts of protected habitat in the same region.

TABLE 4.6-2
Conservation Benefits and Impact Minimization and Mitigation Measures for Marbled Murrelet in Alternative C

Measure	Conservation Benefits/Impact Minimization and Mitigation Functions
(4) Development of a corvid management program to reduce predation pressure on nesting murrelets in RNP and Redwood State Park.	This measure is designed to reduce predation pressure on nesting murrelets in RNP and Redwood State Park.
(5) Funding for murrelet research.	This measure supplements the other measures by providing for data collection and scientific studies that will improve the efficacy of conservation programs for the murrelet. To the degree that the funded research will provide population estimates and document the status of the local murrelet population, the measure also indirectly provides mitigation in the form of monitoring.

Because phased harvesting of isolated stands of late-seral or old-growth forest habitat that would not occur under the other alternatives, implementation of Alternative C could result in a temporary reduction of late-seral habitat and a permanent reduction of old-growth habitat within the Primary Assessment Area. This could also reduce suitable habitat for other wildlife species, such as eagles, owls, and bats. These effects would be mitigated by implementation of other conservation measures that would occur primarily outside the Primary Assessment Area, but within the 11 HPAs.

4.6.6.4 Effects from Bald Eagle Measures

Under Alternative C, Green Diamond would survey for bald eagle nests within proposed THP harvesting units and establish 30- to 40-acre nest site management zones within which management prescriptions would be jointly developed by Green Diamond and USFWS representatives on a site-specific basis. Implementation of this additional mitigation/management measure could provide greater protections to the bald eagle relative to the No Action. Under the No Action, Green Diamond would not harvest timber or conduct other tree removal, construct new roads, reactivate closed roads, or extract gravel within the best 10 to 40 acres of suitable nest-site habitat around active, occupied nests of the bald eagle. Because general habitat conditions are not expected to change as a result of implementation of this additional measure, adverse impacts to other species relative to the No Action would not likely occur from implementation of this measure either.

4.6.6.5 Effects from Western Pond Turtle Measures

Under Alternative C, Green Diamond would avoid road construction in meadows and open areas in upland habitats that are located near suitable aquatic habitat for pond turtles. Under the No Action Alternative, Green Diamond would not build roads in meadow areas, but could construct roads in open areas outside of the WLPZ. Implementation of this additional mitigation/management measure would likely provide greater protections to the western pond turtle relative to the No Action. Because general habitat conditions are not expected to change as a result of implementation of

this additional measure, adverse impacts to other species relative to the No Action would not likely occur from implementation of this measure either, but would likely provide additional benefits to species that utilize open areas, such as the northern harrier, short-eared owl, and western burrowing owl.

4.6.6.6 Listed Wildlife Species and Other Wildlife Species of Concern

For the most part, the impacts to listed wildlife species would be similar to those described for the Proposed Action, with the exception of short-term adverse impacts to some species from the phased harvesting of isolated marbled murrelet stands noted above. Phased harvesting of isolated stands of late-seral and old-growth forest habitat would not be provided for under the other alternatives but would be implemented under Alternative C. The associated short-term reduction of late-seral habitat within the Primary Assessment Area under this alternative would result in short-term impacts to the bald eagle, northern spotted owl, Vaux's swift, Humboldt marten, Pacific fisher, red tree vole, white-footed vole, Del Norte salamander, and some bat species. Species that would benefit from the phased removal of late-seral habitat include: Cooper's hawk, sharp-shinned hawk, and yellow-breasted chat.

These short-term impacts would be mitigated by other measures included under this alternative that are designed to improve and expand large blocks of late-seral habitat identified as suitable for murrelet nesting on or immediately adjacent to public lands over a 50-year period. These measures would provide long-term benefits to all of the species noted above compared to the No Action, although these benefits may not be realized until after the Permit period. Other wildlife species of concern that would benefit from improvement and expansion of late-seral habitat would include: foothill yellow-legged frog, northern red-legged frog, southern torrent salamander, and tailed frog.

4.6.7 Cumulative Impacts – Terrestrial Habitat/Wildlife Species of Concern

The assessment of potential cumulative impacts on terrestrial-wildlife habitat and wildlife species of concern was conducted using the approach described in Section 4.1.2, Cumulative Impacts. The assessment area for cumulative impacts consists of the 11 HPAs that contain Action Area lands owned by Green Diamond and covered in its AHCP/CCAA; and other lands that are predominantly either privately owned, administered by a Federal resource management agency, or are State or Federal park lands. Resource management strategies being applied in these HPAs, combined with future management strategies that would be used by Green Diamond, have the potential to result in cumulative effects on terrestrial-wildlife habitat and wildlife species of concern.

As discussed in Section 4.5, Vegetation/Plant Species of Concern, under the current management regime, forest trends in the Green Diamond ownership will lead to increased age class and size, as well as increased total acreage with dense canopy closure. These trends are expected to accelerate under the Proposed Action and other action alternatives over the duration of the term of the Permits. The accelerated development of mid- and late-seral stand types as a result of implementation of the conservation measures under the Proposed Action and other action alternatives is anticipated to be most pronounced within riparian areas. These trends would be expected to result in some long-term beneficial effects to wildlife species that use these habitats relative to the No Action.

Although certain minimal habitat disturbances are anticipated to occur, no significant effects to listed terrestrial wildlife species or other wildlife species of concern are expected. Under all alternatives, including the No Action, Green Diamond would either: (1) implement specific measures contained in existing regulations, or developed pursuant to the THP process; or (2) implement measures contained in the AHCP/CCAA and accompanying ITP and/or ESP to minimize and mitigate environmental impacts of incidental take and comply with other requirements of the ESA. Existing regulations also require that impacts to other wildlife species of concern (if they occur) be minimized to a level of insignificance. This cumulative impact assessment considers four other predominant conservation or management strategies, besides Green Diamond's, that are being used in the 11 HPAs. (See Section 4.1.2, Cumulative Impacts, for a description of these strategies.)

As discussed under the No Action Alternative, continued implementation of existing regulations on commercial timberlands within the 11 HPAs would result in a more varied vegetation mosaic over the landscape, compared to existing conditions, trending toward development of a greater number of mid- and late-seral forest types. These trends would also be generally consistent for the Proposed Action and other alternatives. Continued implementation of the CFPR measures designed to protect riparian vegetation and minimize potential impacts to marbled murrelet and bald eagle habitat would provide for a greater number of large trees, over time, in riparian areas in the Primary Assessment Area. Vegetation management activities in riparian areas would be expected to remain relatively unchanged from existing timber-harvesting practices, and similar species compositions would be retained. On non-Green Diamond timberlands, continued implementation of measures contained in the CFPRs (special protections afforded to meadows and wetlands) and other measures identified during the THP preparation and review process would minimize potential adverse impacts to listed and other wildlife species of concern to a level of insignificance.

Conservation measures associated with the PALCO HCP are designed to: (1) promote riparian and upland wildlife habitat quality; (2) minimize and mitigate the impacts of incidental take of specified species; (3) minimize potential adverse impacts to listed wildlife species; and (4) minimize or mitigate potential adverse impacts to wildlife species of concern, using various general conservation prescriptions and species-specific conservation measures. Additional measures contained in the PALCO HCP that are specific to the marbled murrelet include: (1) establishing a series of reserves, which are large, contiguous areas of second growth and residual old growth surrounding the major remaining stands of uncut old growth on PALCO lands; and (2) limiting timber harvesting within these reserves to habitat enhancement projects that benefit the marbled murrelet over the next 48 years; and (3) implementing silvicultural prescriptions, outside the reserve areas, that favor attainment of mature forest conditions within 300-foot selective harvest buffers on PALCO property, adjacent to old-growth redwood in State parks. These measures augment existing CFPR protections for listed wildlife species and wildlife species of concern. The beneficial effects of the PALCO HCP on terrestrial habitat and wildlife species of concern would have a primary and positive influence within the Eel River and Humboldt Bay HPAs, where PALCO has ownership.

The USFS and/or BLM also manage Federal lands in the Blue Creek and the Smith River HPAs. Less than 7 percent of lands in the other HPAs are managed by either of these

agencies. The resource management strategies on lands administered by the USFS and BLM include the continued implementation of aquatic and riparian resource guidelines contained in the NWFP for Federal lands. These strategies are generally conservative and low-priority in nature; do not allow timber harvesting or other activities in wide, fixed-width riparian buffers prior to a completed watershed analysis; and provide a wide range of benefits to wildlife species of concern that rely on these habitats for feeding, roosting, or shelter. The NWFP strategy also places heavier emphasis on late-seral-stand development that would favor species with late-seral habitat associations, such as frogs, salamanders, herons, eagles, bats, marbled murrelets, and owls. The USFS management plan for the Six Rivers National Forest also contains general and species-specific management directions that provide benefits to wildlife species of concern that rely on upland habitat associations. Current benefits to terrestrial habitat and wildlife species of concern, in those HPAs where Federal agencies are the predominant land managers, would be expected to continue into the future.

Potential impacts to terrestrial habitat and wildlife species of concern associated with resource management on lands administered by the State of California and the National Park Service are most important in the Redwood Creek and Smith River HPAs, where State and Federal park lands together comprise 41.8 percent and 15.9 percent of the total land ownership, respectively. Resource management strategies in park lands essentially allow no commercial timber harvesting; although precommercial thinning of some timber stands may occur occasionally for purposes of stand improvement. In addition, streamside and upslope activities that would affect riparian resources are extremely limited. The absence of active land management practices within park lands may result in a certain homogenization, over time (but well beyond the term of the Permits), of upslope forest vegetation types, and, consequently, terrestrial habitat types, which favor species that rely primarily on late-seral habitat associations. Thinning of some stands in combination with the absence of commercial harvesting of mature and over-mature trees would accelerate this process. Positive benefits associated with continuation of low-level management in the parks would accrue to those species that rely on these habitat associations. Species that rely on early-seral or mid-seral habitat associations would not be as strongly favored, and populations of these species may actually decrease over time, as these habitats decline on park lands. However, current population levels of many early- and mid- seral species are not likely reflective of population levels that existed historically in the area.

Overall, the cumulative result of implementing all of these resource management programs would be a trend toward development of more mid- to late-seral forest stands within each of the 11 HPAs, beyond currently existing levels and levels that would be expected under the No Action Alternative. This trend would favor species with late-seral habitat associations. Impacts to wildlife species of concern, however, would be relatively insignificant.

4.7 Air Quality

The purpose of this section is to evaluate the potential for air quality impacts from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.7.1 Methodology

As discussed in Section 3.7, Green Diamond-owned lands in Del Norte and Humboldt counties are in attainment for all State and Federal air quality standards, with the exception of the California standard for PM_{10}. The analysis in this section focuses on whether the conservation measures in the Proposed Action (AHCP/CCAA Section 6.2) or the other action alternatives would result in degradation of existing air quality.

4.7.2 No Action Alternative

Under the No Action Alternative, Green Diamond would continue to conduct timber harvesting and related operations in the Primary Assessment Area in accordance with the measures described in Section 2.1 of this EIS. NMFS and USFWS would not issue Green Diamond an ITP or an ESP, and Green Diamond would not implement an AHCP/CCAA.

Existing sources of PM_{10} in Del Norte and Humboldt counties include vehicles, sea salts, wood stoves (particularly in the winter months), dust, pulp mills, nitrates, sulfates, and other unknown sources. Management actions by timber landowners in the Primary Assessment Area and the 11 HPAs (including Green Diamond) are also contributors to particulate emissions (see Section 3.7). Incidence of PM_{10} from Green Diamond's timber management is typically attributable to slash burning and roadway dust entrainment.

Under the No Action Alternative, Green Diamond's management activities would continue similar to current practices, with some possible changes in harvest levels (and subsequently slash burning and road travel), depending on future changes to riparian buffer widths specified in the CFPRs. For the purposes of this analysis, however, harvest levels are assumed to remain the same under the No Action Alternative, and therefore, Green Diamond's contribution to air quality conditions would not change. In addition, Green Diamond would continue to follow AQMD burning restrictions and any new restrictions that could be adopted.

4.7.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting in the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. In addition, these existing measures used by Green Diamond to protect Class I, Class II, and Class III streams would be supplemented by Green Diamond's AHCP/CCAA Conservation Strategy (AHCP/CCAA Section 6.2), which includes establishment of RMZs for Class I and II streams, establishment of EEZs for Class III streams, and limited activities within the RMZs and EEZs. Green Diamond also would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs.

Conservation measures (e.g., restrictions on areas in which timber can be harvested, exclusion of heavy equipment in RMZs) could reduce Green Diamond's contributions to area PM_{10} over time by improving road conditions (and reducing PM_{10} visibility impacts). Although these measures are anticipated to result in some improvement in air quality (reduction in PM_{10} generation by improved road conditions, the improvements are not anticipated to be measurably different than those anticipated under the No Action

Alternative. On this basis, the impacts to air quality under the Proposed Action would be the same as those anticipated to occur over time under the No Action Alternative.

4.7.4 Alternative A

Under Alternative A, take coverage would not be extended to unlisted species. This would not affect air quality differently than the impacts described for the Proposed Action and Green Diamond would continue to conduct timber operations as described for the Proposed Action (see Section 2.2). On this basis, no change to air quality would occur under Alternative A compared with what would occur under either the Proposed Action or the No Action Alternative.

4.7.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. Application of these buffer areas and the no-cut provisions would potentially reduce PM_{10} emissions relative to the Proposed Action, but the reduction would be negligible. Overall timber operations would be comparable to those described for the Proposed Action (see Section 2.2) and the No Action Alternative (see Section 2.1) and, therefore, no change to air quality would occur under Alternative B compared with what would occur under either the Proposed Action or the No Action Alternative.

4.7.6 Alternative C

Under Alternative C, Green Diamond would continue to conduct timber operations as described for the Proposed Action (see Section 2.2), with the exception of adding 25,677 acres of rain-on-snow areas as areas to be covered by an AHCP. The potential impacts to air quality are anticipated to be the same as for the Proposed Action and, therefore, would be less than significant.

4.7.7 Cumulative Impacts – Air Quality

Other commercial timberland owners in the Primary Assessment Area, plus State and Federal land managers in the 11 HPAs, are anticipated to continue with similar practices that have the potential to result in impacts to air quality in the 11 HPAs. On this basis (and because Green Diamond's timber operations with the potential to affect air quality would not change under the Proposed Action or any of the alternatives), the cumulative result of implementing any of these resource management programs is not expected to be significant.

4.8 Visual Resources

This section evaluates the potential for impacts to visual resources from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.8.1 Methodology

For this analysis, an impact to visual resources would occur if the quality of the landscape was diminished as a result of implementing the AHCP/CCAA conservation measures that pertain to Green Diamond's existing timber harvest operations.

4.8.2 No Action Alternative

Under the No Action Alternative, Green Diamond would continue to conduct timber harvesting and related operations in the Primary Assessment Area in accordance with the measures described in Section 2.1 of this EIS. NMFS and USFWS would not issue Green Diamond an ITP or an ESP, and Green Diamond would not implement an AHCP/CCAA.

Green Diamond's activities have the potential to affect aesthetic resources by introducing elements that interrupt the visual continuity of the landscape, such as even-aged harvesting. Timber harvesting within the Action Area would be conducted within sight of scenic highways (e.g., U.S. Highway 101 and State Highway 299) and recreation areas on adjacent public lands (e.g., Redwood National and State Parks, Smith River National Recreation Area). These operations can diminish aesthetic resources enjoyed by the public. Under the No Action Alternative, timber harvest levels would be similar to current levels and, therefore, such actions would be consistent with historical use patterns, including aesthetic effects. Existing visual conditions experienced by highway travelers and recreation area users would continue to occur under the No Action Alternative. Visual effects of timber harvesting could be expected to be reduced to some extent by implementing existing provisions that are designed, in part, to minimize the potential visual impacts of commercial forest management. These measures are:

- Individual clearcuts cannot exceed 30 acres.
- Individual clearcuts shall be separated by an area at least as large as the clearcut or 20 acres, whichever is smaller, and shall be separated by at least 300 feet in all directions.
- Units adjacent to a clearcut cannot undergo even-aged harvesting until after a specified amount of time has passed, or the clearcut has regenerated to an approved age- or size-class composition.
- Clearcuts should be defined by logical unit boundaries but may be irregularly shaped and variable in size in order to mimic natural patterns and features found in landscapes.
- Special consideration for aesthetic enjoyment must be given to silvicultural treatments and timber operations within 200 feet of the edge of the traveled surface of any permanent road maintained by the County or the State, or within 200 feet of adjacent non-Federal lands not zoned for timber production.

4.8.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting in the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. In addition, the existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment

of RMZs for Class I and II streams, establishment of EEZs for Class III streams, and limited activities within the RMZs and EEZs. Green Diamond also would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs. Accordingly, the potential for impacts to visual resources is expected to be comparable to the conditions described above for the No Action Alternative.

4.8.4 Alternative A

Under Alternative A, take coverage would not be extended to unlisted species. Under Alternative A, the potential for impacts to visual resources would be comparable to the Proposed Action conditions because the application of take coverage only for listed species would not affect visual resources.

4.8.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. Fixed no-cut riparian buffers under Alternative B would result in no timber harvesting within riparian areas and, therefore, potential visual benefits would occur only where hillslope areas are visible from adjacent highways or public recreation areas.

4.8.6 Alternative C

Under Alternative C, the potential for impacts to visual resources would be comparable to the Proposed Action conditions because the AHCP/CCAA conservation measures affecting visual resources are the same under Alternative C as they are under the Proposed Action. The only difference between Alternative C and the Proposed Action for visual resources is that the conservation measures described under the Proposed Action would apply to the additional rain-on-snow acreage.

4.8.7 Cumulative Impacts – Visual Resources

Similar minor visual differences could also occur in other private forestlands in the Primary Assessment Area, but State and Federal lands within the 11 HPAs would continue to be managed to meet visual quality objectives. Accordingly, overall the individual and cumulative result of implementing any of these resource management programs would be less than significant in each of the 11 HPAs over time.

4.9 Recreation

This section evaluates the potential for impacts to recreational resources from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.9.1 Methodology

As discussed in Section 3.9, Recreational Resources, Green Diamond offers limited access to its forestlands to groups and individuals for recreational activities of hunting, fishing, camping, picnicking, hiking, mountain biking, motorcycle and horseback riding, and shooting. A recreation impact would occur when the recreational experiences enjoyed by

the public are diminished by activities conducted within the Primary Assessment Area. This assessment is based on the potential for the AHCP/CCAA conservation measures to diminish enjoyment of recreational opportunities listed above. Because of the ongoing nature of timber harvesting activities over such a broad geographic area, it is not possible to accurately predict when and where specific impacts would occur.

4.9.2 No Action Alternative

Timber harvesting in the Primary Assessment Area would be conducted within sight of recreation areas on adjacent public lands, including highly sensitive recreation areas such as the Smith River National Recreation Area and the Redwood National and State Parks complex. These operations can diminish aesthetic resources enjoyed by the public. Under the No Action Alternative, timber harvest levels throughout the Primary Assessment Area are expected to be similar to current conditions and, therefore, such actions would be consistent with historical patterns of use, including the aesthetic impacts of such use. Green Diamond and other private forest landowners within the Primary Assessment Area would continue to follow existing regulations designed to minimize visual and associated recreational effects (see Section 4.8, Visual Resources).

4.9.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting in the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS and the NSOHCP. In addition, these existing measures used by Green Diamond to protect Class I, Class II, and Class III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment of RMZs and EEZs, and limited activities within the RMZs. Green Diamond also would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs. Accordingly, the potential for impacts to recreational resources is expected to be comparable to the conditions described above for the No Action Alternative.

4.9.4 Alternative A

Under Alternative A, authorized incidental take coverage would not be extended to unlisted species. Under Alternative A, the potential for impacts recreational resources would be comparable to the Proposed Action conditions because the limitation of take coverage to listed species has no effect on recreational resources. Impacts under Alternative A would be the same as they are under the Proposed Action.

4.9.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. Fixed riparian buffers under Alternative B would result in reduced timber harvesting within riparian areas and, consequently, some associated recreational benefits. On the basis of the case-by-case determination of access to Green Diamond's lands for recreational purposes, however, it is not known whether these fixed buffer areas would be the sites on which recreational activities were allowed or could occur. It is unlikely, therefore, that improvements to recreational resources in these areas would result in a noticeable change in recreational

experiences of users compared with either the No Action Alternative or the Proposed Action.

4.9.6 Alternative C

Under Alternative C, the potential for impacts to recreational resources would be comparable to the Proposed Action conditions because the AHCP/CCAA conservation measures affecting visual and associated recreational resources are the same under Alternative C as they are under the Proposed Action. The only difference between Alternative C and the Proposed Action for visual resources is that the conservation measures would apply to the additional rain-on-snow acreage.

4.9.7 Cumulative Impacts – Recreation

Because the Proposed Action's conservation measures are associated with existing timber harvesting activities, which would not change under the Proposed Action, no cumulative impact would occur from implementing the Proposed Action in association with other private forestlands in the Primary Assessment Area. In addition, State and Federal lands within the 11 HPAs would continue to be managed to meet recreational objectives. Accordingly, potential individual and cumulative impacts would be less than significant.

Further, alterations to fish and wildlife habitat resulting from the AHCP/CCAA conservation measures and from timber harvesting conducted under the No Action would also be consistent with historical practices. Based on the analysis in Section 4.4 (Aquatic Resources) and Section 4.6 (Terrestrial Habitat/Wildlife Species of Concern), changes to fish and wildlife habitat under all of the alternatives would continue to support wildlife viewing, hunting, and fishing opportunities. Anglers could experience potential benefits from improved fishery conditions. Other expected habitat improvements throughout the 11 HPAs as a result of continued implementation of the PALCO HCP, continued implementation of existing regulations on other commercial timberlands, continued management of USFS and BLM lands pursuant to Northwest Forest Plan guidelines, and continued management of State and national parks would also provide benefits. Accordingly, overall the individual and cumulative result of implementing any of these resource management programs would be less than significant in the 11 HPAs over time.

4.10 Cultural Resources

This section evaluates the potential for impacts to cultural resources from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.10.1 Methodology

Timber harvesting and other management operations can result in impacts both to individual sites (or resources) and to resource networks (e.g., trails). Impacts to cultural resources would be significant if they did not comply with existing regulations for protecting cultural resources. Federal agencies have a duty under the National Historic Preservation Act (NHPA) to consider potential impacts to cultural resources for actions which are determined to be undertakings. The Services have determined that issuance of the

Permits to Green Diamond, as described in the Proposed Action and Alternatives A, B, and C, constitute an undertaking to the limited extent that they authorize take incidental to non-Federal actions that are not themselves Federal undertakings, but which may result in take of covered species and in such an instance would require Federal authorization to lawfully proceed.

4.10.2 No Action Alternative

Under the No Action Alternative, Green Diamond would continue to conduct timber harvesting and related operations in the Primary Assessment Area in accordance with the measures described in Section 2.1 of this EIS. NMFS and USFWS would not issue Green Diamond an ITP or an ESP, and Green Diamond would not implement an AHCP/CCAA.

Under the No Action Alternative, Green Diamond will continue to comply with the CFPRs in the preparation of THPs. Pursuant to the CFPRs, the following steps must be taken in preparation of THPs.

- Conduct an archaeological record search at the Northwest Information Center North Coast Information Center (Yurok Tribe, Culture Department).
- Contact local Native Americans identified by the Native American Heritage Commission (NAHC) and allow for their participation, particularly in regard to sacred site areas.
- Provide a professional archaeologist or a person with archaeological training (in accordance with the CFPRs) to conduct a field survey for archaeological and historical sites in the area covered by the THP (previous archaeological surveys within the site survey area may also be used to partially or entirely satisfy this requirement).
- Prepare a confidential addendum to the THP, including a survey coverage map showing the locations of identified cultural resources. The addendum should describe record search and survey methods, results of contact with Native Americans, qualifications of the surveyor, a description of identified archaeological and historical sites, and a description of specific enforceable protection measures to be implemented both within the site boundaries and within 100 feet of the site.
- If a known archaeological or historical site could not be avoided during timber harvesting, then a preliminary determination of significance would be necessary. California Department of Forestry and Fire Protection (CDF) would determine if a substantial adverse change to the resource would occur, and protection measures would be developed to reduce the impact to a less than significant level.
- Submit completed site records for each site determined to be a "significant" archaeological or historical site in a manner consistent with the recording standards identified in the State Office of Historic Preservation's Instruction for Recording Historical Resources.

Typical examples of site specific measures which have been used by Green Diamond and other commercial timber land owners that are designed to achieve a finding from CDF of "no substantial adverse change" include, but are not limited to:

- No timber operations within a site's boundary or within a site's Special Treatment Zone (STZ). The STZ is defined as the area extending outward from a site's boundary to a distance of 100 feet.
- Allowance of limited timber operations within a site and STZ or only within the STZ. These limited operations are designed to avoid impact on a site's cultural or historical value. Such limited operations may include, but are not limited to:
  - Directional falling of timber from within a site's boundary, towards a site's edge and into the STZ and beyond, contingent upon the ability to yard the material with minimal ground disturbance (i.e., through helicopter or high lead cable yarding) and without ground based equipment entering the site, except on previously existing and treated roads, landing or skid trails. RPFs must mark trees in advance, and if trees cannot be directionally fallen, for reasons of safety, they may not be cut without submission and approval of alternative approaches which will achieve the same outcome.
  - Required extensive archeological surveys (i.e., subsurface testing) and onsite monitoring to ensure road construction or reconstruction within a site or STZ avoids impacts on the site's cultural or historical value.
  - Roads and landings within a site or STZ, which are proposed for use and maintenance, are covered with geotextile fabric and caped with culturally sterile material sufficient to conduct use and maintenance without scarifying preexisting road material. These roads and landings are also drained to avoid deflection of water onto site areas.
  - Skid trails within a site or STZ, which are proposed for use and maintenance, may be required to be covered with slash or other debris, prior to use, depending on the size of timber to be skidded and distance to haul roads.

If an archeological or historical site that was not identified in a THP is discovered during timber operations, the licensed timber operator would immediately stop operations within 100 feet of the site and notify CDF, and resource protection measures would be implemented. In the event of discovery or recognition of any human remains outside a dedicated cemetery, no further disturbance of the site or any nearby area would occur until the county coroner determined that no investigation of the cause of death is required. If the remains are of Native American origin, then the descendants of the deceased Native Americans must make a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains of any associated grave goods as provided in Public Resources Code Section 5097.98. Further work could occur if the NAHC was unable to identify a descendant or the descendant failed to make a recommendation within 24 hours after being notified by the Commission.

4.10.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting and other covered activities in the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. The minimization and

mitigation measures in this alternative would not change the way in which State cultural resources regulations are applied. Green Diamond would continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs, and would continue to comply with the cultural resources protections discussed above for the No Action Alternative. One covered activity that is not subject to State cultural resource regulations, development of new rock quarries, is a covered activity contingent on Green Diamond's completion of a record search and field survey for archaeological and historic sites in each quarry area and, if necessary to ensure that the effects, if any, of the quarries on archeological and historic properties are taken into account in accordance with the NHPA, consultation among Green Diamond, the Services, and the tribal historic preservation officer, or state historic preservation officer, as appropriate. As a result of applying the CFPRs, and any additional protective measures arising from consultation under the NHPA, effects to cultural and historic properties are expected to be equivalent to or less than those of No Action Alternative. At this time, the Services have not concluded consultation pursuant to NHPA. The outcome of this consultation will be incorporated into the Record of Decision.

4.10.4 Alternative A

Under Alternative A, take coverage would not be extended to unlisted species. Under Alternative A, the potential for impacts to cultural resources would be comparable to the Proposed Action conditions because the limitation of coverage to listed species would not affect cultural resources. Impacts would be the same under Alternative A as they are under the Proposed Action and the No Action Alternative.

4.10.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. The implementation of fixed riparian buffers under Alternative B would not change the ways in which existing cultural resources regulations are addressed. Resulting conditions under Alternative B would be the same as under the Proposed Action or the No Action Alternative.

4.10.6 Alternative C

Alternative C impacts would be the same as those of the Proposed Action (i.e., no impacts). The only difference between Alternative C and the Proposed Action for cultural resources is that the AHCP/CCAA conservation measures would apply to the additional rain-on-snow acreage. Thus, the level of effect to cultural and historic resources is expected to be comparable to or less than those arising from the Proposed Action or No Action Alternatives.

4.10.7 Cumulative Impacts – Cultural Resources

As noted above, Green Diamond would adhere to the CFPR requirements for the protection of cultural resources under all alternatives, and the requirements would also apply to other commercial timberlands in the Primary Assessment Area. Management objectives on State and Federal lands within the 11 HPAs also provide for the protection of cultural resources; cultural resource surveys are performed on the Six Rivers National Forest similar to CFPR requirements. Accordingly, the cumulative impacts of implementing any of these resource

management programs regarding cultural resources would be less than significant in the 11 HPAs over time.

4.11 Land Use

This section evaluates the potential for impacts to land use from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.11.1 Methodology

Land use impacts are typically described as inconsistencies with applicable land use plans and policies. In accordance with California law, local governments directly control land use through the adoption of general plans and zoning ordinances. The general plan provides policy direction regarding land use, and the zoning code provides specific mechanisms to implement general plan policies. As described in Section 3.11, Land Use, the Green Diamond forestlands and other private forestlands in the Primary Assessment Area are included within the General Plans and Zoning Ordinances of Del Norte and Humboldt counties. Conflicts with adjacent land uses (e.g., incompatibilities with the type or intensity of existing or planned surrounding uses) are also a type of land use impact. Other regulatory mechanisms, such as the CFPRs, the Basin Plan of the North Coast Regional Water Quality Control Board, and various endangered species recovery plans, indirectly control land use; compatibility with these plans is described elsewhere in this document, under the appropriate resource category heading.

4.11.2 No Action Alternative

The General Plans of both Del Norte and Humboldt counties designate the Green Diamond forestlands and other private forestlands in the Primary Assessment Area as suitable for timber production. This designation is consistent with past and intended future use of the Primary Assessment Area. Because the No Action Alternative would continue essentially the same type of management activity as is currently practiced (i.e., timber production), it is consistent with the Del Norte County and Humboldt County General Plans. With regard to zoning, most of the Green Diamond forestlands and other private forestlands in the Primary Assessment Area are designated as Timberland Protection Zone (TPZ) in the Zoning Ordinances of Del Norte County and Humboldt County. As described above, land use in the TPZ district is restricted to growing and harvesting timber and compatible uses and establishes a presumption that timber harvesting is expected to and will occur on such lands. Because the No Action Alternative involves the continued production of timber on the Green Diamond forestlands, it is consistent with the intent of the TPZ district.

4.11.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting in the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. In addition, these existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment of RMZs and EEZs, and limited activities within the RMZs. Green Diamond also would

continue to implement ownership-wide mitigation, management, and monitoring measures in accordance with the requirements of the CFPRs. The AHCP/CCAA conservation measures would conform to existing approved land use, as defined above. No impacts would occur.

4.11.4 Alternative A

Under Alternative A, take coverage would not be extended to unlisted species. Under Alternative A, the land use impacts would be comparable to the Proposed Action and the No Action Alternative because limiting coverage to listed species would not affect land use conformity.

4.11.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. The implementation of fixed riparian buffers under Alternative B would not result in inconsistency with existing land use plans or policies. The impacts under Alternative B are the same as under the Proposed Action (i.e., no impacts).

4.11.6 Alternative C

Alternative C impacts would be the same as those of the Proposed Action (i.e., no impacts). The only difference between Alternative C and the Proposed Action for land use is that the AHCP/CCAA conservation measures would apply to the additional rain-on-snow acreage. Inclusion of this additional acreage would not be inconsistent with existing land use plans or policies.

4.11.7 Cumulative Impacts – Land Use

Timber management activities on the Green Diamond forestlands are also consistent with activities occurring on other commercial forestlands in the areas. Implementation of the No Action Alternative would not result in the creation of a new and incompatible land use, because timber management activities on the Green Diamond forestlands would be consistent with past management activities and with existing land use plans and policies. Additionally, the TPZ zoning establishes the presumption that timber harvesting is expected to and would occur in the future, and the Timberland Productivity Act states that "timber operations conducted [on TPZ land pursuant to the CFPRs]…shall not constitute a nuisance, public or private."

Land use activities under the Proposed Action and other alternatives would occur in a similar manner as under the No Action Alternative. Accordingly, the cumulative result on land use of any of these resource management programs would be less than significant in the 11 HPAs over time.

4.12 Socioeconomic Conditions

This section evaluates the potential for socioeconomic impacts to occur from implementing the Proposed Action (the conservation measures in the AHCP/CCAA) and the alternatives, including the No Action Alternative.

4.12.1 Methodology

Over the term of the Permits, key socioeconomic indicators (e.g., Green Diamond employment) are likely to be affected by several internal (e.g., continued implementation of the NSOHCP) and external influences (e.g., market forces in the lumber and wood products sector) that are unrelated to the AHCP/CCAA. This analysis assesses the potential for such changes to occur under the Proposed Action and the alternatives. In addition, environmental justice impacts are assessed in accordance with Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994).

4.12.2 No Action Alternative

As discussed above, key socioeconomic indicators are likely to be affected by several internal (i.e., Green Diamond-related) and external influences that are unrelated to the AHCP/CCAA. In addition, regulatory requirements will continue to affect management activities in the Primary Assessment Area and have the potential to affect timber harvesting (and socioeconomic conditions, including subsistence and commercial fishing by Native Americans) in the absence of an approved habitat conservation plan (e.g., the AHCP/CCAA). Consequently, some changes in socioeconomic conditions relative to current conditions could occur. The ability to predict them, however, is subject to market indicators and influences that are not readily evident or are unknown. For the purposes of this analysis, timber harvest levels under the No Action Alternative are expected to remain about the same as current levels and, therefore, changes in socioeconomic conditions are assumed to be minor.

4.12.3 Proposed Action

Under the Proposed Action, Green Diamond would continue to conduct timber harvesting on the Primary Assessment Area in accordance with existing regulations and guidelines discussed in Section 2.1 of this EIS. In addition, these existing measures used by Green Diamond to protect Class I, II, and III streams would be supplemented by Green Diamond's Operating Conservation Program (AHCP/CCAA Section 6.2), which includes establishment of RMZs and EEZs, and limited activities within the RMZs. Timber harvesting is projected to remain approximately the same as current levels.

Commercial timber harvesting would not occur within 150 feet and 75 to 100 feet of Class I and II watercourses, respectively. The potential reduction in timber harvesting in these areas, however, is expected to be minor and could be balanced out by increased harvesting in other areas. Overall, the average volume of timber harvested from the Primary Assessment Area would be about the same under the Proposed Action as would be expected under the No Action Alternative.

The socioeconomic consequences of changes in timber harvesting levels are not expected to be significant. Timber harvesting activities would continue to occur on the Green Diamond forestlands and, therefore, the need would still exist for Green Diamond to employ timber management and support staff. In addition, the implementation of measures contained in the AHCP/CCAA (e.g., road management and decommissioning actions), that augment existing practices described under the No Action Alternative, could generate additional employment needs. Accordingly, Green Diamond's employment levels (as of July 1, 2002) are expected to

remain similar to current levels and similar to expected future employment under the No Action Alternative. In addition, minor changes in timber harvesting would have a negligible effect on local businesses supported by the indirect effects of Green Diamond employment, and yield taxes paid to Del Norte and Humboldt counties would not change by a substantial amount. Native Americans dependent on subsistence and commercial fishing in the region could benefit from implementation of measures contained in the AHCP/CCAA to the extent that the covered species benefit; however, resulting incremental improvements in Native American socioeconomic conditions would be minor.

Overall effects on the local economy due to timber harvesting on other private forestlands in the Primary Assessment Area are not expected to be substantial for the reasons described above. Management activities on State and Federal lands within the 11 HPAs are expected to remain similar to current conditions. For these reasons, potential individual impacts on socioeconomic conditions would be less than significant.

4.12.4 Alternative A

Under Alternative A, take coverage would not be extended to unlisted species. Under Alternative A, socioeconomic impacts would be comparable to the Proposed Action and the No Action Alternative because limiting coverage to listed species would not affect the local and regional economy.

4.12.5 Alternative B

Under Alternative B, fixed no-cut riparian buffer widths would apply to Class I and II watercourses on Green Diamond's fee-owned lands in the Action Area. This could result in the loss of some additional timber volume relative to the No Action Alternative. The loss in timber yields, however, is not expected to be substantial and, therefore, the employment impacts of decreased timber harvesting levels would be less than significant. Accordingly, Green Diamond's employment levels (as of July 1, 2002) are expected to remain similar to current levels, and similar to expected future employment under the No Action Alternative and the Proposed Action. In addition, minor decreases in timber harvesting would have a negligible effect on local businesses supported by the indirect effects of Green Diamond employment, and yield taxes paid to Del Norte and Humboldt counties would not change by a substantial amount. Under Alternative B, Native Americans dependent on subsistence and commercial fishing in the region could benefit from implementation of fixed, no-cut riparian buffers to the extent that the covered species benefit from this measure; however, resulting incremental improvements in Native American socioeconomic conditions would be relatively minor and less than significant when compared to the No Action Alternative.

4.12.6 Alternative C

Alternative C impacts would be the same as those of the Proposed Action (i.e., no impacts). The only difference between Alternative C and the Proposed Action for land use is that the AHCP/CCAA conservation measures would apply to the additional rain-on-snow acreage. Inclusion of this additional acreage could result in a benefit (e.g., additional local employment) that could occur from increased timber harvesting in the additional rain-on-snow acreage included in this alternative.

4.12.7 Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994), requires Federal agencies to make the achievement of environmental justice part of their mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. EO 12898 further stipulates that the agencies conduct their programs and activities in a manner that does not have the effect of excluding persons from participation in, denying persons the benefits of, or subjecting persons to discrimination because of their race, color, or national origin. The Presidential Memorandum that accompanied EO 12898 states that a NEPA document should include analysis of "effects in minority communities and low-income communities." Potentially affected minority populations in the Primary Assessment Area include the Yurok Nation and Hoopa Tribe. The close proximity of Yurok and Hoopa lands to Green Diamond lands has resulted in close coordination between Green Diamond and the tribes regarding issues of shared concern, such as road use, timber harvesting, and wildlife. Informational meetings with the tribes are described in Section 1.7.1 of this EIS in relation to the NEPA scoping process.

As presented in Sections 4.2 through 4.12, the potential impacts of the Proposed Action and alternatives would be either less than significant or result in benefits to the environment. In addition, under all alternatives, timber harvesting levels are expected to remain similar to current levels. On this basis, the Green Diamond workforce (as of July 1, 2002) and other local employment would remain similar to current conditions, and the potential for increased unemployment, including disproportionate job losses affecting minority populations, is not expected to occur as a result of implementing the Proposed Action or alternatives.

In addition, salmon are an important resource of concern to the Yurok, Hoopa, and other local tribes. As described in Section 4.4, *Aquatic Resources*, key factors affecting aquatic habitat (e.g., suspended sediment, LWD, stream shading) are expected to improve as a result of implementing conservation measures under the AHCP/CCAA. Because all impacts would be less than significant, there would be no environmental justice impacts.

4.12.8 Cumulative Impacts – Socioeconomic Conditions

Covered activities on the Green Diamond forestlands are consistent with activities occurring on other commercial forestlands in the areas. Implementation of the Proposed Action and other action alternatives would not substantively change the socioeconomic conditions compared with the No Action Alternative and existing conditions and, therefore, would not result in cumulative impacts.

4.13 Summary of Cumulative Impact Analyses

This section presents a summary of the detailed cumulative effects analyses located at the end of each of the resources discussion in this chapter. Adverse conditions currently exist in some areas of the 11 HPAs, primarily as a result of past practices. Continuing impacts of these past practices include conditions associated with a general lack of LWD, lack of riparian vegetation, and aggraded stream channels (AHCP/CCAA Sections 4.2 through 4.6).

Some of these areas and conditions may recover over the next 50 years, while others, such as low gradient aggraded stream channels, may take longer than 50 years to recover (see Section 4.2).

The No Action Alternative, under which Green Diamond continues to undertake its timber management program pursuant to its institutional BMPs and the CFPRs, would result in an improving trend from the current adverse conditions and will lead to an overall reduction in the level of adverse environmental conditions which currently exist in some areas of the HPAs. However, this improvement may not reduce the level of concern below a level of significance within the next 50 years.

Management of the Action Area under all the action alternatives would further improve current conditions relative to implementation of the No Action Alternative. The benefits to geomorphology are expected to be equal or slightly greater under the Proposed Action and Alternatives A and C than under Alternative B because of differences (or, in some cases, absences) in a broad range of enhanced forest management practices and implementation of an adaptive management monitoring program with structured feedback mechanisms. The sediment control benefits associated with implementation of the Road Management Plan and the accelerated road sediment site repairs under the Proposed Action, Alternative A, and Alternative C will result in a greater reduction in sediment delivery compared to all the other sediment conservation measures combined. Therefore, implementation of the Road Management Plan, the accelerated road repair, and limitations on equipment use during wet weather conditions provide the greatest benefit to the covered species.

Implementation of the measures contained in the Proposed Action would result in equivalent or improved water quality conditions, as discussed in Sections 4.3.2 through 4.3.6. Hydrologic conditions associated with the Proposed Action and other action alternatives are not anticipated to significantly change compared with existing conditions or the No Action Alternative. One potential impact under the action alternatives is a slight (and less than significant) change in water temperature resulting from increased shade attributable to overstory canopy closure retention requirements. Another possible impact is locally increased peak flows on a short-term basis following harvesting. These impacts would be insignificant given implementation of the riparian management prescriptive measures included in the Proposed Action (AHCP/CCAA Section 6.2.1).

The aquatic and riparian habitat conditions would improve under the Proposed Action relative to existing conditions and relative to implementation of the No Action Alternative. The anticipated improvement in riparian conditions and the reduction in sediment production and delivery to streams would speed the improvements expected over time under the No Action Alternative, and would likely result in improved physical habitat for the covered species. Improvements in aquatic and riparian habitat benefiting the covered species would, in general, benefit other species associated with these habitats. It is expected that benefits to all of these species and their habitats under the Proposed Action would accumulate incrementally over the next 50 years as the improved forest management practices and conservations measures are implemented throughout this period.

Conditions resulting from all the action alternatives, related to Air Quality (Section 4.7), Visual (Section 4.8), Recreation (Section 4.9), and Cultural Resources (Section 4.10), are anticipated to be the same as those expected to result under the No Action Alternative.

The Proposed Action would result in an improvement in the overall condition of habitat for the covered species in the Action Area over the 50-year term of the Plan and Permits. Implementation of the Proposed Action would contribute to the development and maintenance of properly functioning habitat. Implementation of the Proposed Action or any of the action alternatives would result in an overall reduction in adverse impacts to the environment compared to existing conditions. However, ongoing impacts associated with past activities (i.e., the persistence of historic management-generated sediment), present actions, and reasonably foreseeable future actions are expected to continue, although with a decreasing trend in impact, over the term of the Permits with implementation of the Proposed Action (Section 2, Section 4.2).

CHAPTER 5

List of Preparers

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List of Preparers

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CHAPTER 6

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CHAPTER 7

Glossary

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Glossary

Action Area	All commercial timberland acreage within the 11 Hydrographic Planning Areas (see below) on the west slopes of the Klamath Mountains and the Coast Range of California in Del Norte and Humboldt counties where Green Diamond owns lands or harvesting rights, during the period of such ownership within the term of the Permits.
Adaptive management	As defined by the Services for purposes of their HCP program, 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 (65 Federal Register 106, 36245).
Age class	One of the intervals into which the age range of trees is divided for classification or use in management.
Aggradation	Deposition in one place of material eroded from another. Aggradation raises the elevation of streambeds, floodplains, and the bottoms of other water bodies.
Alevin	Larval salmonid that has hatched but has not fully absorbed its yolk sac and has not yet emerged from the gravel.
Alluvial (***alluvium***)	Referring to the process of sediment transport and deposition resulting from flowing water (*sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries*).
Anadromous	A life history strategy in which fish are born and rear in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce; an example is Chinook salmon (*Oncorhynchus tschawytscha*).
Bank stability	The ability of a stream bank to resist erosion.
Bankfull channel width	Channel width between the tops of the most pronounced bank on either side of a stream reach where water would just begin to flow out onto the floodplain.
Basal area	The cross sectional area of a single stem, including the bark, measured at breast height (4.5 feet above the ground).
Bedload	Sand, silt and gravel, or soil and rock debris rolled along the bottom of a stream by moving water.

Before-After-Control-Impact (BACI)	An experimental approach that utilizes a paired design with treatment and control sites. Data are collected from both experimental sites before and after the treatment and an analysis is done to determine if the relationship of the response variable(s) between the treatment and control sites differs following the treatment.
Beneficial use	One of several uses of streams and lakes that may include drinking, fish habitat and recreation. This phrase has a specific technical connotation because the Federal Clean Water Act requires states to adopt standards and procedures that protect designated beneficial uses of public waters.
Bog	A peat-accumulating wetland that has no significant inflows or outflows and supports acidophilic mosses, particularly sphagnum.
Boulders	Substrate particles greater than 256 mm in diameter. Often subclassified as small (256-1,024 mm) and large (>1,024 mm).
Breaks-in-slope	A decline in slope gradient below the specified minimum slope gradient for, the given, HPA and of sufficient distance that it may be reasonably expected to impede sediment delivery to watercourses from shallow landslides originating above the slope break.
Broadcast burning	A prescribed fire allowed to burn over a designated area with well-defined boundaries to achieve some land management objective.
Bucking	Use of a saw to remove log lengths from a tree after it has been felled.
Buffer	A vegetation strip or management zone of varying size, shape, and character maintained along a stream, lake, road, or different vegetation zone to minimize the impacts of actions on sensitive resources.
Cable logging/yarding	Taking logs from the stump area to a landing using an overhead system of winch-driven cables to which logs are attached with chokers.
California Forest Practice Rules (CFPRs)	Rules promulgated by the California Board of Forestry and administered by the California Department of Forestry and Fire Protection governing the conduct of commercial timber operations on State and private land in California.
Candidate Conservation Agreement with Assurances (CCAA)	An agreement between a non-Federal property owner and the Service(s), in which the property owner commits to implement conservation measures for a proposed or candidate species or a species likely to become a candidate or proposed in the near future. The property owner also receives assurances from the Service(s) that additional conservation measures will not be required and additional land, water, or resource use restrictions will not be imposed should the currently unlisted species become listed in the future (64 Federal Register 116, 32727). This agreement accompanies an Enhancement of Survival Permit (see below) issued under Section 10(a)(1)(A) of the ESA.

Canopy closure The ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and commonly expressed as a percent of total ground area.

Canopy cover The proportion of ground or water covered by a vertical projection of the outermost perimeter of the natural spread of foliage or plants, including small openings within the canopy.

Channel Natural or artificial waterway of perceptible extent that periodically or continuously contains moving water.

Channel complexity Qualities of streams that have great diversity of habitats available for fish rearing, hiding, and foraging. These qualities include the presence of overhanging banks, pools, riffles, large woody debris, and boulders.

Channel migration A natural process in which streams shift position laterally on their floodplain or valley floor.

Channel migration zone (CMZ) Current boundaries of the bankfull channel along the portion of the floodplain that is likely to become part of the active channel in the next 50 years. The area of the channel defined by a boundary that generally corresponds to the modern floodplain, but may also include terraces that are subject to significant bank erosion.

Class I watercourse All current or historic fish-bearing watercourses and/or domestic water supplies, including springs that are on site and/or within 100 feet downstream of an operations area.

Class II watercourse Defined by the California Forest Practices Rules as watercourses in which fish are always or seasonally present offsite within 1,000 feet downstream and/or provides aquatic habitat for non-fish aquatic species. This designation excludes Class III waters that are tributary to Class I waters. As defined in Green Diamond's AHCP/CCAA, Class II watercourses do not contain fish, but do support or provide habitat for aquatic vertebrates. Seeps or springs that support or provide habitat for aquatic vertebrates are also considered Class II watercourses with respect to the conservation measures.

Class III watercourse Defined by the California Forest Practices Rules as watercourses in which no aquatic life is present. The watercourse shows evidence of being capable of sediment transport to Class I and II waters under normal high water flow conditions after completion of timber operations.

Clearcutting Even-aged regeneration method where all the merchantable trees in the stand are removed in one harvest. Regeneration is accomplished by natural or artificial means.

Cobble Substrate particles 64 - 256 mm in diameter. Often subclassified as small (64 - 128 mm) and large (128 - 256 mm).

Codominant trees	Trees with crowns that form the general level of the forest canopy and receive full light from above, but comparatively little light from the sides. Codominants usually have medium-sized crowns, but are crowded on the sides.
Commercial harvest	Removal of merchantable trees from a stand.
Confined stream Channel	Stream alignment that has a small chance of migrating to significantly different locations because of valley walls or high banks.
Covered Activities	Certain activities carried out by Green Diamond in the Action Area that may result in incidental take of covered species and all those activities necessary to carry out the commitments reflected in the AHCP/CCAA's Operating Conservation Program and IA.
Covered Species	The species identified in Table 2.2-1 of the EIS, which the AHCP/CCAA addresses in a manner sufficient to meet all of the criteria for issuing an incidental take permit under ESA Section 10(a)(1)(B) and all of the criteria for issuing an enhancement of survival permit under ESA Section 10(a)(1)(A), as applicable.
Cull	A tree or log that does not meet merchantable specifications.
Culvert	Buried pipe structure that allows streamflow or road drainage to pass under a road.
Cumulative effect	The change in environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.
Debris flow	A landslide with mixed particle size and a high water content that acts in a fluid or plastic motion.
Debris slide	A landslide of mixed particle size. May move fast or slow and may be shallow or deep.
Deep-seated landslide	Landslides that have a basal slip plane that extends into bedrock. These are typically vegetated with trees and/or grass and typically move incrementally.
Degradation (stream)	To degrade or lessen the habitat value of a stream.
Diameter at breast height (dbh)	The diameter of a tree 4.5 feet above the ground on the uphill side of the tree.

Dissolved oxygen Oxygen found in solution with water in streams and lakes. Solubility is generally measured in mg/l and varies with temperature, salinity, and atmospheric pressure.

Distinct Population Segment (DPS) A group of organisms that is discrete from other populations (*i.e.*, markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors) and is significant to its taxon. Significance is measured with respect to the taxon (species or subspecies) as opposed to the full species.

Ditch relief culvert A drainage structure or facility which will move water from an inside road ditch to an outside area.

Dominant tree A tree whose crown extends above the general level of the forest canopy and receiving full light from above and partly from the sides.

Downed woody debris Logs, rootwads, and large branches on the forest floor.

Drainage An area (basin) mostly bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed.

Early-seral The biotic community that develops immediately following the removal or destruction of the vegetation in an area. The stage in forest development that includes seedling, sapling, and pole-sized trees.

Early spring drying The period from May 1st through May 14th where no measurable rainfall has occurred within the last 5 days and no rain is forecasted by the National Weather Service for the next 5 days.

Earthflow Relatively large semi-viscous and highly plastic mass resulting in a slow flowage of saturated earth.

Edge The place where different plant communities meet or where different successional stages or vegetative conditions within plant communities come together.

Element A biotic or abiotic feature that is a component of a habitat patch, but which occurs somewhat independent of overall patch conditions.

Eleven (11) HPAs The area encompassed by the eleven Hydrographic Planning Areas identified in Figure 3.3-1 and Table 3.3-1 of the EIS and described in Section 3.2.4 of the EIS.

Embeddedness The extent to which large streambed particles (boulders, cobbles, rubble, and gravel) are surrounded or covered by fine sediments, usually assessed by visual examination of spawning riffles and pool tailouts and measured in classes according to percent coverage.

Endangered	A plant or animal that is in danger of extinction throughout all or a significant portion of its range.
Enhancement of Survival Permit (ESP)	A permit issued by the Service(s) pursuant to ESA Section 10(a)(1)(A) for any act that enhances the propagation or survival of a listed species that would otherwise be prohibited by ESA Section 9. The permit that authorizes incidental take of species covered by a CCAA.
Equipment Exclusion Zone (EEZ)	An area where heavy equipment associated with timber operations is totally excluded for the protection of water quality, the beneficial uses of water, and/or other forest resources.
Equipment Limitation Zone (ELZ)	An area where the use of heavy equipment associated with timber operations is partially restricted for the protection of water quality, the beneficial uses of water, and/or other forest resources.
ESP species	The species for which Green Diamond is seeking an ESP from the USFWS; the species named on the ESP.
Estuary	Semi-enclosed body of water that has free connection with the open ocean and within which seawater is measurably diluted with fresh water derived from land drainage.
Evapotranspiration	The conversion of water, whether open or as soil moisture (both by evaporation) or within plants (by transpiration), into water vapor that is released into the atmosphere.
Even-aged	A forest stand composed of trees with less than a 20-year age difference.
Even-aged management	The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Clearcut, shelterwood, or seed tree cutting methods produces even-aged stands.
Evolutionarily Significant Unit (ESU)	A population (or group of populations) that is substantially reproductively isolated from other population units of the same species, and represents an important component in the evolutionary legacy of the species.
Extirpate	The elimination of a species from a particular area.
Feasible	Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, operational, and technological factors, and considering what is allowable under law.
Fine sediment	Sediment with particle size of 2 mm and less, including sand, silt, and clay.
Fish-friendly structure	Culvert or other structure that will provide upstream and downstream fish passage for all life stages of fish and not restrict the active channel flow.

Floodplain	The area adjacent to a stream where the soil surface is temporarily covered with flowing water during periods of high flow (*i.e.*, a 100-year floodplain is the lowland area bordering a stream onto which the stream spreads at a 100-year flood stage).
Fluvial	Describes a condition that is produced by the action of a stream or river. Also describes a fish or plant species living in a stream or river.
Forest fragmentation	Isolating or breaking up large tracts of forest as a result of natural events (such as wildfire) or by the implementation of timber management or other human activities.
Forest management	Activities undertaken for the purpose of harvesting, traversing, transporting, protecting, changing, replenishing, or otherwise using forest resources.
Fry	Life stage of salmonids between full absorption of the yolk sac and a somewhat arbitrarily defined fingerling or parr stage (generally reached by the end of the first summer).
Geomorphic processes	Landscape modifying processes such as surface erosion, mass soil movement, and stream flow.
Gradient	Average change in vertical elevation per unit of horizontal distance.
Gravel	Substrate particles between 2 and 64 mm in diameter.
Green Diamond's ownership	Commercial timberlands that Green Diamond owns in fee and lands owned by others subject to Green Diamond harvesting rights.
Ground-based yarding	Movement of logs to a landing by use of tractors, either tracked or rubber tired (rubber tired skidders) or shovels (hydraulic boom log loaders).
Habitat	The place, natural or otherwise, (including climate, food, cover, and water) where an animal, plant, or population naturally or normally lives and develops.
Habitat Conservation Plan (HCP)	As defined in the Services' HCP Handbook, a planning document that is a mandatory component of an application for an incidental take permit under ESA Section 10(a)(1)(B); also known as a conservation plan. The document that, among other things, identifies the operating conservation program that will be implemented to minimize, mitigate, and monitor the effects of incidental take on the species covered by a Section 10(a)(1)(B) permit.

Harass	A form of take under the Federal Endangered Species Act; defined in Federal regulations as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). The Department of Commerce/NOAA Fisheries has not defined "harass" by regulation.
Harm	A form of take under the Federal Endangered Species Act; defined in Federal regulations as an act that actually kills or injures wildlife. Such acts may include significant habitat modification or degradation when it actually kills wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
Harvesting	All activities necessary to cut, remove and transport timber products from the Action Area. Also see Timber Harvesting.
Harvesting rights	Rights to conduct timber operations on lands owned in fee by another. Short-term harvesting rights generally expire upon the conclusion of timber operations, upon a date certain, or a combination of the two. Perpetual harvesting rights pertain to existing and subsequent crops of timber and continue without expiration.
Headwall swale	Area of narrow, steep, convergent topography (swales or hollows) typically located at or above the head of a Class III watercourse that has been sculpted over geologic time by repeated debris slide and debris flow events.
Heel-boom loader	A stationary piece of log loading equipment located on roads and landings, similar to a construction crane, that uses a crane-like grapple to deck, move, and load logs onto log trucks from one central pivot point.
Historically active landslide scarp	Any ground crack or landslide scarp that has movement within the past 100 years. Conservation measures are for scarps that exhibits at least 3 inches of horizontal displacement or at least 6 inches of vertical displacement.
Historically active landslide toe	An area below the inflection point of the convex, lobate landform at the downslope end of a historically active landslide.
Hydrographic area	An HPA that encompasses either multiple watersheds or a fraction of one watershed.
Hydrographic Planning Area (HPA)	The hydrographic areas and hydrologic units mapped in the AHCP/CCAA that encompass Green Diamond's California ownership and surrounding lands in common watersheds.
Hydrologic unit	An HPA that encompasses an entire watershed.

Hydrologically disconnected Isolation of the road network such that drainage will not directly enter watercourses.

Implementation Agreement (IA) An agreement between the Service(s) and the incidental take permittee(s) that identifies the obligations of the parties, identifies remedies if parties fail to meet their obligations, provides assurances to the Service(s) that the conservation plan will be implemented, and provides assurances to the permittee(s) that implementation of the plan satisfies ESA requirements for the species and activities covered by the plan and permit.

Incidental take Take of any federally listed or State-listed wildlife species that is incidental to, but not the purpose of, otherwise lawful activities.

Incidental Take Permit (ITP) Permit issued by NMFS or the USFWS pursuant to Section 10(a)(1)(B) of the ESA to a non-Federal entity (state, tribe, private landowner) that authorizes incidental take of a threatened or endangered species named on the permit. The permit also requires the permittee to carry out specified actions that minimize and mitigate the impacts of incidental take.

Inner gorge A geomorphic feature formed by coalescing scars originating from landsliding and erosional processes caused by historically active stream erosion. The feature is identified as that area beginning immediately adjacent to the stream channel extending upslope to the first break in slope. Inner gorge is a subset of Steep Streamside Slopes.

Insloping Describes a road where the inner edges of the road surface are lower than the outer edges of the road. Consequently, runoff is directed into an "inside" ditch between the road surface and the adjacent uphill sideslope.

Intermittent stream A stream that flows only at certain times of the year and/or when it receives water from springs or from surface sources. It ceases to flow above the streambed when losses from evaporation or seepage exceed the available streamflow.

Issuance criteria The criteria specified in the ESA and Federal regulations for issuance of an ITP or ESP; also, the criteria specified in the CCAA policy for an ESP.

ITP Species The covered species for which Green Diamond is seeking an ITP or ESP.

Lacustrine Pertaining to or associated with lakes, such as fish stocks that spend their entire lives in lakes.

Lake A permanent natural body of water of any size, or an artificially impounded body of water having a surface area of at least one acre, isolated from the sea, and having an area of open water of sufficient depth and permanency to prevent complete coverage by rooted aquatic plants.

Landings	The areas where harvested trees are gathered (through skidding or yarding) for subsequent transport out of the forest.
Landscape	An area composed of interacting ecosystems that are variously repeated in response to geology, landform, soils, climate, biota, and human influences throughout the area.
Landslide headscarp	The uppermost scarp of a landslide below the landslide crown, but above any secondary scarps; may also be referred to as crown scarp, main scarp, or primary scarp.
Landslide prone terrain	Potentially higher risk areas for producing shallow landslides compared to adjacent slopes.
Large woody debris (LWD)	Larger pieces of wood in stream channels or on the ground, including logs, root wads, and large chunks of wood, that provide important biological and physical functions.
Late-seral	The stage in forest development that includes mature and old-growth forest.
Late-successional	See "late-seral."
Listed species	Species, including subspecies and distinct populations, of fish, wildlife, or plants listed as either endangered or threatened under Section 4 of the Federal Endangered Species Act or under the California Endangered Species Act.
Mainline roads	Roads that support significant amounts of traffic annually from major tracts of timber or provide the main access into a tract for non-harvest management activities.
Mainstem	Principal stem or channel of a drainage system.
Management roads	Roads that are needed to either support long-term management activities in the Action Area or provide access to timber that will be harvested within the next 20 years.
Mass soil movement	All geologic processes in which masses of earth materials move downslope by gravitational forces. Includes, but is not limited to, landslides, log dam breaks, rock falls, debris avalanches, and creep. It does not, however, include surface erosion by running water. It may be caused by natural erosional processes or by natural disturbances (e.g., earthquakes or fire events) or human disturbances (e.g., mining or road construction).

Mature forest	A defined stand of trees for which the annual net rate of growth has culminated. Stand age, diameter of dominant trees, and stand structure at maturity vary by forest cover types and local site conditions. Mature stands generally contain trees with a smaller average diameter, less age-class variation, and less structural complexity than old-growth stands of the same forest type.
Maximum extent practicable	Term used in the ESA and Federal regulations to describe the level of impact minimization and mitigation required for incidental take of a listed species to be authorized under ESA Section 10(a)(1)(B).
Maximum sustained timber production	Harvest levels planned under CFPRs to balance forest growth and timber harvest over a 100-year period and to achieve maximum sustained production of high quality timber products while protecting resource values such as water quality and wildlife.
Maximum Weekly Average Temperature (MWAT)	A calculated value, based on experimental data, which is the upper temperature recommended for a specific life stage of a species.
Merchantable	Trees or stands having the size, quality, and condition suitable for marketing under a give economic condition, even if not immediately accessible for logging.
Mesic	Pertaining to or adapted to an area that has a balanced supply of water; neither wet nor dry.
Microclimate	The climate of small areas, such as under a plant or other cover, differing in extremes of temperature and moisture from the climate outside that cover.
Microhabitat	Specific combination of habitat elements in the place occupied by an organism for a specific purpose.
Mid-seral	The period in the life of a forest stand from crown closure to first merchantability, usually at 8 inches dbh. Brush, grass, or herbs rapidly decrease in the stand due to stand density.
Minor forest products	Secondary forest materials including tree burls, stump products, boughs and greenery for wreaths and floral arrangements or similar purposes.
Multi-layered	Term applied to forest stands that contain trees of various heights and diameter classes and, therefore, support foliage at various heights in the vertical profile of the stand.
Multi-storied	See "multi-layered."
National Marine Fisheries Service (NMFS)	The Federal agency that is the listing authority for marine resources and anadromous fish under the Endangered Species Act.

Old-growth A forest stand with moderate-to-high canopy closure; a multi-layered canopy dominated by large overstory trees; a high incidence of large trees with large, broken tops, and other indications of decadence; numerous large snags; and heavy accumulations of logs and other woody debris on the ground.

Operating conservation program Those conservation management activities which are expressly agreed upon and described in a conservation plan or its implementing agreement, if any, and which are to be undertaken for the covered species when implementing an approved conservation plan, including measures to respond to changed circumstances. In the Green Diamond AHCP/CCAA and IA, the conservation management activities and specific measures (including provisions for changed circumstances, funding, monitoring, reporting, adaptive management, and dispute resolution) as set forth in AHCP/CCAA Section 6.2.

Outmigration The downstream movement of juvenile salmonids toward the ocean during which a physiological adaptation termed smoltification occurs, allowing the young fish to survive in a saline environment.

Outsloping Describes a road where the inner edges of the road surface are higher than the outer edges of the road. Consequently, runoff is directed onto the sideslope downhill of the road.

Overstory That portion of trees in a forest that forms the uppermost layer of foliage.

Parr Young salmonid, in the stage between alevin and smolt, that has developed distinctive dark markings ("parr marks") on its sides and is actively feeding in fresh water.

Permanently decommissioned roads Decommissioned roads that will not be needed for future management activities.

Permit or permits The incidental take permit (ITP) issued by NMFS to Green Diamond pursuant to ESA Section 10(a)(1)(B) or the Enhancement of Survival Permit (ESP) issued by USFWS to Green Diamond pursuant to ESA Section 10(a)(1)(A), or both the ITP and the ESP.

Plan The Aquatic Habitat Conservation Plan and Candidate Conservation Agreement with Assurances prepared by Green Diamond, dated October 2006.

Plan Area	All commercial timberland acreage within eleven Hydrographic Planning Areas (HPAs) on the west slopes of the Klamath Mountains and the Coast Range of California where Green Diamond owns fee lands and Harvesting Rights (Green Diamond's ownership), during the period of such ownership within the term of the Permits, subject to the limitations described in AHCP/CCAA Section 1.3.2.3 and in the IA, and up to 100 miles of roads on lands where Green Diamond owns and exercises Road Access Rights within its approved Timber Harvesting Plan (THP) areas in the Eligible Plan Area during the term of the Plan and Permits. This is the geographic area where incidental take will be authorized, the covered activities will occur, and the Operating Conservation Program will be implemented. Except where stated otherwise in the Plan, references to lands, commercial timberlands, and Green Diamond's ownership in the context of the Plan Area include lands owned in fee and lands subject to harvesting rights.
Pond	A body of water smaller than a lake, sometimes artificially formed.
Pool	A stream channel feature characterized by a wide, uniform channel bottom, low velocity, and lack of turbulence or entrained air. Substrates often consist of gravel and sand.
Population	A collection of individuals that share a common gene pool.
Practicable	Defined in Section 404 Clean Water Act regulations as "capable of being done (or capable of achieving the project purpose and need), taking into account costs, existing technology, and logistics (40 C.F.R. § 230.10(a)(2))".
Precommercial thinning	Thinning or pruning of dense young forest trees to achieve optimum diameter growth and increase the eventual value of the tree.
Prescribed burning	Introduction of fire under controlled conditions to remove unwanted brush, logging slash, and/or woody debris.
Professional Geologist	A person who holds a valid California license as a professional geologist pursuant to California's Department of Consumer Affairs Geologist and Geophysicist Act.
Rare	A State of California classification for a plant species that is not presently threatened with extinction, but the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.
Recovery	The process by which the decline of an endangered or threatened species is arrested or reversed, or threats to its survival are neutralized so that the species' long-term survival in nature can be ensured.

Redd	A spawning nest constructed by a fish. A depression excavated in gravels where eggs are deposited. In this "nest," embryos incubate and hatch following their development.
Regeneration	The renewal of tree cover by natural or artificial means. Also the young tree crop (seedlings and saplings).
Registered Professional Forester (RPF)	A person who holds a valid license as a professional forester pursuant to Article 3, Section 2, Division 1 of the California Public Resources Code (as in effect on the date of issuance of the Permits).
Residual	A tree that remains standing after some event such as selection harvest.
Riffle	A stream segment characterized by swiftly flowing water with surface agitation and having bars of deposited sediment. Riffles typically occur in areas of increased channel gradient where hydraulic conditions sort transported sediments (gravel, cobble, and boulders).
Rill	One of the first and smallest channels formed by surface erosion; also, a very small brook or trickling stream of water.
Riparian	That portion of the watershed or shoreline influenced by surface or subsurface waters, including stream or lake margins, marshes, drainage courses, springs, and seeps. Riparian areas usually have visible vegetative or physical characteristics reflecting the influence of water. Riversides and lake borders are typical riparian areas.
Riparian buffer	A set-back or management zone of varying width that is used to protect riparian and water resources from impacts from adjacent activities.
Riparian Management Zone (RMZ)	A riparian buffer zone on each side of a Class I or Class II watercourse that receives special treatments to provide temperature control, nutrient inputs, channel stability, sediment control, and LWD recruitment.
Riparian Slope Stability Management Zone (RSMZ)	An RMZ below an SMZ or where streamside slopes exceed the minimum Steep Streamside Slope gradients.
Riparian vegetation	Vegetation growing on or near the banks of a stream or other body of water in soils that exhibits some wetness characteristics during some portion of the growing season.
RMZ inner zone	The first 30 to 70 feet of the RMZ area (depending on stream class and sideslopes), as measured from the first line of perennial vegetation.
RMZ outer zone	The remaining 45-foot to 100-foot area (depending on stream order and sideslopes) of the RMZ or the entire area extending to the edge of the floodplain from the RMZ inner zone edge.
Rookery	A nesting or roosting colony of gregarious birds.

Rotation	The planned number of years between the regeneration of an even-aged stands and its final cutting at a specified stage.
Rotation age	The age of a stand when it is harvested at the end of a rotation.
Run (fish)	A group of fish migrating in a river (most often on a spawning migration) that may comprise one or many stocks.
Runs (stream)	Runs are stream segments characterized by swift flowing water with little surface agitation and no major flow obstructions. The substrate composition of runs usually consists of gravel, cobbles, and boulders.
Salmonid	A member of the fish family *Salmonidae* that includes all species of salmon and trout, char, and grayling.
Salvage operations	The removal of dead trees or trees damaged or dying because of injurious agents other than competition, to recover economic value that would otherwise be lost.
Sand	Substrate particles 0.061 - 2 mm in diameter.
Second-growth	Timber stands established after natural or human-caused removal of the original stand or previous forest growth.
Sediment	Fragments of rock, soil, and organic material transported and deposited by wind, water, or other natural phenomena.
Sedimentation	The deposition of material suspended in water or air, usually when the velocity of the transporting medium drops below the level at which the material can be supported.
Seep	An area of minor ground water outflow onto the land surface or into a stream channel; flows that are too small to be a spring.
Selection harvest	The removal or trees, individually or in small groups, from the forest.
Sensitive species	A species designated by the California Board of Forestry pursuant to 14 CCR 898.2(d). Currently, these species are bald eagle, golden eagle, great blue heron, great egret, northern goshawk, osprey, peregrine falcon, California condor, great gray owl, northern spotted owl, and marbled murrelet.
Seral stage	One of several successional stages of plant community development, beginning with an early seral stage, following a major disturbance, and ending with a late-seral stage near or at climax stage.
Shade tolerant trees	Tree species capable of reproducing under the shade of parent trees. These species have characteristics such as the ability to photosynthesize in limited light intensity and ability to withstand root competition from competing trees.

Shallow-rapid landslides	Rapid event landslides confined to the overlying mantle of colluvium and weathered bedrock (in some instances competent bedrock) that commonly leave a bare unvegetated scar after failure. These landslides may include debris slides, debris flows, channel bank failures, and rock falls.
SHALSTAB	A GIS-based slope stability computer model that delineates the relative potential for shallow landslides across the landscape. SHALSTAB identifies potential unstable areas based on both slope steepness and contributing upslope drainage area.
Silt	Substrate particles 0.004 - 0.062 mm in diameter.
Siltation	The deposition or accumulation of silt that is suspended throughout a body of standing water or in some considerable portion of it; especially the choking, filling, or covering with stream-deposited silt behind a place of an impeded flow.
Silviculture	The specific methods by which a forest stand or area is harvested and regenerated over time to achieve the desired management objectives.
Single-tree selection harvest	The selection of individual trees for harvest, where new regeneration occurs in their place and all species represented in pretreatment stands are represented post harvest where feasible. Retention standards in stands after harvest are as follows: Site I – 125 square feet basal area; Sites II and III – 75 square feet basal area; Sites IV and V – 50 square feet basal area.
Site index	A measure of forest productivity expressed as the height of the dominant trees in a stand at an index age.
Site potential tree height	The height that a dominant tree may attain given the site conditions where it occurs.
Size class	The categorization of trees into one of the following four dbh classes: seedling (<1″), sapling (1″ to 4.9″), pole (5″ to 11.9″), sawtimber (12″ and larger).
Skid trail	An access cut through the woods for skidding logs with ground-based equipment. It is not a high enough standard for use by highway vehicles, such as a log truck, and is therefore not a road.
Slash	Woody residue left on the ground after trees are felled, or accumulated there as a result of a storm, fire, or silvicultural treatment.
Slope Stability Management Zone (SMZ)	The outer zone of an SSS zone.
Smolt	Juvenile salmonid one or more years old that has undergone physiological changes to cope with a marine environment.

Snag	A standing dead tree.
Special-status species	A species listed as threatened or endangered by the Federal or State government; classified as a California Species of Special Concern, a Federal Species of Concern, Rare, or a Board of Forestry Sensitive species; or designated a Fully Protected Species under the California Fish and Game Code.
Species	As defined in ESA Section 3(15), "the term 'species' includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife, which interbreeds when mature." Also, a population of individuals that are more or less alike and that are able to breed and produce fertile offspring under natural conditions.
Species of concern	An informal means of referring to species listed as threatened or endangered under the Federal or State of California endangered species acts, classified as a Federal "species of concern" or State of California "species of special concern", or classified as a "sensitive species" by the California Board of Forestry.
Spring	An area of groundwater outflow onto the land surface or into a stream channel; flows are greater than a seep.
Stand	A group of trees that possesses sufficient uniformity in composition, structure, age, spatial arrangement, or condition to distinguish it from adjacent groups.
Status	The classification of a species regarding its position in the listing process under the State or Federal endangered species acts.
Steep Streamside Slopes (SSS)	Steep slopes located immediately adjacent to a stream channel, defined by: (1) a minimum slope gradient leading to a Class I or Class II watercourse, (2) a maximum distance from a Class I or Class II watercourse, and (3) a reasonable ability for slope failure to deliver sediment to a watercourse.
SSS zone	The area in which default prescriptions for SSS will be applied; consists of an inner zone (the RSMZ) and outer zone (the SMZ).
Stocking level	The degree to which trees occupy the land, measured by basal area and/or number of trees by size and spacing, compared with a stocking standard; that is, the basal area and/or number of trees required to fully utilize the land's growth potential.
Stream	A natural watercourse with a well-defined channel with distinguishable bed and bank showing evidence of having contained flowing water indicated by deposit of rock, sand, gravel, or soil.

Stream order A number from 1 to 6 or higher, ranked from headwaters to river terminus, that designates the relative position of a stream or stream segment in a drainage basin. First-order streams have no tributaries; the confluence of two first-order streams produces a second-order stream; the confluence of two second-order streams produces a third-order stream; etc. However, if a first-order stream joins a second-order stream, the latter remains a second-order stream. It is not until one stream combines with another stream of the same order that the resulting stream increases by an order. Also see Watercourse Order.

Substrate Mineral or organic material that forms the bed of a stream.

Summer period The period from May 15th through October 15th.

Surface erosion Movement of soil particles down or across a slope, as a result of gravity and a moving medium such as rain or wind. The transport of sediment depends on the steepness of the slope, the texture and cohesion of the soil particles, the activity of rainsplash, sheetwash, gullying, and dry ravel processes, and the presence of buffers.

Suspended sediment Sediment suspended in a fluid by the upward components of turbulent currents or by colloidal suspension. That part of a stream's total sediment load carried in the water column.

Sustained yield The yield of commercial wood that an area can produce continuously at a given intensity of management. These yields are professionally planned to achieve over time a balance between growth and removal over time.

Swamp A wetland dominated by trees or shrubs.

Take Defined under Section 3 (19) of the Federal Endangered Species Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" a Federally listed endangered species of wildlife. Federal regulations further define these terms and provide the same taking prohibitions for threatened wildlife species. Defined under Section 86 of the California Fish and Game Code, take for solely State-listed species means "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, capture, or kill."

Temporarily decommissioned roads Decommissioned roads that may be used again in the future for management activities (typically not for at least 20 years).

Terrace A valley bottom landform composed of glacial or alluvial fill that occurs at a higher elevation than the active floodplain or channel migration zone.

Thinning A treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality.

Threatened	The classification given to a plant or animal species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Timber felling	Physically cutting a tree from its stump including cutting of the felled tree into predetermined log lengths.
Timber Harvesting	All activities necessary to cut, remove and transport timber products from the Action Area. Also see Harvesting.
Timber Harvesting Plan (THP)	A plan describing a proposed timber harvesting operation pursuant to 14 CCR Section 4582 (as in effect on the date of issuance of the Permits).
Tractor logging	Use of a tractor to move logs from the harvest site to a landing.
Translational/ rotational rockslides	A subset of deep-seated landslides. Landslides that occur by movement of a relatively intact slide mass with a relatively deep failure plane extending below the colluvial layer into the underlying bedrock.
Turbidity	An indicator of the amount of sediment that is suspended in water. It has been used as an expression of the optical properties of a water sample that causes light rays to be scattered and absorbed, rather than transmitted through the sample.
Unconfined stream channel	Stream alignment that has a moderately high chance of migrating to significantly different locations because of low banks or lack of valley walls.
Undercut bank	A bank that has its base cut away by the water action along man-made or natural overhangs in the stream.
Understory	Vegetation (trees or shrubs) growing under the canopy formed by larger trees.
Uneven-aged	A stand with trees of three or more distinct age classes, either intimately mixed or in small groups.
Uneven-aged management	The application of a combination of actions needed to simultaneously maintain continuous forest cover, recurring regeneration of desirable species, and orderly growth and development of trees through the range of diameter or age classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.
Unforeseen circumstances	Changes in the circumstances affecting a species or geographic area covered by the AHCP/CCAA that could not reasonably have been anticipated by Green Diamond and the Services at the time of the Plan's negotiation and development, and that result in a substantial and adverse changes in the status of the covered species.
Unlisted species	Fish, wildlife, or plant species not currently listed as threatened or endangered under the Federal or State Endangered Species Acts.

Waterbarring A technique to divert flowing water off roads or trails to prevent erosion and sediment delivery to streams. Usually, a ditch or shallow gully is constructed across the road or trail at a diagonal angle to prevent water from flowing directly down them.

Watercourse Any well-defined channel with a distinguishable bed and bank showing evidence of having contained flowing water indicated by deposits of rock, sand, gravel, or soil. Watercourses may also include manmade watercourses.

Watercourse and Lake Protection Zone (WLPZ) A strip of land, along both sides of a watercourse or around the circumference of a lake or spring, where additional management practices may be required for erosion control and for protection of the quality and beneficial uses of water, fish, and riparian wildlife habitat. (14 CCR 895.1)

Watercourse orders The watercourse order signifies the relative position of a stream segment in a basin drainage network: the smallest, unbranched, intermittent tributaries are designated order 1; the junction of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3, etc. However, if a first-order stream joins a second-order stream, the latter remains a second-order stream. It is not until one stream combines with another stream of the same order that the resulting stream increases by an order.

Watercourse transition line That line closest to the watercourse where perennial vegetation is permanently established.

Water drafting Direct removal of water from a stream or pond into a water truck or for storage in reservoirs or tanks for use in dust abatement or fire suppression.

Watershed The catchment area of land draining into a river, river system, or body of water; the drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake.

Wetland A transitional area between aquatic and terrestrial ecosystems that is inundated or saturated for periods long enough to produce hydric soils and support hydrophytic vegetation.

Wheeled front-end loader A machine with special forks, lifts, or grapples for loading logs onto trucks, pallets, or railcars.

Windthrow Trees blown down by wind; also called blowdown.

Winter period The period from October 16th through May 14th.

Yarding A method of bringing logs to a roadside area or landing for truck transport.

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APPENDIX A

Management Considerations and Implications Even-Aged vs. Uneven-Aged Regeneration Systems

APPENDIX A

Management Considerations and Implications—Even-Aged vs. Uneven-Aged Regeneration Systems

Green Diamond Resource Company

	Uneven-Aged	Even-Aged
Species mix	Favors shade-tolerant species such as hemlock.	Favors shade-intolerant species such as redwood and Douglas-fir.
Growth and yield	Less opportunity to "manage" and promote individual tree diameter growth of selected species.	More opportunity to "manage" and promote individual tree diameter growth of selected species, especially during the early stages of stand development.
Product management	General product manufacturing and marketing is more opportunistic under uneven-aged management, because the diameter and species mix from harvested stands is more "unpredictable."	General product manufacturing and marketing is less opportunistic and subject to greater long-term planning under even-aged management, because the diameter and species mix from harvested stands can be more easily "managed" at an early stand age.
Logging system	More emphasis on downhill tractor yarding using skid trails.	More emphasis on uphill yarding using cable corridors.
Road and skid trail layout	Greater concentration of roads and skid trails along the mid and lower slope reaches within a watershed; usually larger landing sizes to accommodate equipment. Skid trails tend to be larger in size than cable corridors for even-aged systems.	Greater concentration of roads and skid trails along mid and upper slope reaches within a watershed; usually smaller landing sizes. Cable corridors tend to be smaller in size than skid trails associated with tractor logging under uneven-aged systems.
Watercourse crossings	The greater concentration of roads on mid and lower slopes within a watershed under this management system usually necessitates a greater number of watercourse crossings.	The greater concentration of roads on mid and upper slopes within a watershed under this management system usually does not require as many watercourse crossings as under uneven-aged management systems.

APPENDIX B

Public Scoping Report

Appendix B: Scoping Report

Environmental Impact Statement for Simpson Timber Company's Anticipated Application for an Incidental Take Permit and Enhancement of Survival Permit

Prepared for

U.S. Fish and Wildlife Service
National Marine Fisheries Service

September 25, 2000

CH2MHILL

Introduction

This scoping report summarizes the public scoping process for the Environmental Impact Statement (EIS) being prepared in connection with Simpson Timber Company's (Simpson's) anticipated application for an incidental take permit/enhancement of survival permit under Section 10(a) of the Endangered Species Act (ESA). The EIS will consider the potential impacts of implementing Simpson's anticipated submittal of the Aquatic Habitat Conservation Plan/Candidate Conservation Agreement (Plan/Agreement). The report is organized in the following sections:

- Background
- Agency Action and the Environmental Impact Statement
- Scoping Process
- Comments Received
- Summary of Scoping Comments

Four public scoping meetings were held and eight comment letters were received, with a total of 179 individual comments. Comments were sorted into two broad categories – EIS scoping suggestions and suggestions on the Plan/Agreement. EIS scoping issues ranged from very broad concerns regarding NEPA compliance and content of the EIS to specific comments on particular resource topics. In general, several comments were made regarding the need to fully analyze alternatives, the need to demonstrate how the Plan/Agreement will comply with state and federal regulations, and the need to provide detailed baseline and operational information in the EIS to be able to analyze impacts to the environment. Specific Plan/Agreement suggestions are not included in this scoping report.

Background

Simpson is in the process of developing a conservation strategy for various aquatic and riparian species occurring on approximately 430,000 acres of Simpson's timberlands in Del Norte and Humboldt counties in northwestern California in connection with its anticipated applications for an incidental take permit and enhancement of survival permit under Section 10(a) of the ESA. Simpson's intent is to help conserve various aquatic and riparian species and the ecosystems on which they depend, within a framework of long-term regulatory certainty and flexibility. As required by the ESA, Simpson is preparing the Plan/Agreement in connection with its anticipated permit applications. Simpson expects to apply for an incidental take permit pursuant to Section 10(a)(1)(B) of the ESA from the National Marine Fisheries Service (NMFS) for coho salmon (*Oncorhynchus kisutch*), chinook salmon (*O. tshawytscha*), and coastal steelhead (*O. mykiss irideus)*. Simpson is also preparing an application for an enhancement of survival permit under the Candidate Conservation Agreement with Assurances policy of the U.S. Fish and Wildlife Service (USFWS) for the coastal cutthroat trout (*Oncorhynchus clarki clarki)*, tailed frog (*Ascaphus truei*), and southern torrent salamander (*Rhyacotriton variegatus*).

The Plan/Agreement prepared by Simpson in support of the anticipated applications described above will describe the impacts of the taking for which authorization is sought. In addition, the Plan/Agreement will request a conservation strategy to minimize and mitigate those impacts to the maximum extent practicable and to satisfy other application requirements of the ESA and its implementing regulations. This conservation strategy currently assumes a Plan/Agreement term of 50 years and is expected to include enhanced stream buffers, a sediment reduction program, a monitoring program, adaptive management measures, and certain salmonid, fish, and aquatic habitat restoration activities. The plan will also identify alternatives considered by Simpson and why those alternatives were not selected.

The issuance of these permits under the ESA is a federal action and, therefore, is subject to environmental review in accordance with the National Environmental Policy Act (NEPA). The Services have determined that an EIS is required for the action.

Action and the Environmental Impact Statement

Simpson may apply for permit coverage for a variety of activities, including: mechanized timber harvest; forest product transportation; road and landing construction, use, maintenance, and abandonment; site preparation; tree planting; certain types of vegetation management; silvicultural thinning and other silvicultural activities; fire suppression; rock quarrying and borrow pit operations; gravel extraction; aquatic habitat restoration; and other forest management activities. The Plan/Agreement would also likely cover certain monitoring activities and scientific work in the plan area.

As required under NEPA, the EIS will examine potential significant environmental effects of the Services' approval of the permits, as well as the potential significant environmental impacts of alternatives to the project.

Scoping Process

The Services and Simpson held four public scoping meetings over a two-day period in July 2000 in Eureka and Crescent City, California.

The Services placed advertisements in local newspapers prior to meeting dates in each locale describing when and where each scoping meeting would be held. The four scoping meetings were held throughout the planning area as follows:

Tuesday, July 11, 2000 3:00-5:30 p.m. and 6:00-8:30 p.m.	Wednesday, July 12, 2000 3:00-5:30 p.m. and 6:00-8:30 p.m.
Cultural Center Atrium 1001 Front Street Crescent City, California	Red Lion Inn 1929 4th Street Eureka, California

The Services published a Notice of Intent (NOI) to prepare an EIS and announcement of public scoping meetings in the Federal Register (65 FR 133:42674 – 42676). The NOI provided information on the background and purpose of the Plan/Agreement, requested public comment on the EIS for the Plan/Agreement, and provided information on the public scoping meetings.

The objectives of the meeting were to inform the public about Simpson's Plan/Agreement and the associated EIS, and to solicit public comment on the scope of the EIS for the action and possible alternatives for consideration in the EIS. Comments received during this period are being considered by the Services during preparation of the EIS.

These scoping meetings were conducted using an open-house format, and were hosted by representatives from the Services and Simpson. The public was greeted on arrival and asked to sign an attendance record form, listing their name, address, affiliation, if any, and whether they would like to provide oral comments at the meeting. Each guest was also given the option to provide written comments or concerns they would like addressed in the EIS, and was provided with a comment card form. The public was asked to complete and return the form upon leaving the meeting or to complete the form later and return it to the Fish and Wildlife Service by August 10, 2000.

The scoping meetings served a dual purpose of information sharing and identification of key issues of concern. Meeting hosts answered questions regarding the Plan/Agreement, the NEPA process, and the general conservation planning process. Following this informational period, Simpson presented an overview of its planning process in developing the Plan/Agreement. After Simpson's presentation, the Services presided over a formal comment period. Comments, issues, and concerns identified by the public during a formal comment period were recorded.

Comments Received

A total of 179 separate comments were received from individuals and organizations during the public comment period. A total of three oral comments were received from the two meetings held in Eureka. No comments were received from the two public scoping meetings held in Crescent City. Eight separate written comment letters, both e-mail and postal letters, were received by the end of the comment period on August 10, 2000. Comments were submitted by private individuals, public agencies, and private conservation groups.

The list of individuals or organizations providing written comments is as follows:

- Brian Gaffney (Environmental Protection Information Center and Sierra Club)
- California Regional Water Quality Control Board
- California Coastal Commission
- Department of Parks and Recreation
- Klamath Forest Alliance
- Northcoast Environmental Center
- United States Environmental Protection Agency
- Walter Cook

Summary of Scoping Comments

Comments regarding the EIS were categorized into five broad categories: (1) general comments regarding the contents of the EIS, (2) suggested alternatives, (3) scope of the impacts analysis, (4) analysis of impacts on aquatic species, and (5) analysis of other impacts. All comments are summarized below. Many comments were in the form of suggestions regarding the form of the Plan/Agreement; these comments are not included in this report.

(1) General Comments Regarding the Contents of the EIS

Several general comments were made regarding the contents of the EIS. Two commentors stated that the preparation of the EIS was premature. Two commentors questioned whether California Forest Practice Rules are protective of the environment, and others questioned if compliance with federal and state regulations would be sufficient to mitigate potential adverse impacts to species. Another substantive comment was that the EIS should analyze the HCP from the perspective that target conditions are criteria to be met for ecosystem viability, rather than determining the limits of disturbance that the ecosystem could sustain within the timber harvest management framework.

(2) Suggested Alternatives for the EIS

Comments on alternatives analysis for the EIS generally focused on the need to fully explore all feasible alternatives, pursuant to the standards set forth in NEPA. One commentor made several suggestions regarding an acceptable No-Action alternative. The commentor indicated that a No-Action alternative would only be acceptable if it assumed that all applicable laws and regulations would be met. The commentor indicated that it would not be acceptable to have a No-Action alternative that was not protective of ecosystem health. Several project alternatives were suggested by one commentor, including (1) no harvesting in old-growth stands, (2) no harvesting in critical habitat areas, (3) no harvesting in watersheds or areas where covered species likely occur, (4) adoption of Northwest Forest Plan or Mantech Report management standards, (5) elimination of tractor yarding, and (6) permit terms less than 10 years.

(3) Scope of the Impacts Analysis

Many general comments on the scope of the impacts analysis were received. Several comments stated the need to assess direct, indirect, and cumulative impacts to the environment as a result of all activities discussed in the NOI. Several comments were made regarding the scope and method of addressing cumulative impacts. Four commentors made several comments regarding the need to identify and address wildlife and vegetation other than threatened and endangered species that have the potential to be impacted by timber management activities.

(4) Analysis of Impacts on Aquatic Species

Many comments were provided regarding the content and scope of the analysis on aquatic species and related issues. Several commentors expressed the need for the EIS to determine if the HCP was in compliance with several federal and state laws or programs, including the Clean Water Act and Total Maximum Daily Load (TMDL) provisions. Several general comments were made regarding appropriate topics to be included in the analysis of impacts on aquatic species, including analyzing impacts of water quality changes on several aspects of species survival. Other suggested topics to be addressed included issues related to aquatic species, such as the analysis of implementing the action on floodplains. Several comments were made requesting clarification on large woody debris recruitment and road management. Several comments were made by one commentor regarding mitigation, including monitoring for short-term and long-term effectiveness and the need for species-specific mitigation. Several comments were made by one commentor regarding specific information requested to be disclosed in the EIR about watersheds that Simpson has ownership in, including a comparison among other watersheds on species viability. Several comments were raised by one commentor requesting specific information on operational procedures, such as yarding standards.

(5) Analysis of Other Impacts

Several comments were provided regarding analysis of other impacts, including other topic areas such as coastal resources, air quality, and environmental justice.

APPENDIX C

Herbicides Used on Green Diamond Resource Company Timberlands in Northern California

APPENDIX C

Herbicides Used on Green Diamond Resource Company Timberlands in Northern California

The application of forest chemicals will not be covered under the ITP. Herbicides are used on Green Diamond Resource Company lands in northern California to control competing and undesirable plant species and to maximize growth of commercially valuable tree species. Two types of herbicides are normally used: Pre-emergent and post-emergent. Pre-emergent herbicides prevent or inhibit weed seed germination or reduce weed seedling survival, and when applied diffuse into the soil and remain active in the immediate area of the shallow root zone. Post-emergent weed control agents kill established plants after being absorbed and translocated to active growing sites within the plant body; these herbicides are usually applied to the leaves, basal stems, injected into the cambial and phloem tissue of larger hardwoods (i.e., "hack and squirt"), or painted onto tree stumps to kill the roots and prevent resprouting. Aerial applications sometimes occur where broadcast treatment is required to control undesirable plant species that are distributed over larger treatment areas.

On Green Diamond lands, both soil-active pre-emergent as well as foliar post-emergent chemicals may be mixed and applied together. The post-emergent materials are directly absorbed by the targeted weeds, and the pre-emergent chemicals migrate from the soil surface to the shallow root zone of the weeds where they affect their controlling influence during the growing season. Where desirable conifer species are already present on a site, herbicide application may occur by hand to avoid direct chemical contact with the conifer seedlings.

Table C-1 lists the herbicides and associated adjuvants and diluents used on Green Diamond lands. On June 22, 2004, the district court for the Western District of Washington in Seattle (see *Washington Toxics Coalition v. Environmental Protection Agency*, Case No. C01-0132C) vacated EPA's authorization of most agricultural uses of 54 active ingredients within 20 yards (and aerial application within 100 yards) of salmonid streams in California, Oregon, and Washington. Those chemicals requiring this buffer are indicated.

TABLE C-1
Forest Chemicals and Methods of Application Currently Used by Green Diamond as Part of Its Forest Management Activities

Chemical Trade Name	Application Type	Active Ingredient	Buffer Required
Aatrex	Pre-emergent; applied by hand. Short in duration in the soil.	Atrazine	No
Arsenal	Post-emergent; applied by hand. Used to prepare clearcut sites for reforestation, to release conifers from competing vegetation, and to provide control of many annual and perennial weeds.	Imazapyr	No
Chopper	Post-emergent; applied by hand. Used to control perennial broadleaf weeds.	Imazapyr	No

TABLE C-1
Forest Chemicals and Methods of Application Currently Used by Green Diamond as Part of Its Forest Management Activities

Chemical Trade Name	Application Type	Active Ingredient	Buffer Required
Garlon 4	Post-emergent; applied by hand, aerially, and roadside. Used to control broadleaf weeds and brush.	Triclopyr BEE	Yes
Honcho	Post-emergent; applied by hand. Used to control undesirable grasses and broadleaf species.	Glyphosate	No
Mirage	Post-emergent; applied by hand and roadside. Used to control undesirable grasses and broadleaf species.	Glyphosate	No
Oust	Pre-emergent; applied by hand. Used for nonselective weed control. Applied to soils at extremely low rates and has moderate to low persistence.	Sulfometuron methyl	No
Riverdale LV6	Post-emergent; applied by hand, aerially, and roadside. Used to control many types of broadleaf vegetation, especially woody species such as willow, alder, sumac, and sagebrush.	2,4-D	Yes
Herbimax (adjuvant)	Foliar applications.	Oil surfactant	No
Moract (adjuvant)	Foliar applications.	Oil surfactant	No
R-11 (adjuvant)	Foliar applications.	Non-ionic surfactant	No
Activator 90 (adjuvant)	Foliar applications.	Non-ionic surfactant	No
MSO concentrate (adjuvant)	Foliar applications.	Methylated seed oil	No
Soy oil	Basal applications.	Soybean oil	No

APPENDIX D

Green Diamond Final EIS Distribution List

APPENDIX D

Green Diamond Final EIS Distribution List

Federal Government

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Washington, D.C. 20510-0504

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