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 A*rabis 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.

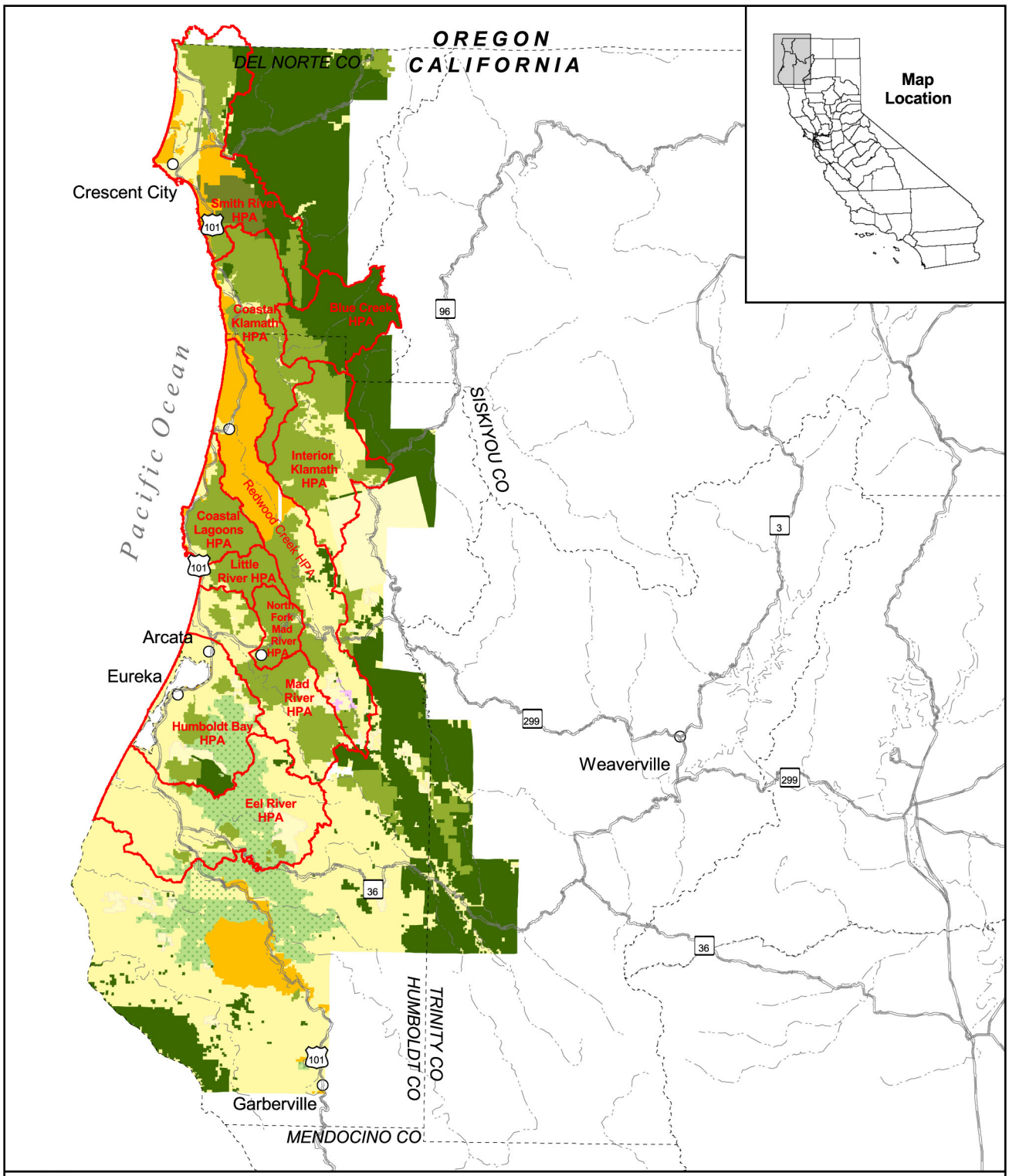
4.1.2 Cumulative Impacts Analysis

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).



LEGEND

- GREEN DIAMOND RESOURCE COMPANY
- PACIFIC LUMBER COMPANY
- OTHER COMMERCIAL TIMBERLAND
- USFS AND BLM
- STATE AND NATIONAL PARKS
- OTHER
- HYDROGRAPHIC PLANNING AREAS
- COUNTY BORDER
- RIVERS
- MAJOR ROADS
- CITIES

N

10 0 10 Miles

SCALE IS APPROXIMATE

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.

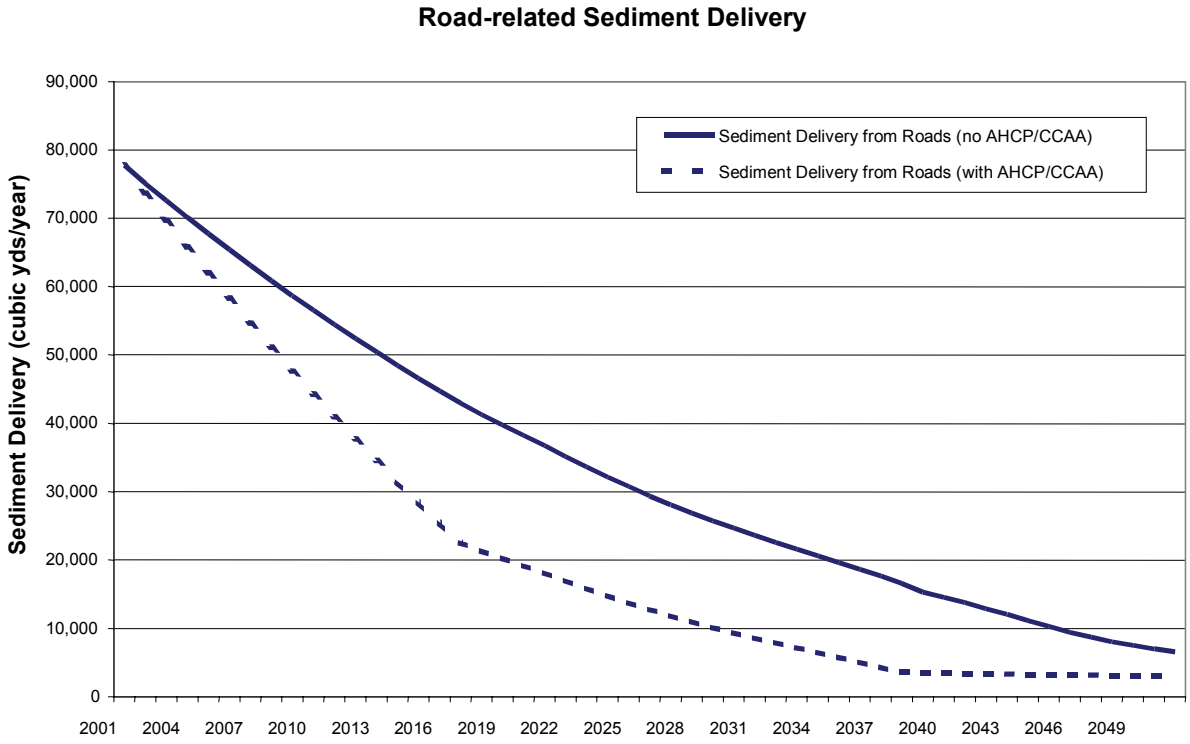

FIGURE 4.2-1
Road-Related Sediment Delivery

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 S*idalcea 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 A*rdea 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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CHAPTER 6

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CHAPTER 7

Glossary

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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

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Board of Supervisors
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Arcata Branch
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